THEORIZING MENTAL MODELS IN DISCIPLINARY WRITING ECOLOGIES THROUGH SCHOLARSHIP, TALK-ALOUD PROTOCOLS, AND SEMI-STRUCTURED INTERVIEWS

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This project explores how disciplinary habits of mind are circulated through forms of representation to instantiate English Studies disciplines, institutions which then shape scholars’ practices for producing knowledge. Using a critical discourse analysis on scholarship, semi-structured interviews, and a talk-aloud protocol, I find that scholars' thinking and writing rely heavily on mental models. Scholars employ small-scale working representations of dynamic systems to help them reason through disciplinary problem spaces, including research questions and composing issues. Unlike the sciences, English Studies fields have not fully exploited mental models in research and teaching; nor have they been considered fully in writing studies’ research on cognition and writing. In order to understand the role of mental models in writing and disciplinarity, I employ ecology theory to link the representational nature of mind to external media.

I find that as scholars write, they produce complex mental models of disciplinary content that are comprised of objects of study, relationality between these objects, and discipline-specific forms of dynamism applied to “run” the models. Mental models are multimodal compositions that employ representational modalities afforded by “mind,” such as force, image, and affect; their design reveals scholars’ tacit values and assumptions. My research suggests that reflecting on mental models can enable scholars to extend their reasoning and critically evaluate their assumptions. During writing and revision, scholars model a generic reader’s mind “unfolding” as it encounters the writing in order to anticipate eventual readers’ “situation models.” Scholars also model hypothetical exchanges with familiars with whom they have
previously written in order to predict critiques and feedback. Mental models have a significant role in enculturating new members and constructing and maintaining disciplinarity. I propose that a facility with mental models is a significant component of reasoning-based “literacies” and suggest ways that scholars and teachers can make deliberate use of mental models in scholarship and in teaching writing. I describe the significance of mental models in knowing and composing in new media contexts with multimodal affordances that compare and contrast to those of the mind. I also suggest additional methods for analyzing and collecting data on mental models and writing.
To my boys, whom I hope to inspire to live happily and fulfill their goals and dreams.
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I have often been impatient with colleagues who seemed unable to discern the difference between the trivial and the profound. But when students have asked me to define that difference, I have been struck dumb. I have said vaguely that any study which throws light upon the nature of “order” or “pattern” in the universe is surely nontrivial. But this answer only begs the question.

—Gregory Bateson, *Steps to an Ecology of Mind*

I not only use all the brains I have, but all I can borrow.

—Woodrow Wilson, “Remarks to the National Press Club”

**Overview of the Project**

Scholars across disciplines are presently theorizing, researching, and writing about the nature of the world, our place in it, and our relationships with each other; the methodological and discourse convention in most of this work is to explicitly acknowledge the central role of the assumptions that undergird what we come to know and share through scholarship. To say that *a priori* ideas shape the knowledge scholars produce likely strikes most as obvious. Clearly, preconceived ideas mediate knowing. Rhetoric and writing scholars are astutely aware that this meditational dynamic happens in large part because ideas, especially those that characterize disciplines, are circulated via writing and other forms of representation, and this circulation enables their uptake by other scholars (see Paul Prior’s *Writing/Disciplinarity*). However, there are critical inscriptive and representational tools in this process of knowing, articulating, and circulating knowledge that we take for granted, both as scholars and as “ordinary thinkers” functioning in a complicated world. These tools are part of a cognitive “tool kit” that makes it possible to have ideas in the first place, and to share them with others in the second. My
dissertation explores how one of these cognitive tools, namely, mental models, participates alongside others in disciplinary writing ecologies and enables scholars to know and compose academic knowledge.

In this chapter I introduce readers interested in the complex cognitive and social nature of writing to the need for a theory of writing ecologies that centrally figures mental models, emphasizing that given the burgeoning prevalence of digital technologies in knowledge ecologies, such a theory must consider not only how mental models function in the production of traditional academic texts but also new media. I then review early scholarship on cognition and writing to argue that a more deliberate consideration of knowledge structures may have explained some of the phenomena that writing studies researchers have observed, particularly cognition and writing theorists who examined how writers represented composing problems and manipulated content knowledge. I discuss the calls for producing socio-cognitive models of writing that emerged as a response to early cognitive models, calls that continue to appear in the field largely because of the difficulties in balancing the social with the cognitive while also maintaining a degree of complexity that accurately reflects the nature of writing. These continued calls for socio-cognitive models of writing highlight the fact that there is still work to be done in this regard. The chapter then sets the stage for this dissertation’s contribution to such efforts by presenting three theories of mind, theories that inform assumptions about mental models and their use. Since mental models work in tandem with other knowledge structures (namely, schemas, scripts, and frames), I review the literature on these other structures from the fields out of which they have emerged and been more widely applied. I also consider some of the ways in which knowledge structures have been regarded by rhetoric and writing scholars, and I argue that a fuller treatment of mental models sheds light on a significant component of
meaning-making and knowledge-building. Whereas the chapter starts by exploring cognitive models of *individual writers*, it ends by presenting the rationale for ecology models of *communities of writers* that also include cognition, and it briefly reviews some of the research that regards disciplinarity from an ecology theory perspective. Finally, the specific research questions and methods-related goals that this exploratory study was designed to address are presented to prepare readers for Chapter 2’s discussion about the methods I used to investigate them.

**Introduction: The Importance of Mental Models in Reasoning and Writing**

Mental models are “small-scale models” (Craik) or symbolic representations that we construct in our heads to help us reason through the complex nature of the world. A type of mental model familiar to most people is the mental map, which contains spatial representations of geographies through which users can navigate in their heads. Another familiar everyday context for mental modeling that most people will recognize involves reasoning through how to get a large piece of furniture through a door, a problem “usually solved by mentally simulating turning over a geometrical structure approximating the configuration of the piece of furniture through various rotations” (Nersessian 150). Mental models have a significant function in everyday reasoning, and they also have an important role in facilitating formal knowledge and its representation to others. For example, “taijitu,” the Chinese pictorial symbol for the concept of yin-yang, is a widely recognized graphic that complements but is distinct from the symbol’s representation in the mind via mental modeling. The model allows its users to consider relational forces. Specifically, it enables thinkers to consider the way in which seemingly opposing forces could interact harmoniously and form wholes greater than their parts. This simple example reveals that mental models
• enable reasoning about relational dynamics (in this case, abstract reasoning about the
dynamics between seemingly oppositional yet interconnected facets of the world, such as
life and death);
• exist as cognitive representations that are structurally analogous to circulated external
representations (the yin-yang symbol is widely disseminated through both Eastern and
Western cultures);
• and carry ideological cargo (in Confucianism, for example, the symbol instructs its users
how to regard opposites as “good” and “bad” by including a moral dimension).

Mental models like the taijitu pervade our thinking. Many are produced ad hoc and disappear
after a single use. Others are taken up and more fully developed, reified through their
representation in one’s mental interior and in the social semiotic spaces through which they are
circulated, often discursively. Whether mental models are highly developed and disseminated or
cast aside after they are employed to reason through a single instant, these knowledge structures
are instrumental in enabling us to produce and share knowledge through writing and other modes
of representation. Yet mental models remain largely unrecognized, even in the most
comprehensive cognitive models of writing, which tend to bundle cognitive knowledge
structures together and leave them underdeveloped in accounts of how we write. However, if the
rhetoric and writing field is to fully theorize cognition’s role in writing ecologies, we must figure
a place for mental models, and for other knowledge structures that inform them.

In this dissertation I respond to the need to include knowledge structures as aspects of
cognition in writing ecology models by exploring how discipline-specific mental models
circulate through scholarship and are taken up in the space of the mind to produce flexible and
interactive mental inscriptions that scholars use to compose knowledge for other semiotic
domains. Most often quasi-visual and multimodal, mental models are generated with assistance from (and function in tandem with) other knowledge structures to enable scholars in their academic disciplines to create and represent disciplinary knowledge through various mediums. As writing scholars have reflected, representation is not distinct from the epistemic process of knowing. The literate practices associated with producing the mental inscriptions that inform knowing and representing are situated in individual minds, yet they are socially constructed and distributed in disciplinary knowledge ecologies that rely on writing, and they contribute to disciplinary cohesion and identity. The cognitive tools considered alongside mental models in this research include schemas, scripts, and frames. Writing scholars, such as Patricia Carrell and Debra Tannen, have explored these latter three variously, though not with the aim of situating them in larger writing ecologies. However, rather than locate schemas, scripts, or frames centrally, I figure mental models as this study’s locus for several reasons: first, while these other knowledge structures have been investigated to varying extents in relation to literate practices in writing studies fields, mental models are as yet a lesser explored phenomenon. Toward that end, I provide thick descriptions of the mental models used by three scholars in two disciplines in English Studies to produce their scholarship. Further, this dissertation argues that the other

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1 Ecology theorists, such as Gregory Bateson (1972), who introduced the notion of “ecology of mind,” make it clear that distinguishing hard boundaries between internal spaces of the mind and external semiotic spaces, or even the technologies of semiotic production, is somewhat arbitrary.

2 For example, the connections between writing and learning have been explored in composition studies in “writing to learn” pedagogies largely attributed to Janet Emig and James Britton (Bazerman et al., 2005).

3 As many new media scholars will attest, finding a term for composing that speaks to an enlarged scope of writing in both textual and multimodal contexts but does not, by its connotations, restrict itself to the realm of written inscription is challenging. I frequently use the term “writing” in this dissertation to refer to both textual and multimodal composing because currently most scholars working in this area come from a writing studies background, so the term usefully signifies not just an enlarged notion of composing, but also a disciplinary orientation to the topic (later, I address the underlying mental model accompanying this term). “Reading” is used similarly: to broadly suggest interpretive encounters with either text or multimodal compositions. I also use the term “discoursal” broadly, to refer to signifiers that can derive their meaning from verbal or other modalities, such as image and sound.
knowledge structures contribute to the construction of mental models, and that together they play an important role in scholars’ efforts to produce knowledge in the context of disciplinary knowledge ecologies. Thirdly, I argue that mental models tend to be experienced by their users as more representational relative to schemas, scripts, or frames, because they are largely quasi-visual, function semiotically, and are informed by the other knowledge structures, which makes them a useful nexus for understanding mental representation’s role in disciplinary writing ecologies. This study regards mental models as semiotic productions and regards the other knowledge structures as tools that contribute to their production, much as a textual or multimodal composition can be distinguished from the software by which it is produced, yet the end result is critically dependent upon and shaped by the tool’s affordances. Lastly, writing studies fields are increasingly challenging the bias toward considering mainly linguistic signification in communication practices, recognizing it as only one of a number of possible modalities for meaning (speech, image, gesture, and sound, for example). The nature and implications of communicating through multiple modalities are currently significant areas of study and have been explored in relation to knowledge representation and new media (see Manovich; Bolter and Grusin), distributed cognition (see Hutchins), and the dissemination of ideology (see Kress and Van Leeuwan). Importantly, like the representations we fashion in external mediums, mental representations are also multimodal, often combining visual, textual, aural, gestural, and other modalities of signification. Given their multimodal nature, mental models warrant a central position in a theory that aims to expand the role of socio-cognitive practices in writing ecologies. In addition to contributing to the research on cognition in writing ecologies, my research extends the scholarship on multimodal representation by considering how mental models contribute to the construction of meaning in multimodal domains. Because mental models are multimodal
representations, this research employs multimodal discourse analysis methods, such as those developed by Gunther Kress and Theo Van Leeuwan in their 2001 work *Multimodal Discourse: The Modes and Media of Contemporary Communication*, to explore mental models in both the writer’s interior and in externally represented forms. The research also uses semi-structured interviews and talk-aloud protocols to uncover the nature of these elusive phenomena. I investigate whether there is a recursive relationship between the cognitive “small-scale models” we visualize in our minds to understand the world and the ways our knowledge of that world is depicted. I explore how our internal mental models shape our external representations, and how the external representations we encounter, those composed and circulated by others, influence our own internal models.

Further, I argue that by becoming aware of mental models, both expert and novice writers can strengthen their capacities to reason and to communicate their knowledge in both textual and multimodal spaces. For example, there are differences in the mental models that novice and expert writers employ for the concept of “audience.” If students tend to figure generic, non-differentiated abstractions of like-minded readers for models of audience, these models provide little dynamism in their construction that could enable novice writers to imagine and respond to the numerous possibilities toward which a piece of writing could develop. In contrast, the research findings suggest that expert writers’ mental models of audience are populated with idiosyncratic persons who are known to them in some manner, and these more experienced

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4 Given that mental models are multimodal, the terms “visualize” and “visualization” are limiting because they only reflect image-based mental phenomena. However, these lay terms are widely used to describe cognitive phenomena since so much of mental representation is visual. Occasionally, I use the terms similarly here as well. However, like the term “writing” in writing studies fields, these terms threaten to circumscribe our conceptions (mental models) of mental representation to only visual phenomena. A valuable exploration about the role of “visualization proper” (i.e., mental imagery) in writing can be found in *The Role of Visualization in Creative and Academic Writing*, a dissertation by Carl Battaglia. See Chapters 3 and 5 for a discussion of the range of modalities that participants in this research employed in their mental models.
writers model hypothetical responses from such personalized audiences in order to push themselves to produce stronger writing. It may well be that the “unique contributions” of a piece of writing arise in part from reasoning that relies on these complex, dynamic mental models of unique audiences. Understanding mental models’ role in writing can enable teachers to help students generate their own more complex models of audience as well.

Arguably, the capacity to reflect on and construct dynamic working models will play an even more significant role for English Studies scholars and students as we continue to expand our use of digital media. If we learn to recognize how mental models enable and constrain thinking and expression, both textually and multimodally, we can use these cognitive tools more deliberately in constructing our scholarship and instructing our students in their own composing. However, while multimodal composing is a critical new frontier, this research explores both textual and multimodal composing5 because the former are still by and large the prominent mode of representing disciplinary knowledge in the academy and in English Studies disciplines, even as changes in publishing gain momentum.6 As Lev Manovich has implored in The Language of New Media, today’s researchers and theorists must not simply focus on futurist speculations about how digital technologies will change what we do and how we do it tomorrow, but should help construct “a genealogy for the language of computer media at the moment when it was just coming into being, while the elements … going into its making were still clearly visible … before they became universal conventions and thus slipped into invisibility” (33). An approach

5 Data was collected and analyzed from two faculty and one PhD student in English Studies who have thus far tended to publish traditional linear texts (either in print or online). Data was also collected from a writing studies scholar who publishes multimodally (and whose work in the online journal Kairos we discussed during our interview) and a creative writing scholar who publishes fiction; while those findings do not appear in the dissertation due to time constraints, they inform assertions I make, particularly those in Chapter 5 on mental models’ role in scholarly composing in new media.

6 Current academic publishing practices, as well as speculations about future practices, are explored in detail in Kathryn Fitzpatrick’s Planned Obsolescence.
that explores how mental models figure in traditional disciplinary textual practices while also exploring their role in multimodal practices accomplishes two important objectives: first, the research answers Manovich’s call to provide “both a record, and a theory, of the present” (33) by examining the mental models and cognitive skill sets that today’s print-based scholars bring to the task of multimodal knowledge-making as they migrate to new media. In “Multimodality, Representation, and New Media,” Gunther Kress points to the “central issues in the linked shifts in representation and dissemination” as we move from the page to the screen, and these include “shifts in authority, in changes in forms of reading, shifts in shapes of knowledge and in forms of human engagement with the social and natural” (emphasis added). He notes that to date, the visual image is the modality we most frequently marry with text in our semiotic representations. More fully understanding the relationship between the increasingly image-dependent “shapes of knowledge” and the image-rich mental models we produce in our minds will enable researchers to include the mind in social semiotic accounts of literacy. Kress’ work on how multimodality affects knowledge production has important intersections with the emerging field of visual analytics, “the science of analytical reasoning facilitated by visual interactive interfaces” (Thomas and Cook 4). The visual organization of information via computational software, which includes but is not limited to large data sets, enables data to be displayed in ways that facilitate interpretation, often through interactive and highly responsive interfaces that let users create contextual models. These models augment cognitive capacities for mental modeling, which enables reasoning through complicated problems that would otherwise be intractable, and this dissertation considers the role of such visualization tools (through multimodality in new media) in disciplinary writing ecologies. Visual analytics, along with infographics and data
visualization, is only beginning to emerge in the digital humanities, and these practices will have implications for the production of knowledge in English Studies disciplines.

Learning to effectively use new media tools, such as visual analytics software, is becoming increasingly important across the professions, and while higher education, and English Studies disciplines particularly, have been slower at incorporating them into their scholarship practices, a facility with these tools will no doubt eventually contribute to digital academic literacies. Gregory Ulmer (2003) attempts a more comprehensive account of such literacies in the age of new media that he calls “electracity,” arguing that new media has important epistemic and ontological consequences. In other words, using new media changes the very nature of our minds. My aim with this project, then, was to explore how knowledge structures bear on both traditional textual composing and new media composing in order to incorporate them more fully into writing ecology models, particularly as these ecologies are evolving alongside digital practices, so that we can make fuller use of them in reasoning and composing knowledge.

Recognizing how mental models are constructed in our imaginations, shape our knowing, and get represented and circulated in social systems enables us to use them with more intention, whether we are scholars investigating and describing the objects of our scholarship or writers attempting to shape readers’ cognitive structures in order to influence their epistemic practices and the “knowledge” they take away from our writing. In other words, mental models are both epistemic and rhetorical tools, and like any technology, whether jigsaw or jackhammer, these tools shape what we can accomplish and how we do it. What this research most significantly

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7 This dissertation considers “knowledge” broadly and as provisional, from a social constructivist perspective in contrast to an objectivist conception. See Mark Johnson’s The Body in the Mind for a detailed discussion of how an objectivist theory of meaning “assumes a fixed and determinate mind-independent reality, with arbitrary symbols that get meaning by mapping directly onto that objective reality” (xxi-xxii). The implication is that objectivism disallows a theory of meaning that includes metaphorical projections because this inherent mapping “requires concepts that are definite, discrete, and fixed” (xxiii).
draws our attention to is the fact that our capacities for sharing what we know are to an extent constrained by our capacities for imagining it.⁸

There is great potential in enlarging our capacities for mental modeling by considering it as a component of literacy, not just so that we might improve our abilities to understand the world we encounter, but that we might also enhance our capacities to share the knowledge we gain, and, when it is advantageous, to use mental model-making as part of an approach to persuade others to think as we do and to hold certain beliefs. This hints at the capacity of mental models to carry ideological cargo just as images do. Ideology accounts for both the structuring of social phenomena (its design and aims) and its structurational role (its role in bringing members of a community into alignment with each other in terms of their values and actions). However, ideological agendas are frequently veiled in social phenomena. The same is true of mental models. For example, when novice writers are taught to model audiences that are largely homogenous and anonymous, not only are they developing a generalized, single conception of the “other”—the “reader” toward whom novices write—but these models of audience also structure writers’ subjectivities as they learn not to write (or read) through unique subjectivities and experiences but through assumptions about what readers (and by extension, writers) are expected to consider. In other words, they learn to read uncritically and without personal engagement. On the other hand, scholars’ mental models feature idiosyncratic audiences constructed out of “familiars” toward whom they write, suggesting the valuing of the particular over the generalizable. In English studies disciplines, as in various other humanities and social sciences, valuing the particular reflects the ideological shift associated with Clifford Geertz’s

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⁸ Imagining what we know and knowing it are separate linguistic constructs, if one regards mental models as distinct from the act of constructing and using them as epistemic tools. Yet, they are, like writing and learning, synchronous, inseparable, and recursive.
1983 prescription that “local knowledge” is “the surer grasp of unshapely and incongruent, even unique, particulars [which] is as proper an aim of science as the abstracted formulation of accepted regularities—and is often more illuminating as well” (Geertz x). This stance reflects an ideological contrast to rationalism and positivism, and it underscores the importance of investigating how ideology can inhere in mental models that circulate in knowledge ecologies to bolster their proponents’ aims by structuring values and practices that are in alignment.

Ideologies are global social frames, such that they assist their members in producing mental models but also exist within the models themselves. As this research demonstrates, mental models and their inherent ideology can be examined through the same visual methods used by researchers like Kress and Van Leeuwan (2001) to assess multimodal representations in social semiotic domains. In order to explore the ideological underpinnings of mental models, the research relies on a critical approach that investigates several interlinked components of scholarly writing: scholars’ discursive and multimodal representations of disciplinary knowledge, their mental models, and their writing practices. The specifics of this approach are described more fully in Chapter 2. However, it is important to first clarify what rhetoric and writing fields understand about cognition and writing and to more fully explore the nature of knowledge structures as well as the previous research on their role in reading and writing. It is also important to explain why an ecology theory perspective presents the best lens for understanding the nature of disciplinary knowledge production and how mental models function in this process. Lastly, I will finish my discussion in this chapter by providing the specific research questions the remainder of the dissertation addresses.
Early Research on Cognition and Writing: Connections to Mental Models and Other Knowledge Structures

Cognition’s role in writing has frequently frustrated scholars, many of whom believe writing processes are too diverse and complex to model with accuracy.9 Cognitive models in the 1980s tended to explore and elaborate on the “three-part Flower and three-part Flower and Hayes model of planning, translating … [and] the reviewing process, especially detection and diagnosis strategies” (Becker 31). In the 1990s, writing models generally evolved to include the role of working and long-term memory as well as the complexity of the task environment. While it is difficult to model the complexities of writing because much of writing (or more aptly, that collection of “situated literature activities” we refer to as “writing”) happens in the interior of writers’ minds and seems beyond our abilities to trace, writing studies scholars recognize that writers clearly think before, during, and after composing. This thinking involves contemplating the “rhetorical problem,” which requires assessing the nature of the goals and available means for responding to it (Flower and Hayes 1980). As Edward Hutchins’ work in Cognition in the Wild underscores, these “available means” are frequently socially distributed cognitive tools, such as language, mathematical formulas, or graphic depictions, and they extend our problem-solving abilities (xvi). These tools function as representations that mediate cognition (117). They exist in/through the various media by which they are distributed. This set of various media must necessarily include the mind, which provides the space for composing cognitive representations. Evidence of task representation (e.g., the writing assignment) and other phenomena observed by early scholars of cognition and writing foreshadow the need to include mental models to more

9 For a discussion of various cognitive writing models in writing studies research, see Alamargot’s and Chanquoy’s Through the Models of Writing (2001) and Becker’s “A Review of Writing Model Research Based on Cognitive Processes” (2006).
fully account for the nature of cognition, and had mental models been considered more fully, these knowledge structures may have imparted greater explanatory power to cognitive writing theories.

For example, Janet Emig (1977) calls attention to writing as a meditational tool for learning, but also to the idea that writing can be seen as an extension of what goes on in the brain, particularly the “unique correspondences between learning and writing.” Mental models could account for these parallels by regarding both external and internal representational spaces as semiotic, by understanding that writers attempt to depict their mental representations on the page or in other mediums. The process is not one in which the mind simply pours its contents into inscriptive forms, but it is far more complex, as writer and writing each affect the other throughout. Nancy Sommers’ (1980) work on revision suggests a dynamic that includes mental representations when she figures revision, not as a final stage of writing, but “a sequence of changes in a composition—changes which are initiated by cues and occur continually throughout the writing of a work” (45). A semiotic theory of mind where writers compare their writing to their mental models can explain the origin of these cues. Sharon Pianko (1979) explores the pauses during writing as important indicators of mental processes. Possibly, she is observing writers as they consult with and modify their mental models or assess the degree to which those models matched the external representations they were attempting to compose. Sondra Perl’s (1980) analysis of composing seems particularly prescient, hinting at the embodied nature of

10 The relationship between mental models’ representations and their counterparts’ in external media is isomorphic, yet because the modalities for meaning-making vary from one to another, this analogical correspondence is more complexly achieved than it may first appear (e.g., both a mental model and a verbal description can represent an “ascent,” yet the latter might rely on an embodied sense of movement for modality while the other, verbalization. See Chapters 4 and 5 for the discussion of “transduction.”

11 Chapter 2 discusses the links between gestures and mental models, including research on the topic by Alibali et al.
mental models when she asks of the recursive process of composing, “‘To what do writers move back?’ ‘What exactly is being repeated?’ ‘What recurs?’” (364). Her answer is that we return in part “to feelings or non-verbalized perceptions that *surround* the words, or to what the words already present *evoke* in the writer. The move draws on sense experience … [it] occurs inside the writer, [is] what is physically felt” (365). She describes the process as “unifying” and adopts the term "felt sense" from by philosopher Eugene Gendlin to label it. These projective structures toward which Perl observed readers returning as they reorient themselves to the writing task are likely mental models. Marlene Scardamalia and Carl Bereiter (1987) observed similar patterns and theorized a writing model where writers compare written texts to “mental representations” of texts in order to decide how to fix the writing so that the two versions match. However, this is complicated by the fact that writers do not generally report having a target composed of a set of words toward which they write. Instead, the standard toward which writers strive is not conceived in terms of words but through other, more efficient modalities. As we shall see, writers work to produce “situation models”¹² in their readers, models that are constructed in a step-wise fashion (in text mediums, at least) by cuing readers through the delivery of additive discourse, and it is likely these situation models toward which they write. Further, in contrast to a set of words, mental models rely on summative “tokens,” or stand-ins for complicated objects and their parts, in order to represent only those components necessary for reasoning through the particular problem at hand. For example, one participant in this study figured disciplinary voices in her argument by imagining herself fitting them spatially onto a white page; each voice was a token for a particular argument by a particular author. However, while “problem representation”

¹² The idea that texts are represented mentally in writers’ minds appears not just in the rhetoric and writing literature, but in other fields as well, namely, discourse processing, where readers are understood to construct a “situation model” of text-based “events.” This type of mental model is discussed more fully in Chapter 5.
figures centrally in Bereiter and Scardamalia’s models of knowledge telling and knowledge transforming as representations of both assignments and resulting texts, they do not consider mental models and their token structures when they theorize these representations. This characteristic is an important mechanism for handling writing tasks without cognitive overload and, as I discuss in Chapter 5, it has other implications as well.

Knowledge Structures in Problem Representation and Content Domains. Generally speaking, cognitive models of writing tend to account for cognitive processes and knowledge domains, and they focus on how writers mentally manipulate content in working and long-term memory, translate content into text, and strategize to manage multiple writing or revision goals at once. Complete and formal conceptions of knowledge structures (specifically, frames, schemas, scripts, and mental models) have less frequently been included in these models, most likely because the models are already populated with complex relationships between dynamic parts that are themselves difficult to describe and figure. Knowledge structures are also difficult to include in cognitive writing models because they do not fit neatly into the domain of either knowledge content or processes for manipulating content, as their dynamic nature makes it hard to tell whether they are a type of knowledge or a strategy for handling knowledge. In fact, they can aptly be regarded as both, depending on where they are seated, in long-term memory (models stored as content), short-term memory (temporary context-specific models), or as artifactual representations that reside outside the mind and function as extended cognition. For example, a scholar may possess a relatively fixed model of the articles appearing in a particular

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13 There are some notable exceptions: “task schema” make appearances in some writing models. Also, Paul Prior’s (1990) “model of the knowledge system” features knowledge structures, but this work is not discussed here because Prior’s model aims to address the larger epistemological system rather than to propose a cognitive model of writing, which renders it a socio-cognitive or ecological approach. Task schemas and Prior’s knowledge system model are discussed shortly in this chapter in the section “Knowledge Structures and Their Role in Writing: Schemas, Scripts, Frames, and Mental Models.”
journal, or if they are composing an article, they might produce a temporary mental model of the finished product toward which they aim. Or they might consult a template for the organizational structure of a particular type of article. As the earlier discussion of Scardamalia and Bereiter’s work suggests, knowledge structures are mentioned in the literature (albeit in ways that are not fully explored) in discussions about “problem representation,” a common component in writing models. For example, the writing model that Flowers and Hayes present in 1986 in “A Cognitive Process Theory of Writing” includes problem representation as a sub-category of knowledge, as well as “problem detection,” “problem diagnosis,” “procedures for improving text,” and a “means-ends table” that enables writers to prioritize those procedures (see Figure 1). In another example, Huub Van der Bergh and Gert Rijlaarsdam’s model of cognition in writing seems to account for knowledge structures in its emphasis on cognitive strategies that are considered “strategic knowledge.” Their model includes a “monitoring module” which evaluates text and ideas and locates the necessary strategies from a “knowledge module”; these are then employed by an “executive module” to produce the text. Knowledge structures, such as mental models, frames, schemas, and scripts, seem to fit the knowledge module well in that they function as both knowledge content (perhaps stored in long term memory) and processes for grappling with content (perhaps initiated in working memory). While many models of cognition and writing seem to include some element of mental representation, they generally do not figure the role of knowledge structures in detail.

As Denis Alamargot and Lucile Chanquoy note from their extensive review of writing models in Through the Models of Writing, authors 14 Some researchers believe that both long and working memory may come into play when mental models stored in long-term memory inform mental models constructed in working memory to address a specific reasoning task (see Nersessian (2002)).
often mention the presence, in Long Term Memory, of conceptual systems as “mental models,” “scripts,” “schemas,” “knowledge about the addressee,” “type of text,” and more recently with Hayes (1996), a set of knowledge both declarative … and procedural. However, these researchers do not specify the pertinence, neither the structure nor the influence of these kinds of structure, on writing processes. (45)

Additionally, after carefully scrutinizing how numerous researchers account for these knowledge structures in their cognitive writing models, Alamargot and Chanquoy conclude that researchers possess competing conceptions of how long-term memory is organized, such that structures like semantic networks, mental models, and a-linguistic conceptual storage “bring researchers to produce different hypotheses to explain the functioning of Long Term Memory in writing. It is clear that writing models do not take into account these theoretical differences” (45). This speaks to the need for a deliberate and careful elaboration of how knowledge structures are understood and defined in the context of the present study. Further, it should be noted that even if knowledge structures are more fully incorporated into a model of cognition and writing, the model must also account for knowledge structures’ relationship to the task environment and the larger social context of writing. A socio-cognitive model such as this must strive to leave neither the cognitive facets, such as how the writer handles the demands presented by the need to manipulate topical and organizational knowledge during composing, nor the social facets, such as how and where writers come to appropriate these strategies, under-developed.
Calls for Socio-Cognitive Models of Writing.

Critics of Flower’s and Hayes’ 1986 cognitive model of writing applauded their early attempts to flesh out the cognitive components of writing processes but felt the model failed to fully acknowledge the inter-relationship between these cognitive components of writing and the social complexities of the task, and many (including Flower and Hayes themselves) worked to refine the model. The impassioned debate over various reformulations led Patricia Bizzell (1982) to note that writing scholars tended to fall into one of two camps: they were either “inner-
directed” and assumed all learners possessed isomorphic, innate writing capacities or they were “outer-directed” and assumed a greater significance for the social context on language learners.\(^{15}\)

Since then, these two binaries have been to some degree bridged by more socio-cognitive conceptions of writing because they account for complex task environments. Cheryl Geisler (1991) notes that, since a call for a socio-cognitive model of literacy in the 1980’s, writing scholars have attempted to explore the role of literate practices in the inter-relationship between individual cognition and social context through a proliferation of studies of situated literate activity. However, straddling both the social and the cognitive simultaneously presents researchers with a challenge not unlike being in two places at once and simultaneously attempting to build a bridge between them. This task is made easier by robust theories that encompass both cognitive and social facets of writing.

Kristie Fleckenstein (2012) suggests the need for robust socio-cognitive theories in “Reclaiming the Mind: Eco-Cognitive Research in Writing Studies” when she asks that those working on the social side more thoroughly account for cognition in theories of writing. She notes that a reluctance to include cognition might in part be due to the fact that cognitive research tends to default to an information processing conception of the mind, which fails to factor materiality, affect, or imagination. However, she believes these can be addressed if we “revise cognitive psychology to refocus on meaning rather than information manipulation” (90).

Such theories are made possible by building on Bateson’s ecology of mind, where mind is understood as “immanent in pathways and messages outside the body,” as well as in the mental interior (90, qtd. in Fleckenstein). According to this view, mind only exists at the moment it is constituted in internal and external linkages. Fleckenstein calls for an eco-cognitive paradigm in

\(^{15}\) Bizzell’s two models of the language learner are revisited in Chapter 4, where I use them to show how a mental counterpart for each model is cued by her discoursal (multimodal) strategies.
which the object of study “is the mind as it materializes from an array of message pathways” (91). This paradigm enables a socio-cognitive ecology approach to writing research, one that is “shaped not by artificial intelligence but by contextual intelligence” (91). However, previous research on mental models suggests that a computational theory of mind and an embodied one are not necessarily at odds. Further, a third branch of theory, namely, a representational theory of mind, can also contribute to socio-cognitive theories of writing. Given that Fleckenstein observes a bias in the field toward computational conceptions of mind, it is important to present readers with alternative theories and to remind them that, as both this chapter’s overview and Alamargot and Chanquoy argue, theoretical assumptions such as these should be explicitly acknowledged because they can significantly alter research findings. Given their significance, a description of these three theories of mind and an explanation of their potential significance for a socio-cognitive theory of writing (particularly, one that includes mental models) is discussed next. Further, I argue that a writing ecology lens best accommodates a robust socio-cognitive theory of this type, one that accounts for both social context and individual writer.

**Theories of Mind: Computational, Representational, and Embodied**

Theories of mind undergird cognitive models of writing and cognitive models generally. Research must explicitly recognize the assumptions informing various models because they affect explanations of knowledge structures and meaning-making. It is particularly important to consider theories of mind in this study because thinking is so central to scholars’ production of knowledge in the academy. *Computational theories of mind* are predicated on the idea that a computational mind is required to process the semantics of language and that such processing is largely algorithmic, or rule-based. From this perspective, mind is a machine that produces representational outputs manufactured from the material of representational inputs. However,
critiques of the computational view of mind argue that cognition is continuous, not segmented into discrete steps, and that dynamical systems theories more accurately depict cognition. Some computational mind theorists have responded by proposing cognitive models predicated on dynamical systems in which the inner dynamics can change in response to the new input from external sources. In this view, the state of a cognitive system changes when any of its aspects change, and the new “state space” that results must be subsequently refigured by new dynamics (Van Gelder and Port). Dynamical systems of writing are those that account for the recursivity that transforms writers and their writing processes as they work in complex, socially constructed task environments and use these environments, including the writing under construction, to monitor and adapt their processes and the writing. Flower’s and Hayes’ 1986 model is an example of a dynamical model because it accounts for the ways that writers return to earlier stages and nested subprocesses, such as goal setting and planning, to reassess and refigure their approach to composing. However, not all socio-cognitive theorists rely on a computational theory of mind to explain these complexities. Rather than presume the mind operates like a calculator to process the phenomena it encounters, some theorists believe the mind represents relationships between phenomena in order to make sense of them.

Proponents of representational theories of mind believe thinking occurs via internal systems of representation that have syntactic and semantic structures which are distinct from linguistic ones. In this view, external realities are represented internally with mental representations or imagery, and these representations may or may not mirror the actuality they are intended to symbolize. Some representational theorists consider mental imagery an inclusive category,
covering all types of pictures created in the mind.\textsuperscript{16} However, others distinguish between mental imagery and its processes and knowledge structures, such as mental models, frames, scripts, and schemas, since many of the images the mind generates are not intended to advance knowing. (For example, many consider dreams as forms of imagery that do not contribute to knowledge.)

Another way to conceive the knowing self is through \textit{embodied theories of mind}, and this assumption frequently underlies the research positing that mental models and other knowledge structures are in accord with, and arise out of, its bodily experiences. Cognitive linguist George Lakoff and his colleagues Mark Johnson and Rafael E. Núñez (1999) argue that human cognition, including abstract reasoning, is dependent upon the body’s most basic physical apparatus and involves the sensorimotor system and emotions. Lakoff and Núñez (2000) assert that even mathematics arises from a foundational ontology of embodiment. In this view, the mind computes but not simply as a mechanistic system. Johnson (1987) makes the case for embodied mind as the ontological foundation that informs the mental imagery produced by cognition in \textit{The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason}. Mental models thus arise out of bodily experiences and, as we shall see, they mediate scholars’ production of knowledge by informing their scholarly reasoning and composing in recursive ways.

Johnson argues that “embodied schemata” are the most fundamental structures of human experience, and he distinguishes these from the “mental pictures” to which they can give rise (23). For example, the embodied in-out schemata arises out of the physical experience of

\textsuperscript{16} Stephen Kosslyn (1994), an earlier theorist of mental imagery, proposes four distinct processes: one associated with constructing the image, one with assessing and interpreting it, one with maintaining it in memory, and finally, one for modifying it over time. This dissertation uses the term “mental images” to connote cognitive phenomena that thinkers experience visually in contrast to mental models, which are dynamic “working” models of systems.
containment, be it containment in a womb, a crib, or a room; the structuring of experience as “in” or “out” cuts across contexts and is common to all human beings. However, these experiential schemata are not the same as the mental models they can inform. For example, one could construct a mental model of “in-out” by imagining a circle with a single point inside it or a rubber ball that contains a focal point somewhere along its core.¹⁷ As Johnson explains, the embodied schemata are the basic “structures that organize our mental representations at a level more general and abstract than that at which we form particular mental images” (24).

Understanding how embodied experience shapes mental schemata and informs mental models is important for research that aims to more fully figure a place for this important knowledge structure in writing ecologies. Further, these three approaches to mind are not incompatible. The structurational systems that arise out of the body inform mental models, which can be enlarged beyond bodily experience to enable knowledge that is not the direct product of bodily experience. Here, the representational theory of mind accounts for complex and abstract knowledge and supplements an embodied mind theory. Further, certain knowledge structures, such as schema, enable a degree of automaticity in perception and knowing, and these phenomena can be usefully informed by computational theories of mind.

As this discussion makes clear, distinguishing among the various theories of mind, knowledge structures, mental representations, and cognitive practices is challenging for writing researchers hoping for a more nuanced understanding of the role of cognition in writing

¹⁷ That the former model is two-dimensional and the latter three-dimensional begins to suggest the malleability of mental models to serve the contexts in which they are employed/deployed. So too does the fact that a mental model may feature a rubberized medium rather than, say, one made of marble. (The former suggests plasticity and perhaps a relationship to an environment characterized by an ability to “bounce back”; the latter suggests a more rigid and bounded whole whose relationship to the environment is perhaps not under consideration.) The information-rich nature of mental models will be explored more deeply in Chapter 3 on research findings.
ecologies, particularly disciplinary ones. Not only is it difficult to accurately pinpoint and describe phenomena we are unaccustomed to noticing and discussing and to consider various theoretical approaches to them, but further complicating the task is the fact that various groups of researchers tend to define the terminology differently. In order to understand how mental models figure in writing ecologies, it is important at this juncture to define the various constructs to be used in the remainder of this dissertation, and to review the research that informs these constructs. Carefully defining the constructs also makes it easier to see how these knowledge structures can be understood through an ecology theory lens. In the remainder of this chapter, I describe schemas, scripts, frames, and mental models, along with my rationale for choosing an ecology approach, and I summarize specific research questions addressed by the study.

**Knowledge Structures and Their Role in Writing: Schemas, Scripts, Frames, and Mental Models**

In this section I review the literature on the knowledge structures that have been identified by key scholars in fields such as cognitive science, communication, and rhetoric and writing. The most commonly investigated knowledge structures are schemas, scripts, and frames. Mental models, another knowledge structure, is also commonly explored in problem-solving and learning in cognitive science and education research, but appears rarely in rhetoric and writing unless it is used loosely to describe a priori expectations for certain text-based genres and their organization (exceptions by Paul Prior (1990) and Cheryl Geisler (1990) will be discussed shortly). Schemas, the most general of the cognitive tools for structuring knowledge, have been dubbed the “building blocks of cognition” because they enable people to categorize their experiences by allowing for pattern recognition and pattern building (Rumelhart). A schema is a “cluster of knowledge representing a particular generic procedure, object percept, event,
sequence of events, or social situation … provid[ing] a skeleton structure for a concept that can be ‘instantiated,’ or filled out, with the detailed properties of the particular instance being represented” (Perry Thorndyke, qtd. in Johnson 19). These are distinct from and arise out of the “embodied schemata” that Johnson describes. Like most knowledge structures, schemas are generally transparent to their users. They are flexible, active, and developing (Bartlett): like the genres found in writing, they can be modified to accommodate new contexts. The structures aid in interpreting meaning from social interaction and can provide cultural or narrative models. Schemas can be circulated and function as “distributed cognition,” such that segments of a schema can reside in some members of a group while other segments reside in different members (Cole and Engeström). Schemas help readers interact with written texts by enabling them to make predictions (Widdowson). They also enable the organization of text by operating at the level of words, clauses, and sentences (microstructures); topics and themes (macrostructures); and genre (superstructures) (van Dijk 1980). Susan Fiske and Shelley Taylor (1984) identify five types of social schemas, including schema for others, self, social roles, events, and schematic rules for processing them. Lakoff and Johnson have pointed out in *Metaphors We Live By* (2008) that these schemas and others are often expressed through metaphor. My project considers how schemas relate to mental models in disciplinary writing ecologies to aid scholars with their writing.

*Scripts* are essentially schemas for events, and they are sequenced causally and temporally. While one might possess a schema for a construct such as “marriage” for example, one might

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18 This transparency is a phenomenon related to a comfort level with tool use that renders it taken for granted. David Russell (2002) has also noted that this transparency characterizes academic writing, and the phenomenon is discussed more fully in Chapter 5.

19 Chapter 5 speculates more fully on the relationship between mental models and genres.
possess a script for an event such as “wedding.” Roger Schank and Robert Abelson (1977) explain that scripts are goal-directed and signify particular actors, actions, and props. In talk, speakers frequently rhetorically construct events as scripted to further their conversational aims (Edwards). Their dual location in both the cognitive ordering in the mind and as discursive strategies relying on specific markers of discourse is a characteristic they share with frames; further, this research explores the ways in which scripts can inform the mental models used to produce and compose knowledge. For example, a writer may possess a sequence for the expected ordering of knowing and composing, which can then inform the writer’s mental model of authors and authorship. Novice writers whose scripts order “knowing” before “composing” in discrete linear phases may possess mental models of authorship as premeditated expertise residing in expert authors and simply relayed through writing. Such a model would result in underestimating the degree to which authors write to in order to know, thereby constraining novices who deliberate too long with research before commencing writing.

In contrast to schemas and scripts, frames are cognitive tools that order segments of subjective experience by defining them. These definitions instruct users toward which elements of a situation they are to consider salient and attend. They are representations of stereotyped situations (Minsky). Further, the meanings of words are dependent on the frame in which they are used. According to Erving Goffman (1974), there is no unframed human activity; frames can be rekeyed through discourse; and actors will break frames in order to redefine a context. Goffman (1981) also observes that in talk speakers can employ numerous frames across “strips” of interaction. Frames are multiply embedded and constantly reestablished during interaction through various mechanisms that realign speakers to each other; Goffman calls these points of alignment “footings.” Debra Tannen and Cynthia Wallat (1993) advance the idea that frames are
interactive, used in tandem with schemas, and built jointly between participants; they also
advance a discourse analysis approach for studying frames in text. John Gumperz extends the
idea of frames as socially constructed in his assertion that situations are defined through
contextualization cues. Further, cues such as code, linguistic variety, formulaic expressions,
register, topic, rhythm, voice quality, and non-vocal signals do not simply indicate context but
actually construct it, which speaks to the spontaneous way in which context emerges and is co-
constructed. For example, two people who have both a friendship and also a professional
relationship may meet for lunch where they expect to employ a frame to interpret each others’
behaviors as “friendly,” yet one may signal to the other to shift the frame to that of professional
colleagues through cues such straightening posture, making direct eye contact, and interjecting a
cueing word such as “So….” While this in situ construction relates to conversational
interactions, contexts are also created in situ in written discourse as well, by, for example, the
journal in which the scholarship appears or through certain key words that trigger specific
disciplinary frames (for example, the term “composition” can suggest to readers a disciplinary
frame that concerns pedagogical implications, most frequently in academic contexts). My project
explores how writing-related frames function in tandem with schemas and scripts to inform
scholars’ mental models employed in producing and composing knowledge.

As an example of a frame, Goffman provides “the slow development of the easy right of
medical people to approach the human naked body with a [clinical] instead of a social
perspective … [and the] special effort being taken to infuse the procedure with terms and actions
that keep sexual readings in check” (35-36). The example is useful for contrasting frames to
schema and scripts, and eventually to mental models. Someone going to see a doctor is likely to
employ a schema for the idea of “doctor,” which may include stereotyped features such as dress,
style of discourse, or manner of touch, all of which are likely to vary to a greater or lesser extent across cultures or contexts. Even the metallic tools on an examiner’s table are likely to be understood as “medical equipment” rather than, for example, as art. These “skeleton structures” differ from the script the patient is likely to rely on in order to sequence interactions with the doctor; these interactions may entail a greeting, followed by a description of troubling physical symptoms, then listening to the doctor’s recommendations. In this context, the frame helps direct how a patient will think about the interaction, including which features of the environment are relevant and how they are to be interpreted; the schema provides stereotyped models that help the patient formulate expectations for doctor and patient actors; and the script provides a pattern for sequential events during their encounter. These knowledge structures are employed in myriad contexts, including writing, and researchers have variously explored how.

Cross-Disciplinary Research on Knowledge Structures. Each knowledge structure is considered by bodies of literature outside the field of rhetoric and writing, fields such as cognitive science, psychology, and education, yet these have a bearing on how we regard them. To begin, frames and frame analysis appear frequently in communications literature, particularly in research related to their use in news media or political discourse, as when rhetors define the terms by which a topic, such as a news broadcast or a political campaign, is to be understood. Framing has also been studied extensively in social movements as “collective action framing,” particularly the dual location of frames in both activists’ minds and in their discourse (Johnston). Kress (2010) and van Leeuwan (2004) have each explored how framing functions in visual images by enabling the elements in a visual space to be brought into relationship with

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20 Research on collective action framing might usefully inform our understanding of academic disciplines and their discipline-specific representational practices, particularly from a critical lens.
each other and, from this relational quality, to derive their meaning. Their work is useful for considering how cognitive knowledge representation is multimodal and contributes to the construction of disciplinary knowledge.

The task of devising full cognitive or socio-cognitive models of writing is not one that all rhetoric and writing researchers necessarily strive for when they consider the role of knowledge structures. For example, in the rhetoric and writing literature, schema theory most frequently appears in relation to English as a Second Language (ESL), where the scholarship explores readers’ and writers’ schemas for organizing discourse (Carrell and Eisterhold; Meyers; Meyer and Freedle; Prior 1990). According to Bonnie Meyer and Roy Freedle, five basic organizing schemas enable readers to understand text genres: collections, descriptions, comparisons, and problem/solutions, and each of these forms can be embedded in another. Scripts, which as we recall are sequenced schema, also appear to feature in the narrative organization of text (Bower, Black, and Turner). The rhetoric and writing literature also figures “task schemas” in cognitive models of writing.

Task schemas are stereotypical tasks that writers encounter, for example, in the composing of specific genres or conventional discourse elements like conclusions. Hayes (2001) positions task schemas centrally in his 1996 model of writing when he revisits Flower’s and Hayes’ 1980 model; here, he defines task schema as a “packet of knowledge, acquired through practice, that is useful for performing the task and is retrieved as a unit when cues indicating the relevance of the schema are perceived” (26). This set of “condition-action-rules” includes a goal, an expected set of writing-related activities to be performed, a set of revision-related sub-goals, templates and criteria for quality, and strategies for fixing problems specific to certain text genres. Hayes notes he borrows heavily from Alan Baddeley’s 1986 conception of working memory, which includes
two structural components: a phonological loop to account for verbal content streaming through memory and a “visual-spatial ‘sketch pad’” for visual representations. Further, Hayes figures three types of representations that writers construct as they are reading source material: representation of the topic discussed; representation of the author’s persona; and representation of the text as a spatial display (28). However, he does not distinguish which knowledge structures are accountable for these representations, nor does he acknowledge that, in addition to the set of representations writers generate as they read to inform their writing, writers also generate a similar set when they compose. Perhaps in response to the suspicion that these representations are under-explored in his work aimed at more centrally considering schemas, Hayes notes that “If these visual/spatial representations play an important role … in reflecting about texts, we need to be alert to the nature of these representations” (34). My research responds to Hayes’ observation with theoretical and empirical research that enable me to produce thick descriptions of scholars’ mental models in Chapter 3.

Like Hayes, Prior (1990) also contends centrally with the role of schemas and mentions mental models in passing in “Schemata, Strategies and Social Construction: Some Implications for Second Language Pedagogy.” Here, Prior lists several knowledge structures appearing in the literature in various fields, including frames, scripts, and mental models, and speculates on their role, not in a writing model per se, but a more global model of a “knowledge system,” one that includes links to discourse processing and production. Prior aims to help ESL students avoid a passive relationship with knowledge and knowing by recognizing that social classroom practices can shape individual cognitive strategies and structures. He notes that research on schema “has led to a radical reappraisal of comprehension as an active process of constructing representations and meanings rather than as a passive process of decoding signals” (54). He observes scholars
theorizing an expanded role for the episodic forms of memory that enable a person to make sense of experiences such as reading text, and he considers how knowledge structures emerge from experiences in context. The result is that “structures like scripts are now seen not as preexisting structures that direct cognition, but rather as temporary products constructed out of episodic memories” (56). Prior’s model of the “knowledge system” has five components: prior knowledge through schemata; emergent knowledge (or mental models) generated in the discovery and construction of new meaning; processes for responding to content and structure; and a control system to coordinate the selection of goals and strategies (many of which are schemas themselves) (60). His fifth component anticipates a systems approach to theorizing affect in discourse production when he notes, “Arousal and emotion are global states like hunger, tiredness, anxiety, drunkenness, and so on … [and] an affective reaction can be seen as a stored memory, as part of a schemata … [that] will have global effects on your mental processes” (60).21 Further, each of these five elements of the knowledge system model can be viewed from (and therefore studied as) either a cognitive or a social phenomena.22 Prior asserts classrooms that account for these elements by creating the complexity and openness to help students engage what is often referred to as the “ill-defined problem” can also enable them to avoid fostering inert knowledge.

Prior’s knowledge model begins to incorporate knowledge structures as a broad category into cognitive models for writing and reading, and while he references mental models, the article does not account for their particular uniqueness or the interaction between the various other types of knowledge structures as they inform knowing and composing. Significantly, however, Prior’s

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21 Chapter 5 refigures affect not just as the source of writers’ impetus to write, but also as a modality of the mind.  
22 Arguably, it is the complicated task of the researcher to present both the cognitive and the social perspectives of knowledge (and writing) ecologies with a fullness such that the representation is as “socio-cognitive” as possible.
knowledge model is in essence a systems model, and it arrives most closely to a speculation about how mental models might circulate in knowledge ecologies or help mediate composing. This dissertation takes up these aims by more fully examining the nature of mental models and their role in writing. Given that previous work largely does not regard mental models in depth, I explore the construct more thoroughly in order to enable a fuller consideration of its role in writing. For example, in Chapter 3 I present participants’ models of readers and learners and explain how these models impact their writing processes and their scholarship. What follows is a review of the literature in other fields that, to date, has most centrally considered mental models in writing.

Mental Models Explored More Fully. The mental models construct has been attributed to Kenneth Craik (1943) and has figured in theory and empirical research in psychology and a range of other social sciences. In broad terms, a mental model is “a dynamic symbolic representation of external objects or events … [by] some natural or artificial cognitive system. … They function by representing relevant components of a system and the relations between them in a symbolic way” (Rickheit and Sichelschmidt 9-10). According to Philip Johnson-Laird, mental models play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological activities of everyday life. They enable individuals to make inferences and predictions, to understand phenomena, to decide what actions to take and to control its execution, and above all to experience events by proxy; they allow language to be used to create representations comparable to those deriving from direct acquaintance with
the world; and they relate words to the world by way of conception and perception. (397)

In the cognitive sciences, mental models have arisen in relation to the production of cognitive maps with which users mentally navigate physical spaces; “naive physics” in which “novices, but also experts often conceive complex physical systems” and frequently construct them via metaphors or similes23; through model-based reasoning conceived as a “semantic process based on the manipulation of mental models”; and in perception and knowledge building (17-22). In the latter, perception is understood to serve as the external stimuli or data that cue cognitive subcomponents, such as processes and knowledge structures, in a “bottom up” or “data driven” manner. Mental models in research on perception and knowledge include “situation” or “scenario models” and discourse processing models (21).24 The complex task of knowledge production, including “consciousness, reasoning, and the understanding of natural, technical, social, or verbal phenomena,” is particularly relevant to the work that scholars do when they investigate their research topics, since knowing is intimately entwined with producing discourse (22). These links between mental models, epistemic processes, and discourse is explored in cognitive linguistics research on both language production and comprehension. Further,

In language production, the speaker or writer must verbalize his or her current mental model, that is, transform a nonlinear structure into a sequence of verbal expressions in order to convey information to the listener or reader. In language

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23 Mental models are commonly employed “in teaching, with emphasis on the means of introducing and visualizing a physical system” (Rickheit and Sichelschmidt 19). This idea will be taken up in Chapter 5 on implications for learning and teaching writing.

24 See also Van Dijk and Kintsch (1983). The importance of situation models is taken up in Chapter 5 in relation to a writer’s ability to construct one in a reader through discoursal cues. It also figures in the writer’s idea of “audience,” as the writer must compose a model of the reader’s unfolding experience with reading as the writer composes.
reception, the listener or reader, proceeding from a string of phonemes or graphemes, must develop a mental model of a—perhaps largely undetermined—external situation that matches the intentions of the speaker and writer as far as possible. (22)

Cognitive linguists have focused on three levels of analysis in determining how mental models figure in discourse processing: the stimulus level, where words’ sounds and other qualities are represented; the utterance level, with respect to propositional structures and the mental representations they give rise to; and the discourse level, where “the listener [or reader] is to develop a representation of the speaker’s intentions, i.e., what the speaker [or reader] is talking about” (23). Further, cognitive linguists find that when a reader aims to understand a text, mental models can come into play in three ways: they can represent concepts, which are the basis of semantic structure and rely on previously developed schema. They can represent some local portion of a text, such as a segment of a narrative or part of the text’s organizational structure. Lastly, they can represent texts holistically (24). Johnson-Laird notes, “Taken together, the function of mental models in discourse processing is to lay the foundation for the function of sense by means of an integration of verbal information and individual knowledge” (24).

However, while the literature from cognitive linguists addresses how we process text as readers, focusing largely on the relationship between linguistic units and mental representation, it does not address how scholarly writers might use these mechanisms as they compose textual or multimodal discourse. My project explores how mental models of both knowledge or content

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25 Clearly, non-linear multimodal discourse and knowledge representation practices will impact the mental models produced by contemporary “readers,” and would be a valuable extension to this exploratory project.
domains and situation models that are cued by discourse function in disciplinary writing ecologies.

Cheryl Geisler’s (1991) article “Toward Constructing a Sociocognitive Model of Literacy: Constructing Mental Models in Philosophical Conversation” begins to shed light on this when it compares experienced academic scholars’ use of mental models to graduate students’ use as they produce scholarly writing. Specifically, Geisler investigates whether philosophy scholars possess mental models of scholarship as participation in an ongoing “disciplinary conversation,” a common assumption in the literature on disciplinarity. Her study revealed that they were creating special mental models that…departed in characteristic ways from everyday practice…of standard conversation. [T]he mental models of advanced literacy in philosophy appear to be different [from that of novice’s]. By expanding their activity structure, abstracting approaches, consolidating and linearizing their responses, and accepting restrictions on their right of repair, the philosophers in these literacy interactions were able to produce knowledge beyond that which is ordinarily possible in everyday conversation. (185)

From this, Geisler notes that a socio-cognitive model of literacy must account for the fact that “advanced literacy practices are embedded in different social contexts than those of standard conversation” (186). This suggests the need for theory and research on disciplinary mental models and their role in a socio-cognitive model of academic literacy that can account for the discipline-specific, socially constructed nature of mental models employed in academic

26 My experience with participants in English Studies suggests this may be a discipline-specific mental model of scholarship, as they in fact did regard it as conversational.
disciplines. Geisler also notes that a comprehensive socio-cognitive model is not within the reach of any one study, but that additional work in this area is necessary in order to further our understanding of how the “experts of advanced … arguments use acts of reading and writing to construct and act upon socially configured mental models” (171).

This dissertation responds to the need to more fully understand how scholars use discipline-specific mental models to produce academic knowledge by exploring the writing practices of faculty in three separate English studies’ fields, as well of a graduate student in rhetoric and writing. First, however, it is important to understand how disciplines might function as knowledge ecologies and why an ecology lens best suits this research, given that it is concerned with understanding how mental models are circulated through academic disciplines and participate in their construction. Once the literature on ecology and disciplinarity is briefly reviewed, I close Chapter 1 with a discussion of the research questions. Then in Chapter 2 I describe the methodology and exploratory methods by which these questions will be addressed.

**Writing Ecologies and the Role of Cognition in the Production of Disciplinary Knowledge**

This research relies on an ecology theory perspective of writing to explore cognition’s role in disciplinarity because an ecology theory approach affords greater capacity to consider the complex interrelationships between social and cognitive components than alternative systems perspectives (for example, discourse communities, communities of practice, or activity theory lenses) by which to conduct socio-cognitive analyses of writing. As Sid Dobrin (2012) describes, Complex ecological approaches begin to account for the complexities of writing, complexities we must admit are so diverse and divergent that we may never be able to fully account for all the facets and functions of writing … More complex,
holistic approaches should begin to account for the whole of writing by way of the whole-part relationship without elevating the individual parts to a status that renders the system of secondary value. (8)

Ecology theories and methodologies, Dobrin asserts, address the complex relations between the parts in order to develop more comprehensive understandings of writing. It is with this observation in mind that I present not just the research findings participants’ mental models and their use, but I also theorize a writing ecology that incorporates them.27 These aims are limited by the fact that exploratory research cannot comprehensively describe the nature of complex systems that are always in flux. However, ecological perspectives are most responsive to this lack of stability because they account for the dynamism of systems.

Marilyn Cooper’s 1986 book “The Ecology of Writing” is the most well-known early argument for investigating the dynamism and recursivity inherent in the ways in which writers participate and are acted upon in social contexts, and this is contrasted with the then-predominant view of writers as isolated actors. Cooper’s ecological perspective hints at the complex role of knowledge structures in writing systems, those that concern the current study, when she says, “One does not even begin to have ideas about a topic, even a relatively simple one, until a considerable body of already structured observations has been mastered” (369). The structuring to which Cooper refers quite possibly derives from socially constructed frames, schemas, scripts,

27 An ecological complexity theory combines elements of ecology theory with complexity theory to form a specific approach to understanding systems. Traditional approaches to the study of systems have focused on single levels of organization, while complexity theory “provides a framework in which the relationships between constructs at different hierarchical levels [e.g. community and nation simultaneously] can be accommodated” (Parrot 2). Further, the ecology focus implies the presumption that these systems are emergent and self-sustaining; and the notion that these are “natural” processes (i.e. found in natural ecologies and by extension, human ones).
and mental models that effect what writers consider salient in their efforts to know and communicate knowledge by composing in rhetorical spaces.

However, like their cognitively-focused predecessors, ecology theories of writing have not yet fully accounted for knowledge structures in writing. Instead, in the late 1990’s an ecological focus coalesced in rhetoric and writing’s literature among a subgroup of scholars who adopted ecology principles for composition, but largely confined their engagement with them as a way to interject environmental issues into composition pedagogy (Dobrin 2). However, others have taken up the approach more globally, and particularly influential are those that respond to the observation that it is not enough to import and apply ready-made theories from environmental systems research; writing studies requires ways of thinking that are unique to writing ecologies (Dobrin 9). In that vein, this dissertation focuses specifically on the unique dynamics of disciplinary writing ecologies and the role that mental models have in them. Further, several previous studies serve as models of ecology frameworks for writing and inform this work.

Among the more striking contributions to ecology theories of writing is Margaret (1999) Syverson’s *The Wealth of Reality: An Ecology of Composition*, which relies on cognitive science methodologies to argue that complex writing systems are all necessarily distributed, embodied, emergent, and enacted, and these characteristics provide this study with a set of basic characteristics for disciplinary writing ecologies. More recently, Jenny Edbauer examines the concept of the rhetorical situation through an ecology lens in “Unframing Models of Public Distribution: From Rhetorical Situation to Rhetorical Ecology,” where she notes that conceptions of context that confine themselves to audience, constraint, exigency, or other more traditional rhetorical elements fail to account for the “affective ecologies comprised of material experiences
and public feelings,” and this study considers the affect that often accompanies mental models (7). Additionally, work from complexity theorists, such as Byran Hawk, Mark Taylor, and Clay Spinuzzi, has contributed to ecology perspectives in rhetoric and writing through investigations into the nature of complexity and the role of inscription to produce and structure complex systems and their dynamics. Integral to these works is a regard for technology that is more than its material instantiation. For example, Collin Gifford Brooke’s *Lingua Fracta: Towards a Rhetoric of New Media* focuses on the juncture and nature of the interface, and conceives of a “new media rhetorics” composed of ecologies of practice rather than texts. This research recognizes mental models as a disciplinary practice, one that scholars learn through their professionalization and employ in their writing. Further, in line with Brooke, it considers how these practices participate in the writing that structures a complex set of relationships, activities, and goals.

Other ecology theorists have considered new media’s role in evolving writing ecologies, though as Dobrin notes, studies need not use the term “ecology” in order to take up the lens (15). Further, “unlike many scientific variations of ecology, writing studies’ ecology is indivisible from technology and … new media studies and writing studies [are] inseparable, if not indistinguishable” (13). These blurred boundaries between media and technology suggest that an ecological study of disciplinary knowledge production must not simply regard academics’ predominantly textual practices but also consider emerging multimodal practices as well, as the media and technology of composing, regardless of modality, are part of the larger dynamic whole.

One such phenomenon that does not fall cleanly into the “either-or” of media and technology is genre, and this dissertation investigates the relationship between genres, mental
models, and disciplinary writing ecologies, taking up Anis Bawarshi’s (2001) observation that, from an ecology perspective, genre functions both socially and cognitively. He notes that the “scene of production” shapes both a writer’s cognition and the writing, and he adds, “Within composition studies this scene is most commonly identified as a discourse community—the social and rhetorical environment within which goals, assumptions, and values are shared by participants who share common discourse strategies for communicating and practicing those goals, assumptions, and values” (69). Bawarshi argues that by framing this scene as a discourse community rather than an ecology, rhetoric and writing scholarship reflects a dichotomy between those who favor the writer as primary agent and those who attribute writers’ activities to social origins, a dichotomy that is theoretically and pedagogically limited as neither the writer nor the context exists independently. Interestingly, Bawarshi’s observation also echoes Bizzell’s earlier observation about the split between two camps of cognitive writing theorists, and this recurring theme suggests the task of representing a balanced model continues to pose problems for scholars who tend to favor one side or another.28 This dissertation frames disciplines as writing ecologies rather than as discourse communities or communities of practice because, as Bawarshi suggests, the former provides a theoretical perspective that can account for the fact that a writer and his or her rhetorical environment are always in the process of reproducing one another, so that the “environment” is not some vague backdrop against which writers enact their rhetorical actions; instead … [we] create our

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28 Arguably, scholars may not feel a balance exists at all, that either the individual or the social is indeed the primary driver in writing, and this begs the question, “How, then, might writing studies scholars best represent the extent and nature of each component in their writing models?” To further complicate this issue with a point that is relevant to this dissertation’s central concern, a scholar’s model may in fact accommodate a set of dynamic relations, but the model’s textual/graphic representation may not impart these dynamics to others. In other words, the mental model may accommodate more meaning than the semiotic representation. This suggests the critical role for new media in knowledge representation, as its affordances will likely dramatically change the way we communicate knowledge.
environments—our rhetorical situations—as we write within them. That is, we create our contexts as we create our texts. And genre is at the heart of this ecological/rhetorical process. (70)

Bawarshi reminds us of Charles Bazerman’s assertion that genres are “not just forms. Genres are forms of life, ways of being. They are frames for social action …. They are locations within which meaning is constructed. Genres shape the thoughts we form and the communications by which we interact” (Bazerman, qtd. in Bawarshi 70). (The relationship between genre and cognition is a significant one, and I explore them from the standpoint of mental models as an originary structuring force in Chapter 5.) Bawarshi also links genres to ideology, and these observations can be extended to the ways that ideology informs/forms mental models. As Bawarshi points out, even our experience of exigency, rhetorical or otherwise, arises from an ideological enactment of goals, values and assumptions. Bawarshi writes, “Structures, in short, are both the ideology and the enactment of ideology at once.” 29

In “Discipline and Publish: Reading and Writing the Scholarly Network,” Collin Brooke, who also employs an ecology lens and calls attention to the role of genre in structuring the way we think about disciplines and disciplinary terrain, notes that various genres (for example, synoptic texts, anthologies, and annotated bibliographies) rhetorically imbue scholarship with varying significance, thereby informing our mental maps of disciplinary terrains. Brooke writes, “Although we may not ever make them explicit, each of us carries with us some sort of network map of the discipline, treating certain texts as more important than others” (100). Brooke recalls

29 As Bawarshi points out, these ideas about the structuring roles of cultural phenomena can be found in both Anthony Giddens’ *The Constitution of Society: Introduction to the Theory of Structuration* and Carolyn Miller’s “Genre as Social Action.”
Berkenkotter’s and Huckin’s influential argument that “genres are inherently dynamic rhetorical structures that can be manipulated according to the conditions of use, and that genre knowledge is best conceptualized as a form of situated cognition embedded in disciplinary activities” (qtd. in Brooke 95). While Brooke does not explore the idea of disciplinary map-making as a formal knowledge structure, he suggests the importance of this cognitive tool in disciplinary enculturation as well as its connection to disciplinary bodies of scholarship via genre. This dissertation extends Brooke’s ideas by regarding other types of mental models that scholars employ as they reason in rhetorical problem spaces both to know and to communicate their knowledge, and it also considers how these particular knowledge structures function in relation to other knowledge structures that circulate in writing ecologies.

Lastly, Nancy Nersessian does not use the term ecology in “The Cognitive Basis of Model-Based Reasoning in Science,” but this work nonetheless provides an ecological lens in its investigation of the role of scientists’ mental models in conceptual change in the sciences. While English Studies disciplines respond to different sorts of research questions and aims, Nersessian provides important observations that apply across contexts. As Nersessian reminds us, it is commonly understood that change in the sciences is the product of “multiple, inter-connected problem-solving episodes extending over long periods and even generations of scientists,” and the cognitive nature of these episodes has been explored by extensively (136). Further, numerous investigations, including work by Bruno Latour, have established that

constructing new representations in science often starts with modelling, followed by the quantitative formulations found in the laws and axioms of theories. The same modelling practices often are used in communicating novel results and “instructing” peers within the community in the new representations. (137)
Nersessian argues that different types of mental models (visual modeling, analogical modeling, and thought experimentation) are often used together, which has led her to provide a unified account of model-based reasoning. Importantly, she produces a model of mental models, arguing that constraints play a central role in the models that scientists produce. These constraints arise from several sources which bear on the current research. First, the type of mental model that scientists employ in their reasoning delimits the model’s flexibility to respond to certain manipulations. Also, pre-existing representations of scientific concepts that provide base models from which scientists work enable and constrain the ability to generate novel models. Also, “external visual representations (including those made by gesturing and sketching) employed during a reasoning process are a significant dimension of cognitive activity in science and should be analysed as part of the cognitive system” (147). Lastly, constraints are presented by the nature of the “target problem” itself, foregrounding significance of content domain in the production of mental models. This “constraint model” of mental models is a valuable starting point for theorizing mental models in complex disciplinary ecologies that evolve over time; further, this research’s emphasis on the importance of content domain in determining the characteristics of mental models supports the need for discipline-specific examinations of mental models. Lastly, Nersessian points to studies comparing experts and novices that “lend support to the possibility that skill in mental modelling develops with learning (Ippolito and Tweney, 1995; Nersessian, 1995). That is, the nature and richness of models one can construct and one’s ability to reason develops with learning domain-specific content and techniques” (140). Thus, it is possible to teach novices to use mental models more effectively in their knowing and composing; mental models can therefore be considered as integral to literacy. This will be taken up in Chapter 5, when implications for learning and teaching writing are considered.
Further, while mental models have not been fully investigated in relation to writing ecologies, their role in systems is of interest to researchers across various fields, which makes this dissertation’s findings about mental models’ socially constructed nature and their circulation through text and other media potentially useful to contexts beyond the rhetoric and writing field. For example, Peter Senge (1990) has popularized the application of mental models to decision-making in “learning organizations” in *The Fifth Discipline: The Art and Science of the Learning Organization*. In environmental ecology Jones et al. (2011) explore how mental models participate in the management of natural resources, particularly as decision-makers construct models of complex natural systems that are often inaccurate and always of necessity incomplete. Additionally, systems dynamics researchers have investigated how mental models can be used to understand and improve systems designs (Moray). This dissertation extends our understanding about how mental models function in dynamic systems by figuring the recursivity and complexity of modes of inscription in the production and use of mental models, including the semiotic role of mind, text, and new media. While it focuses specifically on academic disciplinary systems, the insights about the role of inscription and representation presented here can usefully inform our understanding of other types of ecologies. Mental models’ role in student learning in educational contexts has also been explored by researchers in the field of education. For example, Stella Vosniadou and William F. Brewer observe in the frequently cited article “Mental Models of the Earth: A Study of Conceptual Change in Childhood” that elementary school children formulate models of the Earth based on their own everyday experience (e.g., they described the Earth as spherical, hollow, or having an edge) and modifying these models over time “to make them more consistent with the culturally accepted model by gradually reinterpreting their presuppositions.” Occasionally, attempts to resolve incongruities between
models gives rise to mergers of models with idiosyncratic results (536). This account of how models change in educational contexts suggests that mental models should be considered in pedagogical approaches to writing, not just to sciences; it also suggests that discipline-specific mental models can play a useful role in the enculturation of novices to experts who then participate in complex disciplinary ecologies by employing (and deploying) mental models. The specific research questions regarding disciplinary writing ecologies and the role of mental models within them that this dissertation addresses are presented below.

Research Questions

The literature suggests that mental models have a significant role in the production of knowledge and its representation. Further, researchers acknowledge a role for mental models in the sciences that extends from early education contexts to scientific communities, and this suggests they may also factor in knowledge production and disciplinary enculturation in English Studies fields, and they may be an important facet of literacy. This dissertation extends the scholarship on mental models by figuring them in relation to other knowledge structures and as functioning in complex disciplinary writing ecologies. The project focused on three scholars’ practices in two English Studies disciplines (literature and rhetoric and writing) in a single department at a medium-sized university in the Midwest, and the research questions coalesce around exploring the particular nature of mental models, their role in composing, their function in disciplinary writing ecologies, and the implications for learning and teaching writing.

As Fleckenstien et al. (2008) argue in “The Importance of Harmony: An Ecological Metaphor for Writing Research,” “Counterintuitive though it may be, complex, diffuse, and messy phenomena require—must harmonize with—complex, diffuse, and messy research
methods” (389). Mental models are without a doubt complex, diffuse, and messy. Further, because this research is exploratory, part of the project’s aim is to derive effective methods of data collection and analysis that harmonize with the study of mental models in disciplinary and other contexts; I respond to this goal in Chapter 4, where I share insights and experiences from conducting the research and present potential alternative methods. However, first, in Chapter 2 I describe the exploratory methods by which I conducted the initial study. Then in Chapter 3 I provide a rich description of the mental models that participants shared with me and I begin to speculate on implications. In Chapter 4 I offer alternative methods predicated on insights that emerged from my experiences with participants for more effectively eliciting writers’ mental models in future research projects. In Chapter 5 I begin to theorize mental models’ roles in disciplinary writing ecologies and present the pedagogical implications for such a theory of writing.

• What kinds of mental models do scholars use when they compose their scholarship, what are they like, and what is their relationship to other knowledge structures (schemas, scripts, and frames)?

• How do scholars employ mental models as they write? What persistent questions in the rhetoric and writing field about cognition and writing might mental models address?

• How might mental models inform a socio-cognitive theory of writing? How do mental models participate in constructing disciplinary cohesion? What is their role in circulating ideology? Are mental models employed differently in new media versus traditional textual productions of knowledge?
• What are the implications of more explicitly considering mental models in learning and teaching writing?

This dissertation’s goals include investigating the nature of mental models, their use in knowing and composing in complex disciplinary writing ecologies that increasingly include new media, and implications for teaching and learning. These are ambitious goals and reasonably, this study will only begin to touch on the ground these questions suggest. In order to do so, the research explores the use of semi-structured interviews, protocol analysis, discourse analysis, and ethnographically-informed journaling by the researcher as methods for understanding mental models in English Studies disciplines. I detail these methods in Chapter 2 in order to ready the reader for a discussion of the findings in Chapter 3.
CHAPTER 2. THE RESEARCH PROCESS: METHODOLOGY AND METHODS FOR STUDYING HOW KNOWLEDGE STRUCTURES ARE CUED IN SCHOLARLY DISCOURSE

Overview

This research explores how scholars use mental models to produce and compose knowledge by investigating the situated literate practices of three faculty and one graduate student in two English Studies disciplines (literature and rhetoric and writing). I have chosen methods that enable me to explore research questions regarding the following:

- the characteristics of mental models,
- their role in scholarly “knowing” and in producing scholarship,
- their function in creating and maintaining disciplinarity, and
- implications for learning and teaching writing and multimodal composing in academic contexts.

The research employs a multimethod\(^{30}\) approach to account for both the complexity of disciplinary writing ecologies and the fact that, as cognitive tools, mental models tend to be transparent to their users, despite their key place in reasoning and composing knowledge. In order to begin to theorize mental models’ roles in complex disciplinary writing ecologies, the study focuses on the connections among three semiotic domains:

- mental models constructed in scholars’ minds (“cognitive productions” captured in thick descriptions through scholarship, semi-structured interviews, and talk-aloud protocols);

\(^{30}\)This multimethod approach entails using multiple qualitative research approaches to exploring mental models and is distinct from a mixed method, which would entail using both qualitative and quantitative approaches in a single study.
• textual or multimodal representations of knowledge, which have been informed by mental models (captured in participants’ scholarship and in their centrally cited sources); and
• textual and multimodal composing practices during knowledge production (captured via talk-aloud protocols).

In order to explore the nature and function of mental models in these spaces, the research methods had to enable me to fulfill the following aims:

• to elicit the nature of mental models from participants;
• to identify other potential knowledge structures’ roles in mental model-making and knowledge production;
• to uncover the relationships between mental models and scholars’ representations of knowledge; and
• to locate mental models in larger disciplinary ecologies, particularly in English Studies.

To accomplish these aims, three distinct methods were employed. These included Discourse Analysis focusing on the following factors:

• text and multimodal digital scholarship (Huckin; Kress and Van Leeuwen)
• semi-structured participant interviews (Sternglass; Gubrium and Holstein)
• talk-aloud protocol analysis (Ericsson and Simon; Hayes and Daiker)

31 As I explain in Chapter 4, given that this work is relatively unexplored in rhetoric and writing fields and that these cognitive phenomena are difficult to elicit, I employed these methods as an exploratory approach. In Chapter 4 I reflect on what my experience has taught me about ideal methods for this topic, and I present some potential alternative methods to use in future research.
I also employed **Semiotic Multimodal Analysis** on mental models as cognitive representations via thick descriptions (Bezemer and Kress; Thibault), as well as **Researcher Reflection and Synthesis** through autoethnographically informed researcher journaling (Canagarajah).

For analyzing discourse (scholarship and transcripts of semi-structured interview and talk-aloud protocols), text-based and multimodal discourse analysis methods were devised from previous research on knowledge structures. These included schemas, scripts, and frames but emphasized mental models. The discoursal data I collected enabled me to investigate how mental models are cued in scholarship and to reconstruct as thick descriptions the mental models participants used during scholarly thinking and composing. This form of data provided access to the mental models as cognitive representations, and these were evaluated with a semiotic multimodal approach informed by Bezemer and Kress (2008), who established a set of analytical tools to evaluate what they call “learning ensembles,” collections of objects, people, and resources that confer learning potential in particular environments. Given that my work is focused on how experienced English Studies scholars use mental models as epistemic tools, this approach enabled me to conceptualize disciplinary writing ecologies as learning ensembles and to begin to understand how mental models function in them when scholars conduct and write up their research to learn answers to questions. Further, it enabled me to begin to speculate how we might use this approach to consider the significance of mental models in teaching both undergraduate and graduate students to write in the academy, particularly as they attempt to model the thinking and discourse that characterize various disciplines. Since in my role as researcher I necessarily employ my own mental models to study participants’ scholarly practices and to produce a textual account of them, I relied on autoethnographically informed journaling to supplement and extend the data on mental models used in disciplinary knowledge production.
Because the study is also aimed at uncovering how ideological cargo inheres to mental models, I employed a **critical methodology** (Fairclough; Gee; Huckin; van Dijk). The critical approach informed my choice of participants as I had wanted to explore how scholars use mental models in writing ecologies in order to understand the potential ideological forces that shape the way they think. As Huckin (1992) points out, communities and their dynamics (i.e. human ecologies) are constructed and maintained largely by their language practices, and a writer is not “an autonomous agent but … a member of one of more discourse communities, each having its own values, norms, and ways of knowing and communicating” (84). This multiple membership contributes to intertextuality between these ecologies.

Motivated by a desire to understand how mental models, either disciplinary or institutional, might be intertextually circulated, taken up, or contested across the different ecologies with which scholars have membership or perhaps just contact, I invited faculty participants from three different disciplines (creative writing, literature, and rhetoric/composition) from an English department in a large university in the Midwest. This enabled me to explore how these different disciplinary ecologies might interact and also to consider the effects of the institutional ecology—the university itself—on scholars’ thinking. Because I intended to discuss the nature of their scholarship, which could potentially present uncomfortable exchanges about how well participants’ scholarship had been received in either disciplinary or institutional contexts, and because I wanted to be sure that participants did not feel that a junior status impinged upon what they felt comfortable discussing, I chose only to invite faculty participants who were tenured, as I believed their tenure status would also enable them to more comfortably reflect critically on ideological underpinnings of both disciplinary and departmental influences. One faculty participant’s area of scholarly expertise includes twentieth-
century American literatures, queer and gender theories, and disability studies; he has published scholarship on illness, disability, and contagion, is affiliated with the American Culture Studies and the Women’s, Gender, and Sexuality Studies programs at the university, and regularly teaches undergraduate and graduate courses on literature and sex and sexuality. The second faculty scholar publishes and presents extensively on composition pedagogy, qualitative research methods, writing assessment, community-based literacies, feminism, and composition, and has published two edited collections in rhetoric and writing. She also teaches a wide range of undergraduate and graduate courses on writing and writing pedagogy, as well as courses for Ph.D. students in the Rhetoric and Writing Program for which she frequently serves as a dissertation committee member.

In order to explore the role of mental models in academic professionalization, I also sought a graduate student participant in English Studies pursuing a Ph.D. at the same institution. For the purposes of this study, I have defined the term “scholar” as specialist in an academic subject area and as one who has produced written scholarship (published or unpublished) in that area. While graduate students are generally less widely published than their professorial counterparts, I define Ph.D. students as scholars for this research because, while they are as yet novices, they are developing area expertise and, particularly later in their Ph.D. programs, have generally written extensively on it for coursework, dissertation projects, or scholarly publication and presentation. The graduate student who participated in this study, a former attorney, was a third-year student who was considerably advanced in meeting her program requirements for both coursework and producing a dissertation. She had also written several conference presentations and a collaborative book chapter on writing in graduate student education. At the time of this research, she had just finished drafting her dissertation on an approach to writing pedagogy that
emphasizes bringing into fruition and assessing not just students’ present abilities but also their “potentiality” (Haswell and Haswell).  

Each of these methods, and the ways in which a critical methodology informs them, is reviewed following a discussion of the specific challenges that studying mental models presents. Because this work is exploratory, I provide an example detailing my own use of a mental model in scholarly thinking to ground the research. In addition to presenting a mental model as an example by which to ground the discussion of methods, in this chapter I also summarize the steps in the research process, explain the rationale for a critical methodology, and describe the exploratory discourse analysis methods I used with the scholarship, interview, and talk-aloud data I collected. Then in Chapter 3 I provide thick descriptions of participants’ scholarly mental models and their use. In Chapter 4, I present alternative approaches to methods derived from my experiences with this project. As part of that consideration, I review the lengths I took to ensure trustworthiness and verification rather than validity and reliability. These discussions prepare readers for Chapter 5’s speculations on a theory of mental models and the implications for learning and teaching writing.

**Examining a Mental Model to Reveal the Challenges in Studying Them**

Difficulties in studying mental models arise from the cognitive nature of the phenomena, the complex nature of scholars’ mental models for disciplinary research, and, as discussed in Chapter 1, the demands invoked by a complex ecology lens to account for mental models’ socially constructed and circulated facets. Previous research has tended to examine mental

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32 As I mentioned in Chapter 2, I also interviewed a scholar in rhetoric and writing from another university who composed multimodally, as well as a scholar who wrote and published works of short fiction extensively. However, given time constraints, I was unable to integrate formal findings from these two participants in the dissertation project. These participants’ practices nonetheless inform some of my assertions about scholars’ mental modeling.
models used by those working in science and technology largely because, while the mental
models used in these domains are more technical than mental models of social phenomena, they
are in fact simpler. As Dedre Gentner and Albert Stevens\(^3\) (1983) note, the naive physics of
liquids, although intimidating to most nonscientists, “is a considerably more tractable domain
than, for example, interpersonal relations. It is very easy to tell an expert from a novice in a
domain like Newtonian mechanics, and very difficult to tell the expert from the novice in a
domain like marriage” (2). This observation relates to my research on two counts: my study is
cconcerned with the models constructed by faculty in English Studies disciplines as they produce
their scholarship, which includes numerous investigations into the nature of complex social
dynamics. Further, scholarship that does not take an explicitly social science approach is often
still focused on speculating and theorizing about human nature and relational dynamics (e.g.,
Deleuze and Guattari’s critique of psychoanalytic conformity informs a good deal of scholarship
in the field of literature, and while this scholarship is not usually structured as social science
research, it nonetheless concerns complex social dynamics). Further, in order to instruct novice
writers and enable them to develop writerly expertise, writing studies researchers frequently
compare experts to novices, just as Gentner and Stevens did in the observation above. I have
included the graduate student participant in the research design in order to speculate about
implications for instructing students on writing, including the professionalizing of graduate
students into their disciplines. These complex social dynamics are not the only factors that make

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\(^3\) While researchers have studied mental models in relation to the sciences by way of exploring the nature of
“scientific thinking,” mental models have not been extensively studied in relation to disciplinarity and “academic
thinking” more generally. Cheryl Geisler’s work was mentioned in Chapter 1. Another example is Richard Lehrer’s
“Designing to Develop Disciplinary Dispositions: Modeling Natural Systems” (2009). Lehrer’s extensive research in
the field of education concerns the importance of modeling and how children and young adults develop the
abilities to think in specific contexts. This scholarship is described more fully in Chapter 5’s discussion of
implications for teaching and learning.
studying mental models difficult. Mental models are also difficult to study because research on this cognitive phenomenon spans multiple disciplines.

Gentner and Stevens point out that, given the interdisciplinary nature of mental models research, “it is clear that the ideal mental models researcher would be a combination of cognitive psychologist, artificial intelligence researcher, anthropologist, linguist, and philosopher, and certainly a knowledgeable practitioner of the domain being studied … [who also possesses] good field intuition” (3). The authors explain that since most researchers do not fit this ideal, an “overlap and conquer” approach enables them to establish common ground that collaboratively constructs a theory of mental models. To most scholars in writing fields, mental models are an unfamiliar phenomenon, and readers hoping to dispel any lingering vagueness in conceptions of these elusive mental productions might find it useful to take a moment to consider whether a mental model may just have arisen in their own minds in response to Gentner and Stevens’ idea that theory-building is a process of “overlap and conquer.” Here, I share my own mental model of this process as an example in order to make the mental model construct clearer and to highlight the unique challenges of studying these knowledge structures, challenges that this study’s methods are designed to address.

When I encountered the mention of an overlap-and-conquer approach in Gentner and Stevens’ text, part of processing that discourse in order to understand the authors’ meaning entailed picturing a series of ovoid circles overlapping around a center, like petals on a flower. The mental model was colorless except for simple white lines that demarcated the boundaries of each petal (which represented each researcher’s domain) to produce regions of overlap. However, its likeness to a flower stopped at this simple structure (by way of contrast, it did not smell, produce seeds, open, close, or follow an imagined sun, features that could have been
The model functioned as a dynamic tool for reasoning in that it began with two “domain petals” and as I considered how a body of theory might arise from additional contributions, more petals appeared in my mind.

My initial attention to the model was on the petals that served to represent domains of research by discrete authors, but not the “center” about which a collective body of research ostensibly “grows” (a decidedly organic metaphor consistent with the flower model). Once I noticed that the mental model had a center, however, I was able to reflect on it and to ask myself, “Why does this model have this feature? What function does it serve?” It became clear to me that the center represented my epistemic assumptions about the nature of “truth” and researchers’ roles in establishing that truth: the model was literally shaped around a supposition that direct knowledge of any phenomenon is unknowable, which was why the petals touched this region but did not “cover” it (as one “covers” certain topics but cannot “cover” everything). Further, the accretion of petals around the center reflects my presumption that researchers cluster around all sides of a research domain in order to “close in on it,” a process that I believe can never fully account for the phenomena they study between them. The “unknowable region” of reality is the flower’s center in my mental model. Further, I experience this center as an abstraction that does not seem to have a material or visual presence.

The overlapping petals suggested the idea that some research domains “touch” on others but not necessarily on all. When I wondered how a Venn diagram would differ from the flower model I had generated it provoked the realization that, in contrast to a two-dimensional Venn diagram, my flower model was three-dimensional—I could see the flower rotating slowly to accommodate the addition of other petals, and the petals drooped slightly around the center. With the petals positioned this way, the model suggested the idea that research is subordinate to the
“truth,” though I had not been consciously aware that this assumption had been operating in my conception of how each researcher’s efforts relate to others’ and how all of the researchers’ scholarship accretes to produce bodies of knowledge related to particular phenomena. Specifically, the petals subordinate to the center reflected my subscription to the idea that scholars “serve truth” through research, a working assumption I used in this reasoning process, but one that is clearly not shared by all who participate in my field, though it is not uncommon. Nor is the assumption that science serves truth an idea to which I consistently or uncritically subscribe; instead, the model reflects the context-dependent assumptions I was using at the moment I produced the model.

These elements of the model suggest disciplinary influences on my thinking. Perhaps more strikingly is the fact that Gentner and Stevens’ phrasing used the term “conquer” but there is no hint in my own model of such territorialist or imperialist expansionism, which is instead an idyllic and organic quality in the flower image; while Gentner and Stevens’ work arises out of the field of cognitive science, I am working from an affiliation with rhetoric and writing studies, and I am situated in a Ph.D. program that is characterized by a curricular focus on feminism. In my studies I have encountered (and taken up) feminist critiques of imperialist agendas in knowledge production and the essentializing of ways of knowing. This suggests that my construction of a mental model in the form of a burgeoning flower rather than, for example, a battlefield where “advances” in knowledge are construed as hard-earned and violent clashes between scholars, reflects the disciplinary values of the field in which I am enculturated. One wonders how such a model either constrains my thinking (and therefore my understanding) about academic knowledge production or perhaps offers affordances of which I am unaware. The
process of contemplating my own model heightened my own critical regard for my assumptions and enabled me to reflect on them.

Additional reflection enabled me to notice that I view the model from an angle that is slightly above and to the right of the flower model and that my position is stationary as additional petals are added and the flower rotates to accommodate them; this stable perspective suggests a subjectivity that is experienced, at least in this instance, as “fixed” in relation to my own self’s beliefs about theory-building. In other words, this mental model does not figure changes to my subjectivity when changes occur in my field.34 Readers’ own mental models for an overlap-and-conquer approach are likely to be structural analogous, even if they differ radically.35

While my model reveals important aspects of my thinking, such as the feminist values that inform my understanding of how knowledge is produced and the fact that I do not actively model changes to the researcher’s subjectivity resulting from changing knowledge, I share it here in order to discuss shortly how mental models function in both discourse processing and discourse production, which are central to disciplinary writing ecologies. Further, sharing this

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34 However, it is conceivable that another model intended to address this issue could indeed figure a changing researcher subjectivity as a body of theory grows and in turn affects the researcher’s own self-conception. Another might strive to represent the dynamic and recursive changing subjectivities of many researchers simultaneously, one depicting how each change has the potential to instigate more change. What would such a model look like and would the model add anything of value to what we understand about the relationship between researchers and their work? These questions suggest that researchers’ abilities to reason through the complexities of their research questions or other scholarly aims are either enabled or constrained by their abilities to construct dynamic and complex mental models. This study argues in Chapter 5 that such capacities are a facet of literacy that should be considered in pedagogical approaches to teaching writing, particularly in WAC/WID approaches.

35 In Metaphors We Live By, Lakoff and Johnson explain that metaphors for the idea that “love is a journey” can take a number of forms (e.g., a bumpy ride [car]; off the tracks [train]; foundering [sea voyage]), yet can be characterized as “coherent (that is, they ‘fit together’)” (44). As I believe my own example demonstrates (and as I argue in later chapters), while their similarities are structural and render them equivalencies to some degree, their differences are significant indicators of important assumptions and elements in thinking that are often taken for granted. Further, reflecting on one’s mental models can heighten the awareness of these unconscious aspects of our thinking.
mental model helps me explain how each methodology enables this project to address its research questions. To begin, the fact that I had been compelled to adopt then share with readers Gentner and Stevens’ conception of theory-building by quoting the phrasing that had spurred me to generate a mental model suggests how mental models circulate via discourse in complex disciplinary writing ecologies and how they impact members’ situated literate practices, including knowing and composing knowledge as scholarship. When I chose to include the construct in my own text, I added dashes which were not present in Gentner and Stevens’ original text, and this textual strategy compressed the multiword phrase into a single unit, rendering it as a holistic construct: overlap-and-conquer. Using a single signifier instead of the multiword phrase “overlap and conquer” is a discursive maneuver that locates and reifies my mental model for knowledge production in the social sciences by creating a shorthand textual representation of it; further, this representation reinforces the idea of overlapping research domains by graphically depicting the words in the phrase as “touching.” Second, in revealing the assumptions and values I had held in this context about the concept of truth and the aims of social science, my mental model example demonstrates the integral relationship between mental models and ideology. Both the discursive strategies and the consideration of ideology are analyses that require a critical multimodal discourse approach that considers mental models as semiotic (described in detail shortly). Also, in order to determine how mental models circulate ideological sediment, a critical text-based discourse analysis of Genter and Stevens’ text could find evidence to suggest whether or not the authors also share an ideological stance that privileges truth and subordinates researchers to it, as well as to enable speculations about how such an ideological stance might inform the authors’ conception of theory-building and their
mental models for that conception. While the current research does not trace key sources that participants cited in their scholarship in the discourse analysis, Genter and Stevens’ text demonstrates how such an analysis could reveal how scholars’ mental models circulate through academic texts to contribute to the construction of disciplinary writing ecologies.

My mental model example reveals the characteristics of mental models that have implications for how I have studied them in this project. First, mental models change as we pay attention to them, which makes it difficult for the researcher to know whether they are eliciting the model-in-use or the model-in-production. While this must be considered a limitation of the study, it also demonstrates the potential benefits of teaching writers to closely attend to their mental models: examining one’s models enables one to note, and therefore critically reflect on, hidden assumptions in reasoning. As I will consider in Chapter 5, by learning to attend to these tools, we can extend our capacities for reasoning and representing knowledge, and we can enhance our awareness of the assumptions and values that may enable or constrain reasoning and knowing. Also, by extension, teaching writers to recognize the role of mental models in their readers’ minds can enable writers to make fuller use of these cognitive tools by more deliberately interjecting text and multimodal discourse to better enable readers to construct their own mental models as they process the discourse. However, before such teaching goals are devised, this

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36 Moreover, and ideally, semi-structured interviews with the Gentner and Stevens model would enable a researcher to confirm the nature and structure of the mental models that inform these authors’ text, and which then inform my own mental model and text. It seems likely their mental models would at least account for the metaphor of “touch” in the idea of overlap, a foundational construct among Johnson and Lakoff’s embodied schemata they both call “contact.” The relationship between mental models and embodied schema such as this is discussed shortly as it informs my theory of mental models in disciplinary writing ecologies and shapes the coding scheme by which the data was analyzed.

37 See Paul Prior’s 2004 article “Tracing Process: How Texts Come into Being” for a description of this method.

38 One faculty participant reflected that he was not sure if he was describing the model he had used when he wrote the scholarship we were examining or if he was generating one in the moment; this phenomenon will be revisited in Chapter 3’s discussion of findings.
research must explore the nature of the links among readers, writers, and mental models in writing ecologies. In order to do so, my research elicited mental models from participants by examining their scholarship, interviewing them, and conducting talk-aloud protocols.

Once I had analyzed these three sources of data on scholars’ mental models, I reconstructed the models textually as thick descriptions, considering as I did the limitations on having direct knowledge of another’s cognitive phenomena, and then I analyzed scholars’ models with a multimodal analysis. As my mental model example suggests, it is necessary to query writers about the multimodal structures of their models—largely because many of their components are tacit, highly ephemeral, or escape writers’ conscious awareness—then analyze the models and their structures with multimodal methods that enable theories of the mind as a semiotic space. The challenges that a study of mental models in disciplinary writing ecologies presents are summarized below:

- Mental models tend to be transparent to their users and highly transient.
- Mental models’ dynamic nature means that models-in-use shift as soon as researchers draw participants’ attention to them, giving rise to models-in-production.
- Given their transparency to users, interviewers must be skilled at getting users to reflect on their mental models and at eliciting thick descriptions of their nature.
- Results are also dependent on participants’ varying tendencies toward introspecting about their own cognitive states and their abilities to articulate these states.39
- Mental models of social dynamics are particularly complex (for example, they may be quasi-visual and employ devices such as movement, sound, or spatial representations of

39 These variances could be related to individuals using mental models or introspection differently, or they may arise from a lack of practice in articulating such experiences. Chapter 5 will argue this is a component of literacy that can be addressed pedagogically. Helen Abel et al. draw attention to the fact that there may be differences between how communities use mental models, and implications of this will also be considered in Chapter 5.
abstractions), so recounting their multimodal nature is difficult for unpracticed participants.

- Research that aims to trace the interconnectedness between semiotic domains (in this case, the scholars’ mind, their scholarly writing, the body of disciplinary discourse from which the scholar draws, and other elements in the disciplinary ecology) requires researchers to conduct multiple methods.

- Analyzing mental models’ representational qualities requires the researcher to speculate on phenomena they cannot observe themselves but only infer from participants’ descriptions, and despite soliciting participants’ feedback on the resulting textual renditions of their mental models, this is a significant limitation to understanding the forms and structures of mental models.

To study mental models in the context of these challenges, this research employed multiple methods through a critical methodology approach. The remainder of this chapter summarizes the research step by step, provides a justification for the critical discourse approach to the methodology, and explains how an exploratory textual and multimodal discourse analysis was used to analyze discoursal data.

**Summary of the Steps in the Research Process**

Given the complexity of multimethod research design, it can be useful to consider how such designs have been conducted step by step, since these more narrative accounts often enable readers to ground the technical discussion of methods by providing answers to basic questions, such as, “Who did what, where, and when?” Toward that end, the major steps by which the research was conducted are summarized below:
• Three participants in English Studies disciplines (two faculty and one graduate student from a single institution) were asked to provide me with either a recent piece of published scholarship or scholarship they were currently drafting; these were reviewed with a holistic approach\textsuperscript{40} in order to identify points in the text that might have been informed by writers’ mental models and to formulate open-ended interview questions about the nature of these mental models.

• During semi-structured interviews, I asked questions about the writers’ experiences composing their texts and elicited participants’ descriptions of the mental models they had employed while doing so. When participants gestured\textsuperscript{41} in the process of communicating their mental models, I verbally described their gestures and asked participants to tell me what the gestures signified, and together we explored how they contributed to the participant’s communicative intent\textsuperscript{42}; these interviews were transcribed and assessed using an exploratory discourse analysis approach in order to begin establishing the nature and characteristics of the mental models that scholars had used in composing their scholarship.

• Two of the participants (one faculty and one graduate student) also agreed to participate in a talk-aloud protocol where they verbalized their thoughts as they worked on revising

\textsuperscript{40} While the discourse analysis was largely informed by a critical approach (discussed shortly), the initial analysis of textual and multimodal scholarship focused primarily on enabling me to speculate about areas that might be informed by scholars’ mental models and to generate questions designed to elicit these mental models and the ways in which they were employed.

\textsuperscript{41} The “gestures” performed in the mind are distinct from the gestures performed through the body; the latter is more akin to the sense of mental movement. Yet, the research indicates that the latter can reveal the former, as when, for example, someone uses their hands to show idea domains or depict the way in which two objects relate. See “Illuminating Mental Models through Gesture” by Alibali et al..

\textsuperscript{42} I used this mode of gathering data on gestures in lieu of videotaping the interviews, which would have required approval from the institution’s human subjects review board, as well as the use of technology and multimodal data analysis approaches involving a significant investment in time and effort I did not have. However, as I describe in Chapter 4, I highly recommend this approach in future research if possible, particularly for research intended to explore the full range of semiotic resources for meaning-making in scholarly communication.
the scholarship we had discussed; after, I asked them about the mental models they had used during their revision process and this data supplemented the findings from semi-structured interviews.

- I rendered thick descriptions of the mental models that participants had used to compose their scholarship from analyses of their scholarship, the interview data, and the talk-aloud protocol data. These thick descriptions of mental models were submitted for evaluation and confirmation from participants, then altered if they provided me with suggestions. Next, the mental models depicted in these descriptions were analyzed as multimodal representations via a multimodal approach to the analysis.

- I kept a journal of my own mental models and my thoughts on them as they arose in scholarly writing and thinking during various stages of my research.

- From this data and other related literature, I began to theorize mental models’ role in disciplinary writing ecologies and to speculate about implications for learning and teaching writing. I also generated recommendations for alternative potential methods of data collection and analyses.

This dissertation is concerned with how mental models circulate in writing ecologies to shape how scholars in disciplinary communities know and compose their knowledge; it is also aimed at exploring how mental models function to circulate disciplinary ideology and contribute to disciplinary cohesion and identity. With these goals in mind, I describe the critical discourse analysis approach and the specific methods and protocols for the study.

**Critical Discourse Analysis, A Methodology for Ideology**

The critical discourse analysis (CDA) approach has roots in linguistics, where it was originally developed by Norman Fairclough in his 1989 volume *Language and Power*. This methodology
offers approaches for examining ideologies and power relations that are mediated by discourse. Fairclough’s CDA conjoins three distinct forms of analysis in order to explore each components’ contribution to sociocultural practice: analysis of texts; analysis of text production, distribution, and consumption; and analysis of discursive events. My research project fulfills the first form of analysis by examining scholars’ texts for evidence of mental models; it embodies the second form of analysis by interviewing scholars about their practices for employing mental models during the production of scholarship and also by considering how new media participates in circulating mental models in disciplinary writing ecologies. It fulfills the last of Fairclough’s analytic approaches by using a talk-aloud protocol to examine writing as it happens. Other researchers apply CDA to explore socio-cultural dynamics through the focal point of discourse but with other strategies and techniques. Teun Adrianus van Dijk (1980) employs CDA by focusing on how micro-level structures, such as language use, discourse, verbal interaction, and other communication, interact with macro-level phenomena between social groups to create social order characterized by power, dominance, and inequality. Van Dijk identifies the following critical junctures at which micro and macro levels are connected: members and groups; discrete actions and processes in systems; local contexts and global social structures; and personal and social cognition (354). Van Dijk characterizes the juncture of personal-social cognition as the intersection of personal knowledge and memories with “shared ‘social representations’ [that] govern the collective actions of a group,” and his assertion about the role of socially constructed “representations,” which arises out of a critical approach to discourse,

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43 The subsequent section on discourse analysis explains the nature of this evidence.
44 Interestingly, van Dijk’s text conjoins each half of these dyadic pairs with dashes, likely with aims that are similar to those I have for a representation of overlap-and-conquer: to construct these abstract loci as concrete regions, literally connected to the other, suggesting that socio-cultural dynamics are “held together” at these points of convergence and they are stable enough to be examined. My impulse to separate them was born of the need to account for each half as independent entities in order to “know where to look.”
hints at mental models’ capacity to carry ideological cargo, as many mental models are shared forms of cognitive representation (354). Once I had established the nature of scholars’ mental models through thick descriptions that I assessed with a semiotic multimodal approach, van Dijk’s four critical micro-macro junctures provided me with a checklist of loci with which to evaluate and theorize the relationships among mental models, scholarly discourse, and disciplinary writing ecologies.

In addition to critically reflecting on the structuring role of mental models at junctures between the individual writer and the social context in which the writer composed, I looked for discoursal evidence for the cueing of specific knowledge structures (schemas and scripts, frames, and mental models) in participants’ scholarship, interviews, and talk aloud protocols. I established this evidence by devising exploratory coding categories for common knowledge structures derived from previous literature (see the next section and also a summary in Table 1.) Because research on mental models has not figured prominently in the rhetoric and writing fields and is largely undertaken as thought experiments in communication and psychology fields rather than as the study of discoursal strategies and features, I spend some time in the next section describing the coding scheme I established to identify evidence of cueing for mental models.

**Methods for Analyzing How Knowledge Structures Are Cued in Scholarly Discourse**

**(Scholarship, Interviews, and Talk Aloud Protocols)**

As I describe in Chapter 1, each knowledge structure is distinct and accompanied by scholarly literature that prescribes methods for identifying when and how a structure is used to either process or produce discourse. In referring specifically to schemas, Patricia Carrell and
Joan Eisterhold (1983), who propose that schemas explain how ESL students interpret text, note that

according to schema theory, a text only provides directions for listeners or readers as to how they should retrieve or construct meaning from their own, previously acquired knowledge…. [T]he process of interpretation is guided by the principle that every input is mapped against some existing schema and that all aspects of that schema must be compatible with the input information. (557)

Knowledge structures exist in readers’ and writers’ heads, not in the scholarship they compose.45 However, knowledge structures can be brought to bear in two ways in relation to scholarship: first, they can be represented discoursally, as when a writer directly describes or depicts a schema, script, frame, or mental model (for example, a scholarly writer or speaker might describe a feminist frame through which readers are to interpret the scholar’s work or may present readers with a graphic or textual model of writing that includes variables and dynamics between them that readers should consider as the author continues to develop ideas throughout the text). Second, a writer may not describe a knowledge structure but can nonetheless cue a reader to compose one by employing specific discoursal strategies (for example, if an author says there is a recursive relationship between reading and writing, perhaps asserting that reading makes writing easier and writing makes reading easier, a reader is likely to model a bi-directional “force” or “impact” of each variable on the other). My early role as researcher, then, was to

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45 Distributed cognition presumes that a) chunks of cognition occur at discrete points in a system and accrete to form systemic patterns of cognition and b) that artifacts external to thinkers can “think for them” (see Edwin Hutchins’ 1995 work, Cognition in the Wild). While both of these observations may have a significant bearing on how a phenomenon such as mental models functions in a writing ecology, for this project, I have focused only on evidence of working, intact mental models that scholars report they are indeed thinking about. This does not rule out the possibility that mental modeling occurs in a distributed fashion, and I will take up this idea further in Chapter 5’s discussion of a theory of mental models in writing ecologies, and suggest that it could be fruitful research.
approach the text holistically as a reader in order to identify points in the scholarship at which these knowledge structures (schemas and scripts, frames, and mental models) are activated or cued. Once the scholarship cued particular knowledge structures during the reading, I noted these so that they could be teased out from and compared to other knowledge structures that were triggered by the text.

Though each knowledge structure is distinct, when activated in a reader’s mind, they are difficult to discern from others; speculating about which structures are instigated by various textual features and strategies in a piece of scholarship is harder still. In other words, I examined my own response to each participants’ self-selected piece of scholarship, and when the text triggered a mental model or another knowledge structure, I noted the textual or multimodal features that had triggered it. To further focus my attention on the discursive strategies that might have triggered these structures, I used the literature to inform a list of variables that functioned as an exploratory coding scheme by which to examine the scholarship for evidence, and what follows is a description of how literature on discourse analysis and knowledge structures informed this coding scheme. While schemas and scripts, as well as frames, are familiar categories in rhetoric and writing literature, mental models are as yet less familiar. Given the

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46 Ideally, this type of discourse analysis, which identifies discursive cues by using the researcher as an instrument upon which to register whether the mental phenomena are triggered, should be performed by more than just a single analyst. This study did not use additional raters and therefore could not accommodate validity in this way (i.e., a confirmation that the selected discursive strategies are indeed the ones responsible for cuing mental modeling activity) or make claims that mental models would be reliably similar among readers. The study is exploratory, and I limit conclusions accordingly. However, the analysis hinges on my response in my researcher role to the scholarship, necessitating an interpretive role (a factor ultimately true for any research). While this represents a limitation to the study, these interpretive assertions by a single reader (myself) should be considered part of the exploratory approach. The research findings have been reviewed by my committee, and they have assured me that the design and its aims are as sound as possible within these constraints. The project is also limited by the fact that as researcher, I had to construct my own visualizations of mental models from participants’ descriptions during interviews (see discussion in this chapter later on direct and indirect observation). However, the accuracy of these depictions was ensured to the degree possible by having participants review the findings where their models are described.
exploratory nature of my study, I devote further effort in Chapter 4 to describing potential alternative methods for data collection and analysis.

Discoursal Evidence for Schemas and Scripts. Schemas (the skeleton structures of concepts that can be filled out in context) and scripts (schemas that are structured as events) can operate in disciplinary content domains in two ways: by activating general schema for “top-down” information processing or by containing data that activate “bottom up” schema, highly specific structures which require data in order to be instantiated (Anderson et al.). Data-rich, bottom-up schemas inform much of the discourse in highly specialized disciplinary scholarship, particularly research that relies on specific contexts (with inherent local characteristics, which serve as data) for its relevance. However, scholarship in English Studies fields is also characterized by top-down schemas, general frameworks such as feminist inquiry or social constructivism, for example, that align with van Dijk’s assertion that topics and themes function to trigger macrostructure schemas, enabling the interpretation of text. Van Dijk also includes micro-structure schemas that arise in response to words, clauses, and sentences and superstructure schemas that are triggered by genre. I examined my participants’ scholarship for evidence of triggers for micro-, macro- and superstructure schemas. Their scholarship, interview responses, and talk-aloud protocol transcripts were also coded for schemas cuing the scholarship’s organizational structure (e.g. whether readers were cued to apply schemas for particular common organizational patterns or genres) or its disciplinary content domain. If the schemas were for event scripts, this was noted as well.

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47 Van Dijk’s superstructures are referred to in the rhetoric and writing literature as “task schemas”; see Chapter 1 for a discussion on them. Van Dijk’s term is used because it usefully distinguishes this type of schema from others that can appear in text.

48 For example, one scholar’s use of the terms “AIDS” and “memoir” cues the data-rich, bottom-up schema for a narrative of degenerative disease, a schema that most regularly figures gay men. As scholarship that falls into both
Discoursal Evidence for Frames. Frames are somewhat easier to identify, though their discursive mechanisms are more dispersed throughout the text. Jim Kuyper’s 2010 article “Framing Analysis From a Rhetorical Perspective” considers “Framing [as] a process whereby communicators, consciously or unconsciously, act to construct a point of view that encourages the facts of a given situation to be interpreted by others in a particular manner” (303). The scholarly works that faculty submitted for consideration, the transcripts of interviews, and the talk-aloud protocol results were assessed for evidence of frames operating in the four key ways that Kuyper say contribute to constructing a point of view: defining problems, diagnosing causes, making moral judgments, or suggesting remedies. The method employed in this dissertation is also informed by Hank Johnston’s “A Methodology for Frame Analysis: From Discourse to Cognitive Schema” (1995). Johnson explores frames that circulate among social movement groups, examining links between the “microscopic concerns of cognitive organization … [and] the marcosociological concerns of explaining mobilization (219). Johnston notes five considerations to include when conducting a micro-analysis: text as holistic construct; occasioning of the text; role analysis; specific “pragmatic intent” of the author; and discursive cues. Johnston’s approach usefully dovetails with van Dijk’s CDA to connect text to explanations of large-scale group behavior, such as academic disciplines. For multimodal compositions, the research employed Kress and van Leeuwan’s approach to multimodal discourse analysis, focusing on identifying framing devices within the multimodal scholarship.49

49 These authors’ work and work by Bezemer and Kress (2008) also informs my approach to a multimodal analysis of mental models as multimodal cognitive phenomena. A fuller discussion on how the latter might inform future research on mental models appears in Chapter 4.
Discoursal Evidence for Mental Models. The last knowledge structure for which I sought cues in my discoursal data was the mental model. Cues to readers to produce mental models are most clearly evident in discourse that announces its aim to present a model, as these models to greater and lesser degrees have their origins in scholars’ minds. Articles describing cognitive models of writing, such as those by Flower and Hayes, are examples of scholarship that, at some point, had cognitive origins. When these models appear in the scholarship, they provoke readers to reproduce them and to reason through their dynamics. However, not all scholarship directs its readers to produce mental models as overtly as those that explicitly describe models. Most scholarship cues readers to produce mental models through text and other multimodal devices, but without deliberate or explicit intention. Authors are largely unaware of mental models and by extension their rhetorical roles in readers’ reasoning (e.g., to aid in persuading a reader to adopt the author’s perspective or argument, usually a systemic or relational one), so most scholars do not consciously seek to cue mental models through deliberate discoursal strategies. Nonetheless, the scholarship that implicitly cues mental models rather than overtly presents them (the bulk produced by English Studies disciplines) triggers readers to compose these knowledge structures because the “text is taken as a cue to interpretive strategies aimed at the subject matter …. The listener is to develop a representation of the speaker’s intentions, i.e., what the speaker is talking about” (Rickheit and Sichelschmidt 23). In other words, readers use authors’ cues to map the text onto a mental model of its organization and its content.

My participants had numerous models of the textual situation and content domains. In the next chapter I present the findings from exploratory data collection and analysis. I learned a great deal from my participants about conducting research on mental models in scholarly writing, and
in Chapter 4 I share some potential alternative approaches to data collection and analysis based on my experiences with this project.
CHAPTER 3. HOW ENGLISH STUDIES SCHOLARS CONSTRUCT AND USE MENTAL MODELS TO PRODUCE SCHOLARLY KNOWLEDGE

Overview

In this chapter I provide an analysis of the data collected from three participants, two faculty and one graduate student. All three participants had shared a piece of their scholarship with me, and I examined them for evidence of mental models. My exploratory approach entailed that I occupy the role of reader and note when the text triggered visualizations in my own mind. From this initial encounter with their writing, I prepared questions for the hour-long semi-structured interviews I conducted with participants in their offices; then I examined the data with research questions in mind in order to find instances that could help me answer them, and I used an exploratory coding scheme to locate and analyze mental models and other knowledge structures that were implicated by the data. I also supplemented the findings at times with my own experiences, because an auto-ethnographic approach enabled me the only occasions for directly observing a scholar’s construction and use of mental models. Given the unobservable nature of this cognitive phenomenon (which increases threats to validity), I also shared the findings with the study’s participants, providing them an opportunity to help me revise or qualify assertions in order to depict their experiences with mental models more accurately. Importantly, the chapter represents an exploratory analysis, and from this exploration I devised a more structured approach to analyzing the data, which I present in Chapter 4. I present this more thorough approach as a set of methods and recommendations for the future study of mental models and their relationship to writing, as I hope to enable other researchers to address the particular challenges that this cognitive phenomenon presents. Ultimately, the interdisciplinary scope of my project, the ephemeral nature of this phenomenon, and the limitations of time
prevented me from conducting more than an exploratory analysis. However, I believe the recommendations for research methods I provide in the following chapter and the implications I share in Chapter 5 reflect that this study of mental models’ role in disciplinary writing ecologies was fruitful nonetheless.

As I start the discussion of each scholar, I describe the scholar and the scholarship that they had submitted for discussion. Then I provide highlights from the interview and, when pertinent, the talk-aloud protocols, summarizing what these individual cases suggest, especially when analyzed in light of the others.\textsuperscript{50} Lastly, I recap the central findings and introduce the reader to some of the limitations and constraints associated with studying mental models in order to prepare them for Chapter 4’s recommendations for doing so in the future.

**Participant #1, “Blake”**

Blake is a tenured faculty participant whose areas of expertise include American literatures, queer and gender theories, and disabilities studies, and he has published extensively on illness, disability, and contagion. He had shared an article with me that had arisen from his dissertation research some years prior, and he was readying to revise and resubmit the article to a journal in his field. I explained to Blake that I was interested in the mental models he had used while

\textsuperscript{50} The connections between *mental models* and *writing* can at times seem remote in the findings as I have presented them here, especially when I delve into the idiosyncratic nature of participants’ models. However, because this study is concerned with disciplinary writing ecologies that aim to produce knowledge (understood in most disciplines as the body of discourse that *claims to be knowledge*), scholarly writing and thinking are intimately entwined. In fact, this is the main affordance of an ecology approach: thinking is linked to writing, even if the thinker is not engaged in the act of producing discourse (for example, the scholar very likely thinks in ways about topics that have been imparted to them through other writers’ texts). Further, my experiences with the participants revealed that considering their *content-related mental models* (i.e., the topics they explore in their scholarship) can facilitate the production of scholarship by enabling novel perspectives and fresh insights. Additionally, the notion that we write to learn (Emig) suggests that much of what constitutes disciplinary knowledge is arrived at through the act of writing. Lastly, the text-based “situation models” (see Chapters 1 and 5) that scholars creates when composing their scholarship are discipline-specific, which means models of content domain are significantly involved.
writing and reasoning. Since most people are unfamiliar with the concept of mental models, I described a mental model familiar to most academics: campus maps. Importantly, these mental maps can vary quite a bit from person to person, as some are structured as bird’s eye perspectives and others as three-dimensional spaces that enable people to “walk” through their mental spaces. I also explained that mental models are often experienced quasi-visually, verbally, or even sensorially, and that we tend not to be aware of them, despite the fact that most of us are aware that words trigger mental images. Importantly, I communicated that I would be asking Blake to attend to experiences he might be unaccustomed to discussing, that it might be difficult to hone in on or describe these experiences to another person, and I reassured him that if he could not answer a question, he should not feel uncomfortable about it, as the research was exploratory and any and all responses to the questions would be valuable. I suggested this to ensure that if he drew a blank, for example, he would not feel in any way inadequate. I also attempted to make Blake more sensitive to his own bodily experiences of mental models by providing an example of what cognitive psychologists call “mental movement.” When we attempt to “put two ideas together,” for example, we often experience a sense of effort or “force” in this process, and I advised him that I would be asking about these kinds of experiences, too. I also explained that I would ask about aspects such as color and perspectival angles, and though I didn’t explain the rationale to Blake, this was in the hopes that I could elicit details that would enable me to produce rich (or as rich as possible, given that direct observation of cognitive phenomena is not an option) descriptions of his mental models. Finally, I emphasized that mental models contain certain features of the reality (what mental models’ researchers call the “target domain”) that we hope to represent to ourselves, and that we construct these models as aids to help us reason through the relationships among phenomena (in what researchers call the “problem space”).
(Lehrer). I shared a similar introduction to each of the participants, and I felt this background prepared them fairly well for the types of questions I asked without overwhelming them. During the interviews I steered participants’ attention to the more complex models suggested by their texts, as I felt these would enable me to make stronger observations about the role of mental models in disciplinary thinking and scholarship. It was sometimes difficult to discern the difference between what one might describe as a fully developed mental model and simply mental images, what various bodies of literature refer to simply as “visualization” or “mental imagery.” In fact, I discovered that even what first appeared to be simple visualizations often contained complex propositional relationships and were employed to work through and represent interrelations between the variables and objects that figured in participants’ mental models (see the discussion of Blake’s use of the term “legible” that follows). I also discovered that my lack of experience as a researcher was a significant limitation, since in hindsight there were often several potential avenues down which I could have questioned but did not. As I worked with additional participants, however, I felt that I grew increasingly adept at recognizing when they were employing complex mental models, either in the scholarship we examined or in our conversation about that scholarship. Blake had one such model for the mediating role that text played in culture and individual identity.

The scholarly writing that Blake had shared with me for our discussion explored the shift in U.S. culture during the late 1980s and the 1990s toward an increased tolerance of gay couples, but only is so far as their struggles with AIDS and illness engendered a limited empathy. Blake

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51 To follow up on an earlier footnote, the term “visualize” is most appropriately used to designate when cognitive phenomena are figured as visual modalities. However, I use the term more broadly, in part because participants seem comfortable using it, even when the modalities they employ to represent cognitive objects that are not visual (e.g., abstractions). I also use it interchangeably with the term “imagine.” For example, one could visualize/imagine the taste of lemon, which may or may not be accompanied by the image of a bright yellow orb.
saw the 2008 vice presidential debates as an expression of this shift’s pervasiveness, and had written that “both candidates declared their opposition to legalization, but were eager to express their support for certain same-sex partner benefits,” particularly rights that enabled gay men to have a role in their dying partner’s medical care. The shift was apparent in—and facilitated through—the AIDS memoir, a genre that had risen sharply in popularity during that time. The cornerstone of his article was a book called *Borrowed Time: An AIDS Memoir*, whose central characters are Paul, the book’s author, and his dying partner, Roger (Monette). Blake explained during the interview that he was “interested in the fact that this particular text [was] circulated and seemed to be representative of a general trend of making minoritized [bodies]—especially queer bodies and ill bodies—visible in the larger public, visible in a kind of national imaginary.” The article he was revising explored the role of this and similar memoirs in the “national imaginary,” and he had argued that these highly sentimental texts were both products of the larger social system in which they appeared and also exerted a structuring effect on that system, particularly on the way that the public regarded and responded materially to gay people. Blake was exploring what he saw for gay couples as a “citizenship in the national family” that was predicated on a recognition that gay couples, like heterosexual ones, love each other. This “humanness” earned them a place in the collective, but Blake was troubled by the fact that while these couples were increasingly accepted culturally at this time, it was only because their relationships had been circumscribed to and defined by their emotional bonds during illness rather than by a more inclusive version of “love” that included, for example, gay couples’ sexuality. He noted, “I’m a little bit suspicious of that version of belonging …. If that’s the only

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52 This project does not include copies of the participants’ texts for several reasons, including copyright as well as the fact that drafts are considered personal and many writers are extremely uncomfortable with sharing drafts publically. Given this, the dissertation does not include traditional citations and page numbers for quoted text.
version of belonging, then that seems to me to be a sort of paltry model … [which] isn’t really fair, and isn’t democratic.” Blake noted that when the gay couple is culturally defined “primarily around care as opposed to around desire or something like that … that couple is legible in a certain way to a wider reading audience and can fit into a notion of citizenship in a way that other people aren’t.” This observation led him to speculate about a social system that invites people into the collective based on specific criteria, especially because such an invitation also suggested to him that criteria exist to exclude people from that collective as well. He explained to me that if this “version … of sentimental dying makes one a ‘proper citizen’ [and gets] one invited into the national family, that also means … other people are not fitting [in]. I’m interested in that balance.” Later, as I analyzed the data from this and other interviews, I would speculate that his reflexive instinct to wonder about an “opposite but equal” relation (i.e., to consider the conceptual opposite of an invitation and to figure this “exclusion” in his model) is reflexive, sequenced, and repeatable form of attention to mental models that enables their construction and modification. This exchange, as I discuss in Chapter 5, had begun to suggest the relationship between mental models and other knowledge structures. Namely, scripts appear to be the cognitive structures we use to routinely perform certain sequential “applications” on our models in order to experiment with and revise them. These scripts are often characteristic to English Studies fields. For example, when a scholar “problematizes” an assertion, this is essentially an evaluative approach to the scholarly problem domain that is scripted and reflexive. Prior hints at these structures when he observes the presence of an overarching “control system to coordinate the selection of goals and strategies (many of which are schemas themselves)” (1990 60). It seems likely that identity schemas (i.e., scholarly identity) are entrained or embedded with scripts, such that when a person takes on the role and function of “scholar,” these scripts are then
handily activated, as the context prescribes. The implication is that scholars reflexively employ certain cognitive protocols in the task of producing knowledge that are intimately connected to discipline-specific identities. These observations are important for scholars seeking to enlarge the scope of their capacities for a critical lens regarding the knowledge they produce. An awareness of how scripts limit responses to the scholarly problems (i.e., how they instruct us to handle our scholarly mental models) can enable them to call these scholarly cognitive practices into question.

Blake and I talked for an hour about his article as I referred to specific passages and asked about them. I quickly learned that if I pointed out a passage and immediately questioned him about what he was seeing in his head, he would draw a blank, a response that all other participants exhibited as well. I realized that it was important to ask him something about the passage first, such as what a particular sentence meant or why he had chosen a certain word; then once he had launched into an explanation, I could ask him what he was seeing in his mind.53 As Blake was to ultimately observe himself at the close of our interview, this suggests that mental models are constructed (or reconstructed) on the fly rather than drawn from long-term memory. Blake recounted that when I had first proposed in an email that the two of us discuss his mental models, he had been “imagining those as very concrete visualizations, like somebody … [had] already cast a movie [with a particular] actor and very specific concrete images,” and he asserted that while he often visualized images, he was not certain that he produced mental models. However, after the interview Blake seemed more confident that many of the visualizations he produced were mental models. He reflected, “Mine are more … fleeting and

53 I began to develop a sense of when the model had been instantiated enough to ask about. In retrospect, I believe I sensed this through non-verbal cues, for example as when participants seemed to gaze off at something in the distance as they described their ideas as well as the act of gesturing.
impermanent. … I’m not super aware of them, and they don’t leave a lot of residue.” Blake was concerned about his ability to accurately recall and convey the exact mental models he had employed during the original writing process, as it had been some time since he had written the draft. He also suspected that the attention he and I gave to his mental models during our discussion changed the models as we talked, so he was also reluctant to assert these were the same ones he had possessed at the start of the conversation. Blake’s observations about his fleeting visualizations are consistent with other participants’ experiences. Our discussion also confirmed that mental models are cognitive tools that frequently escape our notice, but with some effort, can be brought into awareness and attended to. These findings are consistent with the literature. It also suggests that mental models are context-dependent and highly malleable, rather than reified. In other words, like genres, mental models are semi-stable or “stable for now.” The implication is that scholars in English Studies who wish to improve their scholarly reasoning can learn to use these cognitive tools, much the same as scholars in the sciences do. Additionally, Blake’s evolving models and his observations about them provided early support for the idea that mental models are constructed in complex ecologies in part through dialogic processes. This means that mental models are highly negotiated and that mental models’ construction is a highly distributed cognitive activity. What follows is an example that demonstrates that we can modify our mental models if examine and assess their limitations and affordances, a reflective process that can be facilitated by dialog.

54 His observations have important implications, both in terms of how we discusses mental models with writers who are generally unaccustomed to considering them and might struggle to articulate them and for how we should regard the “mental model tool” as semi-stable in nature, which serves as both an affordance and a limitation; these topics are taken up in the Chapter 5. Here I also theorize about the implication that “awareness” is in essence a compositional effort.
One of the most complex mental models that Blake shared was of the reader, the book, and the actual events that had been described in the book. As he explained what he had visualized, Blake used his hands to gesture to the different spaces, and he confirmed when asked, that this gesturing reflected the relative location of each of the domains in his mind. On his right, at what he described was about 2:30 on a clock’s face, he had conceptualized “a kind of movie version” of the actual events (though, to be clear, a movie rendering of this memoir has never been produced), and, though these events had preceded the book, they existed simultaneously with it, and with the reader who was reading the book. When I prompted him to comment further on the positioning of the three domains in his mental model, he observed, “The reader of the book would be sort of close.” I asked him to speculate on why the movie version was farther from himself, the reader, and the book. Had he positioned it at a distance because he felt the actual events were more temporally or spatially distant? Or did he feel it was necessary to allocate the event domain a larger space in order to accommodate the representations of multiple bodies and events across time—representations that are larger in actuality than a book or a single reader? He reflected, “It’s not so much the movie as it’s me visualizing the actual people, the characters in this memoir … living their lives. … I think it’s just that [it] needs more space.” The model evidences the often-iconic nature of mental models, meaning that their features parallel

55 Blake alludes several times to technologies and makes the direct observation that his mental models are a product of those technologies. That available technologies structure our thinking is a topic I explore again later in Chapter 5.

56 Readers may be struggling to imagine the descriptions of my encounter with Blake in their heads, which underscores an important point about the affordances of dialogically constructing mental models: while Blake and I struggled at times to articulate and share his mental models in our conversation, the deployment of multiple communicative tools, such as gestures that mirrored the models as well as nods and other nonverbal cues, that enabled our mutual understanding arguably in ways that this textual account cannot possibly do. This suggests an important role for face-to-face contact in the circulating of mental models in writing ecologies and has implications for disciplinary enculturation. Lastly, I have observed that this face-to-face sharing of mental models is characterized by a type of compression, at least in terms of word count and I suspect in terms of the time it requires to successfully communicate them. Compression is also a theme that will be taken up again in this chapter.
the characteristics of the target object domain. It also reflects the use of narrative imagery as a component of mental models, supporting my assertion that mental models can be productively studied as multimodal compositions; in this case, the mental composition includes a representational modality akin to “video.” This exchange reveals that, similar to scholars in the sciences, scholars in English Studies do indeed have sophisticated models for their scholarly domains. Common “objects of study,” including texts, readers, and authors, are central to English Studies disciplines, and the way in which scholars mentally model these objects affects the claims they make about them. By heightening their attention to these models, scholars can free themselves to consider alternatives.

Blake’s mental model also suggests the utility of a semiotic multimodal interpretation, as the spacing of his components (e.g., the book nearer himself, the events unfolding at a distance) is meaningful, specifically suggesting his relationships to these objects as well as assumptions in his own thinking. By way of example, at one point Blake became aware that Paul and Roger, who populated the actual events domain, were watching the reader, and he seemed surprised by this; it struck him as “wrong.” As I argue from examples drawn from exchanges with other participants as well, “minor details” such as this are often quite significant and can be understood by critically examining their arrangements through a semiotic lens. When we examine the arrangements of the component features in our mental models, we can often discern meaningful reasons for their inclusion, placement, and specific representational qualities. As the discussion with other participants reveals, such reflection and interrogation can produce important insights for thinkers, such as helping them identify unexamined assumptions, which then enables them to
modify their mental models by experimenting with alternative configurations and different relational dynamics between the models’ components.57

I did not think to ask Blake why he was presuming the “actors” could see the readers. Did Blake believe both Paul and Roger knew Roger would eventually write a memoir that would be read? Or did Blake feel that Paul and Roger were aware of participating in a private narrative that nonetheless unfolded in some sense on a public stage, which led them to feel their story was already being “read” by a public who judged them, their sexuality, and their partnership? If I had asked these questions and Blake had indicated that either of these explanations resonated with him, I might have then asked him to reflect on how the “actors’” awareness affected the memoir and whether Blake thought this was an important factor in the complex relationship he was theorizing between “actuality” (i.e., the reality beyond the text), textual representations, and readers. In other words, I would have queried Blake about whether he was unknowingly theorizing an unorthodox role for time in these relationships (i.e., had the text impacted Paul and Roger, and perhaps other gay couples, long before it had ever been written?). If so, this might evidence that an evolving role of time in explanations of phenomena that concern English Studies scholars construct. In other words, time might be increasingly figured in the mental models constructed by English Studies scholars. It may be that mental models present early indicators of conceptual change in disciplines by presenting subtle features that upon first notice strike us as irrelevant (or, in the discourse of frames and other knowledge structures that shape perception, features that do not seem “salient”). Scholars who trace the history of the academic

57 My research revealed that the nature of the dynamism inherent in a mental model is significant because it affects a mental model’s utility for reasoning in certain contexts (i.e., some forms of dynamism are more appropriate to certain contexts than others). Further, forms of dynamism are often scripted (Shank and Abelson) and are also specific to and circulated throughout disciplines. These ideas are discussed further in Chapter 5.
disciplines might find it fruitful, then, to consider as part of those histories, the evolution of the disciplines’ mental models.⁵⁸

It seems likely that this feature of the mental model did indeed function to represent the complex interrelationships between text and identity that Blake had been exploring: not only had Blake figured a recursive, structuring effect between the sentimental AIDS memoir and the “national family’s” increasing inclusion of suffering gay couples into the fold, he had also indicated in our conversation he thought the sentimental memoir and the public’s empathy for a limited kind of “gay coupling” had also structured gays’ own understanding and enactment of their partnerships as expressions of care rather than desire. Given the relational dynamics Blake sees among the text, its actors, Paul and Roger (who represented the class of gay couples battling illness during that time), and the national culture, it is likely that the actors in the narrative sphere of his model who “break scene” and demonstrate an awareness of their audience-qua-readers are an expression of Blake’s working assumption that gay couples at this time had indeed experienced an ever-present public scrutiny over their private lives that affected how they conducted their lives. Additionally, Blake had described the reader in his model as focused on the book; the reader did not return Paul and Roger’s gaze, which suggests the underlying assumption that the public’s views of Paul and Roger, or any other gay couple, are mediated by text, such that readers never do see “real people” or their suffering.⁵⁹

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⁵⁸ This is an argument advanced by Nancy Nersessian, who advocates for a cognitive historical methodology. I discuss this again in Chapter 5.
⁵⁹ It might also have been fruitful to ask Blake whether he felt the “reader” in his mental model had the desire or even the capacity to see Paul and Roger if they had wanted to, and this conversation would likely have led to the discussion of the nature of the borders and boundaries between these regions, an idea that recurred with other participants.
While I was unable to posit these questions to Blake or ask if the thought the reflection and discussion provided him with any useful insights, one of the models we discussed did reveal to him a working assumption he had previously not considered fully. In fact, he realized that it was a feature that set his thinking apart from previous scholarship, though he had not noted this before. Blake had been explaining the process by which sentimentality enables certain groups to join the national family, and he had been using his hands to explain that thinking. With the fingers of his right hand pressed together, he picked up an invisible object and deposited it into a circular area he was demarcating with his left hand. I asked if he was using his right hand to “interject sentimentality into the national imaginary.” He explained that this was not the case; instead, these gestures were reflecting the nature by which individuals were being placed into the national family. As he explained the gestures, he reflected that sentimentality was “more like a tool that brings certain people into the national imaginary. … [T]he way that the national imaginary works is that there’s a certain kind of sentiment, a certain kind of affect, that’s built into it,” and this functions by providing its members with “a sense of how people feel in relationship to each other and who is felt to belong or not belong.” In retrospect, I realized that his left arm, in plucking up imaginary objects, swinging in a regular arc, and releasing those objects, had been depicting a mechanistic process not unlike the movement and function of a crane; this was supported by his use of the terms “tool” and “built.” As he explained that the death of a loved one can function as the mechanism by which sentimentality is engaged, Blake

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60 I would like to draw readers’ attention to the prevalence of metaphors I use and that these structure the mental models my readers construct. For example, the word “mechanism” suggests machinery and reflects the Blake’s use of the term “built” and the idea of structuring that pervades his work. The word mechanism is opportune for explaining the difficulties of producing discourse on mental models that does not overly bias the results by virtue of what the researchers’ word choices suggest. Ordinarily, I attempt to choose words that are less suggestive, if they are available. In this case, a word that is less likely to bias this interpretation of this exchange is “manner.” While clearly research is rhetorical at its heart, in this project I have tried to remain sensitive to this phenomenon and confront it as best as I can. See Lakoff and Johnson on the prevalence of metaphor in our discourse.
realized that this contrasted with the conception of the “imagined community” posited previously by theorist Benedict Anderson (1983), “where the focus is on an active mental process of imagination.” Blake felt that bringing attention to this figuring of sentimentality as the mechanism for instantiating community, in contrast to Anderson’s imagination as mechanism, would be useful for his revision. By carefully attending to the features of the mental model, Blake had become aware of what distinguished his model from others’ and he felt this was an insight that could serve his revision process.

This exchange evidences several important points. First is the communicative function of gesture: when we share mental models with others we use gesturing to help signal important features of the models’ composition (Alibali). This model was structured around the function of a “vehicle,” and his gesturing to pick up and transport people into the national imaginary was structurally analogous to the discourse he used to describe his mental model (i.e., sentimentality “brings people in”), and gesture and discourse worked in tandem to support Blake’s meaning. In fact, Blake had noted that when he is “talking about space,” he is often also “sort of drawing borders with my hands.” My exchange with Blake also revealed the importance of space and its relationship to meaning-making in mental models. At the close of our interview, Blake commented that “I probably do think in, [and] I’m very interested in, borders and boundaries … like actual borders and boundaries and spaces, which involve geographic movement and things like that.” His thinking also relied on regions and their relationality, and an idea with which other participants were concerned as well. This may be linked to feminist theory’s history in English Studies disciplines, as scholars whose research relied on feminist theory had also extensively

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61 The importance and function of gesture (as well as Blake’s observations about using gesture in his classroom teaching) are presented in Chapter 4’s recommendations for researching mental models and Chapter 5’s discussion of gesture’s importance to mental models in learning and teaching writing.
explored the nature of borders and boundaries related to “self” and “other.” Future research on mental models could trace whether contemporary mental models relying on the modality of spatiality are connected to earlier feminist scholarship in order to understand how and why English Studies scholars grapple with their disciplinary “problem spaces” in particular ways (e.g., one might ask whether the common mental model for the rhetorical act of “definition” is structurally analogous to the mental models of boundaries and boundedness evident in feminist theory).

Lastly, my discussion with Blake revealed what is perhaps an unsurprising tendency: English Studies scholars choose words that originate from terminology associated with discourse processing and language production. For example, in a passage of our discussion quoted earlier Blake had used the term “legible”; he had also used it in his draft, asserting that the memoir he had examined was “representative of certain ways of making the experience of AIDS in the 1980s legible to a national imaginary, a text that drew on but also wrestled with the sentimental mode endemic to narratives of the death of a loved one” (emphasis added). I asked why he had chosen this term and he explained that legibility implied “intelligibility,” that unlike the alternative term “visible,” Blake felt the word legible “implies the sense of reading and understanding.” With a single word choice, Blake had suggested to his readers that accepting the gay couple into the national family through the mechanism of sentimentality was a two-part epistemic process, one that included not just the public encountering them through the text, but also actively interpreting them after that encounter. The word suggests once more the importance that Blake ascribes to the text as intermediary, both enabling and constraining the public’s ability to “know” what gay couples experienced or who they really were. It also suggests this “knowing” was not episodic in nature, but ongoing and subject to revision. This
instance reveals how powerfully interconnected word choice and mental model formation are, as Blake had constructed a complete and complex model that pivoted on the use of a single term.

Blake and I also explored the use of the term “underwrite” in his article to describe how “the sentimental” enabled readers of the AIDS memoir to create “bonds of sympathetic understanding between characters within the text and [themselves] in order to underwrite the claim to citizenship for otherwise disenfranchised groups” (emphasis added). When he contemplated the word, he visualized handwriting that linked individuals together in the social system, and this reflection enabled him to realize that he had figured that ties between individuals are constructed materially and literally through words circulating as a kind of substrata; these words provided the foundation for the bonds between gay couples and the public that he had explored in his scholarship. “Underwrite,” like “legible,” had been carefully chosen to reflect the mental model that Blake had for the phenomena, and its visualization as handwriting revealed how Blake’s modeling of this process arose out of the discourse of language and meaning-making that is central to English scholars’ disciplinary concerns. While the assertion that language metaphors are central to people who work in language-related disciplines might seem obvious, its significance lies in the fact that our mental models have affordances and limitations that stem from the configurations we inherit from the disciplines within which we work; carefully reflecting on these mental models and questioning their configurations can enable scholars to critique, as well as revise, their models. The fact that mental models tend to arise out of foundational disciplinary assumptions is particularly important for considering how fields might produce new knowledge and facilitate their own advancement,

62 It also demonstrates how representational technologies shape our mental models, as does Blake’s nod to a “movie version.” This topic is revisited in Chapter 5.
as new knowledge might be best facilitated by reflecting on field-wide mental modelling practices, a process that can bring attention to disciplinary assumptions. Further, given the emphasis on interdisciplinary knowledge-making, a capacity to attend to extra-disciplinary thinking at the level of mental models might well enable us to produce novel and creative scholarship. The ability to interrogate the components and dynamics of one’s mental models and the implications then also frees one to experiment with alternative configurations, and this can yield fresh insights. These ideas are taken up again in the discussion on other participants that follows.

**Participant #2, “Jillian”**

Jillian is a tenured faculty scholar in the field of rhetoric and writing whose scholarship centers on composition pedagogy, qualitative research methods, writing assessment, community-based literacies, feminism, and composition. She frequently writes collaboratively with faculty colleagues and Ph.D. students who are in the graduate program in which she teaches; she publishes scholarship on her collaborative experiences and the importance of collaborating for fostering mutual understanding and building knowledge. The text that Jillian had submitted to me for our discussion had been published as a book chapter in the prior year, and in it Jillian describes the nature of teacher research, and explains that readers might be surprised to learn teacher research is far from simply defined. In fact, she writes, there are “long-standing epistemological disagreements—differences of opinion on what teacher research is and does.” During our interview she explained that it was her aim with the chapter to introduce these complexities to graduate students who may not be familiar with the disciplinary conversations on the topic.
As with Blake, at the start of our interview I introduced Jillian to the concept of mental models and explained their function by providing a few examples; I also explained that if she experienced difficulty in responding to my questions, she should not be troubled, as we are generally unaccustomed to noticing and describing these cognitive phenomena. As with Blake, I pointed out passages in the text and asked Jillian to explain their meaning. Once I felt she had fully engaged her ideas through the process of articulating them, I asked her to reflect on the visualizations that were accompanying her ideas. One of the more complex mental models Jillian shared with me was also central to her chapter’s argument: she had written that foundational to the definition of the teacher-researcher was the idea that scholars “conceive of and practice teacher research as a form of action research, the goal of which is improved teaching effectiveness, which in turn leads to the development of the teacher-researcher as pedagogue and investigator.” Jillian explained to me that once a teacher-researcher has investigated a question by conducting formal or informal research, the findings necessarily change the teacher-researcher’s subsequent teaching approach. Jillian saw this process as continuous and described it as “reflecting, enacting, reflecting, enacting ….” As she talked about it, she drew a circle in the air with her finger, and when I asked her about it, she confirmed that she was also experiencing a sense of mental movement as she made this gesture. I asked, “When you move along this circle, as you’re thinking through this process, do you experience anything different from the beginning [than when] you travel along the circle?” Jillian explained that her imagined teacher-researcher appeared to her as an abstraction rather than a fully featured or specific person, and this vagueness in the representations of persons in mental models also characterized other participants’ descriptions, too. According to Johnson-Laird’s 1983 work with mental models, this vagueness enables thinkers to populate their models with general rather than specific objects;
these objects are essentially “tokens” that are defined by context-driven constraints (398). These roughly hewn figures can stand in for whole classes of people or other objects of thought, enabling us to work with generalizations in our mental models, much the way that a mathematical statement can include “x” or “y” to designate a number of potential actualities that could fulfill the mathematical relationships implied by the statement. While Jillian’s teacher-researcher did not possess facial features or gender, for example, her model of the teacher-researcher was defined instead by personality traits or, more specifically, by affective characteristics, and these traits persisted over the cycle of growth and development she visualized. Her teacher-researcher was “someone who’s truly energized by teaching and puzzled by it at the same time.” As Jillian explained and demonstrated with her circling gesture, the teacher researcher is “never at the endpoint, always in process.” I asked Jillian to describe how the teacher-researcher changed over the course of this development. She seemed to envision them as anchored to a mix of affective stages and activities that would occur over the process of teaching and researching, noting,

[First] there’s the interest, then there’s the study, then there’s the reporting of this study to various audiences, so there’s bound to be insight or frustrations or “befores” and “afters.” And then the “So what, so what now, what next?” But I think it just goes back to “So what’s the next question?” or “How do I continue to problematize or complicate this question?”

Here Jillian summarized the central drive of the teacher researcher, and as with her summary of the process of “reflecting, enacting, reflecting, enacting,” this reduction of the model to what

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63 Cognitive psychologists who study mental models explain that they function as “token systems,” whereby their users designate certain objects to fulfill certain functions with the models (Johnson-Laird).
many scholars colloquially refer to as a “take-away” seemed to suggest that mental models themselves are often reduced to less complicated mental models, versions that encapsulate complex relationalities among parts. It is likely that the contexts within which a scholar employs a simpler rather than a complex model is not determined solely by the desire to summarize her thinking or justify the thinking by offering audiences an assessment of the model’s implications and utility, but is rather the product of a more complex process of evaluating the context. Perhaps it is based on the rhetor’s assessment of their audience’s own mental models as well as their capacities for modeling complexity, and also dependent on the thinker’s own reasoning tasks and communicative goals. These questions present opportunities for future research.  

This mental model also figured a component (and an accompanying gesture) that I was to observe in my interview with Lily, the graduate student participant, as well. Namely, a learner (i.e., the teacher-researcher or, as Lily had visualized, the writing student) is represented as an object traveling along an arced trajectory with what seems to be a smooth and uninterrupted momentum, in contrast to, for example, a sequence of peaks and troughs, perhaps as the “ups and downs” of growth and development, which is easily gestured by moving the index finger or the hand up and down. I did not explore this arc with Jillian, but my subsequent interview with Lily suggested that the smoothness of this trajectory represents the assumption that growth and development is ultimately progressive. It might have been productive to ask Jillian if she shared the same perspective as Lily on this and to request she consider the possibility that some teacher-

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64 The reduction of complex mental models to compressed discoursal “packets” (e.g., the term “activity theory” is a shorthand term that, when encountered, cues readers to consider elements practices, artifacts, institutions, persons, and communities) suggests that an ecology perspective of mental models should consider the distribution, activation, and function of these discoursal packets, as well as how they might be hierarchically layered alongside other mental models. For example, how do readers know when it is appropriate to “unpack” a mental model and for how long does it remain activated? Do these factors figure in how readers understand the nuances of an argument and do writers provide cues to direct the depth of activation or instruct readers to sustain certain activated mental models in order to provide context and backdrop for other assertions in the text?
researchers “regress” rather than “progress” over the course of difficult experiences with teaching and researching. If she did entertain this possibility, did it require a different model, or did the current model accommodate the possibility of regression?65

While I was not able to investigate whether exploring this particular mental model’s assumptions could have provided Jillian with fruitful insights, she and I did explore the configuration of another of her models, and at the close of the interview, she noted with what seemed like surprise and delight that the discussion had given her something to consider. Specifically, Jillian had quoted Ruth Ray in her chapter on the nature of the “collaborative spirit, its emphasis on the interrelationships between theory and practice, and its interest in bringing about change—in the teacher, the student, the school system, the teaching profession, the field of study, and the practice of research—from within the classroom” (Ray 183). I had asked Jillian to describe how she visualized this interrelationship between theory and practice, and she reminded me about our earlier conversation on the teacher-researcher’s identity as ideally a unified one wherein both parts of this selfhood were given equal consideration. She said that, like teacher and researcher components of identity, theory and practice are also “ideally two halves of the same whole. As writing studies researchers and teachers, what we do in the classroom matters to our work outside the classroom and vice versa. I mean it’s pretty basic to me.” I pressed Jillian to consider this further, asking, “When you think about theory and practice having an interrelationship and you talk about two halves, it sounds like they’re coming together—that they’re each kind of discrete but they come together?” She confirmed this interpretation and when I asked if each half seemed discrete and bounded, she answered, “Ideally, [but] there’s also

65 In Chapter 4 I review some other mental models of language learners that have circulated in the rhetoric and writing fields. Since language learners are central to English Studies fields, the ways in which scholars model them warrant further investigation.
an overlay, and you could look at it differently, too.” The word “overlay” suggested she might have been visualizing a Venn diagram with an intersecting region, a “common ground,” but to be sure, I posited possible alternatives to see if these resonated with her. I asked, did the two parts of the whole “fuse … or might [there] be some kind of synthesis or …?” Jillian reflected on this and mused,

[T]hat’s possible … synthesis is possible, but I see them more as two halves of a whole. … I have graduate students in mind here and I know in many places teaching is a service. And you are to do well as a scholars and then you are to meet with your students and fulfill that obligation.

Even after reflecting on the modeling of the teacher research as two halves coming together to form a whole, Jillian was insistent about the idea of two halves of a whole: at the end of our discussion, I asked her to reflect on whether any of the discussion had provoked her to consider anything she might not have previously. She noted,

The idea of identities as teacher and researcher. Yes, for some reason I want to hold on to that “two parts of a whole,” kind of a yin and yang rather than, [as] you said, “fuse”— I was so interested, because I’m all about fusion, but no! Not in this case. Why? … [T]hat will be something that I stay with and I’ll likely come back to.

Her resolve to retain this modeling of teacher-researcher identity as two halves of a whole, even after recognizing the appeal of alternative models, suggests her model was chosen because it served a specific, though perhaps unregistered, need. Jillian had earlier asserted that she conceived of her audience as graduate students, and when we explored her commitment to the original model, she had felt compelled to mention them again. Given their importance to her, it is
possible Jillian chose a model she knew appealed to their likely experiences rather than her own. Specifically, many graduate students are situated in institutions that impose this split on them through a traditional conception of teaching and research as separate functions. Jillian may have unconsciously been using a model of their experiences as a starting point to communicate with them. Further, this may be the mark of an expert writer: to forgo complexity in instances when an audience does not share an equally complex model. This exchange suggests important implications for what constitutes persuasive writing, and it extends our understanding of cognition’s role in persuasive writing. The example suggests that adept writers may begin their arguments with their audience’s mental models, rather than their own, then attempt to modify the components of their audience’s models by drawing their audience’s attention to the models’ components, perhaps by calling certain features into question and suggesting alternatives. My exchanges with Jillian suggest that understanding an audiences’ starting mental models, especially the shared models they bring to the rhetorical situation, might be key to writing in ways that activate and/or modify audiences’ thinking (i.e., their mental models). This point deserves further study and could be accomplished through a discourse analysis method that identifies places in scholarly text that invoke a model, which the author then unpacks, critiques, and modifies over the course of the argument.

My exchange with Jillian also revealed another important insight, one that I take up again when I present findings from my discussion with Lily. Namely, affect has significant roles in

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66 This possibility is supported by another episode in our conversation: when Jillian discussed the importance and difficulty of integrating alternative arguments with which she did not relate into her own writing, she asserted, “It’s like eating your broccoli: ‘It’s good for you. Eat your broccoli.’” She returned to this later, interjecting, “It’s, I mean again I guess, the metaphor of eating broccoli—but I like broccoli!” It suggested she had favored a model of the utility and discomfort of remaining open to alternative perspectives that could appeal to a wider audience by invoking a common experience rather than one that simply mirrored her own preferences or experiences. In other words, her assessment of the audience drove her model-making. This idea is revisited with my discussion of exchanges with Lily, who uses planetary metaphors to discuss systems.
scholarly mental models. At times, specific affects are figured as objects within mental models, as when Jillian had represented various stages of the teacher-researcher’s development as “interest” and “frustrations.” This suggests that in the representational medium of the mind, affect is another modality that is not available in other media. While it is true that we can represent affective states through modalities such as words and images, it is not in fact the direct and unmediated presence of affect that the mind can produce to serve as a component of a mental model. These exchanges also shed light on the nature of the relationship among affect, mental representation, and writing, perhaps presenting important aspects for further research, particularly by considering whether and how affect can be translated among media (see the discussion of transduction in Chapter 5). Equally, affect’s role in mental models has implications for a theory of mental models in disciplinary writing ecologies that increasingly employ new media, and I will discuss this again in Chapter 5.

The second role that affect plays in mental models is that it can animate them by structuring the form of dynamism with which the models function. For example, Jillian visualizes a teacher-researcher who experiences desire for understanding; in her model this affective state propels the teacher-researcher over the trajectory that is her growth and development. As I discuss shortly, Lily too animates several of her mental models through a dynamism that is figured affectively, one that she senses in the “unfolding” of the model as she puts it in motion in her mind. This is consistent Lily’s interest in affect studies and provides

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67 Affect can be explained in complex writing systems through stigmergic mechanisms where traces in the environment (i.e., writing) stimulate an organism’s response and result in seemingly coordinated behaviors (e.g., predictable and patterned affective responses to modes of text that instigate these responses). See Leslie Marsh and Christian Onof’s “Stigmergic Epistemology, Stigmergic Cognition” (2008) for descriptions of “social stigmergy as the extra-cranial analog of an artificial neural network providing epistemic structure … [or] so-called extended mind thesis” (136). Writing is one such mode for extended mind, or “ecology of mind” in Bateson’s terms.
additional evidence that our mental models participate in complex disciplinary ecologies that have structuring influences on them.\textsuperscript{68} Again, these findings implicate new roles for affect’s relationship to writing and present opportunities for future research.

However, before I present the findings from my discussion with Lily, I want to share two observations from my interview with Jillian. First, like Blake, she too constructed mental models that figured language centrally, but in a less metaphorical way.\textsuperscript{69} This too can be seen in her mental model discussed earlier. In contrast to a mental model that uses speech as a metaphor, Jillian’s model of the teacher-researcher figures speech \textit{as a representational modality}. Spoken words function as tokens that represent certain constructs in highly compressed ways. To remind readers, in describing the teacher-researcher’s trajectory of growth and development, Jillian had told me that it started with interest, led to investigation, yielded insights and frustrations, “And then the ‘So what, so what now, what next?’” But again, I think it just goes back to ‘So what’s the next question?’ or ‘How do I continue to problematize or complicate this question?’ Here she is figuring objects in her mental model of the teacher-researcher as speech. “Talk” is not simply functioning in the model as an aural component (i.e., as someone’s voice), nor as a metaphor on which to predicate the model’s dynamics (e.g. development as dialogic), but is instead functioning as a representational \textit{modality} that enables her to construct tokens made of speaking.

\textsuperscript{68} Readers might wonder at this point, as I confess I have, what the distinction is between the “ideas” we generally refer to in our scholarship and the mental models we produce, as the boundaries become blurred at times. It is useful to distinguish the two by recalling that mental models are the quasi-visual representations that accompany our ideas; they are the “small-scale working models” by which we conduct mental experiments and reason through problem spaces (Johnson-Laird). The utility of distinguishing between mental models and our scholarly ideas is, as I have argued in this chapter, that it enables us to attend to model-making in order to critique and modify our models and our subsequent ideas.

\textsuperscript{69} Jillian does note at one point that she prefers to read “texts that speak to me,” and she explains that this speaking is in fact an appeal to her subjective stance, a positionality towards which she can empathize and relate. This is more in alignment with figuring a construct from “discourse” metaphorically as she models the phenomena of being engaged in scholarship.
in order to model salient objects. In this case, “So what, so what now, what next?,” for example, represents the stage after the teacher-researcher has studied the classroom and must make sense of findings and decide how to respond to them in subsequent teaching. As with Blake’s use of the term “legible,” Jillian’s use of speech as a token object in her mental models affords great representational compression. This is an important feature of effective modeling, because alternatively, the risk is that an overly complex model will cognitively overload the thinker. This observation, coupled with the observation that writers use reduced “summary tokens” to represent complex objects, reiterates the important functions of cognitive processes, such as memory and schema, toward which cognitive writing theorists have previously called our attention. The implication is that if we are to extend a cognitive theory of writing to include mental models, it must not neglect to include the ground established by earlier cognitive writers.

My conversation with Jillian provided me with some important considerations for how mental models function to aid scholars, and, perhaps for more novice writers, the writing process. Jillian had written in her chapter that “Berthoff envisioned teacher research as practitioners calling upon extant knowledge based on recollections of and reflections on teachers’ experiences in their classrooms and situating that knowledge among new scholarly conversations.” She confirmed when asked that this was essentially the idea of fitting old knowledge into a new context. She shared,

> What I tried to imagine is a blank sheet of paper—and that’s the argument—then building on that argument and bringing voices together, so first I need to acknowledge who’s in the room. So I guess there’s also a metaphor of a three-dimensional space, but I want … I want preexisting conversations in conversation with what I’m proposing. So what I try to do [is] imagine … this blank piece of
paper [as] different percentages of the page. So … Berthoff is very important to this chapter … how much of the page do I want to give her?

Jillian explained that the page was the way in which she envisioned the “new context” into which she fit “old knowledge.” I asked her if this “fitting” was associated with a force; did it “go in easily,” for instance? The exchange to this point had profound implications for the ways in which writers mentally model the idea of disciplinary arguments and knowledge-building, but what she shared next as she described her cognitive strategies for coping with her own resistance was equally profound, because it suggested that experienced writers construct mental models of the writerly influences in their lives and use these models of “familiars” to reason through their writing difficulties.

In response to my question about the force required to fit difficult arguments into her text, she noted that when “something is feeling forced, that doesn’t sit well with me, so I have to stop and think about it and maybe ….” She added, “I tend to walk at night [thinking ‘the] fit isn’t working … why isn’t it working?’” I asked her if this walking and thinking process was accompanied by any visuals, and without hesitation she asserted, “Always. [D]epending on where I’m at … I will either pick up the phone and call one of a couple people or I will imagine them in my head. And I guess I use a range of people, depending on what I’m writing, the topic and argument. I start to have the mental conversation with them.” Here, she had gestured with her finger in a circular motion a few inches above a piece of paper on the desk in front of her; she confirmed that this space contained the people with whom she consulted. I asked her what

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70 One wonders what her conception of “new context” would be in an age where English Studies’ scholarship is marked by the prolific use of new media.

71 Unlike Cheryl Geisler’s philosophy professors, Jillian frequently figures disciplinary knowledge-building as “conversation.” This suggests that mental models of scholarship, what it is and how it changes, are discipline-specific.
the circular area was, and she responded not by ascribing it a name (e.g. “friends” or “talking”), but a list of qualities: “[It’s safe. It’s round. It’s not back and forth. It’s fluid. It’s questioning. Yeah, it’s a safe space.” Her ability to combine emotional states (“safe”), mental motion (“back and forth” and “fluid”), and actions (“questioning”), and space (a representational modality that all the participants’ mental models employed) once again points to the high degree of compression that characterizes mental objects’ representations, as well as the multimodal nature of mental models.\(^{72}\) Jillian described the process of consulting these “long-term writing partners” to help resolve the resistance she had frequently felt when she attempted to make space for certain masculinist or logocentric arguments in her own writing: “They’re collaborators, they know me, I know them. I respect their work. And I try to imagine [when] I’ve been in a similar spot: what would this person say? What advice would I get? What would they suggest? So [I] try to call upon previous conversations.” Jillian went on to describe the mental models she had of a few particularly significant writing partners she had. She visualized active conversations with real bodies of the people she knew and said she felt “grateful to have those imagined conversations and then receive feedback—very grateful.”

One of her writing partners’ scholarly work was dissimilar to her own and, from this different vantage, he had often provided her with much useful critique on her scholarly writing drafts. Previously, she had indicated she constructed her mental models of writing partners based

\(^{72}\) The transposing of affective states to mental movement and spatial representations also characterizes what Bezemer and Kress call “transduction” between modalities and seems to have connections to synesthesia, the phenomenon whereby one sense is understood in terms of a second sensory pathway. For example, many synesthetes experience graphemes (letters, words, or numbers) in terms of color representations. This ability to shift signification into alternative modes may be an important capability in developing expertise in thinking and writing and warrants further study.
on feedback, and I asked her whether the exchanges she modeled with this partner also mirrored previous real-life experiences. She said these were “a more exaggerated version of his position and mine,” one somewhat more critical than he had ever been in reality. Her response to the severity exhibited by her imagined writing partner was gratitude. As she described it, “I appreciated the critique. It was thoughtful critique. He taught me through his comments: ‘Here’s my position; here’s what informs my position, and here’s what it brings.’” Jillian recalled “giggling” about this hyperbolized version of a trusted writerly influence and “having fun” with it. This experienced scholar relied on the mental modeling of writerly influences to help her reason through her writing difficulties. Remarkably, her models exhibited interactive qualities that enabled her to produce insights she might not otherwise. Further, she was comfortable receiving the imagined criticism produced through her mental models, even when it was severe. In fact, she enjoyed it.

These exchanges suggest that writers’ abilities to generate dynamic models of other writers enable them to generate their own feedback might be a key difference between the expert and novice writers. Mental modeling, it would seem, enables us to transfer writerly advice from past experience and instruction. It also suggests that mental modeling might play an important role in a writer’s ability to transfer what they learn to new writing contexts. Specifically, this writer appeared to easily model valuable alternative perspectives on her writing.

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73 I have often had similar experiences writing poetry, where I have imagine the critique I might receive from mentors or peers. Like Jillian’s, my mental models also figured embodied dialog. Often, I have rejected the critique, recognizing, for instance, that these other writers possessed aesthetics or goals for their work that differed from my own (i.e., beliefs about what constituted “good writing”). I would even hear myself justifying my rejection of their advice and my own choices, a practice I feel strengthened my own confidence in my ability to write well, and I called on this during the revision process. I believe my own mental modeling of other influential writers has been enabled in part by my exposure to the “workshop approach,” as many of the models I constructed were of people I had encountered in workshops. Workshops gave me a great deal of exposure to actual readers actually responding to my texts, and I feel this exposure enabled me to model them and their styles of reading and providing feedback. This speculation is supported by comments that Lily made and they appear in the next section of this chapter.
by modeling the people from whom she had learned these perspectives. This may be a key element in facilitating the goal of transfer in educational contexts, to help students learn about writing in the composition then transfer what they learn to alternative contexts. Using mental models to facilitate transfer could be a pedagogical approach with far-reaching implications. For example, while the audience for Jillian’s chapter is graduate students, the readers she invokes during the writing process are not her intended audience but other trusted writers. However, as Andrea Lundsford and Lisa Ede (1984) and Susan Wall (1982) make clear, the notion of writers producing an imagined readership as they write and revise is far from simple. Perhaps it would be fruitful to teach writing students to model trusted peer writers or their instructors. I speculate at length on these implications in Chapter 5.

Participant #3, “Lily”

Lily, a graduate student pursuing her Ph.D. in rhetoric and writing, had defended at the time of our interview and had recently accepted a position to teach writing at a four-year college. She had also presented at several conferences and had collaboratively authored a book chapter on writing’s changing role in graduate education. Previously, Lily had earned a law degree and had worked as a lawyer before deciding to pursue a degree in writing studies. Lily had completed her dissertation in three years, a full year less than most students; she was a highly motivated student and an extremely effective writer. Lily had shared the first chapter of her dissertation for our discussion. Her project applied Janis Haswell’s and Richard Haswell’s (2010) notion of “potentiality” to students’ own regard for themselves as writers. Particularly, Lily had written in the first chapter of her dissertation that her goal was to understand “what [the] self-assessment of affects might do for students on their own trajectories as developing writers, students, and agents.” Central to this goal, she had sought to “define potentiality in ways that can empower
student writers to assess their own work, and their own developing sense of what it is to engage
in literacy and to be literate in the narrowest and broadest senses.” What Lily came to understand
through her research was that students did not need to be encouraged to perform self-assessment,
as they engaged in the practice constantly through informal reflection on their writing
experiences. Further, they had formed identities of themselves as writers in essence by unifying a
series of writing-related events and experiences (which they had assessed) over their lifetimes.
These events served as the material on which their writerly self-conceptions were built. Further,
their self-assessments already centrally figured potentiality, since they interpreted their
experiences with past, present, and future contexts in mind. Lily also noted that teachers were
often solely concerned with their students’ development only in the context of their courses with
them, and this prevented teachers from seeing students from a broader perspective that included
their evolving literacies and identities, or in other words, their potentiality. She argued that if
teachers learned to see students in terms of their as-yet-unfulfilled potential, they could help their
students do more of the same. Further, if students were taught to consider their own potentiality
more centrally when they assessed themselves as writers, this form of assessment would enable
them to explore and extend their own agency.

Lily had written in her chapter that she had “situate[d] this dissertation within the bodies
of literature on writing assessment, feminist theory and feminist pedagogy, affect studies, and
liminality,” and I wanted asked her about what these domains had in common. I expected we
would explore her conceptions of disciplinarity and that the conversation would enable me to
consider how we represent how disciplinary domains come together, as in “interdisciplinarity.”
We would eventually consider that issue, but at this juncture, Lily shared how she had conceived
of her own research project, shedding light on how those who are new to their disciplines
understand their scholarly work. Early in the process her work was figured as her interests in “agency, empowerment, [and] breaking down binaries,” interests she had discovered through affect studies; later she would represent the work as the conjoining of multiple fields. These constructs represented her research project before she understood her project in terms of research questions. She explained,

I was then in search of the research project. And in reading more about affect studies and feminist theory, it occurred to me that how students interact with their own work would be a basis do to the actual research, and that’s where the connection to writing assessment developed. Particularly self-assessment ….

Again, I think agency and empowerment became connections there …. And then liminality was actually suggested to me … it very much intersected with affect studies and feminist theory and pedagogy in its notions of this period of suspension of time, where you’re not a member of a society yet but you’re preparing to be a member.

Here Lily explained that it was agency, the breaking of binaries, “as well as issues of how you negotiate the self and the world around the self,” that made these scholarly domains go together. Her conception of the research project evolved, as it had begun from her interest in a single disciplinary domain and was later understood a set of interconnected constructs; the intersection of several domains; an activity that occurred a particular juncture (the point at which students regarded and interacted with their own writing); a set of research questions; and finally, Lily said, the project “stopped being about affect theory in my mind and started being about the data,” data she had collected from interviews with students. I did not question Lily about how she had visualized each of these conceptions of her research, but the models that accompanied her
conceptions of her research could have important implications. For example, did she model data as actual exchanges with students, or did she model it as transcriptions? This has implications for identifying how and where students *locate* knowledge production, a point that Jillian has likely considered through her exploration of teacher research wherein “knowledge” is understood to arise from the classroom. Further, writing researchers who have studied cognition recognize that student writers possess mental models of their “writing assignments,” as well as models of their own writing and conceptions of how well this writing fulfills the assignments. The dissertation is in essence a highly complex writing assignment, and my discussion with Lily suggests that her mental models of this writing assignment are also highly complex; each iteration figures an intersection centrally: of constructs, disciplinary domains, actual objects and events in the world (e.g., students and their writing), and points in the data. Understanding how graduate students conceptualize their research could enable their mentors to help them fulfill the requirements of dissertating more easily, perhaps by articulating this progression and enabling students to such stages. This has implications for how graduate students are enculturated into their disciplines, as their relationship to the content domain and the profession is dependent on how they mentally model the production of scholarly knowledge. Further, like Jillian, Lily seemed to want to encapsulate her complex conceptualizations of her research into one with more compression:

"In the end, after having done the whole project, that’s where the intersection is, at that what affect studies called “the surface”— you know, there is this interplay between who you are internally or who you perceive yourself internally … and how do [you] understand that relationship to the external world?"

I pressed Jillian about her “self-world” model, and our discussion revealed that this “interplay” was an important characteristic of her model, a form of dynamism on which her project pivoted.
This dynamism is a version of “recursivity” that characterizes much of the modeling of phenomena in English Studies disciplines and it opens up possibilities for understanding how patterns of thought spread through academic disciplines. My research suggests that mental models have a role in constructing English Studies’ disciplinarity that is equal to their role in the sciences. Lily explained that self-world was the binary that cropped up most frequently in her research and she sought to break it down, as these categories, particularly in the context of the classroom, had prevented teachers from coming to valuable insights.

I began by asking Lily to focus on one component of her model, to describe what she visualized when she considered the “self.” The self was a featureless person, though not necessarily a student; it had “edges, but not sharp edges, not like some cartoons [that] have a black line—it’s not like that.” When I asked why there was no heavy line, Lily referred to our earlier conversation on the idea of the “surface” as a “skin … a permeable membrane from biology, like a little cell.” She reiterated this permeability and noted that “[It] enables things [to] pass in and out of it. There’s a surface to it that keeps it as a unified figure, but it’s a passable surface.” She explained that in her dissertation she had argued that “it’s your ability to act as an agent that keeps you unified.” Later, I was to more closely consider the causal order in this declaration, as it surprised me—I would ordinarily have expected that unification would precede and enable agency. However, Lily’s model was far more complicated, and its causal structure reflected her purpose, her context-specific questions. She was not focusing her attention on an inquiry into the nature of agency, but an inquiry into the nature of unification. The exchange suggested that the causal ordering of a mental model’s working components is an important characteristic of its dynamism, and it has implications for how the model will function when applied to the reasoning task. Like my conversations with Blake and Jillian, this exchange also
highlighted the prevalence of, and perhaps pre-occupation with, ideas of boundaries and boundedness in English Studies scholars’ mental models. Like Blake and Jillian, Lily grappled with their nature, and this was evident in her modeling of “world.”

Her visualization of the world component of her self-world mental model revealed more possibilities available for modeling the ways that the “objects” we imagine come together in the representational space of the mind: “I guess I visualize [the world] more as motion rather than any particular image.” Here Lily reported she employed the modality of movement to represent another component of her model. When I pressed her, she explained that the self was also in motion,

just as the environment that it’s in—the world—is in motion. And they’re occupying the exact same space and maybe some more space but constantly changing. There’s nothing static about it. So it would only be in a second that you would be able to identity … anything stable in it. Like [the way] the solar system is wildly spinning as the galaxy is wildly spinning, too.

The permeable yet bounded entities in her model came together not as “two halves of a whole,” nor as the common ground that Venn diagrams suggest, nor as fusion or synthesis; instead, Lily had modeled the relation between these mental objects as constant exchange.

Additionally, the “system inside a system” that she called up through planetary images was both highly compressed and suggestive of the idea of a relative perspective. I felt an instant understanding as her words had triggered my own rapid mental modeling in response, and it suggests there exists a store of culturally shared images and symbols from which we draw when we communicate. While theorists Kress and Van Leeuwan (1996) and many others have said as
much, their intent with such assertions is to draw our attention to the ready-made signs present in media such as print and video, rather than, as I intend, to draw attention to the ready-made mental models that circulate as well. In fact, these mental models are required for their media counterparts to be effective, because the representations in external media trigger the production of the models in the mind. This relationship between internal, cognitive representations, and external media representations is at the heart of this research project. My research suggests mental models, as knowledge structures, have both an inscriptive quality and a structuring role. Like genres and other culturally understood units of meaning, mental models are circulated through writing. These semi-stable structures simplify the task of meaning-making and communicating, much like language and other circulating symbols do. Once a person has inscribed a mental model structure into their mind (usually with the aid of external representational media that instructs us how to think), they can quickly call it forth and use it to process their private reasoning or to interject *stock relational dynamics* into social exchanges.

My discussion with Lily provided evidence to support this ecology perspective of mental models as a form of discourse, and I revisit this topic in Chapter 5, paying particular attention to the ways in which mental models and genres work together.

There were two features of Lily’s model I had not thought to follow up on during our conversation. First, I regret that I did not ask what she meant by “and maybe some more space.” Did it reflect the assumption of a perpetual state of expansion and growth, applicable to both the person and the world? Also, I wondered about her use of the pronoun “it” to refer to the self in her self-world model. Did the pronoun reflect a lack of significance for gender, or did it signal the process of *objectifying* the “self” component? If so, then the term might have been signaling a form of dynamism that Lily applied to her model in order to erase or disallow the
characteristics of personhood, which could muddy her assessment of the relationship between self and world. In other words, “it” might have functioned to help her remain “objective.” If I had asked these questions, Lily’s responses might have enabled me to assert more confidently that even the most insignificant components of our mental models are meaningful, arranged with intention to carefully represent the constraints and conditions we believe characterize the problem spaces through which we seek to reason. It might also have enabled me to understand whether and how tensions between scientism and humanism ripple through English Studies disciplines. Further, by becoming increasingly aware of our models and their compositions, we become increasingly able to identify and interrogate our own assumptions and conclusions. Also, if we recognize that helping audiences construct mental models is part of our rhetorical task, and that there are stock relational dynamics that we can trigger through culturally shared mental models, we can hone our persuasive abilities. This implies that efforts to learn and teach writing can benefit by attending to mental models during writing processes, and this is particularly true for enabling the novice writer to grow into their expertise.

My discussion with Lily also suggests that, like Blake and Jillian, she possesses mental models for other scholars and readers, and that the characteristics of these models are potentially significant. For example, Lily reported that when she thought about affect studies, she figured this disciplinary domain, not as a group of scholars as Jillian had done, nor as “conversation” or set of “voices,” nor as a body of text. Instead, as I describe presently, Lily figured a complex object comprised of image and intention to signify the construct of affect that she used to consider the general domain of affect studies. However, the construct was subsequently anchored to specific scholars. Lily said she associated affect studies generally with the idea of “not-yetness” that Deleuze and Guattari use to describe the range of potential actualities that have not
come to pass but could. When I pressed Lily about this construct, which has strong conceptual ties to her project on potentiality, she explained that she visualizes Alice, from *Alice in Wonderland*. Specifically, she explained that Deleuze had once described not-yetness as akin to the moment when Alice, who is locked in a room and wants to leave, is too small to reach the door knob and too big to fit through the keyhole. Lily said it was this *state* that she visualized when she thought of affect studies, and her model suggests again that the modalities afforded by mental representation are more extensive than those afforded by other representational media. Lily has represented a disciplinary domain as a phenomenological experience, one characterized affectively by the anticipation that accompanies the unfolding of one moment into the next. It is likely that this mental model either arose in part from, or helped inform her understanding of, liminality, that state of suspension between one state and the next. This suggests that mental models, their component objects, and their dynamics migrate; they are often unconsciously transferred and adapted to new problem spaces. As my earlier exchanges imply, transfer, that process by which we apply knowledge from one context to another, might be highly dependent on our abilities to produce mental models; exploring how writers produce models of the topical domains on which they write might help us learn to facilitate their abilities to transfer what they learn in one writing task to another and can extend the literature on this topic in writing studies fields.

Lily has a different way of conceptualizing another scholar who had published on affect studies, and this suggests that there may be a relationship between level of disciplinary experience and mental models of disciplines as comprised of *people*. In other words, by facilitating the modeling of actual people, disciplinary mentors might enable junior members to more easily connect with their disciplines, a central component of enculturation. When Lily
visualizes one particular scholar, she sees an image of him mountain biking, as this was how he
had depicted himself in one of the works she had read.74 I asked Lily whether she, like Jillian,
modeled readers and their reactions to her text as she wrote. She revealed that she had not had
extensive experience writing with partners, with familiars who regularly gave her feedback.
When she had written briefs during her work as a lawyer, she had often visualized specific
judges who would read them. When she wrote her dissertation, she visualized only those people
on her committee, as she believed her dissertation would not have a readership beyond them.
When I asked about the book chapter she had collaborated on, she said that she had visualized
only the other authors as readers. She had not visualized others reading her writing once the book
was published, admitting, “I don’t know that I have a real good sense of who those people are.”
This speaks once again to Ede and Lundsford’s, Russell Long’s, and others’ assertion that
invoking an audience is no simple matter. As these scholars have suggested, it raises the
pedagogical question of whether we should leave behind the notion of audience, and keep the
focus on enabling novice writers to develop strong bonds with other “real” writers as readers. As
I discussed earlier, in contrast to Lily, Jillian had reported having extensive experience with close
writing partners, and she had developed a facility modeling their responses to her work, and from
this she drew reassurance, feedback, and fresh perspectives. These possibilities deserve further
study.

My discussion with Lily provided evidence that mental models play significant roles in the
way we figure disciplines, disciplinary constructs, habits of mind, and imagined readers. At the

74 Jillian similarly represents scholars with whom she is not personally familiar by anchoring them in a context.
Fishman and McCarthy, who have published on teacher research, appear together in her visualizations but are not
figured in the classroom among students, the way that Ruth Ray is; I would have liked to explore this situating for
its significance, if I had thought to.
close of our conversation, I had asked Lily about her experiences sharing her mental models with me during our discussion, as I wanted to understand if scholars found it difficult or fruitful. While she said the discussion helped her think through some issues and questions she had not previously considered (e.g., I had asked her to speculate on whether multiple selves in her “self-world” model might cluster and possess a singular shared identity, and did this have any utility when considering the writing classroom?), she noted that she found the experience of discussing models anxiety-producing. She said that sharing her mental models felt like divulging private thoughts:

[W]hen they’re private, I don’t have to worry about whether they’re good by any certain standard. But once you share them with somebody, they’re up for scrutiny, so they don’t give you the same comfort they did when they were just private. [T]here’s an element of worrying about “Well, was that a stupid way of thinking …?”

She also admitted that she felt similarly about sharing her writing. As this exchange reveals, if mental models are to be usefully considered as a potential pedagogical tool, it is critical to keep this experience in mind, as it is likely that Lily’s experiences are not isolated.

**Summary of Findings**

These explorations with scholars with varying interests and levels of experience revealed that the study of mental models’ relationship to writing is fruitful on several counts. First, there were several exchanges that indicated that models of readers plays significant roles in how we understand the role of text as mediational (as with Blake, who models readers’ relationship to the memoir); how we can use mental models to help reason through the potential responses our
writing might engender from readers (as Jillian imagines her writerly influences); and how mental models reveal our relationship to disciplinary communities of potential readers that we visualize to lesser or greater extents (as with Lily, who understood affect studies by its central construct, and Jillian, who in contrast anchored the topic of teacher research in a “conversation” between scholars she modeled as she wrote to participate in that discussion). Further, the research suggests that a theory of mental models in disciplinary writing ecologies is fertile terrain. For example, mental models employ modalities, such as affect and force, that other external media do not. Also, gestures and stock relational dynamics figure in such an ecology. The implication is that, as we increasingly represent scholarship multimodally, the relationship between our thinking and our representations will strengthen, and this is a topic I take up more fully in Chapter 5. Lastly, the findings suggest there are numerous implications for learning and teaching writing. For example, students who are instructed on the value of creating mental models to reason through reader response, as well as the content that a students’ writing will grapple with, are likely to be stronger. Further, the research findings suggest that an understanding of an audience’s mental models presents a starting point from which to construct more persuasive arguments, those that help audiences transform their own models as they encounter the text. This is likely to be something that is of use to experienced writers, but it can also help novice readers anticipate what their readers are modeling (usefully contrasted to what their readers are “thinking”). Lastly, the findings suggest that thinkers can heighten their awareness of mental modeling in order to usefully critique and modify their models. These revised models can then be employed to reason through content-related problem spaces or problems related to writing (such as organization or argument, for example; this notion is more fully explored in Chapter 5).
However, as fruitful as this exploratory work is, it is nonetheless limited. In order to aid future researchers to work with mental models and their relationship to writing, I have dedicated the next chapter, Chapter 4, to recommendations for future research methods. These include not simply ways to address the limitations of studying phenomena that is not directly observable, but also recommendations for additional protocols, such as the talk-aloud protocol that instructs participants to verbalize their thinking as they write and multimodal data collection through video-taping to capture gestures. It also presents several potentially fruitful approaches to discourse analysis that focuses on how and where the discourse triggers mental models. These approaches arise out of traditional methods but are modified to account for the particular challenges presented by studying mental models in writing ecologies. After this discussion, in Chapter 5, I begin to theorize how mental models function in disciplinary writing ecologies. Because of time and space constraints, the last chapter also touches in a limited way on connections between mental models and classical rhetorical theory, as well as on the potentially extensive implications of mental models for learning and teaching writing.
CHAPTER 4. MENTAL MODELS AND METHODS: RECOMMENDATIONS FOR FUTURE STUDY VIA DISCOURSE

Overview

An investigation of mental models in disciplinary writing ecologies is an expansive project, in part because this cognitive phenomenon is not directly observable and the research that attempts to investigate it is interdisciplinary. The project is also expansive because an ecology lens structures the scope as both macro (e.g., disciplines, disciplinarity, and their construction) and micro (e.g., the place of the individual mind writing in this context). Also, previous research in rhetoric and writing fields does not explore mental models in great depth, featuring it instead under the category of “knowledge structures” that participate in cognitive processes involved in writing. Further, the scholarship in writing studies fields on cognition and writing is richly layered, complex, and difficult to synthesize because it reflects ongoing, historically situated studies and responses to those studies that are themselves complex and historically situated. Given the topical scope of this project and time limitations for completing it, my analysis of the data was necessarily exploratory. However, this initial research stage provided me with insights on how to conduct interviews that better elicit mental models from scholars, better employ the talk-aloud protocol to further our understanding of mental models, and more effectively collect sources of data (including non-discoursal sources, e.g., gestures that participate in the process of circulating mental models). Most significantly, it provided me with an opportunity to consider ways to more thoroughly analyze the collected data so that I could understand the nature of mental models, their construction, and their role in scholarly knowledge production. This chapter presents several possible approaches to data analysis that other researchers might consider employing in order to extend this research to other contexts.
example, researchers may be interested in examining the prevalence and distribution of models for a specific object of study (see this chapter for an exploratory analysis of this sort on mental models for “language learners” in English Studies). Another researcher may be more interested in extending this exploration into ways to employ mental models in writing pedagogies (see Chapter 5 for some suggestions on a potentially fruitful writing pedagogy that integrates mental models). Also, there is much left to explore regarding mental models’ role in the disciplinary writing ecologies in English Studies (for example, an analysis of creative writing as a form of scholarly knowledge could reveal surprising disciplinary differences and similarities between this field and other English Studies fields). In order to facilitate such future research, I present suggested approaches to data analysis in this chapter. I suggest using coding approaches based on the functional attributes of mental models, such as depictions of “system states,” because when a writer discusses how a concept or set of concepts is intended to function, this often suggests the presence of a mental model; looking for these “functions” can provide nodes at which to conduct deeper investigation. I also suggest a method of identifying forms of dynamism, as these describe the operational nature of mental models, and this operational nature tends to be specific (for example, I have mentioned the prevalence of recursivity in English Studies fields, and I list several others in Chapter 5). Identifying the dynamism of mental models is important for establishing a sense of the shared habits of mind circulating in English Studies disciplines. I also suggest a method of identifying and coding semantic structures of relationality. These can be thought of as the “arrangement” of objects within mental models. This level of analysis enables researchers to begin to fully render scholars’ mental models, and these thick descriptions can serve as the basis for a semiotic analysis of their design. I also suggest ways to identify frames, scripts, and schemas, because these knowledge structures work
in tandem with mental models. This is particularly important for researchers who wish to extend our knowledge of the cognitive processes we employ in writing. I then present a method for a semiotic analysis of mental models as cognitive productions, as ephemeral yet significant forms of discoursal representation. This approach enables researchers to see how the components of a mental model are meaningful and to begin to understand what these elements imply about scholarly assumptions and values. This is an important lens that enables researchers to reflect critically on the nature and role of mental models in disciplinary writing ecologies. Lastly, in order to fully understand those ecologies, I describe an approach to conducting a situational analysis, which can enable a researcher to link shared scholarly habits of mind to the construction of disciplinarity.

In order to lay the groundwork for these alternative approaches, I begin by presenting analyses of three scholarly articles (two with which the majority of readers in rhetoric and writing fields are familiar, Donald Bartholomae’s “Inventing the University” and Patricia Bizzell’s “Cognition, Convention, and Certainty: What We Need to Know about Writing,” and one which is purely hypothetical). These works feature discoursal cues to readers to construct specific mental models of language learners, and exploring and describing these cues in this chapter usefully demonstrates the process of examining the discoursal strategies by which writers trigger mental models in their readers. Also, I have chosen to examine these particular pieces because the notion of “language learners” is central to all English Studies disciplines and, as I describe shortly, this scholarship was published in the 1980s as part of an ongoing disciplinary investigation in writing studies that has had a formative role in the disciplines’ history. Further, I might instead have chosen to examine mental models of communication rather than language learners in writing studies discourse or in English Studies’ scholarship more broadly. For example, in 1979 Michele Reddy noted the wide-spread use of the conduit metaphor in the latter; this figuring consists of a three-stage process.
mental models of language learners continue to be refigured and represented in the field’s scholarship, and these early models continue to inform scholarship today, often figuring as the ground against which alternatives are explored. For example, in *Writing/Disciplinarity*, published in 1998, Prior notes that Bizzell, Shirley Brice Heath, and Martin Nystrand all published scholarship within a year of the others on the role of communities in shaping language learners, and that this scholarship emphasized social construction over individual cognition and represented a shift in the conceptualization of writers and writing across the field. In contrast to these earlier structuralist models of language learners (where the underlying assumption is that language and knowledge “must be abstract and uniform systems, not plural, particular, and personal”), Prior models a language learner who is shaped *sociohistorically* through *situated literate activities* (18). He asserts that this “weaker model of intersubjectivity” endows the learner with their agency in ways that earlier structuralist models had not (19). This desire to sort out the tension between intersubjectivity and agency in language learners is also evident in the calls for socio-cognitive and eco-cognitive approaches to writing that I discussed in Chapter 1 and in my exchanges with participants. Jillian modeled the developing teacher-researcher as someone who has studied the classroom and chooses to re-enter it as “learner” to be shaped again by the dynamics there; Lily modeled the novice student writer’s potential for growth as a trajectory that is actuated largely by the student’s relationship to and experiences with their own

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where speakers put ideas into containers made out of words and these objects travel through a conduit of air to the listener, who extracts the meaning from the words. See Chapter 5 for a discussion of the distinction between mental models and metaphors.

76 Prior traces this work back to Dell Hymes’ scholarship in the 1960s and early 1970s. Hymes grounded the language learners’ competence in speech communities and a structuralist emphasis on the rules of communication (10-11). Prior also identifies two structuralist conceptions of the mechanisms by which language learners develop. Vygotsky termed the first the “botanical model,” and it figures knowledge as blossoming under the right conditions and with the right nutrients; the second mechanism is what Friere called “the banking model” of education where knowledge is deposited into the learner qua container (18). How these foundational conceptions inform contemporary scholars’ mental models and their scholarship warrants further investigation.
literacies; and Blake modeled the development of the larger cultural group, rather than the individual learner, when exposed to text, specifically, the AIDS memoir.

By examining the two pieces of canonical work in rhetoric and writing fields that concern themselves with language learners, I suggest there are important links between scholars’ mental models and the conclusions they draw about the scholarly “problems” with which they grapple in their writing. This examination of scholarship on language learners also enables us to better understand the importance of shared mental models and the role of scholarship in accomplishing this circulating function. Importantly, for this demonstration I have chosen scholarship that does not rely on textual strategies alone, as one piece includes graphics that function in tandem with the text to provoke readers to produce mental models with particular traits as they process the scholarly discourse. My analysis suggests that the progression in English Studies disciplines from text-based scholarship to multimodal scholarship, particularly in new media, which has a richer array of semiotic resources than traditional print media, will have important implications for scholarly knowledge production, especially on how scholars think and how they construct mental models.

As I discuss in this chapter in relation to semiotic approaches and revisit in Chapter 5, the representational technologies we employ, and their respective resources, affordances, and limitations, structure our mental models while our mental models structure the forms our scholarship takes. This means that as English Studies scholars continue to produce scholarship in new media, particularly with interfaces that make it easier for scholars to communicate through other modalities, such as image and motion, our scholarly compositions are more likely to mirror the limberness and complexity of our mental modeling; reciprocally, our mental models are more likely to be informed by the innovative technologies and mechanisms that shape the way our
Text-based scholarship primarily uses text to cue readers to produce mental conceptions of authors’ meanings, but a closer look reveals that, at least in a limited sense, multimodality still characterizes “the page,” because the graphical nature of alphabetic characters and the use of space, especially to suggest the organization of argument, are visual modalities. However, images and graphics are also included in text-based scholarship, frequently to demonstrate relationships between abstract constructs. As I discussed in Chapter 1, new media theorists are vehement in asserting we must not fail to notice how meaning-making in traditional texts is extended by the multimodal affordances of new media. Further, in order for scholars to be prepared to take advantage of these affordances, especially in English Studies disciplines which continue to present both opportunities and pressures to publish scholarship in new media, it is useful to speculate on how mental models and new media might each inform the other, and change the way that knowledge in English Studies disciplines is produced in the future. In order to explore the relationship between new media and mental models and the implications for producing knowledge in the disciplines, I first present an analysis of a print-based example of scholarship, one that relies solely on linguistic mechanisms to cue a complex mental model of “language learners.” Then as a point of contrast, I present an analysis of a second piece of print-based scholarship on language learners, but this one also employs visual modality, namely graphics, to supplement the text and cue readers to produce mental models of learners. Following the analysis of these two scholarly articles is a final one on a hypothetical article in a new media.

Here I want to point out that if I have written this passage effectively, I have triggered in readers a model that figures a recursive relationality between inscriptive technologies and mental models. The discoursal mechanisms by which this was accomplished include the use of the word “reciprocally,” which encourages the construction of an equal and opposite “force,” and the semicolon, which suggests a close tie between the functioning in the first clause and the functioning in the second clause. However, as a small scale model for a dynamic system, what is missing from the discourse is a cue to readers to actively foreground the “updating” (or new “system state”) that each half undergoes before it informs the other. As I will discuss again in Chapter 5, this is much like the model of a writer who is transformed by what they have written, then in turn transforms the writing by revising and adding to it. This speaks to writers’ abilities to cue models with greater or lesser degrees of complexity.
context, and with this imagined scholarship I demonstrate how various media’s particular affordances both enable and constrain the types of cues that an author can use to provoke readers to produce mental models. In addition to enabling speculations about the significance of the relationship between mental models and multimodal representations, this approach also begins to shed light on how additional research on the discoursal strategies that cue mental models could be fruitful. After the three analyses I describe some approaches that may be useful for extending this exploratory work further. I also describe the limitations to my approaches to both data collection and analysis, and these apply to the alternative approaches I present as well. Then in Chapter 5 I provide some preliminary observations about mental models in disciplinary writing ecologies, including speculations about mental models in new media. I also touch on implications for learning and teaching writing.

**Three Examples of Discoursal Analysis: Identifying How Writers Cue Readers to Construct Mental Models**

In order to devise more specific approaches to discourse analysis and to speculate on how an increasing multimodal array of media for English Studies scholarship might impact mental models (i.e., scholarly thinking), I present a detailed analysis of discoursal cues to readers to produce mental models in two pieces of scholarship that are familiar to many people in rhetoric and writing studies. I chose to examine these pieces because they concern a central object of study across English Studies fields: language learners. By closely examining how language learners are mental-modeled in the scholarship, I demonstrate how mental models are revealed through discourse, and I show what the additional meaning-making resources are gained through multimodal scholarly composing and how these can contribute to scholars communicative aims. The first piece I examine, David Bartholomae’s “Inventing the University” (1985), employs text-
based cues to produce mental models of how a learner adopts the discourse of an academic context, while the other, Patricia Bizzell’s “Cognition, Convention, and Certainty: What We Need to Know about Writing” (1982), combines text and graphics to help readers construct mental models of how the learner adopts the discourses from multiple contexts. These examples are intended as an exploration into how cues to produce mental models are discoursally constructed by writers, so that the recommendations for a more structured analysis of the data that I present next makes sense. These examples are both responses to Flower’s, Hayes,’ and other cognitive theorists’ scholarship; they represent the backlash against the intense disciplinary focus on cognitive approaches to writing that many in the field worried were circumscribing writing studies narrowly to the writers’ mind and precluding other approaches. As Bizzell described in an afterward to her own article, when she had written her article, she recognized that writing studies fields had gravitated to cognitive approaches because they lent the fledgling field of composition the legitimacy it desperately needed at the time (500). However, she had felt compelled to respond because she objected to what seemed to her an “‘authoritative certainty’ that … no scientific research can provide” (500). She feared that any model claiming such certainty would be imposed “on all students, with relatively greater harm being done to students at greater social removes from the culture-bound assumptions about thinking and writing that … informed the model” (500). Bizzell and Bartholomae’s scholarship are useful to examine through the lens of mental models because they represent attempts to refigure discipline-specific models and they reveal that models of a disciplines’ core objects of study represent fiercely contested grounds. What follows my analysis of these two examples of how text cues discipline-specific mental models is a final example, a hypothetical one in a new media context that demonstrates
how media’s particular affordances both enable and constrain the types of cues that an author can use to provoke readers to produce mental models.

*Example 1: Discoursal Cues for Models in “Inventing the University”*

In 1985 in “Inventing the University,” David Bartholomae responds to earlier work, largely from a cognition and writing orientation, that figures the language learner as “trapped in a private language,” arguing instead that the novice writer is not suffering from a cognitive deficiency but is “shut out from … the privileged languages of public life” (609). This refiguring is essentially a critical response to what some scholars perceived as a tacit implication of cognitive approaches to writing: that a language learner’s struggles arise from cognitive limitations rather than limitations that are often social in origin.78 Bartholomae begins the article by describing how the student who is appropriating (or being appropriated by) a specialized discourse

has to invent the university by assembling and mimicking its language while finding some compromise between idiosyncrasy, a personal history, on the one hand, and the requirements of convention, the history of a discipline, on the other hand. He must learn to speak our language. Or he must dare to speak it or carry off the bluff. (524)

While each reader will likely construct a somewhat unique mental model of the student of specialized discourse, readers are cued to produce them similarly through features in the text. Most readers’ models of the student’s experience will likely centrally figure student subjectivity

78 Bartholomae alludes directly to Linda Flower’s 1981 “Revising Writer-Based Prose,” taking issue with the notion that novice writers’ problems stem from a “difficulty in negotiating the transition between ‘writer-based’ and ‘reader-based’ prose” (609).
(i.e., they will construct a model that includes a point of view emerging from a set of student eyes\textsuperscript{79} rather than from a teacherly gaze onto the student). Further, given the description of the student that Bartholomae provides, readers are also likely add to their models of “student experience” a character that arises out of the tensions between two opposing influences: the idiosyncrasizing of unique experience and the homogenizing of social context. Readers perform this additive process on their mental models of Bartholomae’s “student” because the text instructs them to do so: it depicts each factor as distinct and as having somewhat competing influences on the student’s attempts to learn specialized discourses via the phrases “on one hand” and “on the other hand.” This set of opposing forces is a form of dynamism, and it holds the elements of the model together in a state of tension, similar to the dynamism that Blake constructs in the model of a national family that both invites and excludes members. Further, Bartholomae’s model provides readers with the resources for prediction, specifically the student’s response to the context, including effects on both the student’s ego and affective states. This is evident in the depiction of the student as “bluffing,” which cues a reader to model both a state of anxiety in the face of demands to appropriate and perform the discourse, as well as the courage to attempt it nonetheless.\textsuperscript{80} Lastly, Batholomae cues readers to produce a mental model of a larger system by including environmental factors in the student model. For example, the mental model of the student learning specialized discourses implicitly includes the university as well as

\textsuperscript{79} The “set of eyes” phrase is used here to stress that the mental model is of an embodied persona (the student), and that embodiment is an important attribute of the model. In fact, embodiment seems to play an important role in enabling whoever produces such a model to fully imagine the subjectivity. In other words, embodiment seems to be a key discoursal mechanism for engendering empathy in readers. Embodiment will also feature in relation to encouraging readers to mentally enact the dynamism inherent in models, an aspect that will be discussed shortly.

\textsuperscript{80} Alternatively, one might be tempted to argue that the knowledge structure this passage cues is in fact a stereotyped schema of “student.” However, while an “anxious learner” student could indeed be a schema, the schema functions as a subcomponent, or “object,” in the overall model, which rests on figuring the student as part of a system, and the model is purposed for reasoning through the student’s experience in such a system. Chapter 5 will discuss more fully how schemas can function as objects of mental models.
the circulation of “commonplaces” from which the student will draw to supplement their academic writing (526).81 Also, Bartholomae’s text implicitly instructs us to represent a collective of students with similar experiences by presenting a “generalized student” that functions as pars pro toto, with the singular “he” standing in to represent the entirety of student experience.82 These textual devices can be contrasted with multimodal devices (e.g., graphics) that cue the production of mental models through other features that are not language-based but nonetheless communicate meaning, often more effectively and persuasively than text. Next, I present an analysis of a piece of scholarship that makes use of multiple modalities to cue readers to produce mental models.83

Example 2: Discoursal Cues for Models in “Cognition, Convention, and Certainty”

Like Bartholomae’s article, Patricia Bizzell’s 1982 article “Cognition, Convention, and Certainty: What We Need to Know about Writing” also explores how learners grapple with appropriating others’ discourses. As I described earlier, her aim is to interject “an alternate research site so as to get the research going and break the momentum of cognitive work,” largely because she was concerned that the cognitive vein of writing research would displace and

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81 A careful read of Bartholomae’s usage of the term “commonplaces” suggests he is in fact referring to commonly used schemas here, such as, for example, the stereotyped notion of “lack of pride” or “lazy” that appears in one student’s essay. As discussed above, schemas have a place in the construction of mental models, and this idea will be revisited in Chapter 5.

82 Bartholomae’s use of the pronoun “he” participates in readers’ construction of a gendered mental model and hints at the ideological cargo that inheres to mental models and is circulated through them.

83 Bartholomae goes on in this article to complicate the model of student by attempting to use data to establish the distinctions between novice (or basic) writers and those who are more successful. For example, he asserts that advanced writers conduct a particular rhetorical strategy whereby they claim authority “by placing themselves within and against competing discourses, and working self-consciously to claim an interpretive project of their own, one that grants them the privilege to speak” (624). The added dimensions in his mental model of student demonstrate both the cultural endorsement of increasing complexity in researchers’ and their students’ mental models (see Chapter 5 for a discussion of the idea of disciplinary “progress” as increasing complexity) and the relationship between a researchers’ exposure to data (in this case, Bartholomae’s exposure to students’ essays) and the formation of mental models.
preclude critical approaches to the study of writing (500). She has chosen to graphically depict an inner-directed model of the development of language and thought with a series of layered boxes. It figures a hierarchical form of dynamism through the numeric ordering of the boxed constructs that proceed from a learner’s experiences in a “mental interior” to “outer experiences,” starting with the inherent capacities of an individual, moving to the learner’s experiences with an immediate world, then to their participation in a society that enables the learner to be socialized in language use and thinking (see Figure 2). Readers are presented with sequential instructions by which to construct their mental models through the combination of numbers and arrows that provide the subcomponent to imagine first (a fully equipped yet unlearned learner) then the factors to add next (the structuring force of immediate “native” experience). Further, instead of presenting readers the information with which to begin modeling at the top and progressing down the page, like most traditional texts do, Bizzell presents readers with the unlearned learner is figured in box one at the bottom of the stack, suggesting to readers that they should conceptualize this undeveloped personhood as foundational, as that upon which all other learning is layered. In this case, readers begin with a simple conception of an individual and the idea of “development” occurs as the result of accreting experiences and social influences. Like Jillian, whose argument had been structured around the mental model she presumed her audience’s possessed (she had retained a model of teaching and research as “two halves of a whole” because graduate students participate in institutions that impose this separatist view on them) and who felt that this model appealed to her graduate student audience’s own experiences, Bizzell, too, seems to take her audience’s tendencies in mental modeling into consideration when she depicts the learner with “layers.”
Further, she aids her readers in their construction of this mental model by meting out the objects that compose it one at a time until the model is complete. This suggests that an expert writer likely possess an intuitive understanding of an audience’s cognitive load and that pacing the cues for mental modeling is crucial for enabling audiences to produce them from the discoursal resources they process.\textsuperscript{84} Lastly of note in this graphic depiction of the inner-directed learner are cues that encourage readers to consider a learner’s subjectivity from a gaze that looks

\textsuperscript{84} As I discuss in Chapter 5, anticipating an audience’s beginning models and pacing the delivery of information in order to cue them to construct alternative ones is increasingly challenging in non-linear new media contexts, as writers must anticipate how readers will encounter and interact with the hyperlinked components of an argument as well as the multimodality on which those arguments are predicated.
onto the learner; she accomplishes this by representing the individual graphically, as a discrete “boxed” entity that sits on the page at a literal and figurative distance from the reader. Both Bizzell’s and Bartholomae’s cues to model the learner from either a subjective or objective lens suggest that subjectivity and positionality have implications for the nature of the disciplinary knowledge produced and, as I discuss in Chapter 5, they are ideologically bound.

Bizzell explains to her readers that there is an alternative conception of the language learner circulating in writing studies disciplines. She enables readers to produce this second, alternative mental model by combining textual and graphical cues; unlike the last graphic, which is composed of stacked boxes, the alternative figures overlapping circles that represent the discourse communities within which the learner participates (see Figure 3). While the model is two dimensional, it clusters irregularly, as if the distance from the individual learner varies depending on the degree and nature of the learner’s participation in the community. This irregular spatial arrangement cues readers to construct mental models of an irregular set of relationships to various discourse communities. Further, some circles are represented as “transparent,” since they reveal the boundaries of the circles (other discourse communities) layered beneath them (i.e., circles a, b, and c). However, other circles’ boundaries are occluded from view (i.e., circles d, e, and f). This overlay pattern suggests that some of the circular areas are foregrounded and others at a distance. This notion that a learner’s relationships to various discourse communities are not identical is strengthened by the use of text; as the figure’s description notes, the “Individual has unequal access to different communities” (371). The text and graphic work together to suggest that both a learner’s proximity to a community and the ease

85 However, Bartholomae does encourage readers to produce mental models with a student subjectivity. This construction is accomplished through a narratively structured text passage that cues readers to model a student point of view rather than the researcher’s.
of entering it are strongly defining factors. Importantly, however, it is not entirely clear whether Bizzell’s half-drawn and undrawn lines are the product of limitations in the available means for graphically representing her thinking or whether these choices have semiotic intent (did positioning the labels for each circle require “erasing” some of the borders, or do those features suggest elements of Bizzell’s thinking, perhaps elements she herself remained unaware? For example, the layout suggests that the native, work, and school communities are primary and interlocked, and that other communities may not share the common ground that exists among these three. Did Bizzell mean to suggest this, or did the representation reflect important but unexamined assumptions in her mental model? For example, it seems possible that a gaming community could have intersections with one’s work community. As my experience with Blake, Jillian, and Lily suggested, becoming aware of the unexamined details in one’s model can give rise to insights that might not have been previously realized. The participants’ experiences with this type of reflection prompt me to wonder whether Bizzell would have found a discussion about the nature, purpose, and function of her model engendered any fruitful additional insights. At the very least, this type of reflection could tease out assumptions in the models from the constraints imposed by the particular media, an important consideration in discourse analysis that aims to consider how writers cue readers to (re)produce their mental models.

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86 The nature of this primacy is not apparent from the graphic alone; here we have reached the limitation of the graphic’s ability to shape readers’ mental models. Also, the term “interlocking” is a metaphor for which I might just have easily chosen the term “interwoven,” yet each term suggests the nature of the interaction between discourse communities that the author may or may not have intended, and, importantly, each term informs a potential model differently, enabling different outcomes that are consequential to the nuances imposed by readers’ models. For instance, an interwoven set of communities suggests a threading through a number of possible mechanisms (e.g., borrowed discourse or overlap in membership), while an interlocked set of communities suggests a more rigid relationship between them, one perhaps maintained through gate-keeping and self-enclosure or resulting from dynamics of the larger ecology of discourse communities, such that each discourse community seeks to retain its equilibrium as it co-exists with other discourse communities in the ecology. This brings home the importance of Lakoff’s work with metaphor; it also stresses the important limitations that the modality of language presents to a researcher hoping to accurately represent texts, aims, and affects, since the language itself risks “reshaping” these by the very choices used to describe them.
The ambiguity about whether certain features are intentional discoursal strategies or a reflection of the constraints posed by the available media (and the scholars’ facility with composing in it) must have a significant bearing on research into the discoursal strategies that scholars use to produce mental models in readers. As Bezemer and Kress note, “The process of sign making is always subject to the availability of semiotic resources and to the aptness of the resources to the meanings that the sign maker wishes to realize. In principle, limitations apply always and everywhere” (170). This aptness is often a product of discourse communities’ conventions. For example, some of the semiotic resources afforded by some forms of media seem at this time inappropriate to English Studies scholarship, rendering their use “off limits” and constraining how the scholar can express disciplinary knowledge. This was the case previously with online scholarly publishing, which was largely regarded as sub-standard in most fields, making the affordances of new media difficult for scholars to pursue. However, as Kathleen Fitzpatrick has underscored in her 2011 work Planned Obsolescence, these restrictions are increasingly (and forever) behind us. Ultimately, any research on mental models’ relationship to the disciplinary writing ecologies must foreground field-specific conventions related to the media and modes each field considers “appropriate” for presenting “legitimate” academic knowledge. This touches on the ideological nature of mental model construction and their representation, topics I discuss further in Chapter 5.

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87 In “Afterthought: Cognition, Convention, and Certainty,” an afterward to her 1982 article appearing in the 2009 Norton Book of Composition Studies, Bizzell notes that in order to establish the concept of “discourse community” as a topic and to argue against the idea that basic writers were merely cognitively deficient, she had “emphasized the forces that make a discourse community cohere, that make it resistant to the entry of outsiders …. Thus I may have made the concept seem more reified than I would actually like to regard it” (500). Her admission suggests that discoursal strategies can have unanticipated effects on readers’ mental models which significantly alter how they are interpreted, adopted, and employed later, as for example, in subsequent scholarship. These can impact the larger course of the disciplines in which they appear.
As we have considered already with the textual and graphical affordances of print, each form of media confers various affordances and limitations to the process of discoursally cuing mental model-making in readers and listeners. Today new media in digital formats provide multiple modalities, such as image, sound, and motion, and these modalities are becoming more available to academics in English Studies disciplines, as many are increasingly encouraged to publish their work in digital forms. In fact, the rapid expansion of such publishing practices in the humanities generally has gathered enough momentum to be dubbed with the disciplinary distinction of the “digital humanities” (Kirschenbaum). Further, when mental models are circulated through forms of media, digital or otherwise, they are (re)structured by these forms.
and this (re)structuring can have significant impacts on how scholars understand their own academic research. In order to see new media’s potential role in enabling scholars to expand their abilities to communicate by more effectively representing and circulating their complex scholarly mental models, and to prepare for studying the implications of mental models in increasingly multimodal disciplinary writing ecologies, it is useful to turn to Bizzell’s model once more and imagine that a scholar wants to extend the model to factor in life cycles of literacy, whereby a learner takes up different discourses at different stages of life. For example, one could imagine a regional idiom being particularly significant and highly effective to a high school student who then leaves it behind in college in favor of a more homogenous dialect or one that reflects the student’s intended profession. A scholar attempting to represent this idea might ask, can a print-based representation depict the shifting primacy of particular discourses and their communities as a learner moves through various literacy lifecycles?

A model that includes such shifts, if confined to the static page, would likely represent these changes graphically by depicting several of these circle-clusters, each serving as a “snapshot” with a different set of communities in the foreground (e.g., a work community at one time and a gaming community at another), perhaps linking each circle-cluster to the next with arrows to reflect the passage of time. However, we might imagine a computer-animated representation that could occupy the same spatial dimensions on the screen as Bizzell’s original

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88 Bezemer’s and Kress’ concept of transduction, for which “semiotic material is moved across modes, from one mode (or set of modes) to another mode (or set of modes)” will be discussed in Chapter 5 in relation to the practice of resituating models from their mental medium to other mediums that inherently afford modes that differ from those that cognition does (175). For example, representations of “taste” in mental models (as when one imagines or “reasons through” changes in the taste of a dish when a new spice is added) will differ dramatically from how taste is represented in other media with modes that do not accommodate the same representations of taste that the imagination does. In this case, one might imagine that text’s descriptive capacities offer the greatest affordances, relative to for example, a picture of an altered dish. However, new media affords the modes of moving image and sound that when used together offer considerably more representational capacity (e.g., as when it shows a person tasting an altered dish and describing its flavor).
print-based page but feature shifts in the primacy of discourse communities over the lifetime of
the learner by designing a single circle-cluster that morphs over time. This latter representation
would strengthen the cue to readers to mentally model changes in the primacy of certain
discourse communities that are *processual and gradual* rather than sudden and discrete (which is
what several distinct, static clusters risks suggesting, at least without supplemental text for
explanation). Such an animated representation of the model would also avoid suggesting a
“relocation” of (or change in) the communities themselves rather than the learner, an inference
some readers might presume from seeing the circle-cluster “resituated” on the static page. In
other words, in contrast to presenting a reader with several snapshots of circle-clusters, a
representation of a single cluster that changes relative to a person’s stage in their literacy
lifecycle conveys the idea that the *communities* haven’t necessarily withdrawn from or imposed
themselves on the learner; rather, that the learner’s relationship to them is relative and subject to
change over time.89 Further, one might ask whether this graphic model could depict not just the
fact that some discourse communities are regarded as more primary than others at different
points in time, but also *what causes these changes?* For example, we might speculate that
relationships with new discourse communities change (begin, end, or morph) when the learner
encounters them through significant *media*, such as the internet, or through one’s associates, who
serve as *intermediaries* and introduce them to new communities. Or perhaps the hypothetical
scholar wants to suggest a different effect on the learner from significant *mediums*, such as
specific internet sites. Could these different *causes* (media, intermediaries, and mediums) for the
changing primacy be represented through color coding, perhaps also including a “key” as an
aside or as a roll-over function that enables supplemental text or images to work in tandem with

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89 It is interesting to speculate on how much more quickly these ideas could be communicated in new media form
with multiple modalities than they have been here through text.
the colors in the graphic? Would these or other alterations to Bizzell’s representation, enabled by new media, help readers more effectively reason through the dynamics she or other authors might hope to convey?90 While this study speculates, based on the work of Manovich and others, that such affordances can indeed enhance the effectiveness of representing knowledge in new media, these examples have been presented here because they expose readers to the nature of the cues I considered when I analyzed the discoursal data I collected for my research (scholarship, interviews, and protocol analyses). Further, they point to the importance of carefully considering each media’s particular affordances in cuing readers’ mental models, something I undertook as part of my analysis.

The first two examples, those authored by Bartholomae and Bizzell rather than hypothetically imagined by me, also point to the importance of recognizing that authors’ intentions are not always available to me as the researcher, a limitation which was particularly evident in this study when I speculated about the reasoning behind some of the authors’ choices, and I discuss this shortly when I present some recommendations for more effectively eliciting scholars’ mental models. In order to take these limitations into account (both the limitations inherent in forms of media and those arising from the inability to know participants’ or their cited authors’ intentions with certainty), I recommend including these constraints in the coding process. Including the limitations inherent in the media in one’s coding scheme enables a researcher to recall them and account for them as they work towards findings.

The rhetoric and writing field, as well as others, stands to benefit from a careful analysis of the ways in which discipline-specific thinking is structured by media’s representational

90 This example suggests that one of the greatest affordances from the modalities available in new media is the ability to represent time. I will revisit this idea as it relates to English Studies scholarship in Chapter 5.
affordances (e.g., the way in which discipline-specific mental models are constrained by the media by which we circulate them) because such an understanding can enable scholars to more deliberately consider the effects of their rhetorical choices for representing disciplinary knowledge and perhaps to expand their available scholarly resources by carefully constructing and circulating arguments about how multimodality helps scholars fulfill their communicative aims. This project helps scholars consider the effects of such choices in representation by focusing on mental models’ relationship to disciplinary discourse, shedding light on the way in which scholarly thinking works in tandem with the production of scholarship and its various technologies. The three examples were provided to demonstrate how mental models are cued discoursally, in order to contextualize the suggestions I provide for other possible approaches to data analysis.

Because previous research on mental models has tended to be in the form of thought experiments and outside the field of rhetoric and writing, I now present an approach that can enable other researchers to employ a more structured approach to alternative methods and data analysis. The next section discusses the literature that informs the preliminary coding strategies for all three knowledge structures that concern this research (mental models, frames, and scripts and schemas), particularly emphasizing how I adapted the characteristics of mental models to form the coding schemes for discoursal cues. Though I was unable to use these coding schemes on the data I collected given the constraints of the project, I hope they provide other researchers with a starting point for conducting data analyses on how mental models function in discourse ecologies. (To remind readers, the data that I collected was from scholarship, interviews, and talk-aloud protocols, and in Chapter 5 I present some recommendations for data collection methods that arise from my experiences attempting to elicit mental models from scholars.)
Potential Coding Schemes for Analyzing How Discoursal Data Cues Mental Models

In order to provide researchers alternatives to “thought experiments” and to move qualitative methods for studying mental models in writing ecologies beyond an exploratory phase, I present several potentially useful approaches to data analysis below. Each is drawn from the literature on qualitative research methods and stands to uniquely serve the study of mental models. Further, multiple approaches to data analysis can potentially enhance the rigor and credibility of analysis. Researchers often triangulate methods to do so, but they can also “Use multiple perspectives or theories to interpret the data, i.e., theory/perspective triangulation” (Patton). The potential approaches to data analysis that I present below might contribute to such a triangulation, or perhaps at the very least, provide those who might wish to study how mental models participate in writing ecologies with initial coding approaches from which to select. The coding approaches to investigating how mental models are cued include coding for functional attributes of mental models; forms of dynamism; semantic structures of relationality; and frames, scripts, and schemas. The coding for mental models as cognitive productions includes using a semiotic multimodal approach on the models and conducting a situational analysis on the writing ecologies in which these mental models participate.

Coding for Functional Attributes of Mental Models

In contrast to the approach in this project, much of the cognitive science-based research on mental models and their relationship to processing discourse has been in the form of thought experiments, where participants respond to limited text selections and report their cognitive processes. Cognitive psychologists like Rickehein and Sickelschmidt have used thought
experiments to investigate how readers form mental models of the texts they encounter. For example, “When reading at the beginning of a text … a discourse model is necessarily fragmentary, and some models remain so in the course of processing [if perception or background knowledge] does not provide the information required to corroborate an intermediate model” (Rickheit and Sickelschmidt 33). Through a thought-experiment approach, these researchers were able to establish that mental models of texts were not highly defined and tenuous. Researchers have also used thought experiments to construct small-scale studies to explore questions about various types of mental models in various contexts (e.g., to investigate whether readers produce two separate models when they encounter a disjunctive assertion such as “there is a red light or there is a green light,”91 or how readers process and represent probabilistic and quantifying declarations, such as “highly likely” and “a lot” [Rickheit and Sickelschmidt 20]). However, as Rickheit and Sickelschmidt make plain, mental models are not limited to a small range of laboratory contexts, but broadly employed in both language production and comprehension. They note that

> In language production, the speaker or writer must verbalize his or her current mental model, that is, transform a nonlinear structure into a sequence of verbal expressions in order to convey information to the listener or reader. In language reception, the listener or reader, proceeding from a string of phonemes or graphemes, must develop a mental model of a—perhaps largely undetermined—

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91 This question provides an opportunity to argue that an auto-ethnographically informed account, such as that which comes from a researcher keeping a journal, can usefully supplement the study of cognitive processes invoked in discourse processing and production: because I have been considering my own use of knowledge structures in knowing and writing since the start of my research, I was able to discern that the answer for me was a single simple model with a red light in the foreground and a green light in the background. Previously, I would not have been conscious of the phenomena I had produced in response to the discoursal cue. I will argue in Chapter 5 that this heightened awareness is an unexplored component of literacy that, if taught to students, could enhance the processes of reasoning and representing knowledge.
external situation that matches the intentions of the speaker or writer as far as possible. (22)\textsuperscript{92}

However, despite this broad range of contexts in which mental models can figure, there is not yet a general typography of discoursal features that function to cue readers’ mental model production. Yet, Rickheit and Sickelschmidt provide a list of general \textit{functions} for mental models: they are intended to represent systems, their architectures, their present states, the nature of their functioning, and predictions of future states (10). Writers and speakers provoke readers and listeners to produce mental models that fulfill these functions, and they do so for both content material (i.e., the disciplinary argument) and for their arguments’ organization by populating their discourse with cues about which topical and organizational mental models readers should construct in order to understand their intended meaning. In order to identify the types of discourses strategies used by scholars to cue their audiences’ mental models, I have refugured Rickheit’s and Sickelschmidt’s functions as categories of discoursal strategies, and I provide them as a starting point for other scholars analyzing discoursal data from participants’ textual or multimodal compositions, semi-structured interviews, and talk-aloud protocols. This approach to data analysis could potentially aid researchers in analyzing thick descriptions of scholars’ mental models. It would allow researchers to identify and investigate further any points in the discourse where the following aims are apparent:

- to describe the purpose of a system

\textsuperscript{92} Importantly, this suggests a linearly unfolding aural or textual discourse, but multimodal compositions that do not rely on linearity for their organizational structure will work differently. As I discuss shortly, linearity can be understood as an “unavoidable affordance,” in Bezemer and Kress’ terms, of both traditional print and oral mediums. Additionally, the nonlinear affordances of multimodal and new media pairs well with the nonlinear structure of mental models, potentially enhancing the production of scholarly knowledge. This will be taken up in Chapter 5’s discussion of the impact of new media on scholarly mental modelling.
• to describe the architecture of a system
• to explain the state of a system
• to explain the functioning of a system
• to predict future states of a system

(adapted from Rickheit and Sickelschmidt 10)

The scholarship by Bartholomae and Bizzell clearly evidenced these aims in the course of modeling the nature of the language learner. For example, Bartholomae described the learner’s affective state as anxious and predicted the future state would be characterized by the desire to master the discourse and a host of imitative activities intended to accomplish this. In the socially directed model of language learners, Bizzell described the architecture of a system comprised of multiple communities with particular discourses and an individual that participates in them. An initial coding scheme expressly listing these functions can enable a researcher not simply to rely on monitoring their own construction of mental models as a clue to how and when discourse cues readers to produce them; instead, this simple coding scheme can provide a more structured approach to identifying the points in the discoursal data that demonstrate these aims and signal to the researcher to examine the models’ construction more closely, enabling the researcher to produce categories for a subsequent, more specific coding of the data. Further, the coding scheme is applicable to cues created through text or other modalities. For example, in Bizzell’s inner-directed model of the language learner, a stack of boxes connected by upward-pointing arrows can be coded as an attempt to explain the functioning of a system. My own exploratory analysis inadvertently considered these broad categories, but implicitly rather than tacitly, and a more structured analysis would have been a helpful way to enter the data.
Coding for Dynamism

The four basic aims listed above suggest the presence of systems in a writer’s or speaker’s ideas, and identifying these aims in the discourse enables a researcher to more closely examine the strategies by which discourse cues readers and listeners to produce mental models. For example, the researcher might code the content of the system (methods for doing so are discussed shortly). However, mental models are not characterized simply by virtue of the objects that comprise the system, but also by the nature of their *dynamism*—in other words, how the mental model “works.” My analysis of the discoursal data collected from the participants in this study supports the notion that this dynamism is crucial to mental models and that specific forms of dynamism are circulated within disciplines, a topic I discuss more fully in Chapter 5. My experience with participants suggested strongly that the way in which the relationality among a mental model’s subcomponents is *transformed* (such as the foregrounding of particular subcomponents of a model and the backgrounding of others, or the inverting of causal order among a model’s objects) is a significant factor in lending a model its overall character. My focus on observing the nature of this dynamism led me to note that Mark Johnson’s (1987) and George Lakoff’s (1987) *image schema* (not to be confused with more general schema) all constitute *forms of dynamism*. As I discussed in Chapter 1, image schema are the most basic type of schema, patterns that we come to recognize as a result of our interactions with the world; they reflect our embodied relationality with a material and temporal existence. While schema broadly speaking are often treated as static fillable structures in the literature on them, there is evidence that this is an oversimplification: Tim Rohrer in his 2005 article “Image Schemata in the Brain”
suggests they are inherently dynamic structuring mechanisms that shape how we encounter the world. He notes that these particular knowledge structures are not temporally static, but take place in and through time. The musical scale is a sequence of activity in time; hearing an ascending pitch scale causes us to anticipate its next step … The temporal character of image schemata creates the possibility of a “normal” pattern completion, which in turn serves as the felt basis for their capacity. Image schemata are thus temporally dynamic in the sense that once they are triggered, we tend to complete the whole perceptual contour of the schema. (5, emphasis added)

This dynamism, as Chapter 5 argues further, is a structuring “force” that thinkers apply to their mental models in order to orchestrate how the models will function in action when they are used to reason through complex problem spaces. Below is a basic list of potential codes for forms of dynamisms that have been derived from Johnson’s and Lakoff’s image schema (“Image Schemas”). These categories can serve as a coding scheme by which to analyze the discoursal data, if a researcher is interested in examining the way in which the mental models that writers and speakers, as well as readers and listeners, use to produce and process discourse.

Image Schemas Adopted from Johnson (1987)

Spatial motion group:

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93 As Johnson suggests, there are likely numerous forms of schemas, and therefore forms of dynamism that might be applied in mental models. He observes that there is “clearly nothing sacred about … any other number of patterns but it is certain that we experience our world by means of various image schematic structures whose relations make up the fabric of our experience, that is, of our understanding” (126). I present only basic image schema as an early approach towards further study of mental models in writing ecologies and refer readers to Johnson’s (1987) and Lakoff’s (1987) work for descriptions of them. In Chapter 5 I share some early speculations on how these dynamisms contribute to disciplinary thinking and whether increasingly sophisticated forms of dynamism might characterize a more mature field relative to one in its earlier stages.
Containment
Path
Source-Path-Goal
Blockage
Center-Periphery
Cycle
Cyclic Climax

**Force Group:**
Compulsion
Counterforce
Diversion
Removal of Restraint
Enablement
Attraction
Link
Scale

**Balance Group:**
Axis Balance
Point Balance
Twin-Pan Balance
Equilibrium

**Others:**
Contact
Surface
Full-Empty
Merging
Matching
Near-Far
Mass-Count
Iteration
Object
Splitting
Part-Whole
Superimposition
Process
Collection

Schemas Adopted from Lakoff (1987)

**Spatial Group:**

Above
Across
Covering
Contact
Vertical Orientation
Length (Extended Trajector)

**Transformational Group:**

Linear Path from Moving Object (One Dimensional Trajector)
Path to Endpoint (Endpoint Focus)
Path to Object Mass (Path Covering)
Multiplex to Mass
Reflexive (Part-whole and Temporally Different Reflexives)
Rotation

These image schemas can be used as categories for the forms of dynamism that cue readers or listeners to construct mental models as they process the discourse they encounter; in the discourse these forms of dynamism function as either explicit or implicit instructions to readers to build mental models with particular forms of dynamism and to “operate” them across particular contexts, such as a disciplinary argument or an organizational structure. For example, returning to the hypothetical scholarship that extended Bizzell’s model on discourse communities to include literacy life-cycles, if this model were animated through moving images in new media so that it featured different circles to represent different communities coming into view in the foreground while others receded, the model would be coded for dynamism with the category of *superimposition*. Additionally, this model should also be coded for *cycle* as it figures a learner who returns intermittently to familiar communities, such work and school groups, for example. Both the categories of superimposition and cycle are derived from Johnson’s image schema. The coding would also apply if the extended model were represented through text-based description. However, if the author of this hypothetical scholarship wanted to depict a trajectory, rather than a cycle (for example, in the unlikely event that they wished to assert that individuals never return to familiar discourse communities, but only move into new ones) and the model were cued through arrows, text, or moving images, for example, then the dynamism would not be cyclic in form but *linear*, a category derived from Lakoff’s “linear path” image schema. The data I collected in my exploratory study suggests that adopting image schema as forms of dynamism is valid. For example, this coding scheme would have helped me identify Jillian’s mental model of the teacher-researcher as *cyclic* and Lily’s model of the developing student writer with expanding literacy and potentiality over their lifetime as *linear*. My preliminary experience with the data also suggests that this coding scheme could help future researchers
produce thick descriptions of scholars’ mental models, which would then provide the researcher
with richer material from which to consider mental models through a semiotic lens, particularly
because from a semiotic perspective, forms of movement are regarded as containing meaning
(e.g., Lily’s mental model figured a smooth movement over the student’s trajectory rather than a
choppy one, and this form of dynamism signaled a focus on an overall path rather than a concern
with ups and downs during development). These analyses would enable a more thorough
consideration of the habits of mind that characterize the disciplines in English Studies.

There are approaches that other researchers have taken with qualitative data analysis that
may also help a researcher investigate the dynamic property of mental models. For example, a
“causation coding” approach to the discourse analysis entails searching “for combinations of
antecedent and mediating variables that lead toward certain pathways … to map a three-part
process as a sequence” (Saldaña 261). The approach is appropriate for processes and
interrelationships, and can assist with “searches for causes, conditions, contexts, and
consequences … or as preparatory work before diagramming and modeling a process through
visual means such as decision modeling and causation networks” (262). As an example, Johnny
Saldaña in *The Coding Manual for Qualitative Researchers* provides “SPEECH TRAINING >
CONFIDENCE > COLLEGE PREP,” a sequence-based code that would be applied to passages
of discourse that suggested the idea that speech training improved confidence and impacted a
person’s sense of readiness for college (or suggested the inverse, that where no training
negatively impacts college preparedness through the mediator of confidence) (261). Causation
coding is well-suited for identifying causal relations that characterize depictions of systems, such
as the mental models on which this research is focused.
Saldaña presents yet another approach that could prove fruitful for identifying and analyzing the discoursal strategies scholars use to cue their readers to produce models with particular dynamisms. “Process coding” entails labeling items in the data that “imply actions intertwined with the dynamics of time, such as things that emerge, change, occur in particular sequences, or become strategically implemented,” and it is particularly recognizable through the use of words ending in “-ing”) (Saldaña 266). While Johnson’s and Lakoff’s image schema are easily refi gured as dynamisms in their “ing” form (for example, “superimposing” and “cycling”), Johnson has noted there may be endless others; in order to identify forms that may not appear on Johnson’s or Lakoff’s lists, a coding step that involves identifying gerunds could keep these more novel forms from slipping through the cracks.

Dynamism is crucial to an investigation into how mental models participate in disciplinary writing ecologies to aid scholars as the produce knowledge circulate it through their scholarship, because dynamism constitutes the habits of mind that establish the bounds of a discipline, perhaps more powerfully even than the objects with which a field concerns itself. For example, writing studies fields have traditionally concerned themselves with writing as the object of their scholarly attention. Yet, the definition of writing has enlarged to include numerous forms of inscription, for example, the environment is said to leave its inscription on our bodies over time, and some scholars regard this too as a form of writing. However, what remains constant is the notion of one object making a meaningful mark on another. The dynamism of writing is far more potent than the object of writing. Given dynamism’s significance to disciplinarity, I believe an approach to investigating mental models’ role in the production of scholarship and the construction of disciplinarity must account for mental models’ dynamic properties.
Coding for Semantic Structures in Order to Identify Other Forms of Relationality

I have argued that dynamism, one of the central characteristics of mental models, can be identified by refiguring Johnson’s and Lakoff’s image schema. However, there are other forms of relationality, and the discoursal strategies by which these are cued might be identifiable by a coding scheme that captures linguistic features. Specifically, there are three distinct “textual units” that are invoked in relation to discourse processing and comprehension: concepts, propositions, and global textual meaning (Rickheit and Sichelsmidt 23-24). Because these textual features are tied to semantic structures and schemas, they provide cues about the nature of the relationality between the objects in a mental model. Concepts are the “principal units of knowledge organization”; they are generally understood as the basis of semantic structure and are frequently identifiable as cognitive schema (23). Again, this type of schema is to be distinguished from the dynamic pattern-making image schema that characterize forms of dynamism in mental models. These schema are the skeletal concepts that we may “fill in” or “flesh out” with specificity by varying degrees. For example, when Blake, Jillian, and Lily each visualize shadowy figures of people who stand in for generalized “readers,” “writers,” or “students,” these are schemas; they are the objects of thought that serve as the building blocks or subcomponents of mental models, and they contain only the details that are salient to the problem space in which mental models are to aid reasoning. They are identifiable as concepts in the discourse, whether textual or multimodal. A thorough data analysis should include coding for both particular and schematic concepts, in order to locate the objects that compose the mental models. These objects will be in related to each other in some manner if they are occupying the mental model’s problem space. To discern the nature of this relationality and identify the discoursal mechanisms that cue readers to construct mental models as they process discourse, a
linguistic coding scheme should also include categories of *propositions*. In this semantic component, “elementary semantic relations are clarified by linking one or more arguments to a predicate” (23). These links are indicative of the nature of the relationality between objects in a model. Linguistically, a proposition can be considered the constant content within a clause or sentence, and it can be related to other semantic objects either through temporal or logical relations (Fleming). For example, the sentence “My friend Greg read that book” proposes (or contains the propositions) that Greg is my friend; my friend read that book; and Greg read that book. Together, these propositions suggest a complex relationality among the semantic objects, and these relations are mental figured in readers’ models as they process the sentence.  

Further, propositions contain three components that participate in this relationality. In the proposition above, for example, read is the *activity*, Greg is the *agent*, and the book is the *patient* (the object upon which the agent acts); a linguistically informed coding scheme designed to investigate discoursal strategies used by particular communities to cue mental models should ideally include an examination of propositions at this linguistic level because propositions and their components contain important patterns of relationality, and they instruct readers to model this relationality through context-specific discoursal choices.

Lastly, as my own exploratory approach to data analysis revealed, mental models are associated with more “holistic aspects of language processing” (Fleming 23). Cuing a reader to link a set of subcomponents in relation to each other then endowing them with a particular

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94 For example, *Greg is my friend* may be represented by the modality of *affect* combined with the modality of *image* (perhaps an image of Greg’s face), which together form a token that might occupy a mental model predicting whether Greg would like a movie rendition of the book. I discuss a coding scheme specifically for identifying modalities employed in mental models shortly. However, this discussion is not in regard to discoursal strategies but the modalities actually employed in the mental productions in the semiotic space of the mind, a slippery but important distinction.
dynamism requires the complex interaction of multiple discoursal constructions. Therefore, I recommend that researchers retain a holistic perspective of the discourse as I did during my exploratory analysis, encountering it from the position of “reader” and observing and recording their own mental modeling in response to the encounter. In summary, these three discoursal constructions (concepts, propositions, and holistic meaning) could be used as coding schemes for scholarship, interviews, and talk-aloud protocol data. Further, all three can be used to analyze cues for mental modeling present in multimodal scholarship. Relationality among objects on a screen is frequently propositionally structured by their arrangement on the space or the interaction between image objects. For example, *Greg is my friend* might be figured by two people sitting in proximity to each other and laughing.

**Coding for Frames, Scripts, and Schemas**

If researchers are interested in teasing out how other knowledge structures interact with mental models in the production and processing of knowledge and discourse, it is important to have coding schemes that can direct them to look for the discoursal strategies that cue these other structures. Then once these discoursal strategies are identified, the researcher can begin to consider how they function alongside mental models. In Chapter 2 I provided readers with a discussion of the discoursal mechanisms by which a writer cues either a frame, script, or schema that other researchers have identified. These knowledge structures tend to be highly context-dependent and so a general list of categories can inform a coding strategy to assure that the researcher identifies them. Frames are often identifiable at the global meaning level (e.g., a feminist frame identifiable in the title of the article or perhaps through its affiliation with a particular journal), and schemas represent generalized objects that function as tokens within mental models (e.g., depictions of the process of reading or a generalized student). Scripts are
frequently associated with the dynamism applied to the model when it is deployed to reason through a specific problem (e.g., the idea of problematizing a previous conclusion and critically re-evaluating it). In addition to the discussion on how researchers identify these knowledge structures’ roles in discourse in Chapter 2, I also refigure the approaches as a coding strategy that I summarize in Table 1 shortly.

Once I had collected the discoursal data from participants, I sought to reconstruct the mental models they had formulated in their minds and to treat this as a semiotic space in order to analyze it. From a research methods perspective, this means that I collected data, analyzed it, produced thick descriptions, applied a semiotic multimodal approach to what I understood were scholars’ mental models, then speculated about what the these descriptions signified (i.e., the findings from each case presented in Chapter 3). However, each of these stages comprises a separate exploratory approach as I experimented with how to effectively investigate mental models’ roles in disciplinary writing ecologies. From my experiences working with the project, I have a better sense of how to conduct each stage. I have provided some recommendations for a more structured data analysis on how writers cue readers to produce mental models. What follows next is a description of how to evaluate the mental models, the cognitive phenomena themselves rather than the discourse produced by either writers or speakers, as representations. I believe this analysis has the potential to shed light on how the representations (inscriptions) in the semiotic space of the mind function in complex representational (inscriptional) ecologies. The next section presents a process for doing so and the limitations of such an approach.

Coding Mental Models as Cognitive Representations

Why Use a Semiotic Approach to Analyzing Mental Models?
This section details approaches to analyze not scholars’ discoursal productions (i.e. scholarship, interview responses, or talk-aloud protocol data), but the mental representations in scholars’ minds, particularly those they employed while composing the disciplinary scholarship I considered in this research project. As I noted in Chapter 1, mental models can be considered representations that occur in the semiotic space of the mind, because this space functions multimodally to construct meaning. Further, because this space is not devoted strictly to language production but participates in the production of meaning through a variety of means, a semiotic approach to multimodal meaning-making is applicable.

As Paul J. Thibault explains in his 2004 book *Brain, Mind and the Signifying Body: An Ecosocial Semiotic Theory* (2004), language should be regarded as one semiotic tool among multiple modalities for meaning-making. For example, gesture, gaze, and movement are also modalities for constructing meaning. Language is often treated as the *prima causa* of all other modalities, but Thibault argues against “delocat[ing] them and their meanings from the full multimodal system in which they are deployed and treat[ing them] as objects of meta-semiotic reflection and manipulation in their own right” (45). He notes that the term multimodality is a meta-semiotic one “that best captures the increased determinacy of specific resources in the mature system and … presupposes the capacity to deploy and to (re)combine specific modalities in ways that display a relative [but inaccurate] independence” (46). What this assertion underscores is the fact that language must be regarded as having its own pattern and level of organization distinct from other semiotic modalities. However, as the author goes on to explain,

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95 Thibault calls on work from Cowley et al. on infants’ “full-bodied sense making,” which occurs because their immature system has not been taught to splinter one mode from another into determinate semiotic systems (45). The contrast between the infant and the mature language-proficient individual usefully reminds us that meaning-making is indeed multimodal and not simply language-based, despite our predilection to privilege language, even in multimodal discourse analysis.
the resource of language does exert a structuring force on meaning-making by virtue of its particular affordances and limitations (e.g., an earlier footnote described the linearity that characterize text and speech, which is not processed at once as an image can be, but over the course of the time and space within which linguistic units are meted out). Further, “language forms have the potential to make differences that bear directly on our experience, as well as on the experience of others … [because it has] the capacity to entrain and direct physical-material processes and flows, including biological ones” (45). In considering the human mind in this context, Thibualt argues that brains are part of the semiotic system because they function to co-ordinate and cross-couple body-brain systems to the ecosocial environment by means of the mediating effects of semiotic artifacts, tools, technological aids (computers, calculators OHPs, and so on), architectural features, human bodies (both our own and those of others). It is through such processes of mediation that the trajectories in time of selves and their dialogical intertwining with trajectories of other selves come into view on various scales. (44)

In other words, the brain (and the body, of which the brain is part) is a signifying space that warrants a semiotic approach to understanding meaning-making in an ecosocial context. This approach is frequently employed by researchers who wish to investigate not just how various modes, such as text and image, work together in discoursal artifacts, but how other material objects participate in meaning-making, both in discoursal contexts and in larger environments, such as, for example, classrooms or cities.
Historically, semiotic multimodal analysis extends from Michael Halliday’s notion of systemic functional linguistics (SFL), which proposes that language should be understood, not by parsing it grammatically, but by regarding it systemically, such that parts affect others, and meanings are “organized in their own terms, as a purely abstract network of interrelations” (Halliday). Further, this system of interrelation produces meaning, which is used as a tool to address particular needs; language is just one of the resources available for constructing meaning. These principles pair well with the characteristics of mental models: the idea that “meaning” is systemically structured and accomplished via linked elements in a discourse system parallels the notion that mental models too are small-scale discoursal systems that contain linked subcomponents constructed from a multimodal set of representational resources. Researchers adopting the semiotic lens whereby meaning-making is an interrelated system of signifying resources have devised methods for data analysis; see for example, van Leeuwen, Kress, Lemke, Thibault, Scollon, Baldry, and O’Halloran (Constantinou 603). Notable is Kress’ and van Leeuwen’s 1996 work, Reading Images: The Grammar of Visual Design, which investigated, for example, the multimodal components of meaning-making in a young girl’s bedroom. The book provided a foundational source for SFL approaches to multimodal semiotic analysis and continues to be particularly useful for researchers employing an ecology lens.

However, a second branch of multimodal analysis arises out of a merger between traditional discourse and critical discourse approaches and is centrally concerned with a critical perspective toward multimodal compositions, often using analytic tools to examine multimodal discourse for its “truth effects” (Constantinou 603). Though distinct, there is overlap between the two approaches:
In short, the SFL-inspired work begins with an interest in the generation and development of multimodal systemic theory ..., whereas the work that is continued in the spirit of DA [discourse analysis] begins with an “object” of analysis, and deploys and constructs analytic categories concerning multimodal semiosis that are intended to illuminate some aspect(s) of the object under scrutiny. These approaches are not in contest. Rather, they complement each other since, most obviously, each aims towards the same broad objective of studying the phenomenon of multi-semiotic meaning making. (603-604, emphasis added)

Given that this project aims to understand how mental models function in disciplinary writing ecologies, I adopted the SFL approach with its emphasis on multimodality in systems when I examined mental models as semiotic cognitive productions with roles to play in larger disciplinary ecologies. However, when I examined the discoursal data (scholarship, interviews, and protocol analyses), I used a discourse analysis approach with a focus on the “objects” of analysis, such as scholarship or mental models as cognitive phenomena, because my aims were in part critical and included understanding how mental models might carry ideological cargo via scholarship that structures disciplines and their disiplinarity. However, ultimately, the process of considering each form of discoursal data for a full semiotic account as Thibault prescribes was far more ambitious than my exploratory study would allow. I felt that employing a discourse analysis method on discoursal data first (which included examining multimodal scholarship with a multimodal discourse approach) enabled me to synthesize findings about mental models in the form of thick descriptions; I was then familiar enough with the mental models to consider them holistically from a semiotic perspective, but only limitedly given the exploratory nature of the project. However, I believe this method of data analysis, if conducted more thoroughly, could
yield insights into both the way that mental models might be interrelated with other components of the semiotic meaning-making systems deployed for human ends, particularly in the context that concerns this research, disciplinary writing ecologies. I also believe a more thorough semiotic analysis approach could yield additional insights from a critical lens, particularly on the way in which our thinking is ideologically structured by circulating mental models or even the objects that comprise those models via discourse. This too especially concerns disciplinary writing ecologies in English Studies disciplines that are necessarily less insular in an interdisciplinary and corporatized academy, where external influences on scholarly thinking abound. From a critical positionality, my aim is to suggest that heightening our awareness about the sources of our habits of mind can enable us to reject those with which we are uncomfortable or believe are antithetical to disciplinary aims, such as expanding literacies.

Using Bezemer and Kress’ Approach to Semiotic Analysis on Thick Descriptions of Mental Models

The analytic categories I considered in an exploratory fashion in my data analysis of mental models as cognitive productions were adapted from Bezemer and Kress’ work in “Writing in Multimodal Texts: A Social Semiotic Account of Designs for Learning” (2008). This article provides a set of conceptual and analytical tools the authors developed to “illuminate principles of designs for representation and help us understand how multimodality functions. Key concepts are sign, mode, medium, frame, and site of display (Halliday; Hodge and Kress; Jewitt; Kress et al.; Kress, Jewitt, Ogborn, and Tsatsarelis; Kress & van Leeuwen)” (169). Bezemer and Kress define these principles in the context of examining changes in the use of image, text, and other modalities in school textbooks over several decades, and they shed light on the epistemological and pedagogical significance of these representational practices in educational settings by
evaluating how “writing, image, layout, and other semiotic resources … create potentials for learning” (169). The features of a composition or an environment, including objects, texts, people, and other elements, work together to create “semiotic ensembles,” which provide “the ground for learning and in that way may shape what learning is and how it may take place” (168). I chose to adapt Bezemer and Kress’ approach to evaluating mental models because scholars themselves participate in learning environments by virtue of their membership in both disciplines and academic institutions. Mental models are cognitive representations that play a significant part of these academic disciplinary learning ensembles where scholars are tasked with producing knowledge and circulating knowledge among students and each other (and ideally, in the society at large, which finds the knowledge relevant and useful). While it is often difficult to translate the categories to the context of the mind and its mental models, I believe they present a starting point for an exploratory approach to evaluating the compositional features of mental models as cognitive productions. In order to conceptualize how these categories could be applied, I suggest thinking of the mind as a semi-closed semiotic space not unlike a girl’s bedroom, which Bezemer and Kress show us can be understood as tucked away from the larger world, yet participating in and connected to it nonetheless. The categories for considering mental models from a semiotic perspective are:

- **Sign:** Element of representation “in which meaning and form have been brought together in a relation motivated by the interest of the sign maker” (170). Creators of multimodal compositions must choose the meaning material among a range of materials considered apt for a particular community. While the sign is generally considered as the external representational element, cognitive representations modeling the problems with which scholars grapple also contain meaning material, such as analogies, metaphors, symbols,
and images. The flower symbol in my mental model to model the overlap-and-conquer approach to research in a topical domain is an example of a sign. “Sign” is not dissimilar to the linguistic notion of “concept” discussed earlier in relation to analyzing discoursal data, however, it is important to remember that a semiotic approach does not privilege signs as linguistic in nature and considers them more broadly. This is especially important because the mind has a variety of resources beyond language at its disposal for making meaning.

- **Mode**: “[S]ocially and culturally shaped resource for making meaning. Image, writing, layout, speech, moving image are examples of modes” (172). Each mode has specific resources, affordances, and constraints, including those determined by community conventions, such that “What counts as mode depends on sign makers acting within the needs and understanding of a particular community and its more or less conventionalized practices” (172). For example, layout requires the resource of space and is constrained by space as well as by a community’s conventions. Further, each mode imparts unavoidable affordances, what Kress calls “epistemological commitment,” as when, for example, two characters in a narrative are represented visually, the distance between each is necessarily depicted, whereas text does not commit the representation of their bodies to a specific distance apart (*Literacy* 55). Bezemer and Kress refer to a set of modes in a composition as an ensemble, and note that the multimodal design that constructs an ensemble’s meaning can be quite complex. An analysis of scholars’ mental models as cognitive productions should include a deliberate consideration of the modes in which they model the scholarly problems they work through and writing about (e.g., images, moving
images, aural elements, words, colors, mental gestures, and surprisingly, mental models employ affect as a mode. I touch on this again in Chapter 5).

• **Medium:** Contains both material and social aspects. As Bezemer and Kress describe, “Materially, medium is the substance in and through which meaning is instantiated/realized and through which meaning becomes available to others” (172). In new media, this materiality is largely invisible to users. “Socially, medium is (the result of) semiotic, sociocultural, and technological practices (cf. film, newspaper, billboard …, a classroom, and so on)” (172). The medium in which mental models are constructed is the semiotic space of the mind, which is centrally seated in the brain. However, Bezemers and Kress’ category usefully prompts a consideration of the social semiotic, cultural, and even technological practices that shape the models that scholars produce in their minds. For example, it is likely that Flower and Hayes were able to flesh out or extend their own mental models of cognition’s role in writing because they used certain technologies, such as pencil and paper, in tandem with mental model-making.96 This category enables mental models researchers who are examining mental models as semiotic productions to thoroughly consider the fact that they are produced in the mind, perhaps even prompting an account for the ways in which the biological substrates underlying cognition inform mental modeling.

• **Frame:** Bezemer and Kress define frames as Goffman does, as “basic framework[s] of understanding available in our society for making sense” (qtd. in Bezemer and Kress 173). However, they refigure Goffman’s construct as “social event” to the category of “genre,” asserting that “Genres are the semiotic obverse of the social event. They are

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96 The role of technology in extending the capacities to think was discussed in Chapter 1. It will be revisited in Chapter 5 when I speculate on how new media might impact scholarly thinking practices.
realized at the textual level; every text has a generic form. Each of these frames/genres defines text in terms of activity, of social relations of participants in an event, and in terms of the use of modes and media” (173). A semiotic analysis of scholars’ mental models should include a search for generic mental models. For example, the mental map is a common form of mental model, though the target domain that the model reflects can range from actual geographies to disciplinary maps. Writing studies researchers might also consider looking for patterns of argument that reflect generic forms of thought and characterize particularly discoursal ecologies.

- **Site of Display:** The authors explain that when a material medium is shaped into a medium for the display of complex signs, it becomes the site of display. A single medium can be shaped as multiple sites of display; as example, the authors point to how a sheet of paper pinned on the wall becomes a poster whereas if it is folded and labeled with a title, it becomes a booklet (173). Frames get mapped onto various sites of display, meaning their social activity is transformed into generic forms that are considered apt for various sites but not necessarily others. For example, “exercises” can appear in text books but not on billboards. “The significance of these issues in design become noticeable where they appear to misfire …. As frames change, new sites of display are created” (172). In relation to disciplinary scholarship, discoursal sites of display, such as scholarly journals, conferences, and classrooms, function as spaces for epistemological arguments. However, the semiotic space of the mind can be considered as a site of display also; it participates in the circulation of disciplinary habits of mind and concepts of knowledge. A researcher might speculate on the number of these sites for a single disciplinary construct, as well as arguments that perhaps compete for that mental space. For example,
one might consider how a disciplinary mental model for developing student writers’ potentiality competes for the same mental space as a model for increasing efficiencies in providing student feedback: what factors determine which mental model will “occupy the mind,” be realized in disciplinary activity, such as scholarship and teaching, and be taken up and circulated in the local ecology and beyond? Sustained engagement with the model? Rate of exposure to the model? The model’s simplicity or explanatory power? Further, how do mental models compete with other knowledge structures, such as long-term memory or image schema? It seems likely that mental models can accommodate a certain degree of complexity that other sites may not. For example, a mental model of cognition’s role in writing may be too complex to generate spontaneously at will, and instead will require multiple mediums, such as scholarly articles and scholarly minds, to simultaneously come to bear in order to reestablish complex, ephemeral models at their sites of display. These questions and observations point to the importance of continuing to theorizing about mental models while also collecting data on scholars’ actual experiences.

In addition to these key concepts, Bezemer and Kress also note that arrangement (which is circumscribed by genre and creates a “reading path” by which a user is expected to engage with the composition), foregrounding (which entails elevating certain rhetorical and representational features that the social environment has decided are salient), and social relations (the social positioning implicit in the composition by way of its structuring of relations, often between reader and author or between reader and content domain or discourse community) are also important mechanisms for multimodal meaning-making. In applying these three constructs to mental models, arrangement consists of the how the sign material is placed in the
representational space (for example, the flower that I had envisioned in my opening example in this chapter featured my view from above). In mental models, the reading path is the starting or initial focal point in the model, which channels the model’s subsequent actions as the thinker reasons through the problem. Foregrounding describes the representational elements that are vivid and central versus elements that are vague or recede from view. Lastly, social relations are figured in mental models just as they are figured in other multimodal spaces: indirectly. In mental models social relations can be inferred from the disciplinary nature of content domains, the origins of central metaphors, analogies, and images, as well as the dynamism that characterizes their active states. For example, the flower model I generated to represent an overlap-and-conquer approach to research demonstrates social relations by suggesting that researchers were working in isolated domains and that as a novice researcher, I did not consider myself part of this activity. Mental models contain these social relations implicitly; they provide evidence of their functioning within semiotic systems or “ensembles.” Together, the five key concepts (sign, medium, mode, frame, site of display) and the compositional features of arrangement, foregrounding, and social relations can serve as useful categories by which to evaluate scholars’ mental models as semiotic cognitive productions and to theorize on their role in disciplinary writing ecologies.

A semiotic multimodal approach has the capacity to remind us that language is not always as central to meaning-making as we might presume, whereas a simpler, discoursal...
approach, as Thibault has pointed out, has the potential to constrain our analysis by confining attention to language-like mechanisms in the environments under study. It was my experience as a researcher that when I used the term “discourse analysis” with myself, it functioned to structure my own mental model of data analysis and it occluded my thinking about other modalities in the ecology. Adopting the “semiotic multimodal analysis” approach helped me to avoid circumscribing my considerations to language-structured meaning-making only. A semiotic approach enabled me to be more receptive to the material and extra-linguistic elements of meaning-making that come to bear on the role of mental models in disciplinary writing ecologies. Nonetheless, several factors limited my research.

Because I studied cognitive phenomena, my analysis of mental models is marked by some immediate and obvious limitations: as a researcher, I can never know what scholars are actually “seeing” in their minds. However, many researchers argue that “direct observation” is still possible. According to Janssen et al. (1996), cognitive processes employed during writing may be studied either synchronously (during acts of writing and composing) or asynchronously (where cognitive data are gathered after writing or composing) (234). Further, each of these approaches can be used to either directly observe cognitive processes, such as when observing writers during talk-aloud protocols, or to indirectly observe cognitive processes, such as when a researcher makes inferences from the process a writer undertakes or from the final product. For

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98 The term provided me this enlarged conception because, like Lily, I constructed a mental model from encountering the discourse about it and then anchored the term to a mental model I constructed as I processed the discourse. Specifically, when I think of a semiotic analysis, I visualize a room with swirling “currents” (abstract forces construed with arrows like wind currents on a weather map), and my attention is drawn to the way in which the walls, the furniture, the books, and past and present conversations in the room all interrelate to construct a holistic “meaning” of that context. It occurs to me that if I had the technical ability to reconstruct this multimodal model, it could help others understand the idea of semiotic analysis as well. This educational implication is revisited in Chapter 5.

99 As Janssen et al. explain, “No method claims full directness. The step from observation to data will always require an induction. All methods are thus indirect, but some are more direct than others” (234).
example, according to Janssen et al.’s classification, when I interviewed participants immediately following a talk-aloud protocol where they had written or composed research, I was directly observing cognitive processes with a “retrospective protocol” that had “individuals reflect about their writing processes and explain why they made certain choices after they have finished (parts of) their text” (235). By eliciting thick descriptions from the scholarship, interviews, and talk-aloud protocols, I “reconstructed” participants’ mental models, then evaluated them with a multimodal semiotic approach. Given that most of us are generally unaware of using mental models, it was difficult to draw participants’ attention to their mental models during interviews, as they preferred to consider the ideas in, and the communicative aims of, their writing. In fact, as I described in Chapter 3, it was important that I not immediately ask participants directly to report on their mental models, but first ask them to describe central ideas in their scholarship and, once they had begun to recount these, ask them to then reflect on the cognitive phenomena. Also, the interviews were conducted well after each participant’s writing had been originally composed; given the lag between the original composing and the semi-structured interviews that asked about composing process, recall was a potential limitation. However, none of the scholars expressed difficulty remembering their work or the writing process at that time.

Another limitation to my semiotic multimodal approach relates to its scope, which is necessarily, and to some degree, artificially bounded and less exploratory than is ideal. As Donna Harroway cautions us,

> Boundaries are drawn by mapping practices; “objects” do not preexist as such. Objects are boundary projects. But boundaries shift from within; boundaries are very tricky. What boundaries provisionally contain remains generative, productive of meanings and bodies. Siting (sighting) boundaries is a risky practice. (595)
This observation highlights the fact that any research will necessarily suffer from the limitations of the researcher’s abilities to map the project. I found it particularly difficult to anticipate what might be included in an interrelated semiotic system that relies on an array of meaning-making resources. The result is that my speculations about disciplinary writing ecologies are necessarily limited. Particularly, at the outset of the project when I was less knowledgeable or aware of mental models, I could not fully imagine the semiotic landscape in which they function. This includes my ability to formulate research questions and to imagine the relevant “locations” to investigate answers. For example, I did not consider how each scholars’ writing spaces might contribute to the formation of intersemiotic meaning, though offices in institutional spaces could conceivably have significant impacts on structuring thinking and writing practices.100 The semiotic multimodal elements I did consider for a theory of mental models in disciplinary writing ecologies included influential scholarship, scholars’ mentors and other significant influences on their writing, the process of professional enculturation, the semiotic space of the mind, and the role of gesture in mental models’ circulation. I was able to consider the last in interview data, because when participants’ gestured as they explained what was happening in their minds, I would describe the gesture to them and ask them about its significance, and this description and their explanation was recorded, transcribed, coded, and used to inform the thick descriptions of mental models that were then analyzed with a semiotic multimodal approach. As a result of my experiences, I would recommend retaining an “emergent design flexibility” if

100 For example, an intersemiotic meaning produced by the combinatorial effect of institutionalized spaces and disciplinary discourses could be hierarchies of knowledge, such that teachers are regarded as knowing more than students, or, if administrators’ offices and desks are larger, perhaps the dominance of instrumentalist approaches to knowledge production, such as those in corporatized academic environments, are valued over knowledge production. However, multimodalities such as these are beyond the scope of my project at this exploratory stage.
possible, as the ability to redesign or adapt the data collection methods “as understanding deepens and as the evaluation unfolds” can significantly strengthen the research (Patton).

**Furthering a Critical Analysis of Mental Models in Writing Ecologies**

The approaches I have presented for future research on mental models in writing ecologies were largely recommended as ways to help researchers effectively analyze how mental models are cued in discourse and investigate the characteristics of mental models as cognitive representations (Bezemer and Kress’ semiotic approach with its categories of sign, mode, medium, and sites of display encourages an analysis of mental models in larger systems but still foregrounds the objects of investigation, i.e., mental models, in this case). However, I would also like to recommend an approach that might assist other researchers in conducting a more deliberate analysis of the role that mental models play in discourse ecologies, particularly their ideological function. Adele Clarke’s 2005 notion of “situational analysis” is a technique for examining complex contexts that extends Anselm Strauss’ “social world/arenas/negotiations” categories by enabling a researcher to produce three maps focusing on aspects of a specific context in order to more fully identify the significant components that give rise to it:

1. **Situational maps** that lay out the major human, nonhuman, discursive, and other elements in the research situation of inquiry and provoke analysis of relations among them;

2. **Social worlds/arenas maps** that lay out the collective actors, key nonhuman elements, and the arena(s) of commitment and discourse within which they are engaged in ongoing negotiations—meso-level interpretations of the situation; and

3. **Positional maps** that lay out the major positions taken, and *not* taken,
in the data vis-à-vis particular axes of difference, concern, and 
controversy around issues in the situation of inquiry. (xxii, emphases original)

Clarke’s situational analysis is ideal for generating grounded theory about “the social,”
especially for what Clarke calls “ecologies of knowledges.” Clark notes that since

The postmodern turn … all knowledges are understood by major segments of 
scholarly words and beyond as situated knowledges … produced and consumed 
by particular groups of people, historically and geographically locatable. Claims 
of universality are considered naive at best and much more commonly as 
hegemonic strategies seeking to silence/erase other perspectives. (xxv)

Further, Clarke recognizes the aggregate value of the numerous situation-based studies that 
explore who is and is not authorized to produce

“knowledges” about whom/what, and under what conditions …. [These situation-
based studies] have initiated a disruptive and truly stunning appreciation of the 
complexities and heterogeneities of our individual and collective situations, 
discourses, and the complexities and heterogeneities of our knowledge 
production.

Clark’s approach points to the significance of research that investigates local contexts and yields 
findings that are not “generalizable” but nonetheless provide critical insights into power 
dynamics and a regard for the multiplicity of human experience; the approach and the situated 
nature of the resulting insights enable researchers to avoid essentializing their participants and 
the contexts in which they function. This approach could be usefully employed in a research 
project to produce not only thick descriptions of and theories on mental models in disciplinary
writing ecologies but also ethnographically informed analyses of mental models in specific local ecologies. Clarke’s three categories provide prompts for researchers so that they produce thorough descriptions and subsequent analyses of the particular complex ecology/ecologies in which participants encountered and used mental models. When coupled with the critical lens that Fairclough and van Dijk’s CDA supplies, Clarke’s situational analysis can aid researchers in observing and theorizing about how mental models can carry ideological cargo that participates in constructing disciplinarity, while also maintaining a regard for producing not generalizable speculations that might apply universally, but rather observations that can add to an emerging conversation about the complexities and heterogeneities that come to bear in complex disciplinary writing ecologies, particularly for scholars and graduate students who must write and learn to write in order to gain admittance or maintain a membership in them. Given the central role that mental models play in disciplinary writing ecologies in structuring scholars’ thinking, both enabling and constraining it within disciplinary bounds, there are significant implications for learning and teaching writing. These are discussed briefly in Chapter 5, which argues that mental modeling is integral to developing literacies.

Because the methods I have recommended as potentially fruitful for analyzing the discoursal cues that prompt readers to produce mental models and the models as cognitive phenomena are somewhat complicated, I present a summary of each them in a separate table in the section that follows.

**Summary of Methods for Data Analysis**

One of the central aims with the data analysis is to establish thick descriptions of scholars’ mental models as cognitive phenomena so that these thick descriptions can then be
subjected to a distinct multimodal discourse analysis in which the mind is regarded as a semiotic space and mental models are investigated for discipline-specific ideologically-informed multimodal representations. The mental models themselves are representations that arise out of cognition; they are not directly observable but derived through the discourse analyses on the scholarship, interview data, and talk-aloud protocols, then considered through a multimodal approach in order to understand their place in the larger disciplinary writing ecology. These results can then be used to inform a theory of mental models in discourse ecologies as well as some approaches to deliberately employing mental models in learning and teaching writing, especially disciplinary enculturation. My project was exploratory and my research suggested several potential approaches to a more thorough analysis of the data; I summarize these approaches in two tables below. Table 1 contains recommendations for data analysis that can aid researchers in uncovering discoursal strategies that scholars use to cue mental models. Table 2 contains a summary of potential approaches by which to examine the actual mental models themselves, the cognitive representations embodied in the semiotic space of the mind.

The methods in these two tables provide approaches to analyzing data that can aid in addressing **the first three aims of this research project**: to elicit the nature of mental models from participants; to identify other potential knowledge structures’ roles in mental model-making and knowledge production; and to uncover the relationships between mental models and scholars’ representations of knowledge. Once I had addressed these questions, I used the results to address **the last two aims of the dissertation**: to locate and theorize mental models in larger disciplinary ecologies, particularly in English Studies, and to speculate on the implications for learning and teaching writing. These two aims can also be understood as requiring specific research methods, and these approaches are briefly described in Chapter 5.
Summary of Methods for Analyzing Discoursal Data on Cuing Mental Models

The methods listed in Table 1 were used to analyze participants’ discoursal data, including scholarship, interviews, and talk-aloud protocols, with the aim of generating thick descriptions of mental models and speculating about their relationship to scholarship. In future research, the data should also be evaluated in terms of the affordances and limitations inherent in the discoursal format in which it was delivered; in other words the scholarship, interview data, and talk-aloud protocol data should be considered in terms of how each format enables or constrains what scholars can communicate to researchers about their mental models. This is particularly important to the process of fully understanding the limitations of the data collection methods for research on mental models not structured as thought experiments but as descriptive case studies (see Bezemer and Kress’ five key categories to guide the analysis: sign, medium, mode, frame, and site of display). These approaches can also be used to investigate the role of intertextuality by tracing key cited sources (sources that relate to the main argument, are foundational to the argument, or are repeated at multiple points in the discourse) to examine the circulation of mental models via scholarly discourse.

<table>
<thead>
<tr>
<th>Knowledge Structure</th>
<th>Method/Aim</th>
<th>Coding Criteria for “Knowledge Structures” in Participants’ Scholarship</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td><strong>Schemas &amp; Scripts</strong></td>
<td>“Discourse Analysis”</td>
<td>Top-down/bottom-up (Anderson et al.); macro-, micro-, and superstructures (Van Dijk 1980); sequences &amp; narratives (Rummelhart)</td>
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<td>----------------------</td>
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</tr>
<tr>
<td><strong>Frames</strong></td>
<td>“Frame Analysis”</td>
<td>Point of view: defining problems, diagnosing causes, making moral judgments, suggesting remedies (Britton et al.); text as holistic, text occasioning, role analysis, author intent, discursive cues (Johnston); multimodal construction of frames (Kress and Leeuwan <em>Reading Images</em>);</td>
</tr>
<tr>
<td><strong>Mental Models</strong></td>
<td>“Mental models analysis”</td>
<td>Descriptions or depictions of purpose, architecture, state of, or functioning of a system (Rickheit and Sichelschmidt); language levels: constructs, propositions, and global meaning (Rickheit and Sichelschmidt); image schemas as dynamism of mental models (e.g., superimposing, cycling, etc.) (Johnson; Lakoff).</td>
</tr>
</tbody>
</table>

*Summary of Methods for Analyzing Mental Models as Cognitive Representations*
Table 2 summarizes methods for analyzing the discipline-specific mental models that participants constructed in their minds as they composed the scholarship we discussed. It is important to repeat the fact that there are major limitations to direct knowledge of cognitive processes and knowing with certainty (or relative degrees of clarity) what participants have produced in their mental interiors, particularly when inquiring retrospectively, as participants find it difficult to recall a type of phenomenon they are ordinarily unaccustomed to noticing. Most of us are also inexperienced at describing our own visual cognitive phenomena with specificity as well, and during the interviews, it is important that the researcher restates what participants describe in order to confirm understanding. While recall would seem to be an issue, none of the participants reported problems with recalling their thinking when they had composed their scholarship. However, recalling their modeling differed and was made more difficult as the participant revisited the model and described it. Sharing the thick descriptions with participants can also help verify their validity.

Table 2. Data Analysis for Participants’ Mental Models as Semiotic Cognitive Representations

<table>
<thead>
<tr>
<th>Cognitive Production</th>
<th>Method/Aim</th>
<th>Coding Criteria for Establishing Thick Descriptions of “Knowledge Structures” Related to Mental Modeling in Participants’ Minds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental Models</td>
<td>“Mental Models Analysis”</td>
<td>Descriptions or depictions of purpose, architecture, state of, or functioning of a system</td>
</tr>
</tbody>
</table>
**“Multimodal Analysis”**

(Rickheit and Sichelschmidt); language levels: constructs, propositions, and global meaning (Rickheit and Sichelschmidt); image schemas as dynamism of mental models (e.g., superimposing, cycling, etc.) (Johnson; Lakoff);

Multimodal discourse analysis (vectors, angles, colors, iconography, indexicality, etc.) (Kress and Van Leeuwan, *Reading Images*);

semiotic multimodal analysis (sign, mode, medium, frame, site of display, arrangement, foregrounding, social relations) (Bezemer and Kress)

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**Final Observations on Limitations**

This project was aimed at exploring the answers to questions about how mental models participate in disciplinary writing ecologies. Specifically, the study investigated the nature of mental models used to reason through scholars’ content domains and their textual and multimodal organization in English Studies scholarship, and it speculated about the role of mental models in instantiating disciplinary ecologies, as well as the implications for learning and
teaching writing. While previous research in cognitive psychology fields has tended to investigate mental models through highly structured thought experiments, this project was aimed at exploring scholars’ mental model use in “natural settings” within complex knowledge ecologies that rely on writing and, increasingly, multimodal discourse to circulate knowledge, values, and ideology, and to advance these academic communities’ aims. In order to address the research questions, I used a discoursal analysis approach on discourse-based data I collected through scholarship, semi-structured interviews, and a talk-aloud protocol. Toward that end, I considered four pieces of scholarship with an exploratory discoursal approach that was informed by previous research on mental models. To evaluate the mental models as cognitive phenomena (because I regarded the mind as a semiotic space functioning in a material and multimodal ecology), I used an exploratory semiotic approach that enabled me to regard the productions of the mind as part of a larger meaning-making system, which implied that mental models can be best understood by examining them contextually and situationally. However, because the work was exploratory and I was a novice researcher, there were several important limitations. Eliciting mental models, a phenomena of which we are largely unaware, takes practice and requires that an interviewer be familiar with the phenomena, ideally possessing both a heightened awareness of their own mental modeling, a thorough understanding of the nature of mental models through interdisciplinary research, and a familiarity with the context of study. My exploratory analysis enabled me to speculate on additional methods for data collection and data analysis that I could not explore within the constraints of the project. For example, in Chapter 5 I speculate about aspects of disciplinary ecologies that I could not verify through data collection. This presents a significant limitation to the project.
Also, it is important to remember that because there is no consensus on how these cognitive phenomena are defined, studies on knowledge structures can define them in markedly different ways, rendering them less able to inform other research and findings. This is especially true in writing studies fields that have yet to consider how knowledge structures participate in writing at the levels of detail I sought in this analysis. This nascency argues for the importance of research on cognition and writing to enlarge our understanding about the nature of knowledge structures prior to figuring them in situated studies or in larger semiotic ecologies. The tenuous and still-contested definitions of mental models, then, also lend limitations to my project.

Given that this research project was confined to a limited number of participants from a single institution, its value will arise out of what Yvonna Lincoln and Egon Guba call the “trustworthiness” of the research, which is dependent on the following characteristics:

- **Credibility:** Accuracy in describing the scope of the study, accomplished in this dissertation project by attempts toward an interdisciplinary review of the literature, a regard for the importance of defining constructs distinctly from one another, and reminders about the difficulties of eliciting descriptions of mental models from participants.

- **Transferability:** Ability of the findings to shed light on another context, achieved in this project by regarding mental models not simply as tools for organizing content around genres or for understanding assignments, as past research has done, but by regarding mental models as employed more broadly in problem spaces within which we reason.

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101 As I discussed in Chapter 1, cognitive theories of writing tend to depict cognitive processes at a meso- or meta-level, which means knowledge structures are often grouped them under one heading or at times, frames, scripts and schemes might be identified separately. However, generally mental models are not expressly identified; nor are their distinct, complex roles in cognitive processes for writing described.
This broader epistemic use of mental models enabled me to speculate in Chapter 5 on implications for others learning or teaching writing.

- **Dependability**: The researcher’s adherence to noticing and reporting on changes in the research approach as a project unfolds; this is demonstrated in my own admission that I was ill-prepared to ask questions that might have better elicited my participants’ mental phenomena and that I did not have the forethought to speculate on or investigate other semiotic modes of meaning-making in these disciplinary writing ecologies.

- **Confirmability**: The ability of another researcher to confirm the findings; I believe for this research this characteristic is highly dependent on how knowledge structures would be defined, and by sharing this concern with readers and being explicit about my own definitions, I have bolstered confirmability as much as is possible for the complex cognitive phenomena I considered.

Further, I focused efforts on the verification of the findings, because, “While strategies of trustworthiness may be useful in attempting to evaluate rigor, they do not in themselves ensure rigor” (Morse et al. 9). Verification strategies enable researchers to consider reliability and validity throughout the project rather than on completion. Ideally,

strategies for ensuring rigor must be built into the qualitative research process per se. These strategies include investigator responsiveness, methodological coherence, theoretical sampling and sampling adequacy, an active analytic stance, and saturation. These strategies, when used appropriately, force the researcher to correct both the direction of the analysis and the development of the study as necessary, thus ensuring reliability and validity of the completed project. (9)
The verification strategies I employed included having participants review my assertions to assure they were accurate and reflected what the participants themselves experienced, particularly with reconstructions of scholars’ mental models from discoursal data.\footnote{Though, as Morse et al. point out, assertions reviewed by participants out of context can at times result in weakening reliability and validity. In order to avoid this, I was careful to remind participants about my goals and aims of the study and to describe and define its central terms and made my work available if participants wanted to see the assertions I made about their mental models in context in order to evaluate them.} The verification process also included using a multi-method approach informed by several researcher’s observations about knowledge structures, and this allowed me to triangulate findings on the nature of mental models. I also produced thick descriptions of the context, including details about setting, participants, data collection protocols, and other interactions, and I included my critical stance as a researcher in order to enable readers to understand the potential biases that might affect data collection and analysis. As to the latter, my critical approach is particularly significant in structuring how I identify and interpret the ideological facets of mental models as well as their role in shaping disciplinarity. This is most important in Chapter 5 when I argue that scholars in English Studies disciplines should be aware of the competing ideological forces that get lodged in circulating mental models and ultimately have a role in shaping the epistemic practices that centrally define the disciplines.

I began this chapter by presenting exploratory discourse analyses of two pieces of scholarship with which I hoped my readers were familiar, so that I could impart the nature research approach and add support to some of the findings I present in Chapter 3. In order to underscore the significance of emerging new media on how we think, I also provided a third analysis of a hypothetical piece of scholarship in a new media format. I demonstrated how the multimodal representation of knowledge provided other affordances that can enable scholars to cue mental models in their readers quite differently. I asserted that a recursive relationship
between mental models and discoursal forms of knowledge representation, such as new media, means that new media will affect our mental modeling and our mental modeling will affect the way we employ new media. While I take up these ideas again in Chapter 5, the three exploratory analyses paved the way for me to share some potentially fruitful approaches to conducting a more structured analysis on both the discoursal strategies by which writers (scholars, in the context of this study) cue the production of mental models in their readers and mental models as cognitive representations participating in a semiotic system.

Chapter 5 begins to theorize how mental models participate in disciplinary writing ecologies. Here, I share some common characteristics of the models I encountered from participants in English Studies fields. I explore the potential function of generic mental models, how ideology is circulated through habits of mind, how the degree of a mental model’s complexity has implications for cognitive overload and affects its circulation through discoursal ecologies, how gesture functions to aid mental models’ circulation, the recursive relationship between the writing and representational technologies we employ and the mental models we produce, implications for disciplinary enculturation, and other topics. However, given the limitations of the dissertation, I can only briefly touch on these points, and I hope that they encourage others’ interest in exploring them more fully.
CHAPTER 5. MENTAL MODELS IN DISCIPLINARY WRITING ECOLOGIES

Some Basic Features of Mental Models in Writing and Knowing

Subcomponents and General Traits of Mental Models

Mental models have been researched extensively by cognitive psychologists who are frequently focused on understanding how mental models are employed in the sciences and also how we process discourse. My aims with this project were to extend research on the concept of mental models to English Studies disciplines, and I began the project particularly focused on how scholars in these fields reasoned through their scholarly problems’ spaces. I focused a great deal of effort on uncovering how scholars constructed mental models to reason through content domains and how these models were circulated among them to grapple with questions concerning the common objects of study in these fields (e.g., writers, language, text, the relationship between self and world, etc.) and to constitute disciplinarity. My project spanned several interdisciplinary domains, such as cognition and writing, theories of mind, theories of human ecologies, multimethod data collection and analysis, mental models and other knowledge structures, writing and disiplinarity, and multimodality and new media composing. Accomplishing this project’s goals was made more complicated by my inexperience with research. My original research aims led me in many instances to privilege my exploration of the mental modeling of disciplinary concepts, largely because this had not been considered before in writing studies fields as it had in the sciences. However, it has become increasingly clear over the course of the research that mental models as they relate to the processing and production of discourse (understood broadly and multimodally) is also central to my project. My project’s overarching goal was to speculate on how disciplinary habits of mind circulate through forms of
representation to instantiate disciplines that shape their members practices for producing knowledge. The literature on discourse processing and mental models must feature centrally to this goal for a couple of reasons: first, discourse itself is the object of study in the fields that fall within English Studies; discourse, in the form of scholarship, is used to study discourse, which involves cognitive processes that require consideration. Also, while generally discourse processing approaches are more likely to figure in communication studies or cognitive psychology fields, an eco-cognitive approach to writing and disciplinarity lends cognitive processes involved in knowledge production (e.g., discourse processing) a prominent role.

The production of scholarship is inextricably bound to the epistemic processes that scholars employ in their research. James Berlin summarizes the view that “Rhetoric exists not merely so that truth may be communicated: rhetoric exists so that truth may be discovered” (165). However, rhetoric and writing scholars applied the insight largely only to language and not to the expansive range of other possible forms of representation. In other words, most did not take a semiotic approach that would have enabled them to regard the resources for meaning-making more broadly, including, for example, institutional designs, hand gestures, modalities such as image and sound, or, as with my research, mental representations. There were exceptions, scholars who considered representation’s role in meaning-making broadly early on. For example, Janet Emig contemplates the role of representation more broadly in the “web of meaning” that enables learning; she draws from Piaget and Bruner the notion that there are “three major ways in which we represent and deal with actuality”: enactive, as in doing; iconic, as in “depiction in an image”; and representational, or symbolic, as when we restate in words

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103 Nietzsche has another take on the ability to find truth through language and I discuss that shortly, as has observations echo the challenges of representing phenomena in different modalities (i.e., the process of transduction) and the reality that these representations are never the objects themselves, a fact we often forget.
She observes that the three ways of “dealing with actuality” (i.e., of knowing) are simultaneously deployed in the act of writing (which may be more broadly and contemporarily understood as composing artifactual representations). However, she consigns the hand (or body) to the enactive mode, the eye to the iconic, and the brain to symbolic. While Emig admits this is “to overstate the matter,” my research suggests it is significantly reductionist to relegate to the visual all that is iconic and to the brain all that is symbolic, and to implicitly preclude from the body that which is symbolic (gesture, for instance, violates the latter premise). In contrast, a cognitive approach to meaning-making by way of the literature on discourse processing and production has enabled me to observe that mental representations involve embodied experiences, visualizations, and symbolic representations that may or may not be linguistic, and when these mental representations constitute “mental models” (because they are composed of dynamic systems’ properties and are operated by thinkers to aid them in reasoning), these mental representations are central to the task of learning. “Learning” is essentially a less formal conception of the idea of the “production of knowledge” that we have come to associate with the literature on academic discourse. Scholars use their writing and composing processes to learn, to produce knowledge, which they conceptualize formally as “scholarship.” Then they circulate this knowledge among others who produce related knowledge; rather, they share their knowledge with other learners whose interests are similar. In this roundabout way, we arrive at the idea of rhetoric as both cognitive and epistemic (Berlin 159-179). A discourse processing and production lens has also enabled me in this research project to understand the full extent of Emig’s assertion that “writing through its inherent reinforcing cycle involving the hand, eye, and brain marks a uniquely powerful multi-representational mode for learning” (126, emphasis
Mental models are central representational modes in scholarly learning, knowing, and the composing of knowledge.

Further, the research on mental models and discourse processing provides an important thread for understanding how scholars produce their scholarship. While my research has extensively considered how scholars mentally model the concepts that are central to their arguments, what are equally or perhaps more important to the production of knowledge are the “situation models” that scholars produce when they compose. Mental models enable knowing by allowing us to integrate what we have come to presume about the nature of the world through past encounters with our present encounter, and this process prevents us from having to scan all the elements of a situation and determine which are salient and deserve our attention. Situation models are a specific form of mental model which, according to van Dijk and Kintsch, enable us to process domain expertise, translate language into meaning, understand a situation simply by reading about it, and coordinate an understanding of a situation from multiple representations of it (e.g., integrating the information from a photograph with a verbal account to produce a singular understanding of a situation). Scholars use situation models to integrate what they know about their scholarly domains with the “situation” that unfolds in the text they are either reading or writing. Texts “produce” situations by cuing readers to model them, and there are several theories for explaining this (see Zwaan, Langston and Graesser; Zwaan and Radvasnky; and Zwaan). These theories attempt to account for how events are represented and accrete to form “situations” in a discourse processor’s mind. The theories also account for the ways by which old information is integrated into new, words activate experiences with referential representations, and sentences are integrated with each other to build representations of situations. The theory posits three distinct processes in constructing mental models of situations: activation through
stimulus, construal of referents, and the integration of construed referents into the emerging situation model. What is clear is that an account of mental models in disciplinary writing ecologies must include both discipline-specific mental models of concepts and concept domains and discipline-specific situation models that are instantiated through scholarship as it is either read or written. Both the “ways of figuring” and “ways of reading” are central to producing scholarship, and these shared practices participate in constituting the disciplines.\textsuperscript{104}

\textit{Mental Models’ Relationship to Other Knowledge Structures}

The research by Zwaan and Radvasnky in 1998 supports my own findings about the basic components of mental models. Researchers observe that the components of a mental model include a situational framework, the situational relations, and the situational content; these correspond to the subcomponents of mental models that I labeled as the objects figured in the model, the nature of their relationality, and the model’s overall dynamic. One of Lily’s models, for example, included the objects of self and world. Their relationality was represented by their form of proximity: the self was figured beside the space that figured the world rather than, for example, inside of the world, which indicated that Lily was figuring an agential self rather than one inseparable from, or a product of, the world in which it existed. The dynamic that characterizes the model’s functional qualities is one of recursivity. The arrangement of objects in a model such as Lily’s is meaningful and corresponds to Kress and van Leeuwan’s notion of design in multimodal compositions (1996). The model’s components and its arrangement are subject to change, as when a thinker calls features into question and modifies them through thought experiments to assess their impact. Further, my research suggests that the more

\textsuperscript{104} Links to Prior’s work in the 1998 text Writing/Disciplinarity is explored in the following section, where I speculate on additional implications for English Studies fields.
commonly explored knowledge structures (which are, like mental models, forms of representation that structure encounters with the world by ascribing to certain features greater salience and therefore more attention than other features) in tandem with mental models. Schemas, for example, are the more static typified objects that are relationally arranged in a mental model. Frames seem to be deployed before a mental model is constructed, and they impose limitations on what may be figured in the model, as well as the possible types of relationality and dynamism that may be applied to the objects (i.e., they are discipline-specific). Disciplinary scripts function as reflexive “checks” that trigger a review and evaluation of thinking generally, but they are also deployed to evaluate thinkers’ mental models, and scholars inherit specific scripts for this purpose through the process of disciplinary enculturation. For example, in a graduate program that centrally figures feminist approaches to writing studies, students are taught that scholars rigorously reassess their epistemic practices throughout the research in order to avoid anti-essentializing participants. In fact, the term “subject” is disallowed from research in this vein, favoring instead the use of “participants,” so that the discourse works in tandem with other encounters that students have to the discipline from the feminist “inlet” to writing studies. The result is that members of the discourse are equipped with reflexive habits of mind that they deploy to assess their thinking, including their mental models. However, to be clear, many of these scripts entail that the scholar check that they are employing the appropriate discipline-specific form of dynamism to their mental model of the target domain under study. Below, I list several discipline-specific habits of mind that can either constitute the dynamism of English scholars’ mental models or be featured in scripts as checks to ensure that the scholars’ mental models are rigorous and assure that discipline-specific standards for thinking about scholarly problem spaces have been maintained.
- **Accretion thinking**: A dynamism that considers that small phenomena can add up to significant effects.

- **Ecology thinking**: A dynamism that figures a set of objects’ impact on each other as systemic, one that updates its state and sustains itself (i.e., it depicts the target domain as functioning like a “natural” system.

- **Problematizing**: A script that calls on the scholar to critically question their mental model, including its objects, relationality, and dynamics.

- **Antiessentializing**: A script to assure the full consideration of the persons (and their personhood) under study rather than a reductionist or generalized regard.

- **Affect thinking**: A script to assure the inclusion of affect as an object in English Studies’ mental models; affect can also be an object or figure as a mode.

- **Spatializing/temporalizing**: Dynamisms that enable a mental model to unfold through the modalities of space or time (e.g., when the layout of the classroom is considered to impact the language learner’s adoption of particular literacies or when learners’ experiences beyond the classroom are factored).

- **Micro-macro thinking**: Dynamisms that link objects and their relationality across different hierarchical scales of organization (e.g., see Chapter 1 for a discussion of complexity theory).

- **Recursive thinking**: Dynamism associated with systems characterized by nested loops and updating states; could also figure as a check in scholars who situate their work in complexity or ecology theory.
• **Mediational thinking**: Dynamism that figures objects (or boundaries) between other objects but through which certain forces pass; these forces are frequently figured as transformed by the medium through which they pass.

• **Boundedness/boundary thinking**: A script that instructs scholars to assess the relationality between objects figured in their mental models in order to ascertain their scope, permeability, and distinction from other objects.

• **Subjectivizing**: Dynamism that places the researcher within the mental model of the scholarly “problem space” because the researcher is presumed inseparable from the research context (i.e., part of the target domain; also serves as a script to assure the researcher carries out the dynamism).

• **Localizing**: A script designed to cue researchers to explore “situated” phenomena and to eschew an approach to modeling phenomena in order to produce generalizable “knowledge.”

• **Open thinking**: A script that provokes researchers to consider their knowledge production not as private intellectual property, but as a socially constructed and distributed public good.

• **Historicizing**: A script that arises from a historical frame (much as anti-essentializing arises from a feminist frame) to cue researchers to model phenomena in relation to their past. It enables researchers to figure objects in mental models as products of their unique sociohistoric trajectories. It also serves as a form of dynamism by enabling forward projections and backward speculations or “unravelings.”
This list represents only some of the discipline-specific habits of mind that I encountered during this research project, and there are no doubt others circulating to both reflect and construct the present sociohistoric moment in English Studies.105 Many of these habits of mind can be traced to the prevalence of systems thinking across academic disciplines, which has led to the recognition of, and interest in, the complexity of human behavior and its organization, topics with which English Studies scholars grapple through the production of knowledge and scholarship.

Importantly, this research revealed the difficulty of maintaining a separation between the discoursal tools and the cognitive phenomena both in terms of studying mental models and in becoming aware of them as phenomena that are separate from their discoursal representations. Lakoff and Johnson confront this task in *The Metaphors We Live By*, which investigates and describes the rich uses of metaphor in discourse. However, these discoursal practices are not to be confused with the mental models that speakers and writers construct in the space of the mind. My project suggests that metaphors are part of an array of external tools from which thinkers can choose in order to inform their thinking, but that mental models are generally far more complex than the metaphors that inform them. For example, in Chapter 4 I noted the common metaphor of the conduit for the idea of communication. The conduit metaphor is in its simplest form characterized by a pathway that facilitates the travel of an object from one place to another, and

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105 For example, in 2010 in *Feminist Rhetorical Practices: New Horizons for Rhetoric, Composition, and Literacy Studies*, Jacqueline Jones Royster and Gesa Kirsch proposed “critical imagination” as an epistemic practice wherein the researcher can come to know the deceased historical persons they study through critically imagining them. This proposal can also be regarded as an argument that our capacity to mentally modeling the historical subject through the process of empathy and imagination is a legitimate method by which we can derive knowledge about others. As the examples from Bartholomae and Bizzell demonstrate in Chapter 4, much disciplinary discourse is dedicated to getting a discipline’s members to refigure their mental models and the habits of mind by which these models are constructed. There is much at stake in this type of scholarship, which strives toward and contributes to defining a discipline.
it suggests a relative ease of travel and a pathway dedicated to, or purposed for, the specific “traffic” it carries. However, the conduit model can be applied to the idea of language. In *Writing/Disciplinarity*, Prior reviews structuralist notions of communication that have characterized previous scholars’ work, explaining that when employing a conduit model of communication, a researcher presumes that a sender “puts thoughts into word containers. These word-thought objects are then transferred from the speaker’s mind through a conduit (the air) to the mind of a listener” (17). His discourse cues in me a very specific idiosyncratic mental model endowed with detail and dynamism that the metaphor on its own simply does not possess. In my mental model, “word” is an object that takes the form of a canister that bank tellers use for drive-through customers: someone inserts meaning into the “word canister” through a hinged compartment and then places this message into a tube through which it roughly travels to a recipient. My mental model far exceeds the metaphor: its hinged compartment signifies I conceive of the word as structure that has the potential to contain meaning but is otherwise and inert until an agential meaning-maker opens a narrow door to endow it with a context-specific goal-oriented meaning. The narrow chamber along which the message travels indicates that I presume the process is not without impediments, but one where the message must make it past the twists and turns between sender and receiver. My mental model includes sound to emphasize this resistance in the channels of communication: I can hear the initial whoosh of the canister and its subsequent bumps along the channel, just as I have heard many times in line at the bank as tellers assist customers in their cars.\(^{106}\) My mental model also suggests the assumption that this communicative process requires a propulsive force behind it in order to “go the distance”

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\(^{106}\) This is yet another instance where technology has a formative role in shaping mental models, i.e., the technology itself figures as an available resource for meaning-making. This was a common theme in my exchanges with participants.
between sender and receiver. It also includes the assumption that messages are “valuable” (like the forms of currency exchanged between bank tellers and customers). That the receiver is figured as a “customer” whom the message-sender serves suggests I endow the role of sender with the responsibility to provide value in the meaning-making exchange. That customers are poised to receive these “word canisters,” extract meaning from them, and then “drive off” suggests that I see audiences as somewhat anonymous and fleeting and their future courses as generally unknown to me. This description of my mental model clearly demonstrates that the conduit metaphor, the discourse used by Prior to describe it, and the resulting mental model I constructed from his discoursal cues are three different phenomena. Discoural respresentations, then, must be regarded as distinct from the cognitive phenomena they describe; the difficulty is that the cognitive phenomena they describe (i.e., mental models) is also a form of representation.

Nietzsche confronted this same difficulty when he considered language in relation to truth and knowledge. In his essay “On Truth and Lies in a Nonmoral Sense,” he argues that the user of discourse “only designates the relations of things to men” (qtd. Bizzell and Herzberg 1173). He traces this process of meaning-making and representation, recognizing the primacy of mental representations.\footnote{\textsuperscript{107} However, mental representations cannot be presumed as a priori to discoural representations, since writing itself (and any other semiotic system) often gives rise to mental models as thinkers rely on artifacts as ways to “extend mind.”}

\[\text{To begin with, a nerve stimulus is transferred into an image; first, metaphor. The image, in turn, is imitated in sound: second metaphor. And each time there is a complete overleaping of one sphere, right into the middle of an entirely new and different one. (1173)}\]
In order to convey the representational quality of each of these as distinct from the object it is intended to represent, Nietzsche asks readers to imagine Chladni’s famous “sound figures,” drawings of vibrating regions on surfaces, such as the backs of guitars, demarcated from those that do not vibrate during when struck and whether a deaf person who encounters such drawings can be said to “understand” sound (1174). This same tenuous relationship characterizes the relationship between words (and other discoursal constructions) and the phenomena they are presumed to accurately represent. In essence, Nietzsche has identified the complicated process of “transduction,” the translation between representational modalities, with which Bezemer and Kress concern themselves, and he recognized that each mode of representation is characterized by unique constraints that preclude us from ever representing any phenomena fully. This, in Nietzsche’s view, renders all discourse untrue, though most take the distinction between representation and reality for granted. This implies that a theory of “mind” as semiotic necessarily considers mental representations as originary lies.

Despite Nietzsche’s observation that most of us take for granted the distinction between reality and the ways in which we represent it, in my interviews, participants demonstrated the capacity to become increasingly aware of their mental models as forms of representation the longer they reflected on them. In fact, as we discussed participants’ mental models, they reported that additional features came into view and that they could not be sure whether these features were present prior to attending them or whether discussing the model led to its extension and development.\textsuperscript{108} This suggests the act of attending is a compositional act, as increased awareness was experienced as, or equated with, the mental model’s development; this relationship between

\textsuperscript{108} Literature on mental processes designates some as characterized by automaticity or control and others by whether they are implicit or explicit to the thinker (see Gawronksi and Creighton).
attention and composition lends “attention” not just the structurating role that researchers argue is the function of deployed knowledge structures, but also a creative one, as my participants’ reported that their mental models (and perhaps the target domain that these models are used to interpret) became increasingly fleshed out and detailed—not because they intentionally added features to them but rather because they increasingly recognized the features. In other words, there was no distinction between paying attention to and composing mental models. Given this, it seems likely that, for the most part, these English Studies scholars’ mental models fall into the category of automatic mental processes.

The other binary by which the field of cognitive science classifies mental processes is by whether they are implicit or explicit. This impacts whether a knowledge structure can be employed deliberately or must be surrendered to the mysteries of the “black box” of cognition. A mental model can be considered implicit if the thinker is unaware of it or explicit if the thinker is conscious of its presence. Further, mental models can move from their implicit status to explicit, as when my participants were asked to reflect on and describe their mental models to me and then became aware of them, or from explicit to implicit status, as when an expert no longer needs to attend to processes and these processes become implicit (Speelman 2013). As Craig Speelman describes, “Some forms of expertise are implicit because they involve knowledge that has been compiled. The original explicit form is inaccessible to introspection” (144). An alternative explanation (or perhaps one that applies in alternate situations) is that this type of expertise is represented in forms that “may be incompatible with verbalization in much the same way as it is not possible to extract information from a compact disc player to extract information from a

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109 Coupling “attention” with “composing” this way in the process of constructing mental representation suggests that it may have a similar overlooked function in writing, as well.
vinyl record” (144). These characteristics have implications for the degree to which scholars can examine their own mental models and then articulate their nature and their use to others, who might subsequently take them up as tools to aid in discipline-specific reasoning tasks associated with producing knowledge in the form of scholarship. Further, these characteristics have implications for whether mental modellng can be usefully employed as a component of reasoning-based “literacies” in English Studies fields, and whether scholars can make deliberate and explicit use of mental models and modeling in the process of enculturating and professionalizing new members. It would seem that since, as Speelman observes, some forms of expertise undergo a change their status from implicit to explicit, it is likely that scholars in English Studies fields can be encouraged to make more deliberate use of their mental modeling in their scholarly knowledge production. As David Russell has noted with language-based academic discourses, the stock tools with which we have the greatest facility often seem transparent and go unnoticed (10). It is possible to turn our attention back to the representational tools that we have come to take for granted, in order to gain an awareness of how they function to both enable and constrain our epistemic processes, and it is possible to share this understanding with those with whom we most hope will critically evaluate the English Studies disciplines.

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110 Further, it points to the value of using representational modes other than discourse to express mental phenomena. Later in this chapter I discuss, for example, the benefits of including drawing (both by hand and increasingly accessible software applications) to elicit mental models and to help writers think as they compose. 111 The widespread popularity of Botler and Grusin’s treatment of remediation evidences scholarly recognition of the structuring role of representation in various media. It also suggests that this burgeoning awareness could be turned toward our own transparent cognitive processes as well. 112 Shortly, I discuss critical reflection more thoroughly, tying it to both novelty and disciplinary innovation as well as identifying the ideological underpinnings of mental models.
Multimodal Nature of Disciplinary Writing Ecologies

An Eco-Cognitive Perspective on English Studies Fields in Institutional Settings

At the heart of how mental models participate in disciplinary writing ecologies is the process by which representational forms cue readers to produce mental models that reflect the scholar’s own. The uptake and circulation of mental models participates in constructing disciplines with shared habits of mind. It might seem obvious to conclude that what gives rise to disciplinarity is a shared perspective. However, such views on the disciplinary objects of study specific to each field arise from the structuring force of shared habits of mind. Because mental models are structurating, shared disciplinary perspectives are in essence common conceptions of the “state of affairs” for certain disciplinary objects of attention. For example, it is likely that the field of composition tends to circulate models of students who, when exposed to educational contexts, grow in largely progressive rather than regressive directions, a humanist model that is similar to the one Lily had and likely has disciplinary origins with Dewey. However, it is possible to imagine a field that does not model students’ growth as humanist-informed self-actualization but as economic progress. The latter model is not as commonly circulated in English Studies fields, but appears commonly in business-related disciplines, where students are regarded as informed customers. In English Studies fields, the commonly circulated mental model for the object of study (in this case, “student”) will affect the way in which researchers in these disciplines study the object. For example, models of student growth as multidirectional, positive, and idiosyncratic are likely to affect classroom studies of students, prompting scholars to perhaps see growth where there is little or none, or to overlook patterns in students’ learning.

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113 This function is described more fully in the section exploring the intersections between genres and mental models.
or efficiencies from regularized teaching approaches. In this way, mental models circumscribe disciplines, and what it is possible to know within a discipline.

The Multimodal Nature of Mental Models and How They Participate in Multimodal Composing and Scholarship

The findings from this research suggest that the modalities available to represent dynamic systems differ between the semiotic space of the mind and the external spaces of representation, such as print-based or digital media. For example, participants did not experience affect solely as a response to the scholarly “problems” they were working through, but also included affect as a modality in their modelling of those problems. In contrast, when affect is employed in external media, it does not figure as a modality, as a “resource for making meaning,” in Bezemer and Kress’ words. Instead, when affect occurs in representational media outside the body, it must be figured by others’ modalities (e.g., a text can describe the pre-verbal forms of energy that, for example, a student feels before setting down to draft a paper; a video can depict this same affective state by featuring facial expressions and contextual cues to suggest a student readying to write a paper; or a multimodal composition can include an emoticon arranged with a set of words, perhaps in a font that suggests anxiety by breaking apart). My research also suggests that movement, or mental gesture, is an embodied modality that composers of mental models employ to represent forms of relationality. For example, participants frequently reported the

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114 The boundaries of the body and mind are subject to debate, and this assertion invokes the notion of “mediation,” or, in Galloway’s conception of it, the “interface effect.” These intermediaries complicate a theory of discourse ecologies because they are often experienced not as mediational but as extensions of the interpreter. This idea is taken up again in the discussion about the relationship between mental models and representational technologies.

115 This assertion is predicated on the idea that affect does not reside in, for example, words and symbols. However, the nature of affect and its transmission is still highly debated (see for example Teresa Brennan’s The Transmission of Affect).
embodied sense of mental movement when manipulating abstractions, such as the placement of
the ailing homosexual couple into the national imaginary through the mechanism of
sentimentality that Blake experienced in his mental model of the changing regard for gay couples
during the 1980s and ‘90s. Movement is of course also frequently employed in multimodal
compositions in external media to suggest particular meanings, but these forms of media do
not typically afford the same embodied, subjective experience of movement, which means the
two forms should be considered distinct modalities. External media that offer the affordance
of movement (e.g., digital media, but not print media) generally rely on the visual mode to
represent it. In the medium of the mind, thinkers experience an embodied sense of movement
during mental model production, while in external media, representations of movement
frequently stand in to convey the actuality of movement. The variances and distinctions in how
this particular modality is figured and employed across media bear further study.

Additionally, my research suggests that abstractions themselves seem to be a distinct
modality; they are not necessarily visual, so they do not constitute mental images (though they
can at times be accompanied by them). Rudolph Arnheim attributes these abstractions to the
category of images which have been so abstracted from their context as to be non-mimetic (151).
He believes mental conceptions of abstractions, including theoretical concepts, mostly arise out
of associations that may or may not be conscious, and that they come to be represented by those

116 For example, one might imagine the word “fat” depicted with bulging letters and taking up the screen is then
reduced and moved to one of its corner, receding into the background; through this movement a viewer could
interpret the composition to mean that a person who feels physically big is ironically made to feel “small” socially.
117 It is possible to incorporate bodily-felt movement in new media. For example, Wii gaming systems employ a
gamer’s bodily movements to navigate the virtual space of the game and Xbox employs vibration in its remotes,
such that the vibration is a modality through which feedback and other signals are “repackaged” and provided to
gamers as they navigate the space. This repackaging from one mode to another is what Bezemer and Kress call
transduction, and it is a crucial consideration of how different representational tools “interface” with each other.
The concept deserves further consideration from the perspective of mediation and remediation.
experiences or objects that have a structural correspondence to them. However, my exchanges with participants suggest that abstract ideas are not limited to representations in image form, but are experienced by thinkers as a distinct modality. Participants described their experience of abstractions as the sense of an aggregate but featureless mass, which may or may not be characterized as possessing independent agency, and this mass functions as a manipulatable token in the model.

Other modalities that surfaced in my research include agency, causality, and even speech. With the latter, Jillian had employed speaking as a way to represent relational dynamics between elements of her models, and the modality functioned in part by endowing elements to engage in a dialogic relationality with other elements; it allowed her to model a provisional “state of affairs” wherein another factor might “renegotiate” its status and change the system at any point. Some of the modalities that the semiotic space of the mind have in common with other external media include image, text, spatiality, time, and modes of movement. The medium of mind affords a three-dimensionality to space that compares to the affordances of new media when it is employed to convey dimensional space (e.g., video is flat when it appears on a screen but nonetheless gives the impression of depth; also, visual arrangements are frequently designed to suggest depth via the technique of foreshortening). The similarities and differences in affordances are significant for understanding the nature of the relationship between mental models and other representational media operating in discourse ecologies, and my research has enabled me to begin to speculate on them, as well as their implications. However, a fuller investigation requires an extensive synthesis between what cognitive psychologists understand about mental representation and what new media scholars, such as Lev Manovich and Jay Bolter, have begun to recognize about how representational spaces engender “virtual” experiences. This
entails not just understanding the techniques and affordances of new media but must include the other half of the equation: understanding the way in which new media are cognitively processed by those who encounter them. While many of these cognitive responses fall under the umbrella of visual processing, we know that there is a great deal of overlap between visual and discourse processing. Firstly, because text is ultimately a graphical system, it has always been a form of visual processing at some level. But secondly, there is overlap between visual processing and discourse processing because text is so often figured in multimodal compositions.\textsuperscript{118} These factors mean that writing studies researchers who understand cognition and “writing” (and cognition and “reading”)\textsuperscript{119} have much to contribute to knowledge about people encounter multimodal compositions. Further, a semiotic approach to these issues can help writing studies researchers better understand how it is that these multimodal meaning constructions, whether they are representing meaning in the mind (e.g., mental models), virtual spaces (e.g., new media compositions), or institutional sites (e.g., offices and classrooms), come to work in tandem as resources for the complex ecology of meaning-making. This semiotic approach is particularly important in researching the production of disciplinary knowledge, as it occurs through disciplinary discourse communities that are situated in academic institutions, and research on knowledge production must consider how this institutional situating effects discipline-specific

\textsuperscript{118} The study of models’ mental representation and their representation multimodality through, for example, new media stands to draw much from research on human attention patterns, which constrain discoursal processing. For example, attention needs to be selectively deployed to certain facets of an object of attention; this “spatial allocation of attention” that occurs during a visual search can be \textit{serial}, as when each element is examined after another, or \textit{parallel}, as when elements in an environment are registered simultaneously (Smilek and Frischen 314-315). Further, attention can be manipulated through \textit{priming}, which suggests that designing persuasive multimodal compositions involves orchestrating the way a reader encounters and attends to them.

\textsuperscript{119} As I have mentioned previously, these terms aren’t entirely accurate for how we encounter forms of discourse other than text. I use the terms here to suggest that writing studies fields have a body of scholarship on cognition and writing that nonetheless usefully informs how we encounter and construct multimodal compositions. Also, see the argument that how reading and writing “go together” and should not be considered separate fields of study in the section that discusses a pedagogy for mental models.
habits of mind and the scholarship produced. The mental models circulated through a discipline construct its disciplinarity by providing a community of scholars with their foundational epistemic practices. Shared mental models function as structures for integrating what scholars observe in the “world of study” with what they already know from previous encounters with it then produce representations of resultant knowledge in their scholarship. However, there appear to be limitations to our ability to generate increasingly complex explanations of the world of study, as there is likely a threshold for diminishing returns on mental models that are overly complex. For example, cognitive models of writing are frequently critiqued for what they leave out, yet it is extremely difficult to mentally “run” these models, operating all their facets at once, when we encounter them as discoursal constructions. It becomes difficult to sustain complete and working models of increasingly complex dynamics in the mind. The tendency to experience cognitive overload in constructing complex models has important implications in disciplinary writing ecologies. Most obviously, it underscores again the important observation that representational technologies enable us to extend our thinking. Also, if accreting facts and details to an existing body of knowledge constitutes progress in “normal science,” as Kuhn suggests in 1962, what constitutes the progress narrative(s) in the social science and humanities disciplines that fall within English Studies? Increasingly complex models rely on the technologies of representation for their sustainment because scholars cannot represent these models in their heads without cues prompting their construction. My research suggests that participants did not draw their mental models out of long-term memory, but constructed them in the moment as they re-engaged with the ideas that circulated through the discourse we co-produced during the interviews. This is not to say that models do not contain objects called forth from memory, but that participants’ mental models were brought into being through the discussion. This semi-
permanent “stable for now” nature of mental models is an important factor in how they function in disciplinary writing ecologies. Compared to genres, mental models’ structurational roles are short-lived.120 This means that each time a scholar wishes to cue a reader or listener to construct a particular mental model, the discourse must re-establish the model’s characteristics, including token objects, their relationality, and the model’s dynamism, in order to provoke the audience to re-create the model with a significant level of detail.

To avoid cognitive overload, the research suggests people construct summary tokens, not just of the objects that compose their mental models, but often of mental models themselves.121 Discoursal cues can trigger audiences to activate mental models at this summary level, as when, for example, Lily modeled affect, not in its complicated dynamic between “self and other” or “self and world,” but as the image of Alice in Wonderland. This image served as “shorthand” for the model in its entirety. Re-instantiating full models requires that authors use discoursal cues to help their audiences unpack summary tokens.122 Unpacking these models requires providing readers with enough cues to enable them to engage the model’s dynamics and objects more fully. Scholars must implicitly or explicitly contemplate to what degree of detail and complexity they want their audiences to construct mental models, as the cognitive effort to do so can either complement or compete with the scholars’ ultimate communicative aims. Those who have

120 Genres bear remarkable similarities to mental models in terms of their structurational roles: they both serve as cognitive and representational “pointers” to those elements that should be considered salient in a particular context, whether textual or physical; their socially constructed nature and malleability. I explore this idea shortly.
121 These tokens representing models can be figured as objects in other models as well, as when, for example, a scholar mentally models how various models in a discipline interact or compete.
122 My mental modeling for the process by which an author uses discoursal cues to help a reader unpack their own summary token for a mental model is to visualize a popular children’s toy: a pill-like capsule contains a colorful mass (red, for me) and when water is poured over it, the capsule breaks open and a sponge burgeons into a fully-formed recognizable shape, such as a dinosaur. By becoming increasingly aware of visualizations like this, I might add to the stock of potential ways to communicate meaning, particularly multimodally, but also by writing more figuratively and descriptively.
attempted to “run” in their heads any of the complex cognitive models of writing appearing in
the writing studies literature can attest to the difficulty of sustaining complex models in the
mind; as a reader, it is often tempting to respond to this cognitive overload by simply ceasing
efforts to process the discourse there and redirecting these efforts to other text passages (or
graphics, etc.) with the hopes of regaining a mental footing elsewhere. Scholars who want to
persuade their audiences to take up their models, complex or otherwise, need to present cues in
ways that do not overload their particular audience’s capacities (just as Jillian did not
overcomplicate her model of researcher-teacher identity by presenting their merger in complex
ways, but simply as two distinct yet connected halves). Doing so requires understanding
potential cognitive limitations, which are not merely derived from an audience’s experience and
abilities (e.g., literacies for reasoning in particular fashions), but are also situational.123

Some scholars seek to advance more complex explanations of phenomena in their
disciplines, perhaps because they regard the accretion of explanatory factors and variables as
disciplinary progress, or perhaps not. Examples from writing studies fields include scholars who
advocate the continued study of cognitive processes in writing and composing in order to
account for additional factors in writing and revising; also, generally scholars who employ
ecology lenses to investigate the intersections between individuals and their environments to
account for both micro, macro, or meso levels of these ecologies generally present increasingly
complex models of them (admittedly, my research aims fall into both these categories). Authors
advancing increasingly complex models must understand, at least implicitly, how and when to

123 These situations can be characterized by, for example, the site of display, which may not induce extensive
deliberations with certain models (e.g., conference presentations or abstracts of scholarship that audience’s might
process in order to decide whether to read a piece of scholarship more thoroughly) or an audience’s intentions
(some readers direct their attention to a piece of scholarship’s conclusions, implications, or “take-aways,”
preferring for numerous possible reasons not to reproduce the cognitive steps by which the author arrives at their
final “state of affairs.”
deploy complexity versus simplicity, and when it is best to unpack certain tokens for readers in order to cue them to activate operational models.\textsuperscript{124} Re-instantiating a familiar mental model in a reader’s mind may help a scholar share their own mental model if it is extended from or predicated on another. Simply knowing whether an audience is familiar or not with a widely circulated disciplinary model is not enough to determine whether it should be explicated; an understanding of the audience’s cognitive processes and their ability to re-activate salient components and dynamics from the model are equally important (i.e., how they will produce a situation model as they encounter with the discourse). On the other hand, a writer may decide that it is not necessary to ask a reader to deploy valuable and limited cognitive resources to reconstruct familiar mental models, particularly if the discoursal cue is intended to contextualize a scholarly argument rather than as an aid to reasoning through the scholar’s own model.

Considering how complexity affects mental models also entails raising the question, from where is increasing complexity in mental models in English Studies derived? Answering this question fully requires studying scholarly publishing patterns broadly, in the manner in which Charles Bazerman has studied publishing in the sciences. However, it might be possible to speculate on the significance and function of complexity by examining the most prevalent forms mental models take in English Studies fields. Contemporary research practices in English Studies fields (for example, ethnographically informed research) have increasingly privileged situated investigations of local contexts, and rather than aim to generalize, these studies maintain the

\textsuperscript{124} For example, cuing a full model of a concept like Burke’s terministic screens might entail helping the reader recall that Burke had bifurcated the understanding of discourse to include the “scientistic” and the “dramatistic” approach. The distinction might be contextually relevant to the scholars’ argument, as for example, in discussions about academic disciplines that rely on the scientistic approach. There may be occasions where helping a reader figure a fuller model enables the author to more fully engage with the author’s own communicative aims, including sharing a model that extends from or is predicated on another model.
idiosyncrasy of the local and find their value in adding to the ongoing “conversation.”

This epistemic approach requires vigilant situated self-reflection, with constant interrogation of factors such as researchers’ own positionality, motivations, emotional responses, power dynamics between researchers and participants, divisions of labor in the research process, and material and historical factors (Sullivan and Porter). The situated knowledge that results is complex and nuanced, and representing it entails portraying the idiosyncratic nature of the local. When a scholar represents this form of situated knowledge, they must effectively must construct discoursal cues that prompt readers to construct situation models similar to those of the author(s). Producing situated knowledge is complex; sharing that complex knowledge involves creating cues that provoke readers to construct highly complex situation models that align with the authors’ own. This increased complexity is generally regarded in English Studies as a valuable turn, adding to what we know about individuals, language, and society, but are there disciplinary implications from the increasingly complex situation models that scholarly writers orchestrate for their readers through discourse? Further, are there pragmatic limits to sharing situated scholarly knowledge? It seems that multimodal composing might offer scholars ways to represent situational knowledge that traditional print-based scholarship does not, via, for example, videotaping participants and contexts.

My research also suggests that when scholars are encouraged to examine their mental models more closely, not only do these models become more vivid and fleshed out with detail

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125 Conversation as a model of the dialogic nature of disciplinary progress seems to be characteristic of English Studies disciplines and contrasts with agonist models of disciplinary progress, which regard growth in the field as the displacement of old ways of thinking by new ones. Geisler’s research suggests that scholars in philosophy do not subscribe to this model, and this supports the notion that mental models are discipline-specific.

126 This type of research often entails negotiated representations, because the scholars have invited participants to participate in composing the scholarship. Research on mental models suggests that “teams” can collaborate to actively construct the mental models they share (see for example, Mathieu et al. and Pata and Sarapuu). The implication is that it is possible to co-construct situation models in collaborative writing. This collaborative sense-making through mental models’ construction can also play an important role in classroom learning.
than before, but this heightened awareness seems to facilitate scholars’ critical regard for their own working assumptions. These potential avenues for extending or revising their original conceptions resulted from the process of reflecting on the implications of their model’s components and arrangements, positing alternative constructions, and considering what these alternatives afforded differently in terms of their explanatory function. Each participant seemed engaged by the process of considering modified models and their implications, and perhaps English Studies scholars might discover that find this form of critical reflection fruitfully extends their scholarship. Research in other sciences, which have considered mental models in ways that English Studies disciplines have not yet, confirm that the ability to heighten one’s awareness of mental modelling and the ability to critical reflect on their construction are capacities that can be extended. Specifically, experts’ mental models differ from those of novices (see Genter and Stevens; Hmelo-Silver and Pfeffer) and children’s mental modeling abilities can be extended through particular curricular approaches (see Vosniadou and Brewer; Lehrer and Schauble). Perhaps English Studies scholars can also extend their mental modeling abilities in ways that enable them to produce novel or creative insights and to spur disciplinary innovation.

Thinking about Writing in English Studies Disciplines

Nancy Nersessian has linked innovative thinking in the sciences to modified mental models, and these changes to models take two forms: kinematic and dynamic (motions and causes). For example, the concept of writing has been re-modeled kinematically by displacing the assumption that it involves a mark upon a semi-durable surface. Writing models have also

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127 Blake had expressed an interest in how certain words, such as “undergird,” framed his argument, and he indicated he would revisit these in his revision process; Jillian felt that she would consider more fully alternate models for the teacher-researcher, such as when these halves are fused rather than joined, and explore the potential implications for this conception; Lily was encouraged to extend her model of the self-world relationship and consider whether multiple selves might construct a singular situationally defined identity (e.g., a group of students in a course) and co-encounter the world.
been revised dynamically by removing the assumption that all writing is intentional. While the term “writing” remains, the mental modeling of this target domain has changed dramatically from modifications to both its kinematic and dynamic features. One might wonder when the field will outgrow the use of the term and simply replace it, for example, with “multimodal composing.” However, the term “writing” is of course central to English Studies fields (which owe their name to one written language, even while their disciplinary domains span well beyond the English language); supplanting so central a term risks dissolving disciplinary cohesion and the sense that one’s work will retain its relevance to these particular disciplinary affiliations. That academic disciplines’ boundaries and boundedness is constructed by privileging language as a demarcating tool is not new terrain (see Fuller; Giesler; Prior 1998; Bazerman). However, the role of mental models in disciplinarity is less well explored, particularly in English Studies fields.128

Further, the disciplinary boundaries established through terms and terminology have important material implications: they “provide the structure needed for a variety of functions, ranging from the allocation of cognitive authority and material resources to the establishment of reliable access to some extra-social reality” (Fuller 126). Steve Fuller contends that disciplines in fact tend to subvert their own definitions, “show[ing] their long term lack of discipline” (127). Fuller’s observations underscore the fact that at the level of the disciplinary ecology, epistemic practices, including shared mental models, and the established “target domains” onto which they are deployed and from which scholars produce scholarship, are only “stable for now.” This stabilizing function undergirds a disciplinary community’s desire to be seen as a significant at at

128 The study of disciplinary boundaries can be traced to the philosophers of science Karl Popper and Rudolph Carnap, who concerned themselves with determining the “demarcation criteria” that would separate the sciences from the non-sciences and pseudosciences (Fuller 126).
the level of the disciplinary ecology, epistemic practices, including shared mental models, and
the established “target domains” onto which they are deployed and from which scholars produce
scholarship, are onever, this tendency toward epistemic cohesion is strained by the pressure to
innovate, and innovation is critical for sustaining the supply of material and social resources;
while innovation provides new cognitive resources (in the form of alternative mental models, for
example), the dynamic provokes interdisciplinary and cross-disciplinary scholarship that
threatens to erode traditional boundaries.

It has been noted that academic disciplines tend to maintain the same boundaries as their
institutional departments (Pierce 22-23). This means disciplinary members are constrained by
their institutional settings as to what they can consider as rce nary and cross-dis and these
institutional settings limit the range of acceptable potential mental models. However, given
scholars’ increased virtual connectedness, these observations warrant revisiting. Additionally,
research might consider the cognitive effects of situating of English Studies fields (which have
traditionally produced scholarship that is distinguished from other fields by virtue of an emphasis
on the study of human culture through primarily speculative, critical, or historical methods) in
largely corporatized academic institutions. Will these factors shape English Studies disciplines
and their bodies of scholarship more generally? The dynamics among communities, persons,
artifacts, institutions, and practices and their effects on disciplinarity have been investigated
extensively through the lens of activity theory (Prior 1998 31). My research extends that account

129 Additional factors that may impinge on and structure scholars’ habits of mind include institutional business
model thinking as well as larger social thinking practices. For example, institutional mental models figure value and
cost in economic terms. Further, neoliberalism, the ideological framework which Foucault critiqued for
propounding homo economicus (the idea of a solely self-interested human to whom “utility” is narrowly and
subjectively defined [Read]) exerts a cultural influence on thinking practices, potentially provoking scholars to
mentally model the centerpiece of their studies (the human subject) through the dynamism of cost-benefit. The
implications extend to disciplinary conceptions of “the student” that can radically diverge from Lily’s and others’
traditional model, where “growth” is defined in terms of self-actualization, civic mindedness, etc.
by emphasizing the cognitive practice of constructing mental representations and the cognitive artifacts (albethey unstable) of mental representation.

Future research might also focus on the gaps in affordances between the representational spaces of the mind and other various external forms of media (and sites of display) in order to help writing studies researchers understand how scholars in English Studies can articulate their ideas in new media in ways that promote the circulation and adoption of those ideas. My research suggests that effectively cuing mental models in readers’ minds facilitates the uptake of ideas, and new media provide scholars with greater range and flexibility to design cues that can prompt readers to construct resilient and fully formed mental models, largely because the affordances of new media are beginning to more closely resemble those of the mind. In other words, there is the potential for a greater degree of iconicity between new media representations and the representations in the semiotic space of the mind. Scholars who want to participate in the digital humanities should be prepared to take advantage of these affordances and should experiment with expressing their scholarly knowledge through multiple modalities with an eye towards cuing readers’ mental model production. Scholars have already been increasingly adopting multimodal approaches, whether they regard their aims as communicative or persuasive. Further, as I argued in Chapter 4 with the description of a hypothetical piece of new

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130 See the section on a pedagogy for mental models for some considerations towards designing effective discoursal cues.

131 While there is the potential to represent what one sees in the mind in new media, this is not to argue that greater iconicity necessarily leads to more effective communication. To make that assertion definitively requires more study, and in all likelihood is context dependent. Also, because some cognitive modalities do not present themselves outside the mind (for example, the use of affect as modality) and some new media modalities are not available for creating mental meaning (most significantly, the ability to record and store new media productions and access them later), these two semiotic spaces will never contain the same representational systems. The tools differ, and what can be constructed by them also differs.

132 They should also be prepared for the tools themselves to change what and how they know, as technology and those who employ it experience a recursively formative relationship: as Marshal McLuhan has pointed out, people make tools, and tools make people (1994).
media scholarship extending Bizzell’s model of language learners to include literacy cycles, scholars should consider that their ideas might be more effectively expressed and more easily circulated within their disciplines if they representing their thinking multimodally.133 This is not to argue that all scholars should depict their scholarly arguments in model form (though many arguments might benefit from this approach), but rather that there are effective ways to *provide cues* (constructed from a range of modalities, such as image or sound) that provoke readers to produce their own mental models, ones that are have structural consistency with the scholars’ own.134

However, given that the modes of representation do not offer identical modalities, in order to share what we model in our heads, it needs to be “translated” from the modalities of the mind into those afforded by the external media. If, for example, I construct a mental model of writing processes that figures affect as an object or a dynamism, I will need to re-articulate it in the available modes provided by the media I choose. Bezemer and Kress refer to this process of translating meaning across modalities as *transduction* for which “semiotic material is moved across modes, from one mode (or set of modes) to another mode (or set of modes)” (175). For example, mental models characterized by recursivity enable the thinker to conceptualize reciprocity not just between two elements, but among several; this requires a medium wherein multidirectional forces operating simultaneously can be represented, as well as regular updates to the system’s state. Given that recursivity is regularly figured in contemporary English Studies scholarship, scholars frequently transduce recursive mental models about scholarly topics from

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133 Understanding how a “reader” encounters these new representations will be an important part of using new media’s affordances. See the discussion on “audience addressed” for a fuller consideration of the idea that mental models help us anticipate such encounters by allowing us to enact them in our minds during the composing process.

134 Research confirms that people produce structurally similar mental models in response to similar information, even if that information is delivered through different modalities (Baggett).
the medium of mind to that of text. However, because text is encountered in a linear or serial fashion, a model’s components must be explicated part by part, rather than presented holistically.135 Writers must cue their readers to retain the previously presented components alongside new ones, and must also provide them a meta-view of the system, which functions as an architecture onto which to add details, such as the nature of the dynamics between elements and the problem space and goals within which and toward which the system is being figured. Writers must also remind their readers to regularly update the state of the system as readers progresses through the text and continue to build specificity into their situation models; they must be reminded to refigure this new state as the base state onto which to reapply the dynamism.136 These are some of the challenges related to the need to resituate mental models from the interior of the mind into mediums that can circulate more easily and widely. These mediums promote the circulation of mental models and because the mediums within which the models are represented are artifactual, lending them more stability than their more ephemeral cognitive counterparts.137 These more stable mediums enable a thinker to extend or critically

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135 The role that human attention patterns play in our encounters with multimodal compositions is addressed in the next section, as it bears on how we design these compositions to effectively cue readers how and where to direct their attention in mediums that do not require a strict serial encounter with the information the writer seeks to impart. (Also, it bears noting that the idea that text is encountered linearly is a generalization that does not always hold up; as experienced readers attest, many of our encounters with text do not in fact occur serially, such as when we review an article’s subheadings before reading the body of the text, when we read the conclusion before the main argument, or when we scan a passage of text for key words then read the proximal sentences. These approaches to the text suggest that readers are already well-equipped to make meaning from nonlinear encounters with discourse, and they reinforce the idea that a semiotic approach to discourse processing and production can help us understand how to effectively compose multimodal scholarly arguments.)

136 See Chapter 1 for additional discussion of the importance of dynamic states and the difficulties of representing them.

137 However, this does not mean that anchoring mental models in artifactual representations is always the most effective way to circulate forms of thought. As I experienced with my exchanges with scholars, other modalities of meaning-making participate in the sharing of mental models; gestures, vocal intonations, or contextual cues, such as institutional settings, contribute to constructing these models. These phenomena all contribute to disciplinary ecologies, and while forms of writing (text and multimodal) are central to constructing disciplines and circulating discipline-specific modes of thinking, spoken discourse has an important role in circulating mental models due to the fact that multimodal elements lend it a high degree of compression, in terms of time, and density (the number
evaluate a mental model by anchoring it or by using modes in ways that reveal the relationality and outcomes of a model, so that scholars can draw inferences and conclusions.

**Links between Mental Models and Rhetorical Theory**

*Mental Models and Doxa*

I have argued that research on mental models usefully extends the scholarship in cognition and writing and much remains to be explored. There is yet another body of scholarship with which mental models research might usefully dovetail, perhaps enabling deeper insights into long-standing topics of inquiry in writing studies, namely, rhetorical theory. For example, the ancient Greek idea of *doxa*, common belief or opinion, may have links to mental models. Both rest on the notion that they function by structuring how we perceive the world we encounter. In *Gorgias*, Plato represents the Sophists as arguing from popular belief for persuasive aims, a practice he judges as manipulative and antithetical to reasoning and true knowledge (Plato). Aristotle, on the other hand, feels that *doxa* has practical value in enabling us to understand the world, and that knowledge of the physical world becomes widespread because it is proven itself accurate through extensive usage; he refers to this subcategory of knowledge as *endoxa* in both *Topics* and *Rhetoric* (Eggs and McElholm). It is possible that both Plato and Aristotle were noting the use of highly circulated mental models of the material world. Interestingly, materiality now threads much of the contemporary scholarship in rhetoric and writing, undergirding explanations of social phenomena (for example, affect is understood as a material energy that is physically experienced and transmitted from person to person). This suggests that it might be fruitful to investigate the connection between the classical rhetorical

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of relevant informational elements in an exchange [see Sigrid Norris]), and allow for the dialogic construction of meaning (as when a listener asks for clarification about a speaker’s thinking).
concepts of *doxa/endoxa* and contemporary research on mental models. Nietzsche revisited the notion of *doxa* in late nineteenth century and argued that “language is rhetoric, because it desires to convey only *doxa*, not *expisteme* [knowledge],” thus drawing attention to our reliance on words to impart knowledge, especially through philosophic and scientific discourse, and emphasizing that words themselves are not the objects they describe, only sound images of them (21). Pierre Bourdieu’s more recent interpretation of the term *doxa* is that which is taken for granted in a culture, the mechanism by which “the natural and social world appears as self-evident,” arises from a contemporary critical lens. Bourdieu argues that *doxa* is used to construct “the universe of possible discourse,” which includes a set of thoughts or assertions considered appropriate for the social station of the speaker, and he argues the effect is to limit discourse and social mobility. This suggests that the often implicit nature of *doxa*—in the form of highly circulated unexamined mental models—may contribute to social power dynamics, and research linking this understanding of *doxa* to the mental models construct might, for example, explore whether and how the implicit character of certain mental models is preserved in particular communities as a form of social control, as well as whether thinkers are discouraged from developing their awareness of these cognitive phenomena through cultural norms.

Mental models are linked with other classical concepts as well, such as, for example, the “Method of Loci” mentioned in *Rhetorica ad Herennium*, Cicero’s *De Oratore*, and Quintilian’s *Institutio Oratoria*, a mnemonic device used by the ancient Greeks to remember extensive treatises (Carruthers). This method enables a speaker to remember by visualizing a “memory palace,” a spatially structured imagined architecture within which parts of the treatise are “located.” Remembering these parts entails “walking” through these loci to encounter them. Examining the use of the practice historically in light of what we are increasingly coming to
know about mental models as cognitive phenomena might help us better understand this ancient practice and result in educational applications, such as, for example, techniques that help graduate students recall the scholarship they encounter during their enculturation by constructing their own disciplinary maps.138, 139

Mental Models and the “Audience Addressed”

Mental models research can also extend what we understand about how writers think about audiences. Ede and Lundsford note that many scholars and teachers advocate envisioning the “audience addressed,” emphasizing its “concrete reality … they also share the assumption that knowledge of this audience’s attitudes, beliefs, and expectations is not only possible (via observation and analysis) but essential.”140 However, my own research supports the notion that writers are able to produce more detailed conceptions of familiars as audiences than generalized readerships. It seems from Jillian’s testimony, and from my own and Lily’s experiences, that the more extensive a writer’s experience is with receiving interactive feedback from actual readers, the more likely they are to create mental models of these readers later and to use these models to

138 I will say more about disciplinary maps as they relate to disciplinariness shortly.
139 Rhetorica ad Herennium encourages anchoring the objects of memory not simply to a spatial locus but also to other forms of anchors, for example, using visual or auditory details to strengthen the memory. It is possible that these additional forms of encoding constitute cognitive “modalities” and that by using multiple modalities, we can create more resilient models. This idea is revisited shortly when I discuss the multimodal nature of mental models.
140 Ede and Lundsford also describe Walter Ong’s (1975) idea of the audience as fiction, or rather the “audience invoked,” which refers to how writers (socially) construct audiences by providing discoursal cues to which actual sets of readers respond, adopting, as it were, temporary identities or positionalities that conform to the authors’ “instructions.” This is not to be confused with an author’s act of mentally modeling an audience during composing. However, one might argue that the identity or positionalities to which an “audience invoked” submits in fact emanates from a mental model of who readers believe writers want them to be.
predict how an actual reading would unfold in these familiar readers’ minds by depicting both affective and intellectual responses to the argument as it progresses. The major affordance of producing a mental model of a reader rather than a set of static characteristics of readers, such as demographics, general motivation, or likely disposition towards an argument, is that a mental model of a familiar reader can be “run,” much like a software application, enabling real-time updates to the conception of the reader in each subsequent moment as the text unfolds. Imagining how a reader reads as new elements of an argument are meted out over a linear encounter with text or talk, and how these additional elements complicate what has come before, is particularly critical for constructing arguments that are appropriately paced so that readers can digest intended meanings. In the continuous process of reading/revising that writers perform as they compose, Susan Wall notes, “There are really not one but two contexts for rereading: there is the writer-as-reader’s sense of what the established text is actually saying, as of this reading; and there is the reader-as-writer’s judgment of what the text might say or should say” (11). What Wall observes here is in essence the writer constructing a mental model of a reader, particularly the reader’s mind in response to the text “as of this reading,” at this point in the text. Such a mental model fits the definition of a dynamic systems model that continuously updates its state. The model’s flexibility and responsiveness enables the writer to experiment with changes in the text and anticipate how those changes might effect a reader’s processing of the discourse. However, in order to construct such fine-grained predictive tools, writers must be familiar with

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141 The “unavoidable commitment” to linearity in text and talk was raised in Chapter 4 in relation to Bezemer and Kress’ discussions on multimodal affordances. However, writers that compose in new media must mentally model “readers” that encounter their compositions in far more complex and variable ways given that readers essentially construct the work’s organization during their encounter with it by choosing a particular navigational path. This complicates the composer’s task of modeling a reader’s/viewer’s situation.

142 The nature of this mental model of the reader is multimodal and variable from person to person and context to context. For example, if modeling a “resistant reader,” the writer might employ a token for negative affect, representing it abstractly or even symbolically (e.g., through a grumpy facial expression). This unique multimodal affordances of mental models were discussed earlier in this chapter.
the manner in which discourse is processed, and must be sensitive to variances across contexts. The implication is that providing novice writers with ample opportunities for face-to-face encounters with real readers in real time, where they can ask about how the text has been experienced and interpreted, can enable writers to learn how readers process discourse.

Further, writers can be encouraged to examine their own responses while reading and to reflect on changes incurred to their mental states that result from exposure to particular discoursal maneuvers. This pedagogical approach contrasts to instructing novice writers to “imagine your audience,” which encourages writers to aggregate “readers” into a class of persons with common characteristics. A pedagogy that integrates mental models in writing instruction can encourage writers to anticipate how readers would be impacted moment to moment by the discourse they will encounter. Since mental models are often implicit, writers who are unaccustomed to registering their mental representations might find it difficult to be asked directly, as my participants did, what models they are producing in their minds as they compose or process discourse. I have already discussed the distinction between implicit and explicit mental models and argued that it is possible to increase thinkers’ abilities to construct explicit mental models and to increase the awareness of their implicit mental models.

Mental Models, Persuasion, the Rhetorical Situation, and Genre

Rhetorical theory considers the ways in which audience awareness enhances a rhetor’s effectiveness, and mentally modeling a reader seems to be the mechanism for anticipating readers’ responses to text; mental models of readers enable rhetors to craft text that guides their responses towards the argumentative conclusions the rhetor wants the audience to make. This process implicates another component of rhetorical theory that intersects with mental models: the
idea of persuasion. As my project, particularly exchanges with Jillian, has begun to suggest, mental models have a role in persuasion. An adept writer recognizes that in order to persuade an audience, they need to understand the assumptions, attitudes, and beliefs the audience possess prior to encountering the writer’s argument, as this information enables the writer to tailor an argument that either takes advantage of alignments between the audience’s dispositions and the argumentative aim or works towards realigning the audience’s disposition in enhance their receptiveness to it. As my exchanges with Jillian suggest, so too do expert writers anticipate their audience’s mental models in order to tailor the discoursal cues they provide in order to achieve their argumentative aims. In Jillian’s case, she had been arguing to an audience of graduate students that the researcher-teacher’s experience of wholeness occurred when these two halves were joined to form a complete identity, yet that joining did not occur through a fusion or synthesis, nor a common ground between the roles, but each part of the whole retained its discrete distinction. Her argumentative aim was to instruct this graduate student audience to strive for the wholeness these two separate identities could offer when brought together to form a singular identity. Exchanges with Jillian suggested that the construction of her argument was predicated on her belief that her graduate student audience had formed a model of researching and teaching as discrete identities by participating in institutions that fostered the view that these were separate and distinct functions. She had tailored her argument to fit her audience’s baseline model in order to encourage her audience to conceive of these functions as “fitting together” and engendering a singular, more holistic identity. The ability to anticipate a reader’s baseline model and how such a model will be modified by certain possible discoursal cues returns us to the importance of mentally modeling readers, as not only does the persuasive aim include shifting attitudes, values, and beliefs, but more fundamentally, a reader’s mental model, one predicated
on these elements. Because mental models are essentially representations of a “state of affairs,” if the rhetor modifies an audience’s representation of that state, they have effectively and literally “changed someone’s mind” about the nature of a situation. This raises theoretical questions about the most effective ways to change others’ mental models. For example, does one attempt to align an audience’s values in order to persuade them to accept a particular representation of a state of affairs, or does one present the state of affairs, which then shifts the audience’s values?

These questions suggest intersections with the scholarship on the “rhetorical situation.” Richard Vatz, who was responding to Lloyd Bitzer’s objectivist construction of a situation comprised of author, audience, and exigency, argues that rhetoric is what defines our understanding of the situation in the first place. Much the way that knowledge structures draw attention to salient features of a context, so too does rhetoric function to draw an audience’s attention to a set of characteristics designated as salient. Any context, according to Vatz, could be defined by an endless set of characteristics, but rhetors with their particular values and aims decide how a situation should be understood. It appears that the structurational role of both discoursal and mental representations function side by side to filter some elements of a context and heighten our awareness of others. As Chaim Perelman notes, “By the very fact of selecting certain elements and presenting them to the audience, their importance and pertinency to the discussion are implied. Indeed such a choice endows these elements with a presence” (qtd. in Vatz 116-117). It would seem that a mental model’s feature achieves its “presence” through its

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143 There are interesting overlaps between the idea of the “rhetorical situation” and the “situation models” that readers construct as they respond to discuss, and it seems likely that a fuller examination would be fruitful. So too the idea of rhetorical “exigency” can be figured as “problem space” from a mental modeling perspective, and genres can be understood to structure the typical responses to these problem spaces. This too ideally warrants a fuller investigation.
instantiation in a situational model. Given this structuring role, a critical regard for mental models is as significant as it is for rhetoric and other forms of discourse.

Carolyn Miller takes up Lloyd Bitzer’s idea of exigency to assert that regular forms of discourse arise out of the need to address common, recurring situations. This view of genre as typified action dovetails well with the notion that mental models provide typified responses to problem spaces. Further, focusing on genre can enable researchers to understand how people come to participate in a community’s activities. Later, Berkenkotter and Huckin posit that genres are flexible tools for responding to dynamic social situations, which explains why genres change: they are responses to changing circumstances. Further, Miller instructs us to understand that genre is “centered not on the substance or the form of discourse but on the action it is used to accomplish” (151). Because genres enable their users to navigate complex social arenas, the authors designate these tools as forms of social cognition (Bawarshi and Reif 79). It would seem then that genres serve mediational roles between cognition and action in social fields. Mental models are the originary sources for genres, for the practice of typifying situations, and like so many demanding cognitive processes, we anchor some of the function of mental models in external representations. Genres earn their generic quality from the fact that they have been transduced from typical mental models of situations; reproducing these familiar models’ core features requires cognitive efforts, so we shuffle off some of that cognitive workload to external

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145 David Russell connects genres to academic disciplines in this way and notes, “In the activities of modern mass education and disciplinary inquiry, the language that counts most is written—but written in ways characteristic of the various cooperative activities, the various communities and subcommunities that make up the system.”
discoursal tools, which we use to cue the basic structures of mental models. Genres enables thinkers to use fewer cognitive resources when they construct situation models they need in order to grapple with the process of understanding a familiar form of social exchange in a new context; this is because external cues that constitute genre provide a degree of *automaticity* in cognitive processing in that they enable a thinker to presume (and represent in the models) prefigured aspects of a situation rather than invest the effort into re-modelling situations in real time. In this way, cognitive resources are freed up to work through new contexts. In regarding genre as social cognition, one could argue that genre is *always social*, but only *becomes cognitive* at the moment when enough discoursal cues\(^\text{146}\) amass to cause a reader to produce the basics of a mental model for the situation. Genre, like all tools, is intended to make our work easier; in this case, that work is to produce a complex mental model that can be used to reason through the problem space with which we are concerned.

**A Pedagogy of Mental Models for Novice Writers**

*Mental Models and Writers Reading*

If mental models are significant to knowing because they help us process content, and if they are significant for persuasion because they enable us to construct discoursal cues for readers who will produce situation models, then we should consider whether mental models should have a place in writing instruction. Further, the fact that they have been so widely taken up for the former in the sciences suggests these tools merit our attention, at least for enculturating and professionalizing graduate students in English Studies fields. In order to instantiate a mental

\(^{146}\text{Semiotically speaking, that is, as the occasion/location of a text also provides cues to the reader who encounters it, and there are other sources for meaning-making cues as well. As Bazerman describes, the means by which genre is enacted in various communities differs, and including for example, “forms of ways of being ... frames for social action ... environments for learning ... locations within which meaning is constructed.”}
model that is resilient enough, in Blake’s words, to “leave a residue” that might then be examined, students can be first encouraged to note specific responses to text, for example, mental images, such as those that accompany a single word. This approach is predicated on the notion that there is an important link between reading and writing. In the past, researchers have largely considered reading and writing as separate domains, and curricular approaches have most frequently treated reading and writing as distinct aptitudes requiring different pedagogical approaches. Their accompanying “high-level cognitive processes have been treated by various disciplines and interdisciplines as two separate, independent fields of study” (Parodi 225-226). However, given the extent of the overlap in the cognitive functions required to both produce and process discourse, this regard is changing. The intersection between discourse processing and production has provided the ground for a new research stream that “systematically investigates comprehension and writing from the same discourse and cognitive perspective aiming at shedding light on their connections” (226). In writing studies fields there is a resurgence of cognitive approaches to writing as the “social turn” returns to cognition in order to consider how cognitive processes are socially constructed. A pedagogy that links reading and writing can encourage writers qua readers to notice their own mental imagery during reading then link this imagery to specific words in the text, and this enables writers to reflect on the power of word choice for triggering cognitive phenomena in readers’ minds. Students can also be instructed to observe their own affective states, such as the positive affect that accompanies the act of producing mental models that provide explanatory power or the negative affect of frustration, which can occur when a reader is unable to produce a mental model from cues in a text because the model’s components or dynamics are only vaguely depicted. Novice writers can also be encouraged to note when they feel overwhelmed (as when the text does not pace the discoursal
delivery of components at a rate slow enough to allow readers to adequately process the
discourse and build a complete working model) or disinterested (as when the text provides cues
in a piece-meal fashion without a holistic framework, preventing readers from “outlining” a
complete working model into which details can be added). Teachers can help students notice the
embodied sensation of mental movement, as when a thinker moves one idea into the domain of
another.147 Once they have gained a facility with observing their own responses to discourse
(which are essentially the phenomenological experiences of constructing elements of models,
such as token objects, dynamism, and other forms of relationality), they can begin to compare
their responses to the selected passages of text with peers, which will enable them to contemplate
the degree to which readers process discourse similarly or idiosyncratically. With the guidance of
a teacher who has practiced observing mental models, they will be able to note that people often
make structurally analogous models of the same phenomena and to identify how central
metaphor is to meaning-making and communicating effectively and persuasively.148 This close
observation of themselves and their peers reading can enable them to construct dynamic models
of readers later when they turn to their writing. Once students are familiar with the practice of
noting how readers read, teachers can introduce the concept of mental models as the “small-scale
working models” we construct in our own minds to reason through problem spaces (which
include understanding the world we encounter by producing mental models of it, such as mental
maps, as well as the discourse we encounter, by producing models of its meaning content and its
organization). Students can then be directed to observe their own fully formed mental models

147 An example of moving one idea into the domain of another that results in the experience of mental movement
is Blake’s figuring of homosexual couples “placed” in the national family through the mechanism of sentimentality.
Similar examples will likely abound in student readings, as this is a common form of relationality.
148 Lakoff and Johnson’s *Metaphors We Live By* (2008), a resource which seems to have declined in popularity in
writing instruction recently, should be considered a valuable tool for helping students consider the relationship
between mental models and persuasive communication.
with questions such as, for example, “What do you see in your mind right now?” or “What do you see when you put $x$ into $y$?” and asked to critically reflect on the models’ effectiveness and whether they imply certain values or assumptions.\textsuperscript{149} This critical reflection can be extended by asking students to modify the assumptions of their models and reflect on whether such modifications alter the concluding states produced by the model when it is “operated.” They can also demonstrate to students that these same responses occur with other discoursal forms, such as image and audio elements of multimodal compositions. These types of exercises will allow students to discover that mental models are significant cognitive tools that writers can deliberately employ for rhetorical purposes. Specifically, a mental models-based pedagogy can help students recognize and anticipate an audience’s cognitive processes upon encountering discoursal productions, which can enable them to write in ways that cue readers to produce the writer’s desired mental models. As the exchanges with Jillian suggested, effective writing implicitly begins with an understanding of readers’ base mental models, then builds on them.\textsuperscript{150}

The pedagogy I have described above is founded on the notion that mental models are a component of literacy. Mental models of domain content constitute disciplinary expertise and the ways by which readers produce situation models is also community specific. This is significant for disciplinary enculturation, which requires that students adopt discipline-specific ways of thinking for particular domains of study. Using mental models in graduate professionalization to foster specific perceptual and reasoning aptitudes can enable disciplines in English Studies to

\textsuperscript{149} As my experience with participants demonstrated, it is important to get students engaged with the idea content before asking them to reflect on their cognitive phenomena, as this assures that the models are resilient and complete enough to register above the threshold for observable and explicit cognitive phenomena.

\textsuperscript{150} As I discussed earlier, this parallels but differs from the obvious assertion that writers hoping to persuade their audiences should understand those audiences’ starting assumptions and construct an argument from there. Specifically, as my research project has begun to suggest, mental models have a rhetorical function in argument in that they represent states of affairs to thinkers. By modifying someone’s representation of the “state of affairs,” a rhetor has effectively (and literally) “changed someone’s mind” about the nature of things.
cultivate members capable of continuing to employ critical lenses and produce novel insights. These are crucial in disciplines constructed around the principle of tolerance for multiple ways of knowing and the capacity to regard each alternative critically.

**Mental Models, Socio-cognitive Theories of Writing, and the Production of Scholarly Knowledge in Disciplinary Writing Ecologies**

Mental models research can contribute much to our understanding of disciplinary writing ecologies. This exploratory project revealed that scholars use mental models implicitly, but when they pay attention to them, their use can be enhanced, as scholars’ models revealed the assumptions and limitations in their thinking and presented them with opportunities for experimenting with alternatives. Mental models change over the course of English Studies fields’ unique disciplinary histories, just as they do in the sciences, though there are numerous co-existing frames that complicate that history. Further, scholars’ mental models will continue to evolve as their use of new media to express scholarly thinking and knowledge evolves. In order to study mental models effectively, scholars will need to experiment with various methods for eliciting them. As Nersessian in 2004 suggests with the sciences, a cognitive historical approach to studying disciplines can help researchers trace the history of English Studies fields by analyzing shifts in mental models that resulted from and gave rise to disciplinary changes. Another research method that can help elicit scholars’ mental models and contribute to our understanding of their role in disciplinary writing ecologies is to instruct participants to draw their models with pencil and paper, as this has proven fruitful in science education research (see Park and Oh). Also, interviews with participants should be videotaped so that a multimodal analysis that includes elements such as gestures and facial expressions can enable an assessment of the density and compression associated with co-constructing discipline-specific mental models.
through talk and text (Norris). This interactive approach to mental models’ construction has important implications for studying and aiding scholars in facilitating collaborative scholarly writing. Further, these methods can also be employed to study how mental model making can be deliberately employed in writing classrooms through a pedagogy that helps students learn to better construct and articulate models of both content domains (descriptions of which can be used to better persuade audiences by aligning with and building on their own, as Jillian did) as well as produce discourse that effectively cues readers to construct situation models by careful pacing and description in the writing. What this project ultimately suggests is that a social cognition approach to cognitive processes is a productive means for providing new insights into socially shaped cognitive processes for writing. Mental representation’s multimodal qualities pair well with new media’s affordances, and each will continue to inform the other. Teachers who aim to prepare students and emerging scholars for writerly lives enacted through new media will want to devise pedagogical approaches that enable their students to critically reflect on their thinking, increase their potential for creativity and insight, and communicate persuasively by investigating the relationship between mental models and multimodal composing.
Works Cited


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APPENDIX

DATE: July 16, 2014
TO: Laural Adams
FROM: Bowling Green State University Human Subjects Review Board

PROJECT TITLE: [393917-8] Habits of Mind in the Humanities: Cognitive Protocols in the Production of Knowledge and the Construction of Disciplinarity
SUBMISSION TYPE: Amendment/Modification

ACTION: APPROVED
APPROVAL DATE: July 16, 2014
EXPIRATION DATE: February 27, 2015
REVIEW TYPE: Administrative Review
REVIEW CATEGORY: Expedited review category #7

Thank you for your submission of Amendment/Modification materials for this project. The Bowling Green State University Human Subjects Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The following modification was approved:

- Title Change from Habits of Mind in the Humanities: Cognitive Protocols in the Production of Knowledge and the Construction of Disciplinarity to Theorizing Mental Models in Disciplinary Writing Ecologies through Scholarship, Talk-Aloud Protocols, and Semi-Structured Interviews

Please note that you must log into IRBNet to change the title by clicking on the "Title" section.

Please note that you are responsible to conduct the study as approved by the HSRB. If you seek to make any changes in your project activities or procedures, those modifications must be approved by this committee prior to initiation. Please use the modification request form for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must also be reported promptly to this office.

This approval expires on February 27, 2015. You will receive a continuing review notice before your project expires. If you wish to continue your work after the expiration date, your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date.

Good luck with your work. If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsrb@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.
This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Bowling Green State University Human Subjects Review Board's records.