

AN INTERDISCIPLINARY SCIENTIFIC STUDY ON THE CONTRIBUTION OF PHYSICAL SCIENCES INTO LANGUAGE TESTING

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Abstract

Recently, there has been a lot of emphasis on the interdisciplinary studies among the fields, brought by the post modernism in the late 20th century. Some of the theories in scientific engineering physical sciences have been of great help into language teaching, learning and testing. Among them, chaos/complexity theory was found to be meaningful similarities with SLA. There also exist outstanding similarities between chaos/complexity theory and language testing and dynamic assessment. The purpose of this paper is twofold: first, it briefly deals with characteristics of the chaos/complexity theory and dynamic assessment; then, it attempts to argue how the study of chaos/complexity theory is meaningful in language testing and dynamic assessment. Concluding that language testing and dynamic assessment as complex systems are dynamic, complex, nonlinear, chaotic, unpredictable, sensitive to initial conditions, open, self-organizing, feedback sensitive, adaptive, strange attractor, fractal, connected and non reducible, this paper sheds light on some of the conundrums of language testing and dynamic assessment.

Key words: *physical sciences, chaos/complexity theory, language testing*

As we march in the third millennium, we come into contact with many more interdisciplinary studies in all the files. Language learning and teaching are not an exception. For instance, Larsen-Freeman (1997) finds that the study of dynamic, complex nonlinear systems is meaningful in SLA in an attempt to take models from physical sciences into SLA. Enumerating 12 characteristics of chaos/complex theory and finding the similarities between the theory and SLA, Larsen-Freeman (1997) states that language as a complex system is dynamic, complex, nonlinear, chaotic, unpredictable, sensitive to initial conditions, open, self-organizing, feedback sensitive, adaptive, strange attractor and fractal. Finch (2004) also explains some key concepts of complexity and systems theory and their relevance to language learning such as openness of system, connectivity, nonreducibility, emergent behavior and unpredictability and regularity.

There is a great need to deal with the very nature of language testing and dynamic assessment through chaos/complexity theory given the integrated reciprocal relationship between teaching and testing put forward by some (e.g. James, 2003; Poehner, 2008). This paper aims at arguing the nature of language testing and dynamic assessment in particular based on chaos/complexity theory and showing how the study of complex dynamic systems is meaningful in language testing and dynamic assessment. First, dynamic assessment and the characteristics of complex systems described by chaos/complexity theory are shortly introduced. Then, the similar characteristics of complex systems in language testing and dynamic assessment are scrutinized. Finally, new lights into language testing and dynamic assessment from the new perspective of dynamic complex systems will be discussed.

I. DYNAMIC ASSESSMENT

Poehner (2008) mentions some reasons for the bifurcation of assessment and instruction like a growing awareness of the political nature of many assessment initiatives, mostly in regard to so-called high-stake tests mostly designed by external agencies adopted by policy makers and school officials and finally imposed upon learners and teachers. Another reason Poehner (2008) mentions is the

teachers' lack of familiarity with the theory and principles underlying assessment practices. Such contentions call for a new perspective to assessment introduced by a dynamic assessment approach.

Poehner (2008) states that dynamic assessment challenges conventional views on teaching and assessment by arguing that these should not be seen as separate activities but should instead be fully integrated. This integration occurs as intervention is embedded within the assessment procedure in order to interpret individuals' abilities and lead them to higher levels of functioning (Lidz & Gindis, 2003, cited in Haywood & Lidz, 2007).

Other definitions are also provided for dynamic assessment. For instance, in Haywood and Lidz' (2007) words, the dynamic assessment is "an interactive approach to conducting assessment within the domains of psychology, speech/language, or education that focuses on the ability of the learner to respond to intervention"(p.1). They maintain that the major component of definitions provided so far for dynamic assessment is "active intervention by examiners and assessment of examinee's response to intervention" (p. 1). Haywood and Tzuriel (2002, cited in Haywood & Lidz, 2007) also define it as "a subset of interactive assessment that includes deliberate and planned mediational teaching and the assessment of the effects of that teaching on subsequent performance" (p.2).

II. CHAOS/COMPLEXITY THEORY: CHARACTERISTICS AND SIMILARITIES IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

In order to find the similarities of chaos/complexity theory in language testing, 12 characteristics of the chaos/complex theory should be introduced as stated by Larsen-Freeman (1997). Complex systems are:

- *Dynamic*: changing over time, process rather than state.
- *Complex*: having many parts, constantly acting and interacting.
- *Nonlinear*: effect is disproportionate to the cause.
- *Chaotic*: a deep, coherent structure within apparent randomness.
- *Unpredictable*: cannot forecast future states.
- *Sensitive to initial conditions*: a tiny change can have a vast effect.
- *Open*: energy/information can flow in or out.
- *Self-Organizing*: a structure/pattern emerges as components interact.
- *Feedback Sensitive*: feedback is incorporated into behavior.
- *Adaptive*: optimizes itself according to environment.
- *Strange Attractor*: global pattern but unpredictable details.
- *Fractal*: a pattern that repeats itself at different scales (e.g. a tree).

Now comments on some of the above characteristics from the viewpoint of the language testing and dynamic assessment are discussed as follow:

III. DYNAMICITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Through testing, the examiners are going to measure the students' knowledge or ability. Nevertheless, the studies along with the experience well show that the examinees' knowledge, ability and performance change over time and affected by many factors. The examinees' performance in all four skills differs from time to time and depends on plenty of factors. For example, many confess that they cannot speak well nor write as well as usual sometimes.

Smith and Samuelson (2003) also believe that changing over time is an integrated property of a system. There seems to be much in common between language and complex nonlinear systems. This can have two usual interpretations. The first common meaning is that language can be described as a collection of static units, but their use in actual speech involves an active process (Larsen-Freeman, 1997). The other common meaning of 'dynamic' is equated with growth and change. Rutherford (1987, cited in Larsen-Freeman, 1997) 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, 1997). Moreover, as Larsen-Freeman (1997) puts it, languages undergo nonlinear changes diachronically. As Ellis, N. (2007) states, an individual's language system with its numerous sub-systems is in constant change and the system as a whole and the sub-systems will show a great deal of variation, that small differences between individuals at a given point of time may have a great effect and that there is no such thing as an end state.

Considering the aforementioned ideas, one can clearly find that language tests though the same tests provide different results of the same subjects due to dynamicity of the language itself, the examinees' language ability and environmental and affective factors. Dynamicity is a more obvious feature of dynamic assessment since this kind of assessment is done over time, accordingly, the change of the learners' language ability and the factors involved make the assessment truly dynamic as the name suggests.

IV. COMPLEXITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Testing aims at measuring examinees' language ability but as Larsen-Freeman (1997) states, complexity is one of the characteristics of language because language is composed of many different subsystems (phonology, morphology, syntax, etc.) which are all interdependent and interact continuously with each other and with their environment.

In addition to the complexity of language, there exists the complexity of the examinees. Human beings are the most complex creatures. As everyone is affected by various genetic and environmental factors, everyone is said to be unique. The complexity of the brain process through which the competence converts to performance is another issue. There are some speculations in this regard but is a matter of high controversy. Therefore, the examinee's performance is affected not only by his/her language ability but also by construct irrelevant factors such as affective, environmental and non language mental factors.

The other source of the complexity is the test and assessment themselves. There are some who propose "discrete-point" and some "integrative" tests. No matter the former or the latter, the tests cannot provide a mere picture of the examinees' competence nor can it extract the performance in a truly natural way though the latter can take a more complete one.

V. NON LINEARITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Language testing and dynamic assessment are much more intricate, complex, and even unpredictable than a linear position would allow. Linguistic theories such as cognitive linguistics and functional linguistics, acquisition theories such as emergentism, and processing theories such as the competition model recognize that there are many interdependent variables, not only within the language system, but also within the social environment and the psychological make-up of an individual.

In Larsen-Freeman's (1997) words, "Complex systems are also nonlinear. A nonlinear system is one in which the effect is disproportionate to the cause. Conversely, in a linear system, a cause of a particular strength results in an effect of equal strength" (p.143). This has been termed the "camel's back" effect. A simple trigger, one which occurs all the time, might be enough on any given occasion to bring about a great convulsion in the system, or to throw the entire system into a chaotic state.

As Mallows (2002) states, “there is no way of knowing when this [*-ed generalization*] may happen with a particular learner, and we cannot predict when the process will end” (p. 4), there is no way to know why examinees perform well on a language component once and quite badly another occasion.

VI. CHAOS AND UNPREDICTABILITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Language testing and dynamic assessment are chaotic since every examinee performs in a unique way at any time of performance. It is also unpredictable as past performance of a certain student or the classroom does not guarantee the same nor similar future performance.

VII. SENSITIVITY TO INITIAL CONDITIONS IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

The examinees` and the examiners` evaluations are sensitive to initial conditions: a small change in the behaviour of a part of the system can greatly influence the behaviour of the whole system. The language skill and the component that the examinee starts to answer on a language test may affect his/her overall performance dramatically. Suppose someone who is not good at listening starts the test with listening part. The examinees` emotional physical status is also of striking effect on their whole performance. A small distracter in the exam condition can affect their performance highly. For example, the unsuitable temperature, chair and noise can be of high inverse influence on their performance. It is the same story for the examiners. The time they evaluate, the emotional and physical conditions under which they evaluate are all of great impact on their scoring and evaluating.

VIII. OPENNESS AND SELF-ORGANIZATION IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Bridging the gap between classroom teaching and assessment, dynamic assessment creates a situation in which there are a lot of interaction between the teacher and the students (T-S), the students (S-S), the teacher and the material (T-M), the students and the material (S-T), the teacher and the classroom context (T-C), and the students and the classroom context (S-C). These various interactions are of great impact on the instruction and assessment in a way that they create a new system. The unexpected turn in classroom interaction reflects the openness of a complex system and its ability to build new structures or patterns as the components of the system interact (self-organization).

IX. SENSITIVITY TO FEEDBACK IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Feedback has been a hot topic in SLA and dynamic assessment. To many (Carroll & Swain, 1992; Dekeyser, 1994; Schmidt, 1994, etc), feedback is an essential part of learning and assessment. The experience also supports the claim meaning that students learn conspicuously and improve their performance by various feedback received from teacher and peers (Reigel, 2005).

X. CONNECTIVITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

One of the basic characteristic of complex systems is that everything influences and is influenced by everything else. These mutually influential relationships are called “connectivities”. De Bot et al. (2005) state that all the components of a complex system are directly or indirectly connected. This new systems view of research focused on organization rather than isolation. Instead of dissecting the subject into parts and further examining these in isolation, it observed the organization of the interactions that held the parts together (Finch, 2002). Finch (2002) argues that human bodies as supra-organisms could be seen from this perspective as open systems which have ordered complexity, and

continually receive input, and therefore do not conform to the second law of thermodynamics, which states that closed systems tend toward entropy.

Larsen-Freeman (1997) also asserts that “Complete Interconnectedness” is one of the characteristics of dynamic systems. She goes on to explain that all variables are interrelated, and therefore changes in one variable will have an impact on all other variables that are part of the system. Consequently, complex systems cannot exist in isolation, but affect each other in a multitude of ways. In terms of the language testing and dynamic assessment, everything occurring in the test, exam condition and classroom can have impacts on everything else as explained above in sections “Complexity” and “Sensitivity to initial conditions”.

XI. NON-REDUCIBILITY IN LANGUAGE TESTING AND DYNAMIC ASSESSMENT

According to Harris (1997, cited in Finch, 2004), a dynamic system cannot be understood by reducing it to its parts. This is a significant finding for applied linguists and language teachers, because target language cannot be fully acquired by studying it in parts, whereas the practice for so long has been to divide the target language into components (grammar, syntax, morphology, pronunciation, etc.) and to teach these in isolation on the assumption that the student will somehow put them all together to form language. Larsen-Freeman (1997) contends that even if we could identify and measure all of the factors in second language acquisition, complexity theory tells us that we would still be unable to predict the outcome of their combination.

In terms of language testing, the so called “discrete-point approach” that emphasizes that each item should test only one point is not valid anymore and “integrative approach” is in line with this feature.

XII. SUGGESTIONS AND LIGHTS FROM CHAOS/COMPLEXITY THEORY FOR LANGUAGE TESTING AND DYNAMIC ASSESSMENT

Larsen-Freeman (1997) 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. According to the aforementioned issues, a couple of suggestions and a number of potential contributions of chaos/complexity theory to various aspects of language testing and dynamic assessment are introduced so that their potential might be realized. In language testing and dynamic assessment, chaos/complexity theory seems to:

1. encourage following relativism and avoiding absolutism in all aspects of testing and assessment.
2. introduce dynamic reliability and validity that is subject and context oriented.
3. encourage the use of feedback.
4. support integrative approach and rejects discrete point approach to testing.
5. emphasize the importance of details.
6. underscore the importance of exam condition.
7. underscore the importance of individual differences.
8. encourage accepting complexity and unpredictability of the classroom and test as natural conditions.

XIII. CONCLUSION

Considering the “striking similarities” found between chaos/complexity theory and SLA by Larsen-Freeman (1997) and Finch (2004), an attempt has been made to look at language testing and dynamic assessment in light of chaos/complexity theory as well in this paper. To put in a nutshell, it is argued that language testing and dynamic assessment as complex systems are dynamic, complex, nonlinear, chaotic, unpredictable, sensitive to initial conditions, open, self-organizing, feedback sensitive, adaptive, strange attractor, fractal, connected and non reducible. In the end, some lights and contributions derived from chaos/complexity theory to language testing and assessment such as encouraging relativism and avoiding absolutism, introducing dynamic reliability and validity, encouraging the use of feedback, supporting integrative approach and rejecting discrete point approach to testing, emphasizing the importance of details, exam conditions and individual differences and encouraging accepting complexity and unpredictability of the classroom and test as natural conditions are suggested and introduced.

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