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Complexity of Language and SLA

Moloud Mohammadi*

College of Literature, Humanities and Social Science, Science and Research Branch, Islamic Azad University, Tehran, Iran

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ABSTRACT

This paper is an attempt to provide a brief review of background and an introduction to those complex systems and the chaos complexity theory in second language acquisition. It is divided into three sections: First, a short developmental background of the notion of chaos complex systems, chaos complexity theory and how it works is provided; then a comparison has been made between its similarities and differences with language learning environment; and finally, it is been related to the notion of second language acquisition. The twentieth century faced with an explosion of scientific and technological progression in human history; aligned with communication and information growth than before through evolution of computer science and technology. At the same time, this evolution has its impact on others sciences such as language learning, theories and approaches of language acquisition, facilitative tools and materials in language learning have been varied and upgraded. And at the same time, new questions have been formed which needed to be answered, questions such as; Does the brain operate more like a computer, storing and processing information? Do learners have language acquisition device (LAD)? Do learners require i+1 level of input in order to learn, or are they aware of noticing hypothesis?

1. Introduction

Language learning process was traditionally viewed through the reductionist perspective as a linear, fixed, cause and effect phenomenon which are added to three levels of reductionism known as context reduction, data reduction and complexity reduction in Second Language Acquisition (SLA).

van Greet [1] mentions that despite the fact that Chaos Complexity Theory (C/CT theory) as nonlinear dynamic systems was originally accepted by researchers and theorists investigating the explanation of phenomena in scientific fields, this theory has drawn attention of educators and social scientists considering complex phenomena such as language learning processes. By accepting C/CT, Larsen-Freeman [2], [3] states that SLA views language as a non-linear dynamic system which is affected by a number of factors. It is not considered as a fixed static phenomenon which is subjected to uniformity or conformity, rather it is a dynamic process which is evolving, growing, and changing from bottom-up in a natural manner following the dynamics of language use. Klein [4] mentions that the consideration of language as a homogenous and static system is nothing but a normative tale.

Larsen-Freeman [5] states that the C/CT theory implies that learners are not expected to progress through consistent, predetermined and stable stages. In fact, variation is observed at one time in learners' performances and inconsistency over time. According to Thelen and Smith [6] and van Geert and van Dijk [7] fluctuation and variation are observed as the main characteristics of dynamic systems. The constant change and consistency in nature of complex systems according to Percival (1993 in Soleimani & Farrokh Alaee [8]) is related to the constant change in the learners' use of language resources (Larsen-Freeman, [5]).

1.1. Body

Larsen-Freeman [2] mentions that Chaos/ complexity theory (CCT) is concerned with the behavior of dynamic systems, referring to the systems that change over time. One of the most important points is that in a dynamic system all variables (either dependent or independent) interact with each other and also with its environment. There are also different definitions provided for the term complex. Larsen-Freeman [2] states that systems are called complex because of two reasons: (1) such systems are composed of various components; and (2) total behavior of these systems cannot be simply referred to the product of behavior of their components and its required to consider all of the existing interactions among such complex system which also relates to the state of being dynamic. van Lier [9] mentions that this vision changed the traditional vision of sciences to considering the whole matters as in chaos/complexity.

* *Corresponding author:* Moloud.Mohammadi@gmail.com

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Larsen – Freeman [2] defines chaos/complexity science as the study of complex, nonlinear, dynamic processes as they occur in the physical world. It is the "science of process rather than state, of becoming rather than being" (Gleick, 1987, p.5, cited in Hadid Tamjid [10]). Capra (1996, cited in van Lier, [9]) emphasizes the need for studying 'processes' rather than causal mechanisms or fixed structures.

Regarding the importance of studying chaos/complexity theory, McAndrew [11] implies that no one can find any reality without chaos. In effect, the popularity of studying complexity is fast becoming a new picture in the intellectual scene. Larsen-Freeman [12] sees complexity as "a metaphorical lens through which diverse perspectives can be accommodated, indeed integrated" (p.173).

1.2. Features of complex nonlinear systems

The scholars who work on chaos / complex systems have identified a number of representative features of complex nonlinear systems. The main features of complex nonlinear systems as mentioned above, are introduced by Larsen-Freeman [2] to be "dynamic, nonlinear, chaotic, unpredictable, sensitive to initial conditions, open, self-organizing, feedback sensitive and adaptive" (p. 142).

Moreover, this type of systems have a number of strange attractors, which are formed in a fractal shape. Chaos / complexity theory is mainly focused on the behavior of dynamic systems, meaning that those systems that change over time. The notion of being chaos (simply known as the randomness generated by complex systems) refers to the study of focusing on the whole process and becoming, instead of studying state and being. Dynamic systems move through space / time, following a path called an attractor, i.e., the state or pattern that a dynamic system is attracted to (Larsen-Freeman, [12] in Hadid-Tamjid, [10]).

Dynamic systems are following those paths which can be traced and followed in time and space. Larsen-Freeman [2] notes that a complex nonlinear system has a strange attractor because although its cycle repeats itself, no cycle follows the same path or overlaps with any other cycle. What is well known among most strange attractors is that they are formed based on a fractal shape such like "a geometric figure that is self-similar at different levels of scale" (p.145). Here, one may refer to the shape of a tree; accepting the fact that trees have various shapes and forms, this can be said that the person will easily recognize it from many other objects.

In complex systems, each component (called agent) "finds itself in an environment produced by its interactions with the other agents in the system. It is constantly acting and reacting to what the other agents are doing. And because of that, essentially nothing in its environment is fixed" (Waldrop, [13], p. 145).

The point here is that no cycle ever follows the same path or overlaps with any other cycle. de Bot [14] claims that the main characteristics of dynamic systems are that all variables interact and this continuous interaction keeps changing the system as a whole over time. Briggs and Peat (1989, cited in de Bot, [14]) argue that smaller systems are part of greater systems; and this can be concluded that complex systems may be nested. According to Larsen-Freeman [2] , systems are called complex because of two reasons; 1. They may have a large number of components, and 2. In order to study the behavior of complex systems, it is necessary to consider the behavior of every component. In fact, the final outcome of a complex system appears when the interactions of its components with other ones and also within themselves are considered; it is not built in any one component.

In such situations, Finch [15] mentions that those interactions (better to say connectivities) amongst the components of the system are the crucial and indispensable components of unpredictable structures which may appear in the future. The "avalanche effect" represents that inconsiderable events can have outcomes passing their estimated proportion and advise us greatly on understanding systems by and large.

Another feature of such systems is being sensitive to initial conditions that can be explained using the notion of butterfly effect which claims that a butterfly flapping its wings in South America can initiate a hurricane in Puerto Rico. So any change in initial condition may cause huge changes in behavior of the systems that are totally unpredictable. According to Harshbarger [16] , the sensitivity to initial conditions represents that small variations in a complex system at a given time may cause large changes and differences in the system's behavior over time. Working on this issue, Alemi and Daftarifard [17] point to Edward Lorenz's butterfly effect in chaos/complexity indicating "the importance of minor changes which lead to great changes at the end" (p. 37).

In a complex system any new change will consequently result in a set of changes and the whole system attempting to adapt to these new changes during the time, so being adaptive can be considered as a feature of a complex system. This feature also represents that a complex system is not closed; it is open to new changes and this is why systems are called dynamic. Being closed to any new change will result in forming a complete static system. As open systems progress and advance, they increase in order and complexity by absorbing energy from the environment. This flow of energy forces the system away from its initial disorder and chaos towards order and complexity (Churchland, 1988, cited in Larsen-Freeman, [2]).

Another feature of complex, nonlinear systems is that they are feedback sensitive and adaptive (LarsenFreeman, [2]). Apparently, this feature refers to the state that any positive feedback will result in positive evolution and any negative one will result in cease and this can also prove that such systems are adaptive. Baofu [18] adds that it is worth emphasizing that the non-arbitrariness feature of a complex system is also sensitive to the feedback it receives, since the output of a subsystem is defused as the input of another subsystem (a chain). This feedback sensitivity can be best understood through the field of biology. In relation to Darwin's view, it is put forward that a main feedback mechanism are built into nature (namely natural selection). Evolution is in fact the steady improvement of a species (Waldrop, [19]). As Briggs ([20], p. 117) puts it, "Positive feedback kicks evolution forward". Meanwhile, negative feedback in evolution keeps mutation changes from spiraling out of control the checking power of many negative feedback loops simply wipes out most mutations and keeps the design of the components stable for long periods of time.

Moreover, the dynamic, complex systems are non-linear, which means that the effect is disproportionate to the cause (Larsen- Freeman, [2]). Chaos theory is defined by Larsen Freeman ([2]) as the study of dynamic systems which are non-linear, referring to the systems in which any small change in behavior of the components of a system may result in unpredictable changes in the behavior of the whole system over the time. Here, an important issue is that, chaos is not equivalent with complete disorder; rather it refers to the behaviors which cause unpredictably in the behavior of system.

Larsen-Freeman [2] also states that complex nonlinear systems seem to enter into chaos unpredictably. Even though the chaos may seem predictable, the beginning of this period of fully randomness is in its unpredictability. It may be said that complex systems act orderly up to their critical point, in which they go chaotic then. Following such chaotic zones, they may become orderly once again (Briggs, [20], cited in Larsen-Freeman, [2]).

As Waldrop [19] puts it, the chaotic and complex systems are usually in transition and unfolding. If a system reaches to the equilibrium point, it is not just stable but it is also dead. That is to say that language learning systems as nonlinear, autonomous, and complex systems continuously move towards the edge of chaos since reaching the undesirable state of equilibrium means the demise of the system. In the case of language learning, the state of equilibrium is gained when learners completely stop learning the language.

Dornyei and Murphe [21] state that each individual behaves differently outside the group. In this regard, Finch [22] argues that complex systems display unexpected and amazing behaviors that are a property of the system as a whole, rather than its elements. He adds that systems represent unpredictability as well as those patterns of regularity. In Kirshbaum's (2002 in Ellis, [23]) view, the unpredictability inherent in the natural evolution of complex systems then produces results that are completely unpredictable on the basis of the knowledge of the original conditions. These unpredictable results are known as emergent properties. Therefore, emergent features represent how complex systems are intrinsically creative.

Larsen-Freeman (2002 in Hadid-Tamjid, [10]) claims that these views (Baofu and Harshberger), then, were modified by some Renaissance thinkers, and then a mechanistic, cause-and-effect view of the universe introduced, following the Industrial Revolution. In this world-view, learning was seen as a mechanic process (reminder of behaviorist school of thought).

van Lier [9] claims that, in fact it was found that with certain phenomena, randomness was inherent. As a result, new insights into science such as mathematics physics, and biology pushed the boundaries of Newtonian science, and studies of isolated structures and nonlinear equations toward the emergence of the chaos and complexity in sciences.

van Lier mentions that it is the connectivity / interactions feature inside a system that determine its character. Contrasting with those traditional scientific approaches which try to analyze systems into their basic components and study them in isolation, chaos / complexity theory (C/CT) views the synthesis of developing wholes from observing the interaction of the individual components. From these unpredictable interactions, the larger structures will emerge when taking on new forms, and it is accepted that the whole is greater than the sum of its parts. If the researcher is to investigate the characteristics of a natural system, it is required to look at the subject in its own context and , more importantly, to describe the interactions which take place between the subjects and their environment.

Finch [15] clarifies this point in an example: consider a tree; the tree can be defined as a living organism which lives with other living organisms (such as insects, birds, plants, and etc.), and which interacts with elements such as soil, other trees, and the climate. The way a tree grows and interacts with related elements in its environment, the shape it takes and its success as a living system makes it more than the sum of its parts

Dynamicity C/CT is known as the science of the process and becoming rather than of state and being (Gleick, 1987, as cited in Larsen-Freeman, [2]). It is concerned with dynamic systems that change over time through continuous interaction with cognitive, social, and environmental factors leading to the emergence of communicative behaviors (Seyyedrezae, [25]).

Complex nonlinear systems and language

As it is mentioned by Larsen-Freeman [2] there are a great number of commonality between language and complex nonlinear systems. Larsen-Freeman [2] states that language can be viewed as a dynamic system and this view can have two interpretations; one is that language can be described as a collection of static units, but their use in actual speech involves an active process, and the other is that the term 'dynamic' is equated with growth and change. Rutherford (1987, cited in Larsen-Freeman, [2]) suggests that an organism is a better metaphor for language than a machine, because machines are constructed, but organisms grow. Language, seen synchronically or diachronically, is undeniably dynamic (Larsen-Freeman, [2]).

Viewing language learning as a complex system, according to Larsen-Freeman [2] its complex behavior as a whole is impacted by a great number of factors, forces, and agents within or beyond its boundaries that is more than the behavior of its individual components. Moreover, as Larsen-Freeman [2] puts it, languages undergo nonlinear changes diachronically. New structures enter and leave the language in a non-additive pattern which are also non-predictable.

Being inspired by the chaos/ complexity theory, Larsen-Freeman refers to a third interpretation of the tern 'dynamic' which mainly focuses on the assumption that the current use and change are not different since they are isomorphic processes. As this view recommend, any time and anywhere a language is used, it does change. Diller (1995, cited in Larsen-Freeman, [2]) asserts that, "a language such as English is a collaborative effort of its speakers, and changes in the system of English are 'emergent'' (p.116). Larsen-Freeman [2] also confirms that other qualities of dynamic systems also hold true for language and language learning among which is the notion of complexity. Based on this view, language is viewed as a complex system which is composed of various subsystems which are interdependent. The other one is sensitivity to initial conditions based on which language also has such characteristics.

Larsen-Freeman considers Universal Grammar (UG) as the initial condition of human language, which contains certain principles that constrain the shape of human languages. These principles have impacts on defining the 'strange attractor' of human language. Mohanan (1992, cited in de Bot, [14]) posits UG as 'fields of attraction' that permit infinite variation in a finite grammar space. Nevertheless, unlike in UG-theory of Chomsky, these principles do not completely rely on definite 'yes' or 'no' choices but on general tendencies or patterns of attraction which languages may reveal (de Bot, [14]).

Finch [15] argues that human bodies as supra-organisms could be seen from this new perspective as open systems having ordered complexity and continually receive input, and therefore do not conform to the second law of thermodynamics, which represents that closed systems tend toward entropy state. Van Lier (1996, cited in Finch, [15]) suggests that it is useful to consider the classroom as a complex system in which it is fruitless to search for casual relations. Larsen-Freeman [2], drawing an amount of chaos / complexity parallels in the language class, states that languages go through periods of chaos and order just like other living systems. In fact, she sees “many striking similarities between science of chaos/ complexity and second language acquisition” (p.141).

According to Finch [14] , the educational context, and specifically the classroom, is considered as a complex system in which events do not occur in linear causal fashion. In such system, a number of factors and forces interact in complex and self-organizing manner which causes changes that are partially predictable. Using the notions of chaos state and complex structure to language learning may have a number of consequential results in viewing learning.

van Lier [9] notes that within a complex system, a large number of influences are present in a partially chaotic, that is, unpredictable way, and among all the interaction, a complex order emerges. This dynamic order provides opportunities for active participants of elements in the setting. Larsen-Freeman [2] argues that SLA is as dynamic, complex, nonlinear system as are physics, biology, and other sciences. Although she does not consider teaching and learning as physical sciences, she mentions that chaos/complexity theory helps us look at what we do in new ways. This can be concluded that language learning is mainly viewed as an additive, linear process.

Focusing on the similarities between complex nonlinear systems and SLA, Larsen-Freeman [2] emphasizes that language learning is a dynamic, complex, open, self-organizing, feedback sensitive, and constrained by strange attractors. The dynamism of SLA is viewed in such everchanging character of learners’ internal L2 grammars. This is called complex because a number of interacting factors are involved in the SLA processes such as learners’ factors, teaching factors, learning factors and assessment factors. As Herdina and Jessner (2002, cited in de Bot, [14]) argue SLA, from a dynamic system theory, is reacting to external input and its entire organization changes with new input; it continuously reorganizes itself in order to reach equilibrium, but even then it does not come to a complete standstill.

However, as Larsen-Freeman [2] argues, there are orderly periods followed often by periods of chaos. This happens when new thing is introduced to learning environment and students have to figure out how it will fit into the system, or they have to revise their understanding and conception of the system in order to accommodate their new awareness. Larsen - Freeman [2] concludes that the conceptualization of language as a fixed, static, atomistic entity is being challenged by one that is much more nonlinear, organic, and holistic. Furthermore, it is known that SLA process is an open process in which the continuous input and also the interlanguage system are self-organizing. This phenomenon represents that this is the time when restructuring in interlanguage happens as a return to order. The revival of order is promoted by the fact that the system is feedback sensitive.

According to Larsen-Freeman [2] , despite the similarities among interlanguages of speakers with different L1s, they are constrained by the strange attractors of their L1s, which may affect, more than the strange attractor of English. She believes that there are issues in SLA that can be illuminated by the chaos/complexity theory, for example, mechanisms of acquisition, definition of learning, the instability and stability of interlanguage, differential success, and the effect of instruction.

She then suggests a number of potential contributions of chaos/complexity theory to language and SLA. van Lier [9] also has added his interpretations from his ecological perspective to her suggestions. They argue that CCT

1. Encourages a blurring of boundaries and dichotomies.
2. Warns against searching for simple predetermined solutions as well as against refusing contrasting perspectives.
3. Presents some new light on the SLA phenomenon.
4. Redefines focuses in the light of new emergent phenomena, foreground certain problematic areas, and try to remove them.
5. Discourages cause-effect -based ideas which seems necessary in assessing such systems.
6. Underscores the necessity of paying attention to details which may cause problems.
7. Insists on holding the whole view and to find a unit of analysis that allows such an overall view.

Larsen-Freeman [2], using the metaphor of dropping a penny, asserts that, in chaotic systems, it is not possible to know which penny will lead to development. The same applies to the development of interlanguage. She also mentions that in the development of interlanguage it is still vague that which elements cause the greatest restructuring, however, it is exactly the point that those maximum growth is possible, known as, the edge of chaos.

Larsen- Freeman [2] states that a teacher should throw the system into initial chaos out of which will emerge a system that is in alignment with the target language. Briefly, the chaos/ complexity theory points to the social participation view existing in SLA, without depriving the psycholinguistic perspective, and therefore it provides scientists with a wider view of SLA in which thinking is motivated in relational terms (Larsen-Freeman, [5]).

Brown [26] also presents an outline summarizing what has been suggested by Larsen-Freeman [2] on C/CT. This outline includes:

1. Be aware of false dichotomies, and search for the inclusiveness, complementarities, and interfaces among the factors,
2. Be conscious of linear, causal perspectives to theorizing. SLA is viewed as a complex process in which a great number of elements interact in a way that they cannot be justified based on only one single cause,
3. Be aware of the notion of overgeneralization based on which those tiny unimportant elements turns out to be very great and significant factors. This refers to the notion of reductionism in thinking.

Conclusions

C/CT is considered as a powerful tool to appropriately investigate the complex process of language learning as an organic entity always in flux and movement. It also broadens our understandings of such a nonlinear, complex, and dynamic phenomenon leading to take a new stance towards it. In fact, the application of theoretical insights drawn from this comprehensive theory can have a striking influence on language pedagogy, methodological choices, and classroom practices. When instructors and researchers gain perceptive understandings regarding the issue that SLA is not viewed as a fixed, linear, and homogenous phenomenon based on many different cause-effect relations, they will change the way of approaching such multifaceted phenomenon. It is thus understood that in the social ecosystem of language learning classrooms, a multitude of factors and influences in a chaotic, unpredictable, and uncontrolled fashion are at work all the time trying to focus attentions to the emergence of a complex dynamic order. This dynamic order also has relative stability based on which it will never reach total equilibrium. This order, as van Lier [9] puts it, provides active participants with affordances and opportunities which are picked up, and eventually learning emerges as the result of interaction between a huge number of factors within or beyond the language learning setting.

References

van Greet, P. (2000). The dynamics of general developmental mechanisms: From Piaget and Vygotsky to dynamic systems models. *Current Directions in Psychological Science, 9*, 64-88.

Larsen-Freeman, D. (1997). Chaos/complexity science and second language acquisition. *Applied Linguistics, 18*(2), 141-165.

Larsen-Freeman, D. (2003). Teaching language from grammar to grammaring. Boston: Heinle/Thomson.

Klein, W. (1998). The contribution of second language acquisition research. *Language Learning, 48*, 527-50.

Larsen-Freeman, D. (2006). The emergence of complexity, fluency, and accuracy in the oral and written production of five Chinese learners. *Applied Linguistics, 27*(4), 590-619.

Thelen, E., & Smith, L. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: MIT Press.

van Geert, P., & van Dijk, M. (2002). Focus on variability: New tools to study intra-individual variability in developmental data**.** *Infant Behavior and Development, 25*(4), 340-374.

Soleimani, H., & Farrokh Alaee, F. (2014). Complexity theory and CALL curriculum in foreign language learning. *International Journal of Applied Linguistics & English Literature, 3*(3), 19-25.

van Lier, L. (2004). The ecology and semiotics of language learning: A sociocultural perspective. Norwell, Massachusetts: Kluwer Academic Publishers.

Hadidi Tamjid, N. (2007). Chaos/complexity theory in second language acquisition. *Novitas Royal, 1*(1), 10-17.

McAndrew, D.A. (1997). Chaos, complexity, and fuzziness: Science looks at teaching English. *English Journal, 86*, 37-43.

Larsen-Freeman, D. (2000). *Techniques and principles in language teaching*. Oxford: Oxford University Press.

Waldrop, M. (1993). Complexity: The emerging science at the edge of order and chaos. NewYork: Simon and Schuster.

de Bot, K. (2005). Dynamic systems theory and applied linguistics. *International Journal of Applied Linguistics, 15*, 116-118.

Finch, A. (2002). A systems view of the EFL class: Mapping complexity. *English Linguistic Science, 11*, 15-26. Retrieved May 20, 2018, from http://www.finchpark.com/arts/systems-1.pdf.

Harshbarger, B. (2007). Chaos, complexity and language learning. *ICU Language Research Bulletin, 22*, 17-31.

Alemi, M., Daftarifard, P., & Patrut, B. (2011). The implication of chaos/complexity theory into second language acquisition. BRAIN. *Broad Research in Artificial Intelligence and Neuroscience, 2*(2), 34-40.

Baofu, P. (2007). *The future of complexity: Conceiving a better way to understand order and chaos*. London: World Scientific Publishing Co.

Waldrop, M. (1993). Complexity: The emerging science at the edge of order and chaos. NewYork: Simon and Schuster.

Briggs, J. (1992). *Fractals: The patterns of chaos*. New York: Simon: and Schuster.

Dornyei, Z., & Murphey, T. (2003). *Group dynamics in the language classroom*. Cambridge: Cambridge University Press.

Finch, A. (2004). Complexity and systems theory: Implications for the EFL teacher /researcher. *The Journal of Asia TEFL, 1*(2), 27-46. Retrieved May 20, 2018, from http://www.finchpark.com/arts/complexity-system.pdf.

Ellis, N. (2007). Dynamic systems and SLA: The wood and the trees. *Bilingualism: Language and Cognition, 10*(1), 23-25.

Finch, A. (2001). Complexity in the language classroom. *Secondary Education Research, 47*, 105-140. Retrieved May 25, 2018, from http://www.finchpark.com/arts/complex/ind01.htm

Seyyedrezae, S. H. (2014). The application of chaos/complexity theory in classroom teaching, task design and lesson planning. *Journal of Language Sciences & Linguistics, 2*(2), 27-32.

Brown, H. D. (2000). *Principles of language learning and teaching*. (2 nd ed.). White Plains, NY: Longman.

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