



Universal Grammar and Chaos/Complexity Theory: Where Do They Meet And Where Do They Cross?

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Abstract

The present study begins by sketching “Chaos/Complexity Theory” (C/CT) and its application to the nature of language and language acquisition. Then, the theory of “Universal Grammar” (UG) is explicated with an eye to C/CT. Firstly, it is revealed that CCT may or may not be allied with a theory of language acquisition that takes UG as the initial state of language acquisition for granted. To compound the problem, even those C/CT theorists who adhere to UG conceptualize it differently from Chomsky to meet the conditions set forth in C/CT, and dismiss the idea of studying language acquisition without leaving room for investigating language use. Secondly, it is argued that unlike Chomsky’s postulation of UG and generative grammar as mutational, C/CT theorists conceive of them as evolutionary phenomena. Thirdly, it is discussed that while advocates of UG, as a biologically predetermined state of the mind, believe that it has no analogue in other systems, C/CT proponents postulate their all-embracing theory as underlying all kinds of complex nonlinear systems operating in the world, of which language is only a case.

Keywords: Analogue, Chaos/Complexity Theory (C/CT), Universal Grammar (UG), Language Acquisition, Language Use, Mutation.

INTRODUCTION

Language as a Chaotic System

Chaos theory, though initially developed by a meteorologist and for the most part hailed in natural sciences (Valle, 2000), has found its way to social and human sciences, as well. Chaos theory is defined as “the qualitative study of unstable aperiodic behavior in deterministic non-linear dynamical systems” (Kellert; cited in Valle, 2000, p. 2). Chaotic systems are:

- “dynamic” as they change with time as

- chaos is a science of process and of becoming;
- “complex” as they comprise a large number of agents, and their global behavior emerges from the local transactions of the components;
- “nonlinear” as the effect is disproportionate to the cause;
- “chaotic” as complex nonlinear systems enter into a period of complete randomness irregularly and unpredictably;
- “unpredictable” as the onset of randomness is not predictable, and complex systems be-

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have regularly until a critical point, then chaotically before they go orderly again;

- “sensitive to initial conditions” as a slight change in their initial conditions can have vast implications for their future behavior;
- “open” as they are open to new matter and energy infusion;
- “self-organizing” as in their evolution, they engage in spontaneous large-scale restructurings and grow in order and complexity;
- “feedback sensitive” as they are capable of learning; and “marked by strange attractors and fractal patterns” as they repeat their cycles, but no cycles follow the exact same path; nor does they overlap any other cycle. (Larsen-Freeman, 1997, 2002; McAndrew, 1997).

Adherents to the view of language as a complex nonlinear system have pinpointed significant similarities between such systems and language. For one, like other complex systems, language is “dynamic” in the following three respects:

1. Language use is an active process, a notion inherent in such concepts as “parole,” “performance,” “grammaring,” and “language’s living capability” (Larsen-Freeman, 1997);
2. Language, as an open system, is constantly changing and growing, and is dynamic from both a synchronic and a diachronic perspective; simply put, diachronic changes of languages are nonlinear as new forms enter and leave the language non-incrementally, and when studied synchronically, a language may seem chaotic with different speakers using different forms to mean the same thing. Which new forms enter the language is unpredictable, and the best that can be done is to explain language’s change a posteriori (Ellis, 2008; Larsen-Freeman, 1997).
3. Language use and language growth are

isomorphic processes, dialogically influencing one another. In other words, using the language meaningfully changes the grammar system in the user and subsequently globally in the language itself. Accordingly, a language is the outcome of the collaborative effort of its speakers (Swain, 1997), and its changes are emergent (Ellis, 2008). From this perspective, language grows, responds to feedback, and organizes itself organically from the bottom up (Larsen-Freeman, 2002).

In addition to dynamism, language, like any other complex system, is characterized by “complexity” as it comprises many interdependent subsystems, namely phonology, syntax, semantics, morphology, etc., and is realized with the interaction of these subsystems (Larsen-Freeman, 2007). Language is also “sensitive to an initial condition,” be it the state of neuron connections in the brain as postulated by connectionists (Mitchell & Myles, 2004), UG or even the first few words that are uttered. Whatever it is, this initial condition entails a strange attractor to language. Borrowed language forms are also “adaptive” in the sense that they conform to the phonological and morpho-syntactic constraints of a language. Language is also “fractal” as it is compressible and sharable. An example is that a word of a particular frequency rank in a language reflects the same frequency in any given text of that language (Larsen-Freeman, 1997).

Complex Nonlinear Systems and Second Language Acquisition

Chaos/complexity theorists postulate that second language acquisition (SLA) is “dynamic” as evident in ever-changing and evolving interlanguages. This fact is evident in attempts to theorize various aspects of interlanguage development and learner language variability. A related point is that by virtue of using the target language, it is transformed. Widdowson (1978, p.62) cogently had the point stating that “we create discourse and commonly bring new rules into exist

ence by so doing.” As such, there is no endpoint to acquisition. Rather, interlanguage can be defined as a developing grammar moving toward and in parallel with a developing target language (Larsen-Freeman, 1997).

SLA can also be said to be “complex” with multitudinous factors interacting in developing interlanguages. The point is acknowledged by Ellis (2008, p.3), positing that SLA “constitutes a multi-faceted phenomenon that defies simple definition.” “Nonlinearity” is another characteristic of SLA, and of all kinds of learning, since learners do not master one item and then move on to the next (Bruner, 1960). Nor is the learning curve for a single item linear (Ellis, 1997).

Interlanguages can also go chaotic, but given that they are open and feedback sensitive, they return to order through self-organization and restructurings. In other words, learners adapt their languages closer to the language of target language users. Conversely, fossilization occurs as interlanguages become closed and attracted to a fixed point attractor. Furthermore, first languages constrain interlanguages through strange attractors, sometimes stronger than the attractor of the target language. This account of interlanguage development or fossilization, with the notion of “*restructuring*” at its heart, has a lot in common with cognitive and information processing accounts of SLA, like Active Control of Thought (Mitchell & Myles, 2004). Moreover, a number of SLA theories place a premium on the concept of feedback sensitivity among which Long’s “interaction hypothesis” stands out (Long, 1996).

C/CT Theorists’ Standpoint on UG

Those who have tried to extend the idea of complex nonlinear systems to language and language acquisition belong to two main camps: those who explain language acquisition without resorting to the idea of UG or an innate language faculty, and those who believe that order would not result from the chaotic state of language or learner interlanguages unless we think in terms of a constraining universal grammar with its own gradient “fields of attraction” (Larsen-Freeman, 1997,

2002). This section offers a more detailed account of these two standpoints.

A UG-proof theory of language as a complex nonlinear system. Not all SLA researchers take Chomsky’s postulated UG for granted. As mentioned earlier, one of the characteristics of a dynamic system is that “the act of playing the game has a way of changing the rules” (Gleick, 1987, p. 24). Such theories mostly parallel connectionism (Ellis, 2008; Mitchell & Myles, 2004). Claiming that UG has no substance to it and that the mind needs no central program to direct it, the connectionist model of the brain maps it onto complex and nonlinear systems: The brain, as a chaotic system, is characterized by the arborization of its dendrites, the chaotic firing of its neurons, the fractal geometrical, statistical and dynamical properties of the nervous tissue, and the tunable weights on the connections between nodes likely to be strengthened by certain sensory input (Ellis, 2008; Larsen-Freeman, 1997). Accordingly, some chaos complexity theorists conceptualize the brain as a complex nonlinear system, and language as a system that grows and organizes itself organically from the bottom up:

..., recent work in connectionism denies the existence of conventional syntactic representations, of Universal Grammar, and of an inborn acquisition device specifically for language. Language acquisition, it is claimed, is not fundamentally different from any other type of learning and can be accounted for by the same mechanisms that are required for interaction with the environment in general (O’Grady, 2003, p.57).

A UG-based theory of language as a complex nonlinear system. Within a C/CT framework, the concept of UG can be exploited to meet the paradigmatic requirements for such a system as language to be considered complex and nonlinear. However, such concepts as universal grammar and generative grammar are viewed in such a way as to fit in a C/CT framework. Assuming that language is a complex nonlinear sys-

tem, the concept of UG has been investigated with regard to language's dynamism and also the initial state to which it is sensitive.

UG and language dynamism. If language is believed to be a complex nonlinear system, language use and language change are inextricably interrelated processes. Explicating the issue, Larsen-Freeman (2002, 2007) points to the prevailing controversy among SLA researchers as to whether SLA can be duly explicated without any concern with language use, characteristic of Chomskyan structuralism. In other words, there is no consensus among SLA theorists as to whether representation and use are separable and whether either can be investigated in isolation (Ellis, 2008; Mitchell & Myles, 2004). While advocates of "the acquisition viewpoint" deem the acquisition process of language, rather than its use, to be the rightful domain of SLA research, and draw a line between language acquisition and language use, proponents of "the social viewpoint" place a premium on the discursive nature of interaction, almost blurring the boundary between language learning and language use. The latter group condemn mainstream SLA research for its:

- a) failure to strike a balance between the social and the psychological, and being too mentalistic and individualistic; more recently, attempts have been made within a sociocultural framework to juxtapose the social and psychological aspects of learning in what has been termed "activity theory" (Lantolf & Appel, 1994); and
- b) failure to appreciate the role of language use and contextual and environmental variables in language acquisition.

On the other hand, mainstream SLA researchers state that the aim of SLA research is to explain language acquisition; such research views language as an internal mental process, and seeks to uncover how changes in that representation are achieved. As such, a preoccupation with cognitive variables is, according to them, inevitable. A related issue is the bone of contention as to what

constitutes successful language learning. Larsen-Freeman (2002) mentions two main perspectives which are delineated in this section.

Acquisition metaphor. Mainstream SLA researchers believe that success is the acquisition of the rules that bring learners' performance into conformity with the target language, in terms of accuracy of production, i.e. the acquisition of such a priori categories as rules or sequences of language which once in place can be transferred and shared. This position emphasizes the individual mind, posits the existence of a clear endpoint to learning, and predicates on the permanence of "having." Resonating with this metaphor is the Chomskyan postulation of grammar as an a priori representation and an atemporal static system of predetermined generative rules, detachable from language use. From this perspective, language learning is tantamount to the acquisition of grammatical structures (Ellis, 2008; Mitchell & Myles, 2004).

Participation metaphor. From this point of view, learning a language is a process of becoming a member of a community, being able to communicate in its language and act according to its norms, and taking part in and becoming part of a greater whole. It emphasizes the bond between the individual and others, i.e. the psychological and the social, posits that learning can never be complete, and predicates on the flux of "doing." In parallel with this conceptualization of learning is the concept of the emergence of a grammar attitude which holds that rather than being a biologically predetermined state of knowledge, grammar is a phenomenon, or an epiphenomenon, whose status is negotiated in speech, indistinguishable from strategies for building discourses. Language is viewed as a real-time activity with provisional regularities. Accordingly, language learning is the expansion of a repertoire of communicative contexts, and as such, there is no endpoint to it (Ellis, 2008; Mitchell & Myles, 2004; Widdowson, 1978).

According to Larsen-Freeman (2002), this

ongoing debate can be quelled through C/CT as a unifying approach. If language is a complex system, in which numerous elements interact and the global outcome is emergent from the interaction of the individual parts, studying the language from either perspective is misconceived and does not do justice to the system of language or the process of language acquisition as a whole. In a similar vein, Givon (1999) objected to the absolutism inherent in both positions: Grammar is not totally flexible, but is context-dependent and usage-driven. Givon maintained that a reasonable theory of grammar must accommodate some “rigidity,” namely UG rules, for rapid speech processing in new contexts and for accounting for the fact that in SLA some carry-over from the first language to the second language is observable. It must also show some flexibility for adaptive linguistic innovation. In conclusion, the acquisition metaphor and the a priori grammar position are representational in nature, while the language use viewpoint of language acquisition, the participation metaphor, and the emergent grammar position can be said to be transition theories, sketching the process of language acquisition (Mitchell & Myles, 2004). Both, Larsen-Freeman (2002) believes, can be fitted into a C/CT framework; the participation metaphor goes hand in hand with a Chaos/Complexity account of language in its postulation that (a) language is not static; (b) agents or language users interact and change in real-world contexts; and (c) language is an open system. C/CT also reflects the acquisition metaphor in two of its underlying tenets:

- a) Language is sensitive to initial conditions;
- b) Language shows a systematic pattern along with a dynamic path.

UG and the initial condition of language as a complex nonlinear system. Adherents to a view of language as a complex system and also UG believe the best candidate for an initial condition to which language has sensitive dependence is UG, with universal principles which

constrain the shape of human languages. In other words, such principles define the strange attractor of human language. Within this framework, contra the idea of parameter setting as put forth by Chomsky in his Principles and Parameters (P&P) approach (see, e.g., White, 1997), cross-linguistic differences are accounted for by UG’s “fields of attraction” that allow for infinite variation in a finite grammar space. Unlike Chomsky’s notion of discrete parameters, such fields are gradient, exerting varying degrees of strength on different languages, inducing interlinguistic variation, and defining the state that a language is attracted to as that language’s unmarked state (Larsen-Freeman, 1997, 2002, 2007).

UG and C/CT Perspectives on Language Nature: Mutational or Evolutionary

A review of related literature (Chomsky, 1968; Larsen-Freeman, 1997) indicates that neither Chomsky and his followers, nor C/CT theorists believe in the evolution of language from animal communication systems. Following Cartesian philosophy, Chomsky put forth the idea of language as a human-specific enterprise, positing that it has no analogue in the animal world. He referred to Popper and Thorpe as advocates of the idea of language evolution (Chomsky, 1968). Popper (cited in Chomsky, 1968) asserted that human language has evolved from a lower stage to a higher stage, from the use of vocal gestures for the expression of emotional states to the use of articulated sound for the expression of thought. Chomsky, however, counter-argued Popper’s theory reasoning that he failed to explicate how the transition from the first stage to the second takes place despite their predication on different principles. Taking a more diluted view of language evolution, Thorpe (cited in Chomsky, 1968) drew attention to the similarities of human language and animal communication systems, namely their being purposive, syntactic, and propositional. Chomsky was critical of Thorpe, too, contending that these three features are not language-specific,

and can be generalized to all other behavior shared by humans and animals. He further stated that any animal communication system is based on one of the two principles:

1. a fixed finite set of signals, associated with a specific range of behavior;
2. a fixed finite set of linguistic dimensions, associated with a non-linguistic dimension and an infinite number of signals like human language, but different from it in that these linguistic signals are not discrete, rather marked by continuous variation.

Consequently, human language and animal communication systems are, according to Chomsky, principally different, and the former could not have evolved from the latter as a natural, biological phenomenon. The mutational emergence of such a qualitatively different phenomenon as language at a stage of complexity of organization has more substance to it. Chomsky (1968) hypothesized that there has most probably existed a language of thought prior to the mutational emergence of a language faculty as the result of some sort of mutation in the genetic instructions for the brain. Moreover, the possession of this phenomenon is associated with a particular form of mental organization; thus, the best way to grasp intelligence and the character of human mental processes, according to Chomsky (1968, 1996a, 1996b), is to explore human language, and to construct generative grammars and the universal principles which govern their structure.

In a similar vein, C/CT theorists are dismissive of the idea of language evolution from animal communication systems. They contend that the emergence of speech can be explained on the grounds that in the face of the increasing complexity of life induced by the acquisition of such skills as tool making, the solely perceptual thought processes of hominids could no longer provide enough requisite variety to model life's challenges. Consequently, a new level of order in the form of concepts and conceptual thinking emerged, and the actual medium for this transi-

tion was speech or verbal language. It follows that language has not evolved from animal communication systems (Logan, 2003). However, unlike Chomsky's belief in the mutational nature of the faculty of language, C/CT theorists posit three proto languages as antecedents to verbal language:

1. Manual praxic articulation (tool making and use)
2. Social/emotional intelligence and the language of interaction
3. Pre-verbal communication entailing the use of hand signal, mime, gesture, and prosodic vocalization

These proto-type languages, Logan (2003) stated, are believed to have provided the cognitive means of developing generativity and representation. According to Logan, there are three reasons why these breakthroughs can be called "languages:"

1. Their function is two-fold: information processing and communication as they resulted in knowledge sharing, social control, coordinated hunting, and the creation of social culture;
2. They have their own semantics and syntax;
3. Each is characterized by a generative grammar, and employing the correct syntax in the proto-type languages evolved into the generative grammar of the verbal language.

It follows from the third reason that viewing language from a C/CT perspective entails the existence of generative grammar. However, unlike Chomsky's belief in its mutational nature, C/CT theorists believe in it as an evolutionary feature, though not from animal communication systems. Moreover, this evolution would not stop with the emergence of speech. The C/CT conceptualization of language is much broader than just speech. It entails that speech, math, writing, science, computing, and the Internet form an evolutionary chain of languages, each emerging as a response to the chaos associated with some kind of information overload. It can

be concluded that a UG and a generative grammar can be postulated for each of these which vestigially retains the UG and generative grammar properties of earlier languages.

This C/CT explanation of language evolution, though not from animal communication systems but from the proto languages of early hominids, renders the idea of “missing links” a myth. Despite Darwin’s conceptualization of evolution as a slow continuous process, Logan believed evolution is characterized by discontinuous transitions resulting from the emergence of strange attractors as a biological system passes from turbulence to stability. Another evolutionary feature, viz vestigiality, is accounted for by thinking of language as an analogue to a species, retaining vestigially earlier forms of expression (Logan, 2003).

To sum, based on a C/CT view of language and complex systems operating in the world, UG has not instantaneously emerged in the brain, rather evolved as early hominids engaged in tool making, the language of social interaction, and also mimetic communication as cognitive precedents to verbal language. However, Chomsky and his followers believe in the Darwinian notion of “missing links” and the mutation in the human brain that inducing the language faculty.

Possibility of UG Analogues

The big question is whether one can find an analogue to UG and generative grammar, and extend the concept of linguistic structure to other systems; according to Chomsky (1968), this question cannot be answered in the positive. Chomsky referred to the common belief in the inapplicability of procedures analogous to phonemic analysis to subsystems of culture and society. He attributed this improper analogy to its advocates’ preoccupation with structure, which is only an epiphenomenon induced by intricate systems of rules, while the richness of structuralist phonology lies in its discovery of the fact that a small number of features have given rise to the organization of all phonological systems.

Accordingly, Chomsky and his followers regard language as a human-specific property and as a unique site whereby to expedite all experiments and investigations on the nature of human mind and thought. It can be seen that Chomsky put forth his theory solely dealing with the nature of language and language acquisition, and then set off on the search for UG analogues in other systems, a search which has not as yet yielded any satisfactory result, hence the ever more convincing substantiation of the uniqueness of human language and its structure.

On the other hand, C/CT, though initially developed by a meteorologist and for the most part applied in natural sciences, has found its way in more social and human disciplines like language acquisition (Larsen-Freeman, 2002). Contra Chomsky’s approach, C/CT psycholinguists have moved from the general to the specific, in an a posteriori manner. Claiming that C/CT captures the behavior and function of complex nonlinear systems from as simple a system as water dripping from a faucet (Larsen-Freeman, 1997) to as complex an entity as the human brain, they have attempted to extend the concept to human language, borrowing from such SLA theories as connectionism, functionalism, and structuralism what has the potential to fit into a chaos/complexity framework, and prove language as a complex nonlinear system. The hypothesis is that if language is a complex nonlinear system, the best candidates for the initial state to which language is sensitive and the strange attractor by which particular languages are constrained are UG and generative grammar, though there can be found other candidates, as well. For one, concerning the model of the brain from a connectionist approach which is consonant with a complex nonlinear system, the initial state could be the weighted connections between neurons. Whatever the initial condition of human language or language acquisition, it is an omniscient state operating in all complex nonlinear systems though different in nature.

Upon comparing how language and UG are conceptualized within Chomskyan structuralism

and C/CT, the idea that C/CT tends to delegate UG and generative grammar to just a case of the multitudinous initial states and strange attractors of complex nonlinear systems seems inevitable. To compound the problem, dynamic processes, according to Larsen-Freeman (1997), are said to be applicable to all kinds of systems, including organic, inorganic, biological, psychological, and social, independent of their physical manifestation and dependent only on the nature of their constituents' interactions.

Conclusion

The theory of Chaos was put forth in the mid 20th century as a theory underlying the operation of complex nonlinear systems in natural sciences (Valle, 2000); however, it was nearly half a century before attempts were made to map the theory's application in the domains of language and language acquisition (Larsen-Freeman, 1997). The present study aimed at reviewing the position of UG within the chaos complexity accounts of language and language acquisition. The following three conclusions were made:

1. A C/CT conceptualization of language can carry on without a UG basis, as does connectionism, or with a UG foundation as an initial state defining the strange attractors to which languages are attracted. Based on the dynamic nature of language, C/CT encourages the blurring of a prevailing boundary in SLA between language acquisition and language use, and in linguistics between the a priori grammar attitude (UG) and the emergent grammar attitude, as both rigidity and flexibility need to be built into a theory of grammar in order for it to be considered adequate.
2. Contra Chomsky's belief in the mutational nature of UG and generative grammar, a C/CT view of language entails the idea that as the chaos induced by information overload led early hom

inids to engage in tool making, generativity characterizing verbal languages began to evolve all the way through to speech, and is still evolving. Maths, writing, science, computing, the Internet and probably in the future, virtual reality and expert systems form an evolutionary chain of languages.

3. Unlike Chomsky's dedication to the unique nature of the structure of language, UG, and generative grammar, C/CT theorists, who have extended the concept from natural sciences to language and SLA, believe what Chomsky has postulated concerning the structure of language is just a sophisticated version of the universal structure underlying all complex nonlinear systems, no matter whether they are organic, inorganic, social, etc, as chaos/complexity processes are presumably independent of the systems' physical manifestation.

Given the discussed aspects of UG and C/CT's divergence and convergence, it can be assumed that theories not specifically developed within the realm of language and language acquisition, e.g., those related to natural sciences, provide a point of reference to determine the extent to which SLA mechanisms map on such theories so as to substantiate the scientific nature of language and the language acquisition process with hard evidence; however, how and to what extent such theories can enhance our understanding of the nature of language and language acquisition are yet to be investigated. Larsen-Freeman (1997, p. 141), though trying to reveal "many striking similarities" between the chaos/complexity science and language and language acquisition, took a cautious stance. Postulating that the just-mentioned analogy may at its best prove to be metaphorical, she opportunely quoted Bowers (1990) as saying: "You don't see something until you have the right metaphor to perceive it" (Larsen-Freeman, 1997, p. 142).

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