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On the complementarity of Chaos/Complexity Theory and Dynamic Systems Theory in understanding the second language acquisition process

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In the late 1980s, I reviewed what was known about the field of second language acquisition (SLA), first with a co-author in a book (Larsen-Freeman and Long, 1991) and then in a highly condensed form for a 25th anniversary issue of the *TESOL Quarterly* (Larsen-Freeman, 1991). Stock-taking activities can be very useful, and I was grateful for these opportunities.

What I observed at the time was that the field was off to an impressive start. Since most researchers date the beginning of the modern era of interest in SLA with the publications of Corder (1967) and Selinker (1972), the field had only been in existence two decades at the time of these reviews, yet much had been accomplished "in staking out the territory" as I reported then. For although many had been interested in language learning for centuries, the promise of cognitive science and the lure of addressing the "logical problem of language acquisition", as posed by Chomsky, proved strong, and scores of studies were being conducted, new conferences organized, new anthologies published, and new journals launched.

Yet, despite all this activity, and the excitement that accompanied it, I confessed then to some uneasiness about direction in which the field was evolving. In my journal article, I asserted that the SLA process was more complex, gradual, nonlinear, dynamic, social, and variable than had been recognized. It was a few years later, in 1994, that I elaborated on some of these nascent concerns. I did so by presenting a paper at the Second Language Research Forum in Montreal, subsequently published under the title "Chaos/complexity science and second language acquisition" (Larsen-Freeman, 1997).

In it, I pointed to the limitations of the somewhat narrow perspective that had been adopted thus far in the field. Furthermore, I worried about what a few years later (Larsen-Freeman, 2002a) I called "premature closure".

> While it is true that one criterion by which theories are judged is parsimony, a pursuit of simple explanations for a complex process such as SLA at this point in the evolution of the field is at best premature, it seems to me. (Larsen-Freeman, 1997, p. 158)

A related aspect of SLA research that I found troubling was the reductionist assumption that by studying influences on the process in a piecemeal fashion, and then aggregating the findings, we would be able to explain the whole. Along these same lines, I worried that the field was also characterized by a split research agenda: some sought to better understand the language learning process, while others sought to account for differential success among learners. But should the two be studied independently? I also expressed concern about the tendency to treat instruction as one more variable to factor in after the natural process of language acquisition was understood.

Troubled by these reductionist tactics, I offered Chaos/Complexity Theory (C/CT), not as a new, grand unified theory, but rather as a more encompassing, balanced, yet detailed-oriented, perspective. I was hopeful that the characteristics of natural systems that it highlighted (that they are dynamic, complex, nonlinear, unpredictable, sensitive to initial conditions, sometimes chaotic, open, self-organizing, feedback sensitive, adaptive, and have strange attractors that are fractal in shape), which I also felt to be true of language and its learning/learners, meant that we had a theory that would honor the complexity and the interconnectedness of the issues with which we were dealing.

As I say, the 1994 paper was eventually published in revised form in 1997. However, even though I thought C/CT held great promise, I did not publish another paper on it for five years (Larsen-Freeman, 2002b). There were two reasons for this hiatus, besides my preoccupation with other projects. The first was that initially only a few researchers shared my enthusiasm for C/CT (see e.g. Herdina and Jessner, 2002; and the authors in Kramsch, 2002a) and my conviction that it provided a new and important supratheory or metatheory (Larsen-Freeman and Cameron, in press), or, at least, metaphoric lens with which to look at our field. And, although it may not be self-evident, science is a social activity (Bhaskar, 1978; Larsen-Freeman, 2000). One needs conversation partners.

Second, the ideas needed time to mature. Admittedly, it was a lot easier to say what does not work than to say what does. If everything is interconnected, then how were

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researchers to go about studying the whole? Modeling was one answer, but modeling also has its limitations. In addition, the SLA field lacked the tools of the kind that dynamic systems researchers Thelen and Smith (1994) had so successfully adopted in their studies of the development of infant motor behavior.

In the article under review, De Bot, Lowie and Verspoor (hereafter DBL&V), and the other Dynamic Systems Theory (DST) researchers that they introduce, address my two concerns. For the remainder of this commentary, then, I would like to leave behind the autobiographical scene-setting in which I have indulged in order to focus on their article.

Certain of the issues that DBL&V lead with are well known in C/CT – the non-linearity, the interconnectedness, the butterfly effect, the attractor states – and have been previously applied to SLA. However, what was a special contribution of this article was the European perspective on DST, which seems to be located principally at the University of Groningen in the work of DBL&V and colleagues van Geert, van Dijk, and others. What our Dutch colleagues offer are some new ways of thinking about dynamic systems and, importantly, the tools we need to be able to extract insights from language learner/learning data in a way that honors their complexity, nonlinearity, and dynamism. It is for these reasons that I believe C/CT and DST to be complementary. This is not the place to present a full genealogy of the ideas that are discussed in DBL&V. Let me, therefore, cite a few ways the authors demonstrate that, as with its close cousin C/CT, DST can be insightful when it comes to SLA.

Chief among them in DBL&V's article is the cluster of concepts: "limited resources", "connected growers" and "carrying capacity" (pp. 12, 14 *et passim*). First, the notion that resources, such as attention span and memory capacity, are limited is critical to explaining certain aspects of SLA. For one thing, the fact that resources are limited helps to explain why learners allocate different amounts of attention to different subsystems/dimensions of language (Larsen-Freeman, 2006). As these DST researchers note, although sometimes the resources compete; at other times, it is possible for them to cooperate. The precise relationship that exists and its changing nature is a key concept in explaining the dynamism, stability, and variation to account for different patterns in learner language. This point seems worth underscoring.

Also noteworthy is the related notion of "connected growers". The fact that not all subsystems of language require equal resources, and certainly not all do at the same time, sheds light on such SLA phenomena as the variability of language learners' performance over time. For example, in a recent study (Larsen-Freeman, 2006), it was found that the developmental trajectories of certain learners showed increasing lexical complexity and increasing fluency, so these two dimensions might be considered connected growers. In contrast, these same learners did not show progress on measures of grammatical complexity and accuracy, the latter two perhaps competing with the former two for resources.

In addition, the term "carrying capacity" that DBL&V use to mean "the state of knowledge that can be attained in a given child's interlinked structure of resources, referred to as the "cognitive ecosystem" (p. 12) is also a useful concept. However, anyone who is interested in the dynamics of a socio-cultural-cognitive process might be given pause by the expression "state of knowledge". This static depiction is just one example of the lexical challenge researchers have when it comes to trying to reconceptualize SLA in dynamic terms, where old static divides such as that between performance and competence no longer obtain.

Another area that DBL&V emphasize is the importance of not overlooking what has previously been called "noise" in developmental data, i.e. the inter- and intraindividual variation. From a C/CT and DST perspective, such variation is seen as an inherent property of a changing system and thus worthy of study in its own right. Just as importantly, the authors bring to our attention tools used by Robison and Mervin to understand variation, in which a DST approach is employed to link two variables. Then, too, we learn that van Geert has developed various other models to simulate different aspects of L1 development. Made aware of this body of work in the DBL&V article, I have subsequently learned that van Geert and van Dijk (2002) have added to the standard methodological toolkit of developmental researchers by offering instruments that are especially useful for visualizing and describing intra-individual variability in individual time-serial data.

In my 1997 article, I noted that one of the appeals of C/CT is the images invoked by the theory. They are not only aesthetically pleasing (as in the fractal image), but also weighty in meaning. For these reasons, I was drawn to Shankar and King's "interactional synchrony" or "dance" (as opposed to fax machine) metaphor for communication (p. 9). As DBL&V note:

> Based on very simple procedures (steps) carried out in coordinated fashions in dyads, complex patterns emerge from the interaction between the two dancers, and even increasingly more complex and unpredictable patterns will emerge over time when a pair of dancers interacts with other pairs on the dance floor. (p. 9)

This metaphor is not only rich in imagery but also captures well how an iterative process can lead to patterned complexity, a process that is calculated in C/CT and DST with differential equations.

Of course, as with any new theory, there is much to be worked out. For instance, in keeping with the metaphor

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of communication as a dance, there remains the question of whether one can separate the dancer from the dance (Kramsch, 2002) or, as I wrote above, the learner from learning.

Yet, how is it possible to respect the interconnectedness of all things and still conduct practical investigations? The answer, I believe, lies in finding the optimal interconnected units of analysis depending on what we are seeking to explain. Even if everything is connected to everything else, this should not lead to a paralyzing holism. As Lewontin (2000, p. 82) notes, "The hand is the appropriate unit for investigation if we are concerned with the physical act of holding, but the hand and eye together are an irreducible unit for understanding how we come to seize the object that is held".

Thus, the challenge for both C/CT and DST researchers in the future will lie in cultivating a dialectical relation between parts and wholes in order to identify the appropriate functional units of analysis, which is of course something that is likely to require ongoing redefinition, depending on the inquiry.

A related issue that I alluded to above is how to understand the relationship between the learner/learning and the context. Understanding the unity of the two remains challenging since both are not only interconnected, but also they are continually being transformed. Nevertheless, we must understand these processes if we are to gain a better understanding of SLA.

With the magnitude of challenges that these last two points present, I am grateful to have DBL&V as conversation partners. And so, I now close this turn in our conversation.

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