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Correspondence, coherence, complexity: Theories of learning and their influences on processes of literary composition

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ABSTRACT: In this article, the authors interpret an event of collaborative poetry writing in a pre-service teacher education class in order to demonstrate the ways in which different theories of learning are and are not able to account for the production of original poems. The first part of the paper offers a conceptual heuristic that organizes a variety of different theories of learning into three categories: correspondence, coherence and complexity theories. For each of these categories, the authors offer a definition, a brief exposition of origins, an overview of key assumptions, and a discussion of their applications and implications for processes of learning. The second part of the article describes conditions of complexity that are useful for both creating and interpreting events of learning and teaching, with specific reference to the poetry-writing activity.

KEYWORDS: Composition, learning theories, complexity science, poetry, curriculum

Considerable discussion and debate among literacy education researchers over the past several decades has been prompted and oriented by some fairly radical breaks in opinion on the natures of language, learning and knowledge (Cunningham & Fitzgerald, 1996; Dillon, O'Brien, & Heilman, 2000; Gaffney & Anderson, 2000). This has been especially so in literary studies, where debates about the authority of the text, the author and the reader continue to influence they ways in which literary texts are taught in schools (Author 2, 1996; Beach, 1993; Dixon, 1967). As Beach (1993) has explained, a variety of different theoretical beliefs about what constitute the "reader" the "text" and the "reading of the text" and the "effects of that reading" have had and continue to have an impact on pedagogical practices. What is often not noticed or made explicit is that underlying all theories of literacy are theories of learning (Sumara, 2002).

Following the work of poststructural theorists such as Foucault (1988) and Derrida (1978), many literacy researchers have come to view language and literacy practices as contributing to the human subject's ongoing development of personal and cultural identities (Sumara, 2002; Luce-Kapler, 2004; McCarthey, 1998; Mahiri & Godfrey, 1998). However, it is important to note that while influences of poststructuralism on literacy research have been significant, other influences continue to have their effects on both the development of theory and practices. As Davis (2004) suggests, new theoretical perspectives do not necessarily *replace* older ones; they enter as discourse *alongside* others. Furthermore, as Foucault (1988, 2004) has argued, competing discourses that regulate human action and experiences of identity are continually in tension with one another, creating conditions for learning that are both generative and restrictive.

Because there has been so much theoretical literature devoted to these issues, it is difficult for researchers to maintain a global understanding of how different theoretical perspectives on learning exist in relation to one another and how these orient literary learning and literary education practice. And, in fact, we would argue that developing any sort of fixed "general" understanding of these complexities cannot occur, simply because both old and new theoretical frameworks continue to evolve and change in relation to one another (Davis, 2004). However, at the same time, we also argue that creating a set of categories to understand a *possible* way of representing different theoretical perspectives on learning as they apply to literacy research can be useful for those of us who are interested in trying to more deeply understand how literary practices shape human learning.

Rather than attempting to summarize these vast literatures, we borrow from semiotics and linguistics the phrases *correspondence theories* and *coherence theories* to refer to the two main discourses represented in current literacy education literature. We also develop a third category that we refer to as *complexity theories,* borrowing this phrase from a transdisciplinary movement that began in the middle of the last century. For each of these three attitudes, we offer a definition, a brief trace of their origins, an overview of key assumptions, and some discussion of their applications and implications for processes of learning literary composition.

In the first part of the article, we develop a conceptual heuristic that, we believe, will help those working in the field of literacy education to better understand how practices are influenced by competing and contradictory theories of learning. In the second part of the article, we describe some "conditions of complexity" that we have found to be useful in creating and interpreting events of learning and teaching. We are including these to illustrate how theoretical knowledge emerging from the complexity sciences can both inform pedagogical practices and, as well, how an examination of the presence of these conditions can assist with analyses of already-enacted pedagogical practices. Before characterizing these movements, we offer a first person narrative of a classroom activity, taught and narrated by Sumara. We will refer back to this example throughout the article to foreground and illustrate some of the obsessions, shortcomings and possibilities of the three categories of learning theories.

WRITING POEMS[1]

> *It is a bitterly cold day and I am giving a poetry-writing workshop to a group of beginning teachers. To start, I ask them about their previous experiences with poetry writing. They tell me familiar stories:*
>
> > *"We were told to just write what we felt."*
> > *"We were told to write a sonnet for our Shakespeare unit."*
> > *"I remember writing free verse poems."*

[1] We are indebted to Rebecca Luce-Kapler for this poetry-writing exercise. Her latest book *Writing with, through and beyond the text* (2004) depicts similar activities and, as well, shows how writing and interpretation practices can function as complex sites for educational research.

From what the students tell me, it seems that poems were seen as artifacts that could either be plucked from the air or extracted from deep inside one's inner being. I tell them to forget everything that they think they know about writing poetry. Then we begin.

I spread a collection of buttons on a large table in the middle of the classroom and invite students to choose one that is "interesting" to them. I ask them to examine their buttons and decide what sort of article of clothing was previously attached to it and to imagine the person who is wearing this article of clothing. With a partner, I ask them to share what was imagined and create a situation where these two people meet. As they are making these decisions, I move around the room passing out envelopes that contain photographs. I ask the pairs of students to examine the photographs and answer the question: What happened just before this photograph was taken? I then ask them to incorporate this event into the situation that they just invented for their two characters. Next, I ask students to work together to write a couple of paragraphs that represents the plot they have just invented. I ask each pair to show the class their buttons and photographs and to read the paragraphs aloud that they have just written. Even though they have only been working on this activity for about 30 minutes, they have created complex plots and interesting characters.

Next, I present students with examples of several contemporary narrative poems.[2] *I ask them to read these to one another in their groups, paying attention to how the author of the poem has created poetic effects. For homework, I ask the students to collaborate with their partners to choose one of these poems that they found appealing and use it as a model for a new poem that they are to create together, using the plot developed from the button/photograph activities. I remind them that they must collaborate with one another throughout the process of creating the new poem. The next day, I ask students to read aloud the small poems they have created. Here's one written by Janine and Rick that I thought was particularly well crafted:*

<u>First Date</u>
A sweater with puff sleeves
A hockey game

Janine told the class about her experience of creating the poem with Rick:

"I began with a small pink button that reminded me of a sweater my older sister used to wear. Rick had a button that he said reminded him of a winter coat he had when he was in high school. We decided that these two characters could meet on the downtown bus. They would see each other for weeks and not know that one was noticing the other – and then one day they would end up sitting next to one another. The picture that we were given showed a simple church in the background and a snow covered parking lot in front. When I looked at the picture, it reminded me of going to church when I was a kid – but when Rick looked at it he was reminded of going to hockey practice on cold winter mornings. We eventually decided that our two characters would get into a conversation on the bus about a hockey game that had happened the night before, which would lead to each revealing to each other how much they liked hockey, and finally with them deciding to go to a game together. Writing the two paragraphs was easy – the plot and the characters were so clear to us. Rick and I worked on the poem online last night – sending

[2] For this particular class, I selected short poems from collections by Lorna Crozier (1992), Michael Ondaatje (1989), Margaret Atwood (1995), and Rebecca Luce-Kapler (2003).

> *ideas back and forth. We copied the style of Lorna Crozier because we liked the simplicity of her language. The poem that we started with was more of a narrative poem – it was a lot longer – telling the story of how these two characters met and so on. As we continued to work on it, though, we kept editing out more and more until we ended up with what we thought was the poetic essence of what we wanted to communicate. It was interesting how our final poem developed. I don't think that either of us could say who wrote what. Neither of us knows exactly where that poem came from."*

CONCEPTIONS OF LEARNING AND LITERACY COMPOSITION

For the writing purposes announced here, this poetry-writing activity and its products offers an opportunity to notice how different theoretical conceptions of learning both are and are not able to account for what happened. In this section, we examine this activity through the lens of three different categories of learning theories: correspondence, coherence, and complexity.

Correspondence theories of learning

A century ago, Saussure (1959) famously critiqued the popular belief that language is a mapping system – that is, a collection of word-objects that correspond directly to real world artifacts and actions. The deeply entrenched assumption of correspondence is also manifest in popular beliefs about the natures of learning and knowledge, both of which rely on the notion that personal knowing has something to do with a correspondence between a learner's internal model of the world and the way that external reality "really" is.

A number of broadly critiqued assumptions are at work here, including such dichotomies as internal/external, imaged/real and knower/knowledge. Correspondence theories only make sense if these sorts of dyads are assumed valid. For the most part, that validity is not often questioned in popular forums. Despite considerable neurological and other evidence that the brain contains no internal representations of outer reality (Donald, 2001; Varela, Thompson, & Rosch, 1991), the belief that learning is a matter of building in an inner model of an outer world is so deeply engrained and so woven into habits of speech that it remains the default position in collective belief (Lakoff & Johnson, 1999).

Correspondence theories of learning have been around for quite some time, dating back at least to Aristotle, with his explicit separations of the realms of the metaphysical and the physical. The former was the domain of what was considered to be "pure knowledge," the latter the domain of base physical reality. Human beings were seen as trapped between these two realms, aspiring to metaphysical truths, but weighed down by the constraints of bodily experience. Hundreds of years later, these notions were further instantiated in Western belief through the philosophical work of Descartes and his contemporaries, who insisted that the world of the senses had to be doubted, and that the quest for truth must be a rational enterprise.

With regard to the phenomenon of learning, there are two main categories of correspondence-based theories of learning—behaviorisms and mentalisms. As we develop elsewhere (Davis, Sumara and Luce-Kapler, 2000), behaviorisms are rooted in the empiricist assertion that only those phenomena that can be reliably measured are the proper concerns of scientific inquiry. Hence the operational definition: Learning consists of (measurable) changes in behaviors that are due to (measurable) environmental influences. Although research in literacy education over the past two decades has offered a thorough critique of correspondence theories (Harste & Leland, 1998; Hruby, 2001; Spivey, 1997) recent demands for achievement accountability in schools have supported the commonsense belief that teaching causes learning to happen, and that learning can be accurately represented and measured using standardized means.

On the surface, mentalisms, which focus on unobservable internal constructs, seem opposed to behaviorisms. Here the measure of learning is the degree of correspondence between subjective interpretation and objectively established fact – a construal that underpins such schooling practices as fragmented and linearized curricula and standardized achievement testing.

That behaviorisms and mentalisms seem opposed is an indication of the deeply entrenched nature of correspondence theories. In fact, these two frames are hardly different at all. They both assume irreconcilable separations of the mind and body, self and other, and the other dyads previously mentioned. This point might be underscored by examining how either a behaviorist or a mentalist would respond to the question: Where is mind? For both, mind is lodged "in the head." Mind is conflated with brain. It is an individual possession that is insulated from the world and isolated from other minds.

The limitations of this theoretical attitude become obvious as one turns to a classroom activity like the one described above. Among the difficulties encountered in a correspondence theory-based interpretation is the issue of the "imagination." The emergent poems, it seems, *need not* correspond to anything in the real world, and can thus only be construed as inventions. Because the important quality of the storylines is their *reasonableness*, not their *validity* or *verifiability*, they cannot be parsed, measured, and tested. In other words, such creative engagements are considered to be *unscientific*. They do not belong in a science-informed education.

Phrased somewhat differently, within a correspondence frame, the experience of the *literary* is reduced to decoding, to *literacy.* And, with this formulation, that which is considered *imaginative* (or *literary*) is not really considered practical. While imaginative engagements with literary texts are still incorporated into most English language arts curricula, there continues to be "close reading" (that is, finding "truths" in the text), on the teaching of moral lessons, and/or on the transmission of one's own or other cultures. All of these "uses" of literary fictions are aligned with the principles that underpin correspondence theories of learning. Imaginative engagements with literary texts are not seen as practical because they engage readers' minds *differently* but, rather, they are seen as practical only to the extent that they are able to mirror other literacy activities —

which are, in turn, understood as "representation" practices that clearly correspond to "real world" ideas and contexts.

This conflating of literariness with literalness is one of the reasons that there continues to be a gap between how literature functions within and outside of schooling contexts. As documented by Sumara, (2002) and others (e.g., Block, 1995, Lewis, 2000) literary engagements outside of schooling contexts are generally not perceived to be "practical" activities but, rather, are seen as opportunities for entertainment, self-reflection, and/or contemplation. In order to "validate" the use of literary fictions within schooling contexts deliberate moves needed to be made to ensure that readers were developing "correct" analyses, through processes of accurate decoding and textual exegesis (Leavis, 1950; Hirsch, 1976). Because correspondence theories of learning continue to function as the underpinnings of school curricula generally, they also continue to regulate the valued ways in which literary texts are approached. In our home province, for example, the Grade 12 English language arts diploma examinations are largely developed with questions that support the belief that there is a direct *literal* correspondence between the texts of literature, the intentions of the writer and the contexts of reading.

Coherence theories

Early in the 20th century, several academic movements emerged that challenged the correspondence-based orthodoxies of language, learning and knowledge. Embracing a Darwinian dynamic rather than a Cartesian logic, a new wave of theorists argued that learning is about maintaining coherence with one's own perceptions and memories and with one's social/cultural contexts.

From our current vantage point, the most prominent figures in this movement included Dewey (1963), Piaget (1954) and Vygotsky (1962) all of whom were influenced by structuralist linguistics and philosophies. At the core of this perspective was the assertion that language must be understood as a set of relations rather than as a set of world-referencing units. As Saussure (1959) developed, languages are the products of recursive interactions between two or more agents. Linguistic symbols are not tagging tools but, rather, they are go-betweens that allow minds to connect. Words are not containers of meaning; they are bridges that facilitate the creation of relations from which meaning emerges.

In his *Course in General Linguistics* (1959), Saussure described language as a closed, self-referential system – that is, as a self-contained set of cross-references in which meaning arises in the contrasts and gaps among words, not in their references to external objects of events. As such, language cannot remain fixed. It is subject to continuous evolution prompted by, for example, changes in collective perceptions, interests and obsessions.

Piaget (1954) also saw such qualities of self-reference, self-containment and internal consistency as aspects of the individual's construed world. For him, learning was the continuous process of adjusting interpretations in order to keep them coherent with one

another. Vygotsky (1962) interpreted social dynamics in similar terms. Departing from the assumption that learning is about "taking ideas in," he argued that one came to an understanding of the world through processes of mimicking, rehearsing and otherwise acting out social roles – that is, by maintaining coherence with the evolving social context.

In the field of education, Piaget's work has been a major prompt in the emergence of individual-focused constructivisms, concerned with learners' ongoing efforts to knit viable theories of the world (Cobb & Bowers, 1999; von Glasersfleld, 1995). Vygotsky's work is reflected in collective-oriented social constructionisms, focused on the collectively produced worlds that come to serve as the backdrops for these individual construals (Lave & Wenger, 1991; Wertsch, 1998).

Coherence theories are thus distinguished from correspondence theories on two principal counts: First, since the theories focus on *fit* rather than on *match*, the main criterion of "truth" is *viability*. Truth is what works, and it is subject to constant modification with new experiences and changing circumstances. Second, for the most part, the evolution of truth is most often a matter of tinkering, not massive revision. These continual adjustments are made "on the fly" with little or no fanfare. Individual and collective construals of the world, from this theoretical perspective, are rooted in the human capacity to *rationalize* rather than their capacity to be *rational*.

In other words, coherence theorists reject the assumption that human knowledge is built on a foundation of rational deduction. Rather, they argue that human convictions are suspended in webs of literalized metaphor (Lakoff & Johnson, 1999; Rorty, 1999). Human beings are mainly analogical, not logical. That is, they are primarily occupied with relationship making as the foundation for the development of what is considered to be "knowledge" and how this knowledge affects and is affected by identity (Bruner, 1986, 1990).

For coherence theorists, "mind" is no longer interpreted as an isolated and insulated phenomenon trapped in a physical body. Instead, mind is understood to arise in the interpretations of coherences among remembered, immediate and anticipated experiences (Beach, 2000; Pinker, 1997). From this perspective, mind is ever-evolving, subject to constraints of physical engagements, the association that our predecessors knitted into language, the foci imposed by culture and circumstance, and the particularities of one's own personal experiences, including one's memories of the past and projections of the future. Although it is experienced as subjective, mind is actually an intersubjective phenomenon.

One could describe coherence theories as "good enough" theories of knowing and knowledge. In assessing learning, what matters is that construals are adequate and functional, not ideal. The research literature in early language acquisition bears this out, convincingly showing how young children move through clumsy stages of approximation in the early stages of language learning, and yet are still able to communicate their intentions and interpret others' intentions (Meek, 1991; Wells, 1986). This also has been

documented in reading instruction, particularly by those who have espoused a "whole language" approach to reading. Rather than emphasizing decoding correctness, whole language teachers have focused on creating conditions for young readers to develop positive relationships with texts and contexts of reading (Goodman, 1994; Harste, Woodward, & Burke, 1984).

This attitude of "good enough" underpinning coherence theories of learning can help to make sense of the success of the poetry-writing exercise described earlier. The abilities of the students to so readily construe and elaborate relationships among seemingly unrelated objects and to quickly assemble a viable narrative around these construals is merely a reflection of how human beings go about their everyday lives – making meaning out of the meaningless, rendering coherence from incoherence. Unlike correspondence theories, then, coherence theories do not treat the imagination as something that exists outside the realm of the practical but, instead, understands the ability to imagine as a fundamental aspect of human knowing (Berthoff, 1990; Sumara, 2002).

It is worth noting that in her first book, *Literature as Exploration* (1938,) Louise Rosenblatt argued the practical significance of literary engagement and in her second book *The Reader, The Text, The Poem* (1978) showed the necessary and complementary relationships between what she called "efferent" (practical) and "aesthetic" experiences of reader/text transactions. Influenced by Dewey and Piaget, Rosenblatt argued for creating classroom conditions that might be able to maximize what we are calling the "good enough" effects suggested by pedagogies supported with coherence theories of learning. While Rosenblatt and other reader-response theorists (Bleich, 1978; Booth, 1963; Holland, 1968; Iser, 1978) have emphasized the reading of literary texts, the poetry-writing activity presented earlier shows how literary composition can also benefit from this pedagogical attitude (Laidlaw, 2005; Luce-Kapler, 2004). As with reading, composition creates conditions where the consciousness of the writer becomes altered through the act of writing. This social-constructivist understanding of reading/writing suggests that the "subject" is not only the topics being developed by the reader/writer but also includes her/his identity (Olson, 1996; Spivey, 1997). From this perspective, literary engagements are productive and practical since they become inextricably enmeshed in the way in which the reader/writer's sense of consciousness is organized (Hruby, 2001; Iser, 1993; Lewis, 2000; Willinsky, 1990).

However, while coherence theories offer a more full-bodied explanation for why the poetry-writing activity was successful, largely because they conceptualize the roles of the imagination in more productive and practical ways than do correspondence theories, they are limited, in part, because they not able to make useful distinctions between collective and individual intelligence. Although coherence theories are able to show how all knowing emerges from webs of social/cultural relationships, they continue to emphasize the *individual* human subject as the primary locus of intelligence and cognition. In other words, the primary "cognizing agent" is not the collective but, rather, resides in the various individuals that comprise the collective (Kirschner & Whitson, 1999; Lave & Wenger, 1991).

Coherence theories, then, cannot really shed light on the comment made by one student that, "We don't really know where that poem came from." That statement is particularly telling, since it shows how knowledge emerges from simple activities enacted within a cultural collective context. However, it is often the case that one cannot trace, with certainty, the trajectory of the development of an idea. It is here that one of the major problems with coherence theories becomes evident: the conflation of experiences of *consciousness* with experiences of *cognition*. For coherence theorists, "intelligent" action is always ascribed to the individual, usually by attending to how he or she "performs" or how he or she represents, in language, what is being thought. In most cases, there is little or no acknowledgement of how individual cognizing is related to, but not identical to, collective cognizing.

Complexity theories

A prominent topic of critique among coherence theorists of learning is the notion of "normal" or, more broadly, the scientistic sensibilities that contributed to the emergence of statistics-based research in the social sciences and the resulting quantified constructs of normality and deviance. As Foucault (2004) has argued, representations of normality are usually deployed in ignorance of the context of their development. The idea of "normal" families, intelligence, physical size, reading ability and so on can only make sense when considered against backdrops of history and context. According to many coherence theorists, attempts to construe normality are rooted in the correspondence mindset of labeling the world as it "really is" rather than understanding that representations of reality are limited and shaped by human perceptions as structured by culture.

A different critique of these types of statistics-based conceptions of normality arose in the physical sciences in the mid-20th Century. This response was structured around the realization that there were different classes of phenomena, and that researchers had perhaps been committing an egregious error by imposing methods developed for one category onto phenomena belonging to another. Information scientist Warren Weaver (1948) was among the first to offer a means to distinguish among classes of phenomena. He proposed three categories: simple systems, complicated systems and complex systems.[3]

Simple systems involve only a few interacting objects. The laws and equations developed by Newton in the 17th Century are usually adequate to analyze, predict and manipulate these phenomena. These laws and equations can give rise to intractable calculations when the number of interacting parts increases only slightly. Faced with more and more of these *complicated systems*, 19th-century scientists turned to probability and statistics to describe their global properties. The issue here was not the validity of Newton's laws (which were still accepted as valid for all phenomena), but the capacity to measure and calculate. That is, the embrace of probability and statistics was pragmatic, not philosophical.

[3] The terms used by Weaver were actually "simple systems", "disorganized complex systems", and "organized complex systems". The terms we use in this writing reflect current usages within the field of complexity science.

Weaver noted that these two categories – simple and complicated systems – do not cover the full range of possibility. In both cases the objects and events are mechanical; they arise in the interactions of inert components, and they always behave the same way under the same conditions. However, some phenomena seem more organic, arise in the interactions of similarly dynamic components, and are prone to reacting differently under virtually identical circumstances. Moreover, these *complex systems* can learn new responses. That is, unlike machines, they can self-modify and embody their own histories. Newtonian mechanics and statistical regression are not very useful for studying these forms. These methods were never intended for systems that transcend their parts. Over the past half-century, this recognition has been at the center of a transdisciplinary movement now know as "complexity science," which includes among its many interests such phenomena as cognition, sociality, culture, economics, weather patterns, and the biosphere (Davis & Sumara, 2000; Capra, 1996; Cilliers, 1998; Laidlaw, 2005).

Significantly, complexity theorists do not reject coherence theories. On the contrary, the two discourses are quite compatible. The key difference between them is that complexity theories offer expanded conceptions of what counts as cognition and learning. For example, for complexity theorists, unities such as the immune system, a social collective and a species are conceptualized as cognitive (learning) systems (Capra, 1996; Maturana & Varela, 1987). Like the brain, these systems are all self-maintaining, self-determining systems that are, at the same time, part of larger cognitive systems. As such, on certain levels, their activities might be construed in terms of maintaining coherence; on other levels, their activities might be construed as contributing to the coherence of other systems. Analogically, these different systems are seen to be nested together in webs of relationships and, through which, each system emerges *in relation* to the other systems. As Maturana and Varela (1987) have argued, complex systems are "structurally coupled" and they "co-emerge" with one another.

The expansions of what count as "cognitive systems" and acts of learning are useful for making sense of events like the poetry-writing activity. From a complexivist perspective, the poem as product cannot adequately be identified as emerging from an individual learner, even if the final draft of the poem was written by one learner, or even if there was no *explicit* collaboration prior to the writing of the poem. Instead, all cultural products, including the poem produced in the poetry-writing activity described earlier, are the complex products of processes of collective cognition. Psychologist Donald (2000) describes this sort of entangled co-authorship as "coupled consciousnesses" (p. 82). Others take this point much further. As Bloom (2000) argues, "We are neurons of this planet's interspecies mind" (p. 223).

Such assertions point to a radically different conception of "mind" from that of most coherence theorists. While coherence theorists acknowledge that the individual "mind" is shaped by sociality and culture, the *location* of the mind continues to be in the individual (or even more specifically, in the brain of the individual). Complexity theorists acknowledge the importance of context but do not limit cognition or mind to these locations but, instead, see mind as distributed across a range of complex systems. While each human subject experiences a personal and individual consciousness, the systems of

of cognition that support this consciousness are not so easily located or even traced. For complexivists, then, "mind" is an emergent phenomenon that involves but also exceeds the individuals who experience conscious awareness. With reference to the classroom example of poetry writing, from a complexity perspective it is more appropriate to speak of the "collective mind" that participated in the authoring of the characters and the images that were eventually represented in the poems. This sensibility, it is worth noting, is represented in Foucault's (1984) argument about the uncertainty of the origins of "authorship," which suggests that no one individual is able trace personal and individual authority for new ideas. Instead, all ideas emerge from collective histories of their discursive productions.

To some extent, what is being argued about the collective influence of cognition seems wholly aligned with coherence theories. What needs to be emphasized is that while complexivists embrace the notion that both subjects and subjectivities are shaped by context and culture, they extend this by attending to the ways in which culture is tied to both biology and ecology. Humans are simultaneously biological and cultural beings, which means that physical and ideational networks are enfolded in and unfold from one another. This is not a new argument; Merleau-Ponty (1962) wrote extensively about this in *Phenomenology of Perception*. From this perspective, it makes little sense to attempt to trace the "source" or the "sources" of an emergent phenomenon. Working from an acknowledgement that complex systems continuously embody their histories, attention shifts to the *conditions* that underlie and support emergent phenomena rather than the *origins* of such phenomena.

SOME CONDITIONS OF COMPLEX EMERGENCE

In this section we develop the thesis that the English language arts classroom might be understood as a complex unity – that is, as an adaptive, self-organizing system. Our strategy is to interpret the poetry-writing example in terms of several necessary (but on their own insufficient) conditions for complex emergence.

These conditions have been identified by researchers over the past several decades in their studies of complex phenomena as diverse as anthills, and the developing and enacting of international trade agreements (Johnson, 2001; Kelly, 1994). Across complex events, certain conditions are always present. In fact, since having been identified, some researchers have begun to deliberately manipulate these conditions in attempts to occasion the emergence of complexity in, for example, the re-establishment of vanished ecosystems.

We are similarly oriented in the writing of this section. The conditions of complexity that we describe are offered both on the level of description, to make sense of complex happenings and as pragmatics – to prompt new ways of thinking about how the teacher might participate in the classroom collective. We argue that the conditions discussed here are always present in any classroom collective. However, they usually operate in the realm of social negotiation, not engagement with the subject matter. Complexity science

suggests that the *possibility* for more complex activity exists wherever self-specifying agents are allowed to interact. However, as has been demonstrated in countless classrooms, it is not sufficient merely to organize students in classroom collectives and then impose common tasks.

Complexity researchers have identified more than a dozen necessary conditions that can support the transition from a collection of learners to a collective learner (cf. Johnson, 2001). We outline five here that we believe are ones that can be specifically and explicitly addressed by the teacher: internal diversity, redundancy, enabling constraints, neighbouring interactions and distributed control.

Before proceeding, however, we must note two important qualifications: First, the suggestion that a new or transcendent unity can emerge from a group of previously disorganized agents is not a claim about a superorganism, a superior consciousness or a metaphysical event. Rather, it is a statement about the expanded possibilities that can come about when differentiated agents, who operate at a local level with local rules, come together in manners that complement and amplify existent possibilities while opening up others through joint action. In other words, we do not mean to erase or minimize the activities of individuals by moving the focus to the collective. In fact, as the poetry-writing exercise demonstrates, an attendance to the collective can support the development of the individual student's ideas.

A second qualification is that emergent events cannot be *caused*, but they can be *occasioned* (Davis & Sumara, 1997). A shift in interpretive focus is central here, away from what *must* or *should* happen toward what *might* or *can* happen. Pragmatically speaking, decisions around planning and teaching are more about setting boundaries for appropriate activities than about predetermining routes to desired outcomes.

Internal diversity

An obvious quality of interactions of participants in the poetry-writing activity is that they contributed different ideas that emerged from their personal, situated, remembered experiences. Even though this is the case, it is significant that when asked about the relationship between these personal contributions and the final products, students were not able to pry apart their contributions or to weigh their relative significance. The paths to the emergent poems were so intertwined that it is more appropriate to suggest that the outcomes belonged to the community of the classroom, not to any individual. The intelligent agent, from this perspective, is the collective, not the individual. In fact, one might say that the *group* acted intelligently.

This is an important insight from complexity science, where intelligence is not so much defined as an internal *capacity* but, rather, as the ability to make innovative responses to emergent circumstances. One of the most important features of collective intelligence is the presence of diversity represented among the agents that comprise the system. In other words, the collective's range of intellectual possibility depends on variation of the experiences and perceptions of its members. Pools of internal diversity enable a

collective to respond flexibly to shifts in circumstance, both internal (among member agents) and external (with the context) to the system.

Of course, such diversity is present in every social collective, no matter how homogenously conceived, including, for example, age-, ability-, and topic-grouped classrooms. However, we suspect that relatively few of these situations can be legitimately described as "complex unities," at least in terms of engagement with subject matter. In order for diversity to become useful within a collective, it must be able to be represented and those representations must become used within the context of events of learning. While this generally takes place outside the "official" curriculum with the ongoing negotiation of the social corpus of classrooms and schools, it does not usually take place within curricular activities.

It is worth noting that one cannot impose diversity from the top down by, for example, naming one person a facilitator of a group, another a recorder, and so on. Diversity cannot be assigned or imposed, it must be assumed. In order for diversity to become generative within a classroom context, several conditions must be in place. The teacher must remember that diversity is present; the teacher must create opportunities for this diversity to be represented; and the teacher must create conditions whereby the collective takes some responsibility for making use of this diversity.

In analyzing the poetry-writing exercise, it is clear that all of these conditions were in place. The teacher demonstrates recognition of the diversity present in the classroom by asking students to work collaboratively on the creating of poems. In so doing, he acknowledges that each participant in the small groups will bring a diversity of experiences to the task. In requiring response to and discussion of the artifacts provided, the teacher creates opportunities for this diversity to be represented and used within the context of a structured writing activity. Finally, the teacher requires that the collective make use of the represented diversity by requiring ongoing collaboration throughout the writing process.

Internal redundancy

It might be tempting to conclude that the success of the poetry-writing class was principally rooted in the diversity of the participants' diverse experiences. In fact, however, while diversity is important for the creating of productive complexity in the collective, the most critical element was likely the similarity among the individuals. The students were much more alike than different – in terms of culture, situation, education, expectation, purpose, and so on. "Sameness" among agents is essential for triggering a transition from *collection* of "me's" to a *collective* of "us."

In more technical terms, a system's capacity to maintain coherence is tied to the redundancies expressed among its individual agents. Just as internal diversity enables flexible response, internal redundancy is essential to the ongoing activities of agents. It is necessary for coping with stress, sudden injury, or other impairments as it simultaneously

enables interaction of agents and makes it possible for agents to compensate for another's failings.

The redundancies that underlie a system's robustness can be difficult to interpret, since they tend to serve as the ground of activity, not the figure. The transparent backdrop of sameness or familiarity in the classroom includes a social habitus that is usually invisible to those who are part of it, and is usually only rendered visible through deliberate contrasts with the norms and habitus of other settings. While the list of redundancies that were present in the poetry-writing class are obviously immense, a few obvious and important ones are worth mentioning: All students were enrolled in a Bachelor of Education program and were all preparing to be Secondary School English teachers. All knew something about processes of learning and teaching. All had some experience of formal classroom teaching. All knew that they would be teaching poetry writing at some point in their careers as English teachers. All lived in a major urban center in Canada. All were able to speak, read and write English. All were familiar with processes of collaborative learning.

It is important to note that the balance of redundancy and diversity among agents in a collective group (or, in systemic terms, of stability and creativity) is not strictly dictated by the system itself. The context also plays an important defining role. Minimal redundancy (or high levels of specialization) is very efficient and most valuable in very stable settings (such as on an assembly line in a manufacturing plant). However, minimally redundant systems are more fragile. If a key agent fails, the whole system has the potential to fail. Maximum redundancy (that is, highly interchangeable agents) is more appropriate in volatile contexts, but it can also engender a lack of creative adaptability, since the capacity for flexible, adaptive response is diminished. With regard to the English language arts classroom, a lesson here seems to be that the skill-and-drill emphasis on redundancy among learners is no better or worse than the more holistic emphasis on individual expression. Both ignore the complex possibilities of collective engagement as they focus on the qualities of single subjects – an emphasis that is shared by correspondence theories and many coherence theories.

Decentralized control

As we review the behavior of the learning clusters (the small groups) within the poetry-writing activity, an important dynamic can be seen to be at work: no one individual was "in charge" of the groups. They organized themselves around the assigned work. As Varela (1999) suggests:

> The whole does behave as a unit and as if there were a coordinating agent present at its center …. [A coherent global pattern] emerges from the activity of simple local components, which seem to be centrally located, but is nowhere to be found, and yet is essential as a level of interaction for the behavior of the whole (p. 53).

Johnson (2001) speculates that the tendency of observers to suspect the existence of a coordinating agent is rooted in the fact that correspondence theories are deeply inscribed in cultural sensibilities. Citizens of the modern world tend to impose cause-effect,

mechanistic explanations onto events that are better understood in complex emergent terms. In fact, Kelly (1995) develops his history of complexity science around the realization that control must be relinquished if complexity is to occur in its most vibrant and robust form.

In terms of processes of schooling, decentralized control should be neither interpreted as a condemnation of the teacher-centered classroom, nor an endorsement of the student-centered classroom. It is the case that under certain conditions neither of these can support complexity and, under other conditions, both of these can support complexity. For us, a key element in effective teaching is not maintaining control or relinquishing control but, rather, in dispersing or distributing control across the network of relationships in the classroom.

To put a finer point on this, both teacher- and learner-centered pedagogies, although usually presented as opposites, rely on similar assumptions about the organization of social systems. In particular, the individual tends to be seen as the locus of learning and the fundamental unit of social action. Once the learner is cast in these terms, it follows that the classroom must be structured *either* around the fiction of the normal child/student (Walkerdine, 1988) or around the fiction of the radical subject. In the extreme enactment of the first case, one must ignore the diversity that is present and treat the class as a teacher-led, redundancy-oriented mass. In the extreme enactment of the second case, one must pulverize the classroom community into an accidental collection of fully autonomous agents, each of whom is allowed agency for independent, individual thought and work. Where interaction occurs, it is not so much for *shared* projects but for response to *individual* projects (such as peer editing of writing, compiling of anthologies, brainstorming for ideas for individual essays and so on), instead of a genuinely collective, shared activity such as the poetry-writing example.

Distinctions between teacher- or learner-centeredness are not very useful for making sense of these shared projects, in large part because the phenomenon at the "centre" of these projects is not a teacher or student, but, rather, the experience of insight around a matter of shared interest. What becomes "authoritative" in such a setting does not reside in any particular individual, idea, or resource. Instead, authority is more distributed across individuals, ideas and resources. In the poetry-writing example, the poems did not emerge from a poetic structure assigned by the teacher, nor did it emerge from the imagination of single students. Instead, the poems emerged from the complex ways artifacts, students and teachers interacted within the contextual conditions of the classroom. Authorial "authority" was decentralized, and that decentralization created a necessary condition for creation of the poems.

Enabling constraints

While the term "enabling constraints" seems oxymoronic, it is an important idea when trying to understand how complex systems operate. In order to unpack this idea, it is first important to understand that although complex systems are rule-bound, those rules determine only the *boundaries of activity,* not the *limits of possibility*. The poetry-writing

activity, for example, was organized around some very specific constraints, including the requirement to work with specific artifacts and to follow particular procedures. However, as limiting as these conditions seemed, they also defined a territory that was rich with possibilities.

The notion of enabling constraints does not suggest an "anything goes" abandonment of learning outcomes, but instead a shift in thinking about the structures that are necessary for generative activity. As Johnson (2001) explains, complex emergence occurs in rule governed systems that function like games, which produce emergent possibilities that are always original and unique, but which are also always dependent upon a set of conditioning rules/constraints. As he argues, "Emergent behaviors, like games, are all about using the space to create something greater than the sum of its parts" (p. 181). The rule structures that organize complex systems maintain a delicate balance between sufficient randomness to allow for flexible, varied response and sufficient organization to channel such responses into coherent collective activities. Such situations do not suggest that everyone needs to do the same thing or that everyone does something different. Instead, there is a requirement that all participants attend to a shared project that is supported within a specified organizational structure that allows for emergent possibilities to be incorporated into the collective knowledge base.

In thinking about the poetry-writing activity, it is obvious that the teacher required students to develop their work around some very specific constraints. Students moved through a specific process and, as well, were asked to transpose the products of this process onto specific literary forms that were provided. At the same time, students were asked to bridge these activities with both their own personal experiences and with the emergent experiences of their shared writing tasks. We suggest that the generative power of the poetry-writing activity is the fact that the processes used mimicked everyday life. Human beings are adept at meeting unexpected and random events and incorporating them imaginatively into their continuously emerging experiences of reality and identity. The task of organizing a narrative to link the juxtaposing of two buttons and a photograph was not all that different from what human beings do constantly. In maintaining an ongoing sense of "coherent" identity, each human subject must continually adjust personal memory with current and projected relationships, contexts and situations. What is called "imagination", from this perspective, is a crucial life-skill, not an ability conferred onto some and not others.

The "enabling constraints" structure that was used to develop the poetry-writing activity, while mimicking everyday life, also aims to make these processes more explicit and, through prescriptive juxtapositions of artifacts and experiences, create opportunities to interrupt perceptual and symbolic familiarity. These are practices that are well known to experienced writers of fiction (Sumara, 2002; Luce-Kapler, 2004). However, because schooling is generally developed around correspondence and coherence theories of learning, they are not usually well understood in many schooling practices, even within the context of creative writing or other explicitly "imaginative" activities.

Neighbour interactions

At first glance, it seems unnecessary to suggest that there must be neighbour interactions in order for complex possibilities to emerge. What is not so obvious is what constitutes a "neighbour" within the context of shared processes of creating and symbolizing ideas.

The most significant "neighbours" in a knowledge-generating collective are not physical bodies or social groupings. In fact, direct personal interactions may not be as vital as commonly believed. Rather, as demonstrated in the poetry-writing activity, the neighbours that must interact in a knowledge-generative collective are ideas, hunches, queries, construals and other manners of representation. Knowledge emerges not simply amid the juxtaposition of bodies, but amid the juxtaposition of interpretive possibilities. In other words, the neighbours in a knowledge-generating collective must be *ideas*.

Such was the condition that enabled the emergence of storylines that had not previously been realized or articulated. In order to understand how this occurred, it is important to understand that the possibility of conceptual blends (of melding together ideas, artifacts, images) was made part of the explicit "rules" of the complex system being developed. Participants were required to invent bridges between buttons and their own remembered experiences, between emergent narratives about buttons and inferences made about photographs, between these emergent plots and existing poetic forms and, finally, between the interpretations of all of these as made by individuals in each small group. Creating this bricolage of ideas and requiring interpretive resolution created the sort of "neighbour interactions" that are necessary to a knowledge-generating system.

It is important to note that it is not merely the presence of multiple persons, artifacts, ideas and/or images that results in the generation of new knowledge. In order for the system to be productive, there must be a structural imperative for the maintaining of coherence of the system. In the specific case of the poetry-writing activity as a knowledge generating system, the students needed to continually try to reconcile new information with their existing storylines and, as well, maintain the integrity of the intended plot within the context of the lyric form that they had selected to finally represent this plot. The presence of "neighbour interactions" without the imperative to maintain this "structural coupling" (Maturana & Varela, 1987) can function to confuse and erode senses of meaning rather than produce new meaning.

SUMMARY AND DISCUSSION

In the first part of this article, we provided an overview of different theoretical perspectives on learning by organizing them into categories: correspondence theories, coherence theories and complexity theories. It is important to re-emphasize here that in creating these heuristics we do not expect to be able to represent the nuances of every theoretical perspective on learning. Our aim is to provide a general "map" of how different theories of learning exist in relation to one another and how these are deployed within the context of literacy/literary education. Through the use of the poetry-writing

activity, we aimed to show how these different theoretical perspectives might be used to analyze a situation of classroom-based knowledge generation. Our primary intention in the analyses provided was to show the limitations of both correspondence and coherence theories in explaining the processes of creative production. Most particularly, we aimed to show how, while correspondence and coherence theories seem diametrically opposed, because both situate the locus of cognition "inside" the body/brain of the learner both are unable to account for the ways in which individuals and collectives of individuals are co-specified during events of learning. It is also important to note that while coherence theories have been important and useful in helping researchers to understand the way in which knowledge production is shaped by situated discourses, they remain useful *only* at the level of description. As von Glasersfeld (1995) has argued, constructivism must be understood as a theory of *learning* that really cannot say much about teaching. Coherence theories do not offer what we call a "pragmatics of transformation" which, as we have argued elsewhere (Davis & Sumara, 2002; Davis & Sumara, 2006), is a vital component of any educational theory. By extending the range of coherence theories to include an analysis of how complex emergence occurs within collectives, complex theories of learning are able to more deeply account for how creative productions occur at the level of shared human activities and, importantly, how these productions can be deliberately structured by educators.

In the second part of the article, we explained how certain conditions must to be present in order for complex emergence to occur in a knowledge-generating system. Again with reference to the poetry-writing example, we aimed to show how imagination and creativity are not so much dependent on an individual's prior abilities to demonstrate these qualities but, rather, are everyday processes of adaptation and generation within complex systems, including knowledge-generating systems. From this perspective, the creation of an original poem does not so much emerge from "inspiration" or a particular gift for individual "creativity" but, rather, emerges from practices that support complex emergence. Cast within pedagogy, the argument for creating these conditions suggests a way between "learner centered" and "teacher centered" approaches.

For centuries, a prominent worry of educationists has been the tension which appears to exist between learners' bodies and bodies of knowledge. For correspondence theorists, this tension is manifest in desire to either ignore internal mental functioning because it cannot be observed and measured (the behaviourists) or to privilege rational deduction over observable behaviour (the mentalists). For coherence theorists, the tension occurs in the desire to somehow acknowledge the socially constructed characters of knowledge and identity, but at the same time to valorize the primacy of the individual's knowledge and perception. In both correspondence and coherence theories of learning, the educational process has often been conceptualized and described as the process of "bridging" internal and external worlds, or of the individual and the collective.

For us, complexity science provides a way of reading across the concerns and contributions of radical, social and critical constructivist theories, while also doing something extra that these discourses are often unable or reluctant to do: speak to the multileveled, deliberate and practical concerns of formal education. In particular, it

prompts us to suggest that in terms of the range of complex forms, the teacher's main attentions should perhaps be focused on the establishment of classroom collectives through tasks that involve collaboration around meaningful, shared projects.

For the teacher of literary composition, complexity science points to structural conditions that can be implemented to help students develop confidence and skill and, at the same time, to remember that like all language forms, poems emerge from the complex (but usually invisible) relations of the physiological, the geographical and the phenomenological. Although identities always emerge from the confluence of these, when they are brought into deliberate juxtaposition through processes of composition, the writer can be affirmed in her or his experience and, at the same time, surprised. Complex insights emerge from simple processes. That is a profound lesson of complexity and it is also a deep insight of those who create art objects. As Jeanette Winterson (1995) argues: "The artist is a translator; one who has gathered from stones, from birds, from dreams, from the body, from the material world, from sex, from death, from love" (p. 146).

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