The pace of change in communication technologies during the previous decade has made the concept of literacy a moving target (Leu, 2000). One of the most significant changes is the capacity of online texts to engage readers in literal rather than metaphorical interaction (Reinking, 2001). Although traditional theories of reading recognize the complex character of literacy (e.g., Rosenblatt, 1994, 1995, 2004) and researchers are exploring the capacity of technology to be responsive (Leu & Hillinger, 1994) and supportive (Anderson-Inman & Horney, 1998), I argue in this essay that even the most forward-thinking theories do not adequately prepare us for the interactive text that is already reshaping literacy online, and that there is a need to re-evaluate some of our most fundamental ideas about literacy, readers, and text.

Rosenblatt likens reading to Searle's (1969) concept of a “speech act” (pp. 22–26), a concept that, unlike more general terms such as speech or language, emphasizes the pragmatic, transactional, and “human element” (Rosenblatt, 1994, p. 41) in understanding literacy and the literary work. Unlike a speech act, however, where two active agents are usually involved, in reading there is only a single active agent. In Rosenblatt’s words, “the author has dropped out. Only his text and the reader remain” (p. 20). As a result, “the reader finds it necessary to construct the speaker, the author...as part of what he decodes from the text” (p. 20). This assignment of readers to an active role and written language to a more passive role is not surprising. Readers have attitudes, objectives, and values that influence their decisions and actions. Written language expresses attitudes, objectives, and values, but it does not act on a literacy environment as human readers do.

A central thesis I develop in this essay is that electronic environments have the capacity to transform written language into a dynamic agent that can modify the reading environment within which it operates. Moreover, although some theorists (e.g., Landow, 1992) promote online literacy as an ally in challenging the independence and authority of text, the disruptive power of Internet worms and e-mail viruses demonstrates that technology can also empower author and text at the expense of readers. The challenge we face as educators is to prepare students for reading environments that are more dynamic than even the most radical theories of
The purpose of this theoretical essay is to explore the limits of traditional conceptualizations of reader and text and to propose a more general theory based on the concept of a literacy agent. The proposed theoretical perspective subsumes concepts from traditional theory and aims to account for literacy online. The agent-based literacy theory proposed (a) reframes the concepts of reader and text as roles defined by criteria that allow human or machine agents to be assigned to either role, (b) distinguishes two types of literacy events that more adequately represent the range of interactions possible in online reading environments, and (c) argues that readers’ views of literacy events and their success in achieving goals depend on how they assign roles in reading. Several examples of literacy events are presented, illustrating the application of agent-based literacy theory and exploring its consequences. Examples are followed by an examination of one historically important critique of the concept of machine readers. The essay concludes by identifying empirical predictions of agent-based literacy theory and reviewing implications of the theory for literacy practice and pedagogy.

El propósito de este ensayo teórico es explorar los límites de las concepciones tradicionales sobre lector y texto y proponer una teoría más general basada en el concepto de agente de alfabetización. La perspectiva teórica propuesta subsume conceptos de la teoría tradicional y apunta a dar cuenta de la alfabetización online. La teoría de la alfabetización basada en los agentes: (a) reformula los conceptos de lector y texto como roles definidos por criterios que permiten que los agentes, sean humanos o máquinas, puedan ser asignados a cualquiera de los roles, (b) distingue entre dos tipos de eventos de alfabetización que representan de manera más precisa el rango posible de interacciones en un contexto de lectura online y (c) argumenta que las ideas de los lectores sobre los eventos de alfabetización y su éxito en alcanzar metas dependen de cómo asignan los roles en lectura. Se presentan varios ejemplos de eventos de alfabetización que ilustran la aplicación de la teoría de la alfabetización basada en los agentes y exploran sus consecuencias. Los ejemplos están seguidos por el examen de una crítica históricamente importante al concepto de lectores máquina. El ensayo concluye con la identificación de predicciones empíricas de la teoría discutida; asimismo se revisan implicancias de la teoría para la práctica y la pedagogía de la alfabetización.

Cet essai théorique a pour but d’explorer les limites des conceptualisations traditionnelles du lecteur et du texte et de proposer une théorie plus vaste basée sur le concept d’agent de littérisme. La perspective théorique que nous proposons tient compte des concepts de la théorie traditionnelle et vise à prendre en compte le littérisme en ligne. La théorie du littérisme basée sur l’agent propose (a) de recadrer les concepts de lecteur et de texte en tant que rôles définis par des critères permettant à des agents humains ou mécaniques d’être assignés à chacun de ces rôles, (b) distingue deux types d’événements de littérisme qui représentent de façon plus satisfaisante l’ensemble des interactions possibles dans un environnement de lecture en ligne, et (c) soutient que les représentations qu’ont les lecteurs des événements de littérisme et de leurs possibilités d’atteindre leurs buts dépend de la façon dont ils attribuent les rôles en lecture. On présente plusieurs exemples d’événements de littérisme pour illustrer l’application de la théorie du littérisme basée sur l’agent et explorer ses conséquences. Ces exemples sont suivis par l’examen d’une critique historiquement importante du concept de lecteur machine. On conclut cet essai par des prédicitions empiriques de la théorie du littérisme basée sur l’agent et par l’examen des implications de cette théorie pour les pratiques de littérisme et la pédagogie.

"Agentская" теория грамотности

Цель этого теоретического эссе состоит в том, чтобы исследовать пределы традиционных представлений о читателе и тексте и предложить более общую теорию, основанную на идее "агента", то есть роли, которую выполняет текст или читатель в акте чтения. Предлагаемый здесь ракурс включает в себя традиционные теоретические категории и стремится объяснить явление онлайн-грамотности. "Агентская" теория грамотности (a) выводит из понятий "читатель" и "текст" некие роли, соответствующие определенным критериям, причем любую из этих ролей можно поручить как человеку, так и машине; (b) выделяет два типа событий, связанных с общением со словом, которые адекватно отражают весь диапазон взаимодействий, возможных в ситуации чтения онлайн; (c) утверждает, что взгляды читателей на события, связанные с грамотностью, и их успехи в достижении целей зависят от того, какие роли назначаются в процессе чтения. В статье представлены несколько примеров событий, связанных с общением с печатным/письменным словом, на их основе демонстрируется применение "агентской" теории грамотности и исследуются результаты этого применения. Помимо примеров, приводится анализ одного исторически важного документа, посвященного критическому разбору концепции "машинного" чтения. В заключение рассматривается значение этой теории для практики грамотности и для педагогики.
literacy have proposed, environments where texts become readers and readers become texts.

Three objectives guide this article. The first objective is to provide a rationale for agent-based literacy theory by exploring limitations of traditional theory in online settings and examining the origin of these limitations in traditional assumptions about readers and texts. A second objective is to conceptualize literacy in terms of the concept of a literacy agent, responding to limitations of traditional theory and new forms of literacy that online environments create. The third objective is to explore agent-based literacy theory as an explanatory and predictive framework in thinking about literacy events that involve multiple agents, both human and machine.

**A rationale for and assumptions of agent-based literacy theory**

Agent-based literacy theory is a general explanatory framework for reading, but it is motivated in part by limitations of traditional theory in addressing the interactivity of online literacy. Although so-called interactive theories of reading have a long history in literacy research, the interactions they refer to are internal to readers. In transactional theory, readers interact with their own response to reading (Rosenblatt, 1994), and in cognitive models (e.g., Rumelhart, 1994; Stanovich, 1980) interaction refers to the back-and-forth flow of information within internal processing systems. Ultimately, interactive theories of reading rely on a static view of text, a view that is plausible and productive in print, but increasingly less plausible and less productive in electronic forms of reading and writing.

More dynamic forms of text are not without precedent in traditional print, including choose-an-adventure stories with branching points and, more recently, personalized magazines and advertisements based on reader profiles (e.g., Meneguzzi, Meirelles, Mano, Oliveira, & da Silva, 2004; Purvis, Harrington, O’Sullivan, & Freuder, 2003). Electronic reading environments, however, go beyond what is possible in print because they allow text to act on, and therefore influence, reading environments. Malicious websites can seize control of a reader’s computer, and Internet viruses spread online like organisms in natural environments (Barabasi & Bonabeau, 2003). Three elements of electronic text, all related to its interactive potential, illustrate limitations of traditional theory in online environments: text structure, adaptive content, and procedural text.

Text structure, long an important element in theoretical and empirical investigations of reading, has been used to specify the content of text, to assess reading, and to generalize empirical results in research studies (Meyer, 1985). Electronic text, however, often cannot be analyzed with existing theories of text structure (e.g., Graesser & Goodman, 1985; Kintsch & van Dijk, 1978; Meyer, 1985). The problem is a scaled-up version of the story line variability in a choose-an-adventure text: the absence of a normative linear structure. Online documents are more accurately depicted as networks of nodes and links that define a virtual structure (McEneaney, 2003; Rosenberg, 1996) that sustains many possible readings, requiring that readers define text structure by choosing links, thus undermining traditional views limited to author-defined structures. A related problem arises when readers’ behaviors and the literacy tools available to them influence text content. Amazon.com, for example, personalizes webpages for individual readers on the basis of cookies, bits of information that record past activity of readers on the site, and new display technologies are pushing websites to customize content for specific displays because content developed for one format (e.g., a monitor) may be unreadable on another (e.g., a cell phone). In effect, the content of a text is influenced in important ways by who is reading it and how it is read.

Finally, electronic reading environments dramatically extend the potential of procedural text
(Longacre, 1996; Murray, 1997) to influence a literacy event. Notes in a textbook explaining the use of charts and stage directions embedded in a script are examples of procedural text in print. In electronic reading environments, however, procedural text may take the form of programming that can modify reading environments without the assistance or even knowledge of the reader. Existing theories of reading focus on human readers, ignoring issues of structural variability, adaptive content, and the behavioral potential of text. These are intrinsic qualities of electronic text, however, and will be essential elements of any future pedagogy, so the need for new theory is both theoretical and practical.

Another important element of a rationale for a new approach arises from the assumptions in traditional theory about readers and text. Traditional theory assumes that human readers initiate and control literacy events, and therefore human readers are the focal point for explanation. Text, on the other hand, tends to be viewed as a stimulus for a reader’s response to it. But text that exhibits behavior may need explanation as well, calling for a more general perspective that views the concepts of reader and text as roles rather than fixed assignments (i.e., people are readers and print is the text). When a reader is conceptualized as a role based on a response to text, however, literacy researchers must acknowledge the possibility that an electronic text may achieve a level of response that makes it a reader. Furthermore, proposing that readers be defined on the basis of observed response to text means criteria must be established to make this judgment. Just as “word calling” would not usually be characterized as reading, researchers of online literacy must be prepared to distinguish trivial personalization of text limited to greetings on arrival at a site (e.g., “Welcome, John!”) from genuinely adaptive behavior in a text with a more sophisticated level of interaction (e.g., recommendations about books and other products based on reader browsing and purchase records). Cognitive scientists and philosophers of the mind have, however, explored this problem, and Dennett’s work on intentionality is relevant to the present argument.

Dennett (1987, 1991) identified three ways to explain events in the world. A physical stance is adopted when we conceptualize events in terms of natural laws (e.g., atmospheric friction causes a satellite’s orbit to decay); a design stance is adopted when we explain events in terms of the ways things are designed (e.g., depressing the gas pedal causes the car to accelerate); and an intentional stance is adopted when we explain events in terms of abstractions such as goals, beliefs, and dispositions (e.g., he doesn’t say hello because he’s a snob). According to Dennett, the most appropriate explanatory stance is the one that most effectively describes, explains, and predicts what we observe.

A physical stance best explains text as an object. For example, earthquakes cause books to fall off shelves without any need to consider design or intention. When a person reads printed texts, however, a design stance usually provides a better explanation because success or failure is usually determined by the relative fit between a reader’s goal and qualities of the text. If readers encounter text that exhibits behavior, however, an intentional stance may be more appropriate. When behaviors are more readily explained in terms of intentionality, agent-based literacy theory proposes that a text is also a reader. In relying on observational criteria to define readers, however, we must be prepared to accommodate uncertainties and shades of gray. A pragmatic perspective, therefore, suggests a view of intentionality as a continuum within which some readers are more intentional than others, in the same way we view degrees of conscious awareness in human beings and other life-forms (Lakoff & Johnson, 1999). A reader in agent-based literacy theory, therefore, encompasses semi-intentional or semi-autonomous (Gillies & Ballin, 2004) agents that are understood as intentional, even if the potential of these agents for response appears more limited than that of human readers.

The rationale and assumptions outlined thus far define a position that is pragmatic and instrumental. The goal of this essay is to define a practical framework that more thoroughly and accurately summarizes, explains, and predicts what we observe when readers take up text, particularly in (but not limited to) online environments. Despite the emphasis that agent-based literacy theory places on practical and pedagogical matters, however, it also raises questions about some of the most basic ideas in literacy studies. Are reading and writing uniquely human acts, or should a theory of literacy account for non-human readers? Can the traditional metaphor of reader–text interaction be taken in a more literal sense, and if so, under what circumstances? What is the consequence of abandoning traditional assumptions about reader and text, relying instead on observation to warrant claims about the roles of reader and text?

The remainder of this essay, addressing these and similar questions, consists of five parts: (a) an introduction to machine agents, (b) a presentation of three core ideas in agent-based literacy theory, (c) analyses of three literacy events that explore conse-
quences of agent-based literacy theory in traditional print texts and electronic texts, (d) a critique of one historically important challenge to the notion of machine readers, and (e) a review of implications of agent-based literacy theory for future research, pedagogy, and practice.

An introduction to machine agents

The most obvious reason for the recent transformation of literacy practice is the World Wide Web (hereafter, Web). Ongoing work by the World Wide Web Consortium (W3C), referred to as the semantic web, highlights the need for a broader view of literacy and a clearer understanding of the connection between literacy and Web technologies (Fensel, Hendler, Lieberman, & Wahlster, 2003). The semantic web seeks to create technologies that will allow machine agents (i.e., programs and the computers on which they run) to interpret and reason with electronic text (Berners-Lee, Hendler, & Lassila, 2001; Hendler, Berners-Lee, & Miller, 2002; W3C, 2005). The following scenario suggests how semantic web technologies could be applied in solving a reading/writing problem that is a common source of frustration for university undergraduates: registering for classes. It also illustrates how a machine agent might be understood to read and interact with a person.

Eric is a third-year teacher education student at a large state university that has recently deployed an agent-based registration system. Last term, faculty and students were directed to a website where they could configure advising and registration agents to assist them in resolving common problems. Eric set up his registration agent to avoid classes on Fridays (because of his work schedule) and indicated a preference for afternoon and evening classes (because he isn’t a “morning person”). Faculty could configure their agents to admit students to closed sections or authorize instructor permission if certain criteria were met. In the past, Eric had to build a schedule course by course, and when sections were closed, the registration process came to a grinding halt because he had to have a physical admit slip signed by an instructor. “What a pain that was!” he thought to himself, hoping that the new system would simplify his life.

When Eric logged on to register, he found that the course registration site had changed quite a bit. The old system relied on two basic screens—one to enter registration requests and a second page that simply reported success or failure. The new system divided the screen up into sections and seemed to use menus and buttons like those on sites that make airline reservations. On the left-hand side of the screen was a list of courses he had taken since his admission two years ago. He had been able to access online transcripts for some time, but this was the first time his completed courses appeared when he came to register. “So this system knows what I’ve taken—that’s interesting,” he thought. In addition, just above the course listing were two notes in a bright red font: one advising him that he needed to satisfy one remaining general education requirement and a second alerting him that admission to student teacher status would require submission of a portfolio and a preplacement interview. The system referred to itself as his “Registration Agent.”

On the right-hand side of the screen he found a tentative course schedule based on his already completed work, prerequisites, and available sections. Because he had been admitted to the advanced methods block, he had few electives and the registration agent recommended five specific sections. It even offered to hold seats for him in three of the sections with 24 hours to make a final decision. One was the instructional design course he hadn’t been able to get into last term. The second was the general education requirement the system had commented on in red, and the third was the media literacy course he needed to be eligible to submit his portfolio in the spring term. All three sections were scheduled to meet Monday through Thursday in the afternoon or evening according to the preferences he had entered last term.

The two remaining block courses were highlighted, however, indicating they required instructor approval. In one, all available seats had been taken. The second required the instructor design course as a prerequisite but allowed concurrent registration with instructor permission. Eric selected options authorizing instructor access to his university records, selected an option requesting approval for both, and hit the submit button. His requests were reviewed and approved almost immediately by advising agents set up by the course instructors. Advising agents had matched information from Eric’s university records against rules set up by the instructors. His request to the closed section was approved under the instructor’s standing rule to admit up to three students beyond the stated limit. His request for instructor permission was approved on the basis of his grade-point average and his enrollment in the advanced methods block.

When the instructor advising agents responded with approvals, Eric’s waiting registration agent forwarded his tentative schedule to a person in the financial aid office responsible for a final review. Within 30 minutes, Eric’s financial aid adviser had reviewed his schedule and sent him an e-mail confirming his eligibility for continuing aid and notifying him of recent changes that provided new grants for some nontuition expenses. Soon afterward, Eric received a registration receipt and an e-mail from a textbook service that provided information about the availability and cost of his required textbooks at a variety of online and local retailers. “Wow,” Eric thought to himself, “this sure beats standing in lines all over campus!”

Although this scenario might seem futuristic, the technology it assumes is currently available, although not widely implemented (rather like the Web in the early 1990s). Furthermore, as a straightforward example of reading-to-do literacy (Moshenthal, 1996), there is a familiarity to this literacy event. There is, however, a telling difference as well. Whereas traditional views of literacy typically focus on a single reader, this example describes a coopera-
tive effort that distributes the literacy event and the processing that supports it across multiple human and machine agents.

Core concepts in agent-based literacy theory

Three related ideas are at the core of agent-based literacy theory. One idea is that the term reader defines a role in a literacy event that can be assumed by any intentional agent, human or machine. A second idea is that literacy events are defined in a fundamental way by whether they involve a single reader or multiple readers. The third idea is that readers’ views of literacy events and their success in achieving goals depend on how they assign roles in literacy events. I discuss each of these core ideas in turn.

Literacy roles: Objects, agents, and autonomous agents

In traditional terms, a literacy event consists of a human reader engaged with text in achieving a purpose or goal. In agent-based theory, literacy is defined in terms of literacy agents, where an agent is understood in a general way to refer to either reader or text, without making assumptions about their respective roles in the literacy event. In addition to agents (i.e., readers and text), a theory of literacy should account for objects in the literacy environment that, although not currently involved in a reading event (e.g., books on a shelf), still have theoretical relevance. Three roles provide conceptual footings for agent-based literacy theory: objects, agents, and autonomous agents (adapted from d’Inverno & Luck, 2001).

Literacy objects, literacy agents, and autonomous literacy agents (hereafter simply objects, agents, and autonomous agents) are defined as functional roles within literacy events that are assigned on the basis of observation. The most general role is “object,” designating something with theoretical relevance in the domain of literacy studies (e.g., paper and ink). A person reading in a library, for example, is surrounded by such objects (i.e., books) that, while not immediately engaged in an ongoing literacy event, still retain theoretical relevance because these objects have an acknowledged potential to assume a role in a literacy event. The role of an agent is a more specialized version of the object role associated with a specific literacy goal. A book chosen by a reader, for example, is used with some goal in mind. The book, therefore, operates as an agent in support of the reader; it has theoretical relevance and is associated with a goal a reader has brought to a literacy event. Finally, an autonomous agent is a specialization of the agent role. Like an object, an autonomous agent has theoretical relevance. Like an agent, an autonomous agent is associated with a literacy goal. Finally, in addition to these qualities, autonomous agents exhibit complex goal-driven behaviors that are more adequately explained by the attribution of intentionality than they are by design or causal mechanisms. In agent-based literacy theory the term autonomous agent is synonymous with the term reader. Like transactional theory, agent-based literacy theory assumes autonomous agents have goals and understands literacy in terms of those goals. Unlike transactional theory, agent-based literacy theory acknowledges the possibility of nonhuman autonomous agents (e.g., machine readers), suggesting that it may be useful to think about an interactive website like Amazon.com as a reader, not simply as a text.

One way to visualize how agent-based literacy theory alters our view of reading is illustrated in Figure 1, depicting literacy events involving print (A) and autonomous text (B). In this figure R refers to a human reader (an autonomous agent) and T refers to a text (which may or may not be autonomous). Figure 1A illustrates reading as traditionally understood, with a single autonomous agent R appropriating a nonautonomous text T, as indicated by the assignment of intention from R to T. In addition, still adhering to a traditional model, there is an assignment of utility from the text to the reader (e.g., information in efferent reading and pleasure in aesthetic reading, as typically conceptualized in transactional theory), and a single-reader event model (Mₐ), representing the human reader’s view of the reading event. In contrast, Figure 1B, illustrating an interaction more like those at Amazon.com, involves two autonomous agents (i.e., two readers) leading to three significant changes. One change is that agent intentions now flow in two directions because both agents bring goals to the reading event and both act on the reading environment in pursuit of their goals; customers act to minimize expense and Amazon.com offers personalized discounts to induce customers to spend more. A second change is that utility also flows in two directions because, while both agents act in pursuit of goals, they also serve as agents (i.e., texts) for each other; customers are useful to Amazon.com just as the site is useful to its customers. A third change is that there are now two dif-
ferent views of the reading event, one (MR) generated by the human reader (e.g., “I got a bunch of great deals at Amazon.com!”) and a second (MT) generated by the autonomous text (e.g., “Remaindered inventory is at our lowest level ever!”).

Literacy roles, however, are determined by what actually occurs during a reading event. Text that operates solely in support of a human reader’s goal is not usually viewed as autonomous. Text observed to behave in support of its own goals, however, as when Amazon.com displays different content based on users’ past behavior at the site, can be viewed as an autonomous agent (i.e., a reader). Establishing a clear and well-grounded view of role assignments in a literacy event, therefore, has important consequences for outcomes, as illustrated in situations where an autonomous text with a hidden agenda (e.g., an e-mail virus) is taken as a static document. In this case, what appears to be a simple engagement of a reader with a static text is really an unwitting interaction with another goal-driven agent. The two situations depicted in Figure 1, therefore, represent archetypes for two distinct types of literacy events. (See d’Inverno & Luck, 2001, pp. 51–59 for a formal analysis.) Figure 1A depicts an engagement, a literacy event involving a single autonomous agent, as when a person reads print. In contrast, Figure 1B depicts a cooperation, a literacy event involving multiple autonomous agents, each bringing goals and each generating an event model that guides action by the agent in the literacy environment.

**Literacy events: Engagement and cooperation**

This section elaborates on, and explores implications of, the two types of reading events described in the previous section. An *engagement* is initiated when an autonomous agent (e.g., a human reader in traditional theory) appropriates an object (e.g., paper, ink) in support of a literacy goal and, in doing so, assigns that object to an agent role. An *cooperation* differs from an engagement in two related ways. One difference is, whereas engagements involve a single autonomous agent, cooperations involve at least two autonomous agents that share control of the literacy event as illustrated in the Amazon.com example. In addition, because multiple autonomous agents are involved, there are multiple goals driving the reading event. Establishing a cooperation, therefore, typically requires an agreement or negotiation among the agents involved. A search engine, for example, can be viewed as an autonomous agent that pursues its own objectives in its interactions with readers. Although readers use search engines to achieve their objectives (i.e., to find materials on the Web), search engines also have objectives of their own, and the use of a search engine involves negotiation, even if it is implicit. In using a search engine, readers tacitly agree to let the search engine use information about them (i.e., their search terms) in support of its goals, usually related to advertising.

Whereas reading print or static webpages can reasonably be interpreted as putting human readers in the role of autonomous agent and text in the role of a nonautonomous supporting agent, literacy events such as those at Amazon.com or search engines may be better understood in terms of multiple autonomous agents. This variability in role assignments means, however, that successful reading will depend on readers’ judgments about role assignments in literacy events, and readers must acknowledge that control of the reading event may be shared. When reading a newspaper, I can enforce my reading goal by only...
attending to material addressing my interests and ignoring the rest. When my reading involves a cooperation, however, I relinquish some of my control because an autonomous text responds in pursuit of its own goals (e.g., popping up ads), rather than simply satisfying the goals that motivate me as a reader.

A second implication alluded to in the Amazon.com example has to do with a reader’s capacity to model a literacy event by constructing a view of the agents involved, roles they have assigned, and, in the case of other autonomous agents, the goals that motivate their behavior. Because sales depend on customers, Amazon.com routinely models customer interests and uses that information in adapting content. Human readers engage in similar behavior when they recognize the implicit goals of search engines and ignore an advertisement presented as a “sponsored link,” the Web equivalent of an advertisement in print dressed up to look like an article. If, as a reader, I have developed strategies that allow me to recognize when a literacy agent (e.g., a search engine) has goals of its own, I am in a position to more effectively achieve mine. If, however, I have an incomplete or inaccurate view of the literacy event, I am less likely to achieve my objectives. What I perceive to be an engagement may, in fact, be a cooperation in which I am manipulated. Interaction can magnify benefits for readers, but it can also create adversarial situations where the goals of one agent conflict with the goals of another, making the call for a critical online literacy of great importance (Leu, Kinzer, Coiro, & Cammack, 2004; Semali & Pailliotet, 1999).

Modeling the literacy event

The preceding section calls attention to a question concerning reading events that involve multiple autonomous agents: What do autonomous agents “know” about reading events and how is this knowledge applied in the pursuit of goals? What does it mean to say that an agent “models” a literacy event? Agent-based literacy theory certainly accommodates simple agents that do not model their environment and are better explained with a design stance (e.g., print), but it also supports text that operates as a more complex deliberative agent as proposed by Wooldridge (2000) and Wooldridge and Jennings (1995). A deliberative agent is capable of representing both its immediate environment and the goals and models of other autonomous agents, what Dennett calls first-order and second-order modeling, respectively (1987, p. 243). Web retailers, for example, have made second-order models of customer interests an integral part of online marketing, offering personalized advertising and discounts based on browsing behaviors and purchasing histories. Understanding and responding to customers clearly benefits from modeling customer goals. Moreover, although modeling can obviously go beyond identifying agents, roles, and goals, only this relatively coarse level of definition is required in broadly defining agent-based literacy theory in this essay. In what follows, therefore, the term model refers to the ways individual readers informally apply the concepts of agent-based literacy theory (i.e., agents, roles, and goals) in their capacity as readers.

Model building is also one plausible reason electronic reading environments highlight limitations of traditional theory and suggest an agent-based framework. Specifically, electronic environments for reading introduce a form of procedural text (i.e., programming) that can create persistent internal representations of reading events (i.e., models) that can be applied in subsequent action. Furthermore, models influence the likelihood a reader will achieve a literacy goal in important ways. A naive reader, for example, using a manipulative search engine that surreptitiously mixes advertisements with other links might assume there is only one autonomous agent operating in the environment, ignoring the possibility that a search engine is operating in pursuit of its own objectives (see Figure 2). In such cases, however, naive readers define the reading event in a way that may disadvantage them compared to an agent that more accurately models the reading event as involving two autonomous agents with different goals.

Agents with different goals in a shared literacy event, however, need not always be viewed as locked in a competition where the completeness or accuracy of modeling provides strategic advantage. Benign or even useful examples of deliberately limited modeling involve the use of agents designed specifically to assist human readers (e.g., Chau, Zeng, & Chen, 2001; Herder & Van Dijk, 2002; Hirsch et al., 2000). Even if such agents operate autonomously, their human users may prefer not to model them as autonomous because this only complicates the reading model without any additional benefit. Moreover, from the perspective of a trusting user, there is a good reason to adopt a simpler model: the cost of maintaining a more complex model. In some cases, a cruder model may be more than enough for an agent to achieve its goals. In other cases, an incomplete or inaccurate model may significantly reduce the effectiveness of an agent (e.g., in a deliberately manipulative situation involving a virus-laden e-mail). Modeling, therefore, involves balancing potential benefits against the costs of building and maintaining models (Carmel & Markovitch, 1999).
Three literacy events: Agent-based literacy theory in print and online

This section presents three examples exploring consequences of agent-based literacy theory, two that focus on traditional print with the goal of demonstrating how agent-based literacy theory subsumes and extends traditional theory, and one that focuses on elements unique to online reading. The first example considers role assignments and the “lived-through” experience of the reader (Rosenblatt, 1994, p. 27). The second example reconsiders a classic example of reading-to-do (Mosenthal, 1996), focusing on the connection between written language and other types of signs. The third example presents an online literacy event involving multiple human and machine agents exploring text autonomy and the concept of comprehension in multi-reader literacy events.

Example 1: An aesthetic engagement in print

The first example considers reading for pleasure in traditional print. In transactional theory (Rosenblatt, 1994, 1995, 2004), a reader’s purpose for reading is captured in a general way by the concept of *transactional stance*. Readers who adopt an efferent stance are typically described as looking for information, while those adopting an aesthetic stance are viewed as having a more process-oriented emphasis on the reading experience. A mystery novel selected for recreational reading highlights the fluid character of stance during a reading transaction. The reader of such a text generally does not require or want supporting resources (e.g., dictionaries, commentaries). Rather, there is a presumption that reading for pleasure will be self-contained, providing for a satisfying and not-too-demanding experience with little need for support. At the same time, however, one distinguishing feature of the genre is that it sometimes relies on factual details and logical (and,
usually, not immediately apparent) explanatory structure, both of which are more commonly associated with efferent reading (Beach, 1993; Willerton, 2000).

The difference in the case of the mystery novel is that the exploration and synthesis of factual information have a looser relationship to external circumstances; it simply serves to create a special kind of reading experience. The literary license that supports aesthetic experience, however, is not arbitrary; otherwise, we would not experience the literary text as either meaningful or satisfying. Rather, the literary text relies on more general patterns of coherence defined by aesthetic strategies (Iser, 1978) that readers apply—Does the work honor established conventions of the genre while not being defined entirely by them? Are characters believable? Is the plot plausible and so on. If the reader is successful in applying these genre-related strategies, the text will generally provide a satisfying aesthetic experience.

The perspective of an agent-based approach conforms to such a traditional analysis with two notable differences. One difference is when role assignments in the literacy event are determined. Whereas traditional theory predetermines reader and text assignments, an agent-based approach begins with a generic model that is elaborated as evidence from the reading event accumulates. Figure 3 illustrates the application of agent-based literacy theory in defining a reading event model at three hypothetical stages. In the initial stage (Figure 3A), the model consists only of a generic framework involving agents whose roles in the reading event have yet to be determined (indicated by the question marks). As the reading event continues, however, evidence begins to accumulate that one agent (agent R) is operating in an autonomous fashion, suggesting that the event is an engagement (Figure 3B). Typically, this is as far as the model develops in print. In the context of the mystery novel, we distinguish a human reader and a printed text and focus on a single event model (i.e., the reader’s). If, however, the mystery novel takes the form of an interactive electronic text or video game, we may be required to acknowledge multiple autonomous agents and event models, setting aside our earlier view of the event as an engagement in favor of a cooperation (Figure 3C).

Therefore, one important difference in an agent-based approach is that it acknowledges initial uncertainty regarding agent roles and relies on observation to build a model as the reading event unfolds. Although it might seem theoretically rigid to withhold the attribution of autonomy to a human reader until observation supports this interpretation, it is important to remember that reader and text represent functional roles and online literacy events routinely occur in virtual environments where none of the agents involved may be physically present (e.g., chat), so the usual physical cues that allow us to distinguish human readers and text are not available. What matters is what these agents do, and with the growing interactive potential of online text there are good reasons to avoid a presumption that a human reader is an autonomous agent while text is not.

A second important difference has to do with the nature of the lived-through experience, a concept central to transactional theory (Rosenblatt, 1994). Whereas transactional theory relies on a loosely defined family of complex concepts (i.e., evocation, response, interpretation), an agent-based approach takes a functional approach to conceptualizing the experience of literacy agents. One example of a more functional view of an aesthetic response is simply recommending a literary work as likely to satisfy another reader’s interests (as exhibited at Amazon.com). In this broader view, a machine agent might assess the qualities of a text with simple keyword matching, latent semantic analysis (Dumais, 2003; Landauer, 1999), and text/data mining technologies (Dörre, Gerstl, & Seiffert, 1999), or rely on what it learns from human readers who purchase or comment on literary works (Hu & Liu, 2004). An agent-based approach, therefore, requires a broader view of the term experience than is typical in traditional theory because machine agents have a capacity to respond to literature in some sense. A commitment to pragmatism requires that we understand the concept of experience in terms of the behavioral semantics advocated by Dewey (Garrison, 1994). In this view “meaning is not indeed a psychic existence; it is primarily a property of behavior” (Dewey, 1981, p. 141). In other words, if we seek evidence of an aesthetic experience we must look to the way the behavior of an agent changes in response to a literary work and, from this perspective, when Amazon.com makes recommendations about literature, this may serve as evidence of an aesthetic response in at least a limited sense. Moreover, because an agent-based approach (like transactional theory) views transactional stance as a continuum, there is no basis to reject the capacity of autonomous text to respond aesthetically if we acknowledge the possibility of efferent response, something that seems difficult to deny. Given these considerations, it is important to avoid defining “experience” and other aspects of the literacy event in specifically human terms. A more productive approach, in keeping with a commitment to pragma-
Agent-based literacy theory

The second example is one traditionally cited (Rosenblatt, 1994; Karolides, 1999) as an example of efferent reading: the reading of a print label by a mother who fears her child has ingested poison. In this example, certain aspects of the situation take on special significance and the mother’s attention is directed in specific ways. Rosenblatt’s analysis relies primarily on the concept of stance, noting that when the mother reads the word *water*,

She would pay attention to what it pointed to, its referent, its public aspect. She would not pay attention to her many associations with the word, from sensations of refreshing coolness to “water, water everywhere” and other oft-repeated lines of verse. She would push these into the fringes of attention. She would ignore her own emotional state, even though she might recall it later. Her attention would be centered on the most abstract referential aspects of meaning—what objects to reach for, what actions to perform after the reading ends. (Rosenblatt, cited in an interview by Karolides, 1999, p. 165)

However, Rosenblatt considers this reading event in largely aesthetic terms that focus more on what is not going on than on exploring how environmental, referential, and symbolic signs shape the reading event. In this example, the mother’s understanding of the text must be aligned with a specific set of observations that are not essentially symbolic. This literacy event depends in a critical way on aligning two related acts of interpretation, one based on environmental signs and another based on written language. The mother’s interpretation of the physical environment and her interpretation of the text must align in order for this problem to be resolved; there must be a larger coherence that bridges signals (e.g., the smell of her child’s breath), referential terms (e.g., *water*), and symbols (e.g., syntactic and logical connectives; see Dewey & Bentley, 1949).

The mother’s attention to the environment and the text are both highly selective, focusing on aspects most directly relevant to her purpose. Bathtub toys in the corner are quickly passed over, as are technical descriptions of the chemical makeup of the material printed on the bottle (unless she is a chemist). And just as the open bottle attracted her gaze, so does a notice printed at the bottom of the label indicating the material in question is caustic, resulting in burns to sensitive skin. At this point she puts down the bottle and examines her child. She tentatively concludes no material was handled or ingested because the child’s hands, face, and mouth show no evidence of burns and the smell of her child’s breath is normal. She returns to the bottle looking for other cues.

In Rosenblatt’s analysis, the reader’s task is to seek out information to determine “actions to perform after the reading ends [my emphasis]”
Example 3: An online cooperation as reading-to-do

This example, like the previous one, focuses on a complex problem-solving situation requiring attention to both text and environmental cues, but this example introduces environmentally aware machine agents to support human decision making. Specifically, the example explores reading-to-do literacy practiced by first responders to an emergency situation (Wagner, Phelps, Guralnik, & VanRiper, 2004).

The difficulty of individuals working in teams responding to large-scale emergency situations is well documented (National Commission on Terrorist Attacks Upon the United States, 2004). In this example, human and human–machine teams were presented with a scenario involving a fire at a petrochemical facility that required evacuation of people, containing or extinguishing fires, and other supporting tasks related to the general goals of saving lives and protecting property. Simulations were based on four teams that arrived at the facility at different times and, in coordination with other teams, were assigned tasks that arose as the simulation unfolded. Unlike the human teams, which relied exclusively on human judgment and walkie-talkie communication, each human–machine team was equipped with a wireless personal digital assistant (PDA). PDAs served primarily as displays, relying on a server that provided information (e.g., building plans, staff directories, emergency plans), supported team agents and the network within which they operated, and tracked the location of team members and resources (e.g., fire extinguishers, ladders, hydraulic cutters) tagged with radio-frequency devices.

Reporting on the results of the simulations, Wagner et al. (2004) indicated that their human teams were overwhelmed, exhibiting obvious signs of stress, and unable to coordinate the various aspects of their assigned tasks. In contrast with these human teams,

Where the mother in the second example operated as a single agent coordinating text and environmental cues, this example presents a scaled-up version of the same kind of problem in a distributed system that does not operate under the centralized control of a single reader. As I discuss in the Implications and Conclusions section, the distribution of a literacy event across multiple autonomous agents has implications for the way we conceptualize
comprehension and inference by literacy agents because "reasoning and information exchange is all distributed—in theory no agent has a complete view of the activities of the other agents" (Wagner et al., 2004, p. 1144). This example also reinforces the value of aligning text and environment to support reader understanding where technology extends human perceptual and cognitive limits. Human–machine teams could essentially see through walls as a result of the digital integration of building plan documents and perceptual data gathered from radio-frequency tags. While the human teams struggled with cognitive overload, the human–machine teams had cognitive resources to spare.

Another element that distinguishes this final example from the previous two is its focus on the issue of autonomy. Although the builders of this system certainly consider COORDINATOR agents from a design stance, it is equally clear that users of the system are better served by adopting an intentional stance, given the complexity of the system and the open-ended nature of the problem. The only practical way a human observer could possibly evaluate recommendations in real time is by adopting an intentional stance that judges the behavior of the system in terms of general values (e.g., preserve life, protect property), situational knowledge (e.g., building plans, flammability of materials, presence of people), and strategies consistent with that knowledge and the pursuit of those values. It is relevant to note, however, that while machine agents in this example perceive the environment in which they operate, they do not act directly on it, suggesting a different kind of autonomy than that exercised by human participants. However, the restriction of COORDINATOR agents to advisory roles simply reflects the fact that this system is a prototype in which agent roles will certainly evolve as they have experienced by a person who speaks Chinese.

But functional equivalence (or even performance that exceeds human agents) may not convince those who view intentionality as a uniquely human state, a position in direct conflict with the pragmatic view of autonomy and intentionality adopted in agent-based literacy theory. It will, therefore, be important to consider and respond to one important and widely discussed challenge to the concept of a machine reader: the argument that nonhuman agents cannot be readers because reading requires an understanding that is uniquely human. The response I present in the following section is a reductio ad absurdum argument demonstrating that the cost of defining understanding (and therefore literacy) in uniquely human terms is unacceptable, both in terms of common sense and our commitments as literacy researchers to public warrants and shared knowledge.

### Machine readers and the Chinese room

A machine reader essentially reframes a question that has been a source of debate since Turing (1950) first raised the question “Can a machine think?” The connection linking machines that think and literacy agents is that when the idea of a machine reader is pushed to its logical endpoint, it becomes an artificial intelligence in the sense that Turing defined it. Briefly, Turing proposed that a machine should be considered “intelligent” if a human, using only text-based interaction, cannot distinguish it from a human being. In effect, Turing proposed that literacy competence serve as the basis for defining intelligence, following the lead of 17th-century philosophers (Webb, 1980). Some argue, however, that functional competence is not equivalent to understanding. John Searle (1980, 1984), one of the most notable of such critics, presented what has come to be known as the “Chinese room” argument in support of this position.

Searle's Chinese-room argument, originally published in a format that included commentary by 27 other scholars, has produced a related literature of well over 100 articles and numerous books, chapters, and edited volumes (Hauser, 2001; Pinker, 1997). Searle proposed that we consider a situation where a person sits hidden in a room. On one side of the room is a slot through which papers with Chinese writing are submitted. Within the room, a set of reference materials allows the person inside (who does not speak Chinese) to generate a Chinese response that is pushed out a slot on the other side of the room. Searle contended that even if linguistic competence is granted (i.e., the answers that come out "are as good as those of a native Chinese speaker" (1984, p. 32), people in the room do not understand Chinese because they are simply executing a mechanical algorithm. Searle claimed that, while behavioral competence is necessary, so is the mental state experienced by a person who speaks Chinese.

Problems with Searle's reliance on internal states are highlighted by the "systems" response to Searle's position (Boden, 1990; Dennett, 1991; Rey, 1986). In the systems response, the person in the room is only one element in a larger system, and, therefore, this one element need not understand in
the first-person sense. Searle’s reply was to allow the person in the room to internalize the symbol conversion system by memorizing all the materials and steps involved in generating responses. He suggested that the person who does this will, on introspection, still experience the same mental state, again affirming the privilege of the first-person account that distinguishes the mental states of the native speaker and the person in the room.

A more pragmatic approach to this situation, however, underscores that what Searle perceived to be common sense has surprising implications. People who have internalized the Chinese room now interact with Chinese-speaking people fluently. Every response is plausible and well formed. But when we ask these people whether they understand Chinese, they respond, “No” (according to Searle). Despite our observations of their flawless interaction, the Chinese-room speakers insist that they do not understand Chinese. When asked in Chinese to account for the apparent contradiction, they explain in Chinese that they are just following a set of syntactic instructions and therefore cannot really understand. But the private mental state Searle claims is missing can never actually be revealed, and it is important to ask whether an assertion, based on private states, that contradicts so much of our everyday experience should be taken at face value.

Language requires a public grounding, even when the subject under discussion is a private state. Someone who converses with Chinese-speaking people while simultaneously claiming not to understand will reasonably be judged deluded or a practical joker. Furthermore, although I might prefer absolute authority in speaking about my internal states (e.g., perceptions, intentions), there is ample empirical evidence that introspection is an unreliable guide. Phenomena such as blindsight (Weiskrantz, 1986, 2002) and subliminal perception (Dixon, 1971; Merikle & Daneman, 1996, 1998) clearly illustrate that the privileged introspective views we have on our internal states may be mistaken (see Wegner, 2002, for an intriguing review of this work). Finally, from the broader perspective of a language/research community, we must be prepared to judge whether real or imagined private mental states matter more than the public meanings that are produced. To hold that private states take precedence over public interpretations is contrary to the pragmatic commitments we have adopted and practical issues we must consider in literacy research. Although the concept of a machine reader may be unfamiliar or even induce discomfort by challenging the special status traditionally assigned to human agents, the nature of online reading environments and a commitment to a pragmatic and empirical approach in literacy studies suggest there are both theoretical and practical reasons to entertain a broader view of literacy that includes machine readers.

Implications and conclusions

The introduction to this essay identifies three main objectives. The first objective was to consider limitations of traditional literacy theory in responding to the issues of text structure, text content, and text behavior in online reading environments. This review suggests that literacy theory has been unnecessarily and unproductively constrained by conceptualizations of reader and text and that there are now theoretical, practical, and pedagogical reasons to consider a different approach. The second objective was to define a literacy framework relying on the concept of literacy agents rather than the traditional concepts of reader and text, with the goal of defining a more general approach that both subsumes theory as traditionally understood and extends it in ways that address its limitations, particularly in its application to online environments. Three features of this restatement of literacy theory were presented as especially significant: the nature of role assignments in the literacy event, the emergence of two distinct types of reading events (engagements and cooperations), and the part reading event models play in defining reading events both for individual readers and for reading researchers.

Although traditional theory makes a priori assignments of autonomous and nonautonomous agent status to human readers and print, respectively, online literacy events may refute this assumption. A pragmatic view suggests roles should be assigned on the basis of observation rather than theoretical fiat. E-mail filtering software, for example, sorts spam, viruses, and real e-mail on the basis of observation. Readers and literacy researchers will need to make similar kinds of judgments in studying literacy online where it may be difficult or impossible to distinguish the activities of human and nonhuman agents. If there is evidence that an agent initiates literacy events by, for example, hijacking a reader’s browser homepage or pursuing goals of its own in a contingent way like that demonstrated by adaptive content at Amazon.com, there is at least preliminary evidence for an autonomous role assignment. If, on the other hand, observation suggests an agent simply adopts the goals of other agents, assigning non-autonomous status may be warranted. These kinds
of observations are an essential aspect of the decisions individual readers make in defining their views of literacy events and are central as well in the broader kinds of understanding literacy researchers seek, particularly when studying literacy involving electronic texts. The second element of an agent-based approach that distinguishes it from more traditional views is the distinction it makes between two different types of literacy events. Engagements, involving a single autonomous agent, are literacy events that correspond to a traditional view. Cooperations, however, are literacy events that involve multiple autonomous agents and, as a result, introduce the possibility of conflicting goals and deceptive agents (Yu & Singh, 2003). Finally, understanding a literacy event may require a view that includes multiple potentially conflicting reader event models. A single model will suffice in the case of engagements, but a single model will not be sufficient in cases that involve multiple readers; understanding reading at Amazon.com may require considering the perspectives of both customer and retailer.

The third objective was to explore the application of agent-based literacy as a predictive and explanatory framework in support of new ways of thinking about literacy involving multiple human and machine agents. The most obvious demonstration of the utility of an agent-based approach lies in its capacity to more fully describe and organize literacy events that traditional theory cannot explain or does not acknowledge (e.g., search engines, e-mail viruses). Theoretical systems, however, must go beyond description in order to be useful. Ultimately, it is important that agent-based literacy theory support ideas that can be empirically tested and applied in practice and pedagogy. The most important testable predictions of agent-based literacy theory are hypotheses related to the consistency and completeness of event models, particularly in literacy events involving multiple autonomous agents. As noted earlier and illustrated in Figures 2 and 3, event models may change during a reading event and situations can arise where one agent’s model is less complete or well grounded than another’s. This possibility has the potential to disadvantage an agent with a less complete or accurate model when the goals of readers conflict.

One line of research suggested by agent-based literacy theory is, therefore, to study literacy events when readers’ goals conflict. The prediction of an agent-based framework is that the accuracy and completeness of reader models (human or machine) are directly related to success when cooperations involve conflicting goals. More specific predictions relating reading outcomes to modeling omissions or inaccuracies are also possible but depend on the circumstances of individual reading events. For example, the decisions a reader makes reviewing e-mail or instant messages reflect the model the reader has defined. Models limited to engagement will lead to different responses than models that acknowledge other autonomous participants. Moreover, there are well-established tools for analyzing this kind of decision making. Game theory has been applied in a wide range of situations involving agents with competing goals including auctions (Lucking-Reiley, 2000) and recruiting and placement of medical interns, law clerks, and professional athletes (Roth & Xing, 1994). Furthermore, its application in analyzing agent interaction online is an active area of research with potential in the design, analysis, and empirical evaluation of interactions among literacy agents (e.g., Parsons & Wooldridge, 2002; Rosenschein & Zlotkin, 1994). One instance where a game theoretic approach has already been useful is in modeling interactions of e-mail readers and spammers, resulting in testable predictions about optimal filtering strategies for readers and expected ratios of e-mail to spam when equilibrium is attained (Androutsopoulos, Magirou, & Vassilakis, 2005).

A second line of research concerns the relation between stance and criteria established to warrant assertions about literacy events. Agent-based literacy theory suggests a reader’s stance will influence the kind of warrants required to support interpretation. Aesthetic reading, as traditionally understood, relies on primarily linguistic and epistemological warrants (i.e., the narrative must cohere and be consistent with a reader’s beliefs about possible worlds). Efferent reading, however, and particularly reading-to-do, typically require more specific warrants across a wider range of signs (Dewey & Bentley, 1949), as illustrated by the poisoned child and emergency responder examples, where environmental observations and language must be aligned. Although these reading-to-do tasks are complex, requiring manipulation of multiple types of signs, connections between print and environment provide potentially important sources of reader support. The reading of a print label or building plan will prompt attention to environmental cues in a way that will not occur in the absence of the text. Likewise, environmental circumstances will alter the way a reader attends to or interprets a text.

The capacity of a reader to make use of different types of signs in ways that help them achieve goals, however, will depend on what those signs suggest about one another. When a print cue indicates a
skin irritation is likely to result from contact with a substance, this represents a prompt to attend in a specific way to the environment. Likewise, evidence that a substance has been ingested is likely to prime attention to portions of a text that refer to ingestion. In a case where a reader makes no connections between word and world, however, opportunities to explore and to extend the first response are more limited. Success in efferent reading-to-do tasks should, therefore, be sensitive both to the immediate relevance of cues to the literacy goal, and on the implicit information different types of signs provide about one another. In other words, efferent reading depends both on effective use of sources of information and on what different sources of information suggest about one another. Redundancy across different sources of information is useful, but observations specific to one source of information that lead readers to explore environments or texts in new ways may be even more important, a thesis that can be examined with appropriately designed texts, environments, and tasks.

A third line of research concerns reading events that involve multiple autonomous agents. As noted earlier, these events can include situations where agents are in adversarial relationships with one another and this has consequences for the event as a whole. Multiple autonomous agents can, however, also work in support of one another, and this kind of event may lead to the counterintuitive outcome that, as the likelihood of achieving a goal increases, measures of the understanding of individual agents may decrease. In the case of first responders to an emergency situation, for example, different teams attend to different aspects of the larger problem. The understanding of each team or individual, therefore, is local in the sense that “no agent has a complete view of the activities of the other agents” (Wagner et al., 2004, p. 1144). Furthermore, even the understanding of a human commander is local in the sense that this is a high-level view that, by necessity, ignores team-level details. Although cooperations can increase the likelihood that a problem will be solved, a distributed approach to conceptualizing and solving problems no longer requires that individual agents establish and maintain a complete event model. Distributed literacy events like the emergency responder example may actually discourage individual agents from developing a global understanding if the event can be more effectively managed by agents that operate locally. When assessment focuses on individual agents rather than the event as a whole, however, individual views may only make sense when, like the tale of the blind men and the elephant (Saxe, 1936), a broader perspective is adopted.

In addition to suggesting new empirical questions, agent-based literacy theory redefines our views of readers and texts to better account for both traditional and online literacy events. As illustrated in the poisoned child example, an agent-based analysis can provide a more systematic and empirically grounded view of efferent reading and the relation of printed text and environment. This example acknowledges the potentially critical role of environment in traditional settings and provides a broader view of literacy that emphasizes the relationship of text and action, suggesting an alternative view of the stance continuum where efferent reading is anchored by the concept of action rather than information. Agent-based literacy theory also brings a new perspective to the dynamic online environments within which literacy skills are increasingly applied, with implications that span practice, pedagogy, and system design. As has been noted, agent-based literacy theory distinguishes different types of literacy events that are crucial in understanding novel aspects of online literacy environments. It also provides a basis for integrating agent-based theories of system design (e.g., d’Inverno & Luck, 2001; Shoham, 1993; Wooldridge, 2000) with an agent-based view of literacy so that interactive reading environments can better accommodate the goals and contexts that define literacy for human readers. Agent-based literacy theory, for example, might operate as the larger framework within which taxonomies of reader goals and search strategies (e.g., Guinee, Eagleton, & Hall, 2003) are applied by search engines in modeling and responding to readers. Likewise, literacy researchers and educators may find that an engineering perspective on electronic reading environments will lead to new pedagogical content and strategies. It is clear, for example, that a basic understanding of technologies such as cookies (Millett, Friedman, & Felten, 2001), URL syntax, http error messages (Spinellis, 2003), and the logic of the browser “back” button (Cockburn, McKenzie, & JasonSmith, 2002; Golovchinsky, 2002) influence the effectiveness of readers online, and instruction should promote and support this kind of understanding.

Finally, agent-based literacy theory defines a new type of online literacy event (i.e., a cooperation) that has implications for instruction. While traditional pedagogical practices will continue to be useful, literacy practices designed for print such as comprehension strategies based on fixed authority-defined structures (e.g., Meyer & Poon, 2004; Pearson & Camperell, 1994) may not transfer to
dynamic documents that are driven by embedded programming or static online materials that depend on reader-selected links. But this kind of literacy is especially demanding of readers both because it puts more responsibility on readers to organize text and because it introduces the possibility that reader goals may conflict with the goals of autonomous text. In cooperations, reader and text negotiate on the basis of multiple agendas and event models that are evolving in real time, creating a significantly more complex literacy environment. Of course, the power of these environments can be applied to the benefit of readers. Autonomous text can be designed to adapt to the needs and interests of users in creating pedagogical scaffolds (McKenna, 1998; Reinking, 2001) and other types of adaptive support (Anderson-Inman & Horney, 1998; Leu, 2000; Leu & Hillinger, 1994). But the same technologies used to create support for readers can also be applied by agents pursuing objectives that conflict with those of human readers. How should we prepare students for this kind of literacy? The blunt and not-so-reassuring truth is we don’t really know, in part because our theory is only beginning to accommodate the dynamic nature of these environments. Agent-based literacy theory offers a preliminary step in addressing this need.

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EDITORIAL NOTE

The version of this article accepted for publication included an example quoted from Scientific American and a cartoon from The New Yorker. The manuscript was revised to avoid the use of these copyrighted materials because the cost of obtaining permissions was prohibitive. The substantive content of this article has not been jeopardized by this necessary revision.

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