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Locusts, Snowflakes and Recasts: Complexity Theory and Spoken Interaction¹

Abstract

Complexity theory is becoming established as a conceptual framework which is relevant to many areas of applied linguistics (Larsen-Freeman and Cameron 2008) as well as to many other academic disciplines. This article examines the extent to which spoken interaction has the characteristics of a complex adaptive system. The study commences by introducing complexity theory and its importance in understanding how nonlinear systems of all kinds function. The typical characteristics of complex adaptive systems in the human and natural world are identified.

L2 classroom interaction is chosen for study as an example of a variety of spoken interaction since it has certain distinctive characteristics and because a description of its architecture already exists (Seedhouse 2004). Interaction in this setting is shown to display some characteristic features of a complex adaptive system, which are illustrated through the use of classroom data. The IRF pattern is selected for particular examination as it is the best-known pattern in this setting. It is concluded that the study of spoken interaction as a system may benefit from the insights of complexity theory.

Introduction

Complexity theory is becoming established as a conceptual framework which is relevant to many areas of applied linguistics as well as to many other academic disciplines. Larsen-Freeman and Cameron (2008) suggest that spoken interaction is a complex adaptive system, and that L2 classroom interaction may be viewed in this way. The study below is the first ever attempt to compare the known characteristics of a specific variety of spoken interaction with the known characteristics of complex adaptive systems in order to establish the degree of fit. The research question is as follows: does L2 classroom interaction exhibit the characteristics of a complex adaptive system? The methodology employed in this study is essentially a comparison between two sets of characteristics as identified by research studies. If the characteristics of L2 classroom interaction overwhelmingly match those of complex adaptive systems, there is then a *prima facie* case that it is a complex adaptive system. If the characteristics do not match in any way, this would strongly suggest that it is not a complex adaptive system. If the results are somewhere in between, the findings would be inconclusive.

L2 classroom interaction is examined as an example of spoken interaction. There are many different varieties of spoken interaction and clearly it is more practical to examine in detail the characteristics of a single variety rather than attempt to generalize about all interaction. However, we should be aware that L2 classroom interaction has a number of distinctive characteristics. In L2 classroom interaction, language is the object as well as the vehicle of instruction. Participants are analysing and commenting on the

linguistic forms and patterns of interaction themselves and employing these as the basis for further interaction. This means that we have an opportunity to observe an interactional system continually examining itself and feeding back on itself in interactional terms. It is argued that these characteristics are particularly conducive to revealing the characteristics of complex adaptive systems². The description of the characteristics of L2 classroom interaction employed in this study derives from Seedhouse (2004). In this study, Conversation Analysis (CA) methodology is applied to an extensive and varied database of language lessons from around the world to answer the question 'How is L2 classroom interaction organized?' According to Larsen-Freeman and Cameron (2008: 183), "CA, by offering careful description of the micro-level of face-to-face talk as a single coupled system, is compatible with the complex dynamics systems approach to discourse ... and provides an important starting point for assembling a complexity toolkit for discourse."³

We should also consider the methods employed by researchers in Complexity Theory to identify a complex adaptive system. According to Johnson (2007: 13) "There is no rigorous definition of Complexity... We will characterise Complexity... by describing the features which a Complex System should have, and looking at the behaviors which it should then show". In the section below I therefore list the typical characteristics and behaviours of complex adaptive systems. These have been identified below by reviewing the literature on complexity theory, the main works of which are cited in the bibliography. I then examine the characteristics of L2 classroom interaction and analyse the similarities and differences.

Complexity Theory

Complexity theory is a science which aims to explain the nonlinear interactions of microscopic elements in complex systems (Mainzer 1997) or a science of the global nature of systems (Gleick 1993). It reveals the subtle relationships between simplicity and complexity and between orderliness and randomness (Hall, 1991, p. 7). A defining characteristic of a complex system is that its behaviour emerges from the interactions of its components (Larsen-Freeman and Cameron 2008: 9-10) and so complexity theory always develops a holistic or ecological perspective rather than a reductionist or atomistic one (Gleick 1993: 7). Complex adaptive systems of many different kinds have been studied so far and include: movements on the stock market and in the global economy; weather systems; the emergence, evolution and extinction of species; the rise and fall of animal populations; the organisation and functioning of the human heart and brain; immune, circulatory and respiratory systems; language, learning and thinking in humans; human cultural evolution; cultural and social systems such as political parties or scientific communities; the rise and fall of civilisations. It has been suggested that complexity theory is relevant to the social sciences (Byrne 1998), classroom dynamics (Kiefer 2006; Radford 2007), language teaching (Tudor 2003), the evolution of language(s) (Hawkins and Gell-Mann 1992; Oudeyer 2005) and organisational change (Boyatzis 2006). A detailed study of the relationship between complexity theory and applied linguistics and discussion of possible applications is provided by Larsen-Freeman and Cameron (2008). The present study focuses exclusively on the possibility of a variety of spoken interaction behaving as a complex adaptive system.

Characteristics of Complex Adaptive Systems

Complex adaptive systems share certain crucial properties, which are specified in the following section. Larsen-Freeman (1997) also provides a succinct summary of these characteristics.

Self-organisation and adaptation of many interacting agents

Matter, even at the most basic level of single-cell life forms, has an innate tendency to self-organize and generate complexity (Coveney and Highfield 1995). Coherent, self-organizing clusters at one level combine to form new and different clusters at a higher level. They are adaptive, in that they do not just passively respond to events. For example, the human brain constantly organizes and reorganizes its billions of neural connections so as to make sense of experience. This also applies at the macro level of society: people trying to satisfy their material needs unconsciously organize themselves into an economy through numerous individual acts of buying and selling. This happens without anyone being in charge or consciously planning it (Mitchell Waldrop 1994). Complexity theory is therefore the study of how interacting agents at all levels of scale form themselves into networks or systems (Johnson 2007)

Non-Linearity

In linear systems, activity produces a straight line on a graph. For example, if we drive a car for 70 mph for 2 hours in perfect conditions, we will travel 140 miles; plotting distance against time will produce a linear display on a graph. Linearity also implies the superposition principle, which says that the whole is only the sum of its parts. (Mainzer 1997: 283). However, an enormous number of systems in the universe are non-linear, meaning that small changes in the external environment can produce large changes in the system (Gribbin 2004: 106) and straight lines are not produced on the graph. Nonlinear systems express relationships that are not strictly proportional. (Gleick 1993: 23) in which the result is not proportionate to the cause. An example of a non-linear system is the weather, where a minute event can result to major changes in weather systems (Lorenz 1993). Complexity theory studies the properties and behaviour of non-linear systems.

Surface complexity arising out of deep simplicity.

Extremely simple systems can generate extremely complex and intricate patterns (Gribbin 2004). This occurs because systems interact with their environment, react to feedback from their environment and feed back on themselves. They are therefore able to self-organize and form new organisations at more complex levels (see above). So, however complex the outputs of a system may seem to be, we still have a chance to uncover the simple systems or machinery which generates this complexity (Lewin 1993). A typical illustration of how this works is provided in figure 1. The illustrated ‘Mandelbrot set’ is claimed to be the most complex object in mathematics, and yet a terse

computer program ($Z = Z^2 + C$) contains enough information to reproduce the entire set. (Gleick 1993: 221).

INSERT FIGURE 1 NEAR HERE

Sensitivity to initial conditions

In nonlinear systems small inputs can lead to dramatically large consequences and very slight differences in initial conditions can produce very different outcomes (Lewin 1993). This characteristic is often associated with Lorenz (1993) who ran mathematical models of weather systems on computers. He found that an absolutely minute difference in initial atmospheric conditions could result in the formation of two completely different weather systems.

Complex systems adapt using feedback from the environment and from themselves

Systems receive feedback from their interactions with the environment and organize and adapt themselves accordingly. As the system evolves in time, minute changes amplify rapidly through feedback. This means that systems starting with only slightly differing conditions rapidly diverge in character at a later stage (Hall 1991). This explains non-linearity, or how it is that tiny differences in initial states can produce radically different outcomes. Systems also feed back on themselves, providing themselves with information on how they are organized in relation to their environment. A key feature of complex

systems, then, is that they are ‘open’ and influenced by their environment (Johnson 2007; Prigogine and Stengers 1984). An example of how positive feedback (systems feeding back on themselves) can create dramatic change is provided by studies of swarming locusts (Palmer 2008) which can devastate vast areas. Locusts are normally solitary and ‘harmless’, but if they come near other locusts, e.g. because they have to compete for food in a confined area, then they may touch each other. If their back legs are touched, they undergo a dramatic transformation to gregarious swarming locusts. Further feedback pushes them to march forward, not only to find food, but also to avoid being cannibalized by the locusts behind them; this constitutes a very literal form of feedback!

Complex adaptive systems arise from the interaction of their parts and function as a whole which is more than the sum of its parts

In complex adaptive systems, the organisation of the whole system is created from the nonlinear interactions of numerous much smaller elements. This principle has great importance to the brain, in which local interactions between neighboring cellular elements create states of global order leading to a coherent behaviour of the organism (Mainzer 1997). This means that complex adaptive systems cannot, in general, be successfully analyzed by isolating properties or variables that are studied separately and then combining those partial approaches. Instead, it is necessary to adopt a holistic perspective and look at the whole system (Hawkins and Gell-Mann 1992).

Complex adaptive systems display both homogeneity and heterogeneity

A key to understanding how complex adaptive systems work is the way in which they simultaneously display both homogeneity and heterogeneity. At the lowest level, no two complex adaptive systems are ever absolutely identical: each starts from slightly different starting conditions and interacts with a slightly different external environment. Yet complex adaptive systems of the same genus display certain similarities. To illustrate this point, Gleick (1993: 311) describes how feedback from the environment creates heterogeneity in snowflakes as they grow:

“As a snowflake falls to earth, typically floating in the wind for an hour or more, the choices made by the branching tips at any instant depend sensitively on such things as the temperature, the humidity, and the presence of impurities in the atmosphere. The six tips of a single snowflake, spreading within a millimetre space, feel the same temperatures, and because the laws of growth are purely deterministic, they maintain a near-perfect symmetry. But the nature of turbulence is such that any pair of snowflakes will experience very different paths. The final flake records the history of all the changing weather conditions it has experienced, and the combinations may as well be infinite.”

This introduces another important point: the degree of homogeneity and heterogeneity we find in a complex adaptive system and in its constituent elements depends on our

perspective as observers and the scale at which we observe it. To the naked eye, snowflakes all look the same. However, under a microscope they display almost infinite variety.

Complex adaptive systems display self-similarity on various scales and levels

The patterns or shapes of complex adaptive systems look similar from different scales, perspectives and levels. This is illustrated in figure 2 below. This property of endlessly manifesting a motif within a motif is known as self-similarity. The motif is mirrored at every scale of length: the edges of a clover leaf will be bristling with smaller clover shapes that will bristle with still smaller clover shapes, and so on indefinitely (Coveney and Highfield 1995). The word ‘fractal’ (coined by Mandelbrot) is used in this context to denote shapes which are irregular all over (fractional) and which have the same degree of irregularity on all scales. A fractal object looks the same when examined from far away or nearby – it is self-similar, which implies that any subsystem of a fractal system is equivalent to the whole system (Sardar and Abrams 1999). Examples of fractals are coastlines and ferns. Fractals are strongly associated with complex systems (Johnson 2007).

INSERT FIGURE 2 NEAR HERE

There are universal properties of nonlinear systems: different systems behave in the same ways

The notion of universality (associated with Feigenbaum) means that different complex adaptive systems will behave in the same ways (Sardar and Abrams 1999). Complex adaptive systems are constantly revising and rearranging their building blocks as they gain experience. At some deep, fundamental level, all of these processes of learning, evolution and adaptation are the same (Mitchell Waldrop 1994: 145-7).

However, the question is whether a systems theory applies to human behavioural systems in the same way as it may do in relation to some other systems in the animal, vegetable and mineral worlds. As Gleick (1993: 278) puts it “The idea that in fact there are universal properties of systems, built into the simplest representations, alienates all of us.” The notion that many or all of the aspects of human behaviour, mind and interaction with others might be governed by the universal properties of systems profoundly shakes our notions of free will, individuality and liberty. In particular, we may have a strong instinctive reaction against the notion that spoken interaction between humans might function as a system in a similar way to a colony of bees. The belief is widespread that humans, their brains and their system of communication are somehow separate and distinct from the rest of the world around them.

The characteristic of universality provides the rationale for investigating whether human spoken interaction displays the characteristics of a complex adaptive system. If universality applies, then we should be able to find evidence for this in the data.

The Characteristics of L2 Classroom Interaction

This section presents an extremely brief account of the interactional architecture of the L2 classroom, based on Seedhouse (1996; 2004)⁴, to which readers are referred for a full account. The study applies CA methodology to an extensive and varied database of language lessons from around the world and attempts to answer the question ‘How is L2 classroom interaction organized?’ The main finding is that there is a reflexive relationship between pedagogy and interaction in the L2 classroom, and that this relationship is the foundation of its context-free architecture. This relationship means that, as the pedagogical focus varies, so the organisation of the interaction varies. However, this also means that the L2 classroom has its own interactional organisation which transforms intended pedagogy into actual pedagogy.

The first step towards describing the interactional architecture of L2 classroom interaction is to identify the institutional core goal, which is that *the teacher will teach the learners the L2*. This core institutional goal remains the same wherever the L2 lesson takes place and whatever pedagogical framework the teacher is working in. From this core goal a number of consequences issue both rationally and inevitably which affect the way in which L2 classroom interaction is accomplished. Drew and Heritage (1992: 26) suggest that each institutional form of interaction may have its own unique *fingerprint*, “comprised of a set of interactional practices differentiating (it) both from other institutional forms and from the baseline of mundane conversational interaction itself.” There are three interactional properties which derive directly from the core goal, and these properties in turn necessarily shape the interaction. These follow in rational

sequence from each other and constitute part of the unique fingerprint of L2 classroom interaction.

Property One

Language is “Both the vehicle and object of instruction.” (Long 1983: 9). This property springs rationally and inevitably from the core goal. The core goal dictates that the L2 is the object, goal and focus of instruction. It must be taught, and it can only be taught through the medium or vehicle of language. Therefore language has a unique dual role in the L2 classroom in that it is both the vehicle and object, both the process and product of the instruction. In other forms of classroom education (history, engineering) language is only the vehicle of the teaching. It should be pointed out that, in this model, L2 classroom interaction is interaction which is produced in the L2 by teachers and/or learners. Of course, many other varieties of interaction can occur in the physical setting of an L2 classroom, including talk in L1, but the above is the sole focus of this model.

Property Two

There is therefore a reflexive relationship between pedagogy and interaction and interactants constantly display their analyses of the evolving relationship between pedagogy and interaction in their talk. This means that as the pedagogical focus varies, so the organisation of the interaction varies. The omnipresent and unique feature of the L2 classroom is this reflexive relationship between pedagogy and interaction. So whoever is taking part in L2 classroom interaction and whatever the particular activity during which the interactants are speaking the L2, they are always displaying to one another their

analyses of the current state of the evolving relationship between pedagogy and interaction and acting on the basis of these analyses. The extract below illustrates how this works even in the first exchange a Chinese L1 beginner makes in his first English class. T = teacher; L1 = identified learner; LL = learners.

Extract 1

- 1 T: OK my name's,
- 2 LL: my name's,
- 3 T: OK, (.) er, hello, (addresses L1) my name's John Fry.
- 4 L1: (.) my name's John Fry,
- 5 T: oh!
- 6 LL: (laugh)
- 7 L1: my name's Ping. Ping.
- 8 T: Ping? yes hello, °you say° (whispers) hello.
- 9 L1: hello my name is my name's Ping.

(British Council 1985 volume 1: 15)

We can see in line 4 that L1 displays an analysis of the current relationship between pedagogy and interaction as being that he must repeat whatever the teacher says. It is easy to see how this occurs, since in lines 1 and 2 the required relationship between pedagogy and interaction was just that. T, however, displays in lines 5 and 8 that his

analysis is that this is not the required relationship and that L1 should instead produce a specific string of forms including L1's own name. L1 then changes his analysis of the relationship between pedagogy and interaction so that in line 9 it finally conforms to that required by T. Interactants are always displaying to one another their analyses of the current state of the evolving relationship between pedagogy and interaction and acting on the basis of these analyses.

Property Three

The linguistic forms and patterns of interaction which the learners produce in the L2 are potentially subject to evaluation by the teacher in some way. As van Lier (1988: 32) puts it, "Everyone involved in language teaching and learning will readily agree that evaluation and feedback are central to the process and progress of language learning." This property does *not* imply that all learner utterances in the L2 are followed by a direct and overt verbalized evaluation by the teacher, as the data show this clearly not to be the case. It means that all learner utterances are *potentially* subject to evaluation by the teacher. This third property derives rationally from the second property; since the linguistic forms and patterns of interaction which the learners produce in the L2 are normatively linked in some way to the pedagogical focus which is introduced, it follows that the teacher will need to be able to evaluate the learners' utterances in the L2 in order to match the reality to the expectation⁵.

Seedhouse (2004) proposes that these three properties are universal, i.e., they apply to all L2 classroom interaction and they are inescapable in that they are a rational consequence of the core institutional goal and the nature of the activity. These properties,

then, form the foundation of the rational architecture and of the unique institutional 'fingerprint' of the L2 classroom. Although L2 classroom interaction is extremely diverse and fluid, it is nonetheless possible to state a basic sequence organisation which relates to the above properties and which applies to all L2 classroom interaction.

1. A pedagogical focus is introduced. Overwhelmingly in the data this is introduced by the teacher but it may be nominated by learners.
2. At least two persons speak in the L2 in normative orientation to the pedagogical focus.
3. In all instances, the interaction involves participants analysing this pedagogical focus and performing turns in the L2 which display their analysis of and normative orientation to this focus in relation to the interaction. Other participants analyse these turns in relation to the pedagogical focus and produce further turns in the L2 which display this analysis. Therefore, participants constantly display to each other their analyses of the evolving relationship between pedagogy and interaction.

The Characteristics of L2 Classroom Interaction compared with those of Complex Adaptive Systems

In this section I cite once again some of the characteristics of complex adaptive systems and then compare these to various characteristics of L2 classroom interaction.

Complex adaptive systems display self-similarity on various scales and levels

If L2 classroom interaction does indeed function as a complex adaptive system, then we should expect to notice some evidence of self-similarity in the structure of the interaction at different levels. In other words, the macro description of the architecture of L2 classroom interaction provided above should be miniaturized in some way in the micro-interactional detail. The best-known interactional phenomenon in L2 classroom interaction is the three-part sequence generally known as IRF (Teacher Initiation, Learner Response and Teacher Follow-Up or Feedback) Sinclair and Coulthard (1975). This pattern has been identified in numerous research studies as ubiquitous throughout the world. As Larsen-Freeman and Cameron (2008: 235) say in their discussion of complexity theory in relation to discourse: “The IRF pattern ... can be seen as an attractor on the classroom discourse landscape that shows variability around a very stable form and that has arisen through adaptation in response to particular classroom contingencies. The discourse system will tend to return to the IRF attractor because it is a pattern that works; it is a preferred behaviour of the system.” The importance of the IRF pattern demands explanation if we are to claim that L2 classroom interaction has a rational architecture. First of all we need to recall the three properties of L2 classroom interaction as stated above and then compare a typical example of the IRF pattern:

- 1) Language is both the vehicle and object of instruction.
- 2) There is a reflexive relationship between pedagogy and interaction and interactants constantly display their analyses of the evolving relationship between pedagogy and interaction.

3) The linguistic forms and patterns of interaction which the learners produce are subject to evaluation by the teacher in some way.

Next we should examine an example of the IRF pattern:

Extract 2

- 1 T: number three:: (0.3) er Dilmo where is the cat?
- 2 L1: the cat is inside the box
- 3 T: *excellent* ok inside the box

(Carr 2006: dvd 14)

In the context of the overall description of the interactional architecture of the L2 classroom, the IRF pattern can be seen as a **realisation in miniature of the three interactional properties** (Seedhouse 1996: 354). In line 1 the teacher introduces a pedagogical focus, expecting the learner to reflexively produce a precise pattern of interaction in response. In line 2 the learner produces an utterance, which is matched against the pedagogical focus and positively evaluated by the teacher in line 3. Language is both the vehicle and goal of the interaction in that the point of the teacher's prompt is for the learner to produce a string of linguistic forms for evaluation. So the functional or rational explanation which we can offer for the importance of the IRF pattern is that it is the most compact vehicle imaginable for the accomplishment of what Drew and Heritage (1992: 40-41) call the institutionalized activity. Because it is so closely identifiable with

the interactional properties and with the institutional business, it is the **most economical method** of accomplishing a complete cycle of the institutional business. For a complete cycle of the institutional business to be carried out, the minimum requirement is that i) the teacher introduces a pedagogical focus ii) the learner produces patterns of interaction in response iii) the teacher evaluates the learner response (although this is not always verbalized) by matching i) to ii). In the case of the previous extract, this complete cycle of institutional business is accomplished in only 18 words.

This explains why the IRF pattern has a satisfying, complete feel to it, or is an *attractor* in the terms of complexity theory. This provides an illustration of what is meant in CA by the rational design of institutional interaction. Not only can it be shown that the overall interactional architecture of L2 classroom interaction derives from the core goal, but ‘surface’ features of the micro-interaction, such as the IRF pattern, can be allocated a functional place within that architecture and related directly to the macro levels. In other words, it can be shown **how** the surface feature is accomplishing the institutional business. This perspective also conforms to Larsen-Freeman and Cameron’s (2008: 236) description of “the language classroom as a complex system, not reducible to its component parts, but in which the parts contribute to the whole while also being formed by the whole.”

From a complex systems perspective, L2 classroom interaction displays self-similarity at different levels, with the IRF pattern a fractal, replicating on a miniature scale the interactional properties of L2 classroom interaction. Further research may reveal how other recognized and well-studied individual features of L2 classroom interaction have this fractal quality in relation to the macro-architecture⁶. A further example is the

construct of recast, which has been very extensively subjected to quantitative treatment in psycholinguistic SLA (e.g. Mackey 2007). According to Loewen and Philp (2006: 537), “Recasts are target language reformulations by the interlocutor of a learner’s nontarget-like utterances that retain the central meaning while changing the form of the utterance, as shown in Extract 3. The recast functions both to confirm the meaning of the student’s utterance and to correct the form.”

Extract 3

S: to her is good thing (·) to her is good thing

T: yeah for her it’s a good thing *recast*

S: because she got a lot of money there

Recasts, then, display a dual orientation to language as object and language as vehicle of instruction in the same move. They foreground the dual nature of language in L2 classroom interaction and hence can be seen as a fractal of the first interactional property. There is a reflexive relationship between pedagogy and interaction (second property) in that the primary focus is on meaning and fluency. The corrective recast is disguised or camouflaged so that the primary business of communication can proceed. The third property is embodied in the designedly ‘by-the-way’ negative evaluation implicit in the embedded correction, but is nonetheless available to the learner as feedback⁷.

Self-organisation and adaptation of many interacting agents

Edmondson (1985: 162) suggests that “The complexity of the classroom is such that several things may be going on publicly through talk at the same time.” Seedhouse (2004: 59-63) examines the following extract and suggests that this is a very complex, fluid and dynamic piece of interaction indeed.

Extract 4

- 1 T: Vin, have you ever been to the movies? What’s your favorite movie?
- 2 L: Big.
- 3 T: Big, OK, that’s a good movie, that was about a little boy inside a big man,
wasn’t it?
- 4 L: Yeah, boy get surprise all the time.
- 5 T: Yes, he was surprised, wasn’t he? Usually little boys don’t do the things
that men do, do they?
- 6 L: No, little boy no drink.
- 7 T: That’s right, little boys don’t drink.

(Johnson 1995: 23)

The full analysis is not included here for reasons of space; by analysing turn-taking, sequence organisation, repair and topic at the same time, Seedhouse suggests that the learner in this extract is able to develop a sub-topic and is allowed interactional space. The teacher is balancing multiple and sometimes conflicting demands, orienting to five separate (though related) concerns simultaneously, as follows.

1) The teacher's pedagogical focus (Johnson 1995: 23) "was to allow the students to share their ideas and possibly generate some new vocabulary words within the context of the discussion." This implies that the teacher needs to control the overall topic whilst allowing the learners some interactional space to develop their own sub-topics. The teacher has to orient, then, to an overall pedagogical plan.

2) The teacher also has to respond to the ideas and personal meanings which the learner chooses to share, and does so successfully in that he/she develops the sub-topic introduced by the learner. So in lines 5 and 7 the teacher responds to the learner utterance with a conversational action of agreement which validates the propositional content of the utterance as well as the introduction of the sub-topic.

3) The teacher also responds to linguistic incorrectness in the individual learner's utterances and conducts embedded repair on them. The linguistic repair is performed in a mitigated way because it is prefaced by an action of agreement and approval and because this type of embedded correction can be treated as a by-the-way matter.

4) The teacher must also orient to the other learners in the class. One problem faced by teachers is that individual learners often produce responses which are inaudible

or incomprehensible to the other students in the class. So in lines 5 and 7 the teacher is simultaneously displaying approved versions of learner utterances so that the other learners are able to follow the propositional content of the interaction and are also able to receive correctly formed linguistic input.

5) One of the most difficult feats in L2 teaching is to maintain a simultaneous dual focus on both form and meaning (Seedhouse 1997). The teacher in the above extract is skilfully managing to maintain elements of a simultaneous dual focus on both form and meaning.

The analysis, then, suggests that L2 classroom interaction involves a number of people orienting to multiple issues on multiple levels simultaneously. Participants are involved in organising the interaction and adapting themselves to others' contributions on a turn-by-turn basis. However, we have only touched the surface of the interaction and the factors identified above do not constitute a comprehensive list. Missing is the whole area of non-verbal communication, including posture, gaze, gesture, intonation, pitch, volume etc. Also, we need to take into account the reactions of other participants and the role of L1 in L2 classrooms.

Non-Linearity

Classroom language teachers are very familiar with the concept of non-linearity, in which you intend one thing to happen in class and something very different happens instead! In this section we consider some of the consequences of non-linearity in relation to L2 classroom interaction. A recent development in the study of language pedagogy is that of

how intended pedagogy becomes converted into actual pedagogy; the realisation has been that learners actively interpret and transform the teacher's intended pedagogical focus. One cannot therefore assume a linear, proportionate relationship between what is intended and what transpires. A variety of terminology has been used in the literature to refer to this gap between intended and actual pedagogy. This study employs the terms 'task-as-workplan' and 'task-in-process' (Breen 1989). The task-as-workplan is the intended pedagogy, the plan made prior to classroom implementation of what the teachers and learners will do. The task-in-process is the actual pedagogy or what actually happens in the classroom. In practice, there is sometimes a significant difference between what is supposed to happen and what actually happens. There is now ample evidence in the literature (Coughlan and Duff 1994; Donato 2000; Foster 1998; Ohta 2001; Platt and Brooks 1994; Mori 2002; Roebuck 2000) of tasks-as-workplan resulting in different and unexpected tasks-in-process. Seedhouse (2005) examines some of the factors which may be involved when there is a gap between task-as-workplan and task-in-process. Here I provide just one example of non-linearity, namely the social dynamics of the classroom, which can radically alter the focus of the interaction. In Seedhouse (1996) I recorded four separate groups of Norwegian learners, aged 17-18 in a state school. All groups were working on the same task and I found that the interaction and enactment of the task-as-workplan was radically affected by group dynamics. The task-as-workplan was as follows: **"Discuss the following statements: Today white dominance is threatened in the US. After 1986 life has been much easier for many of the illegal immigrants. There is no restriction on immigration in today's US. The diversity of the American society is clearly reflected in its political and cultural institutions. Intermarriage is looked upon**

as the key to americanization. Since the USA is a nation of immigrants, tolerance and respect for people with another cultural background is one of its characteristics. Bilingual education is the key to success for the large Spanish speaking community”. In the groupwork below, for example, the group dynamics become the focus of the interaction as the discussion becomes somewhat heated, with the following extract characterized by competition for the floor, interruptions and disagreement. In lines 6 to 14, the topic has shifted from discussing the statements to the emotions, relationships and behaviour of the interactants.

Extract 5

- 1 L2: aha. so how can you believe just like you said that everyone is like that when=
2 L3: =I don't say everyone.
3 L2: you just said the Italians doesn't want to=
4 L1: =yeah. and the Mexicans.
5 L2: so what so what do you suggest=
6 L3: =angry you get just angry=
7 L1: =no this was about=
8 L3: =just angry. you can twist and turn the words as much as you like but you
9 can't change my attitude.
10 L2: no but=
11 L1: =no but this is about education.
12 L3: stop twisting my words so fucking much.

13 L1: (laughs)

14 L3: you're twisting my words=

(Seedhouse 1996: 400)

So there is clear evidence that we cannot assume a linear relationship between intended pedagogy and actual pedagogy; it is essential to track how the task-in-process evolves. It is difficult to predict in advance which factors will impact on interpretations of a particular task-as-workplan by particular students. This suggests, then, that the relationship between pedagogy and interaction is a nonlinear one. It is a complex relationship which may be affected by a number of factors on a number of levels.

Surface complexity arising out of deep simplicity.

Seedhouse (2004) suggests that the entire architecture of L2 classroom interaction is based on one simple principle, which is unique to the L2 classroom, namely that there is a reflexive relationship between pedagogy and interaction. As the pedagogical focus varies, so the organization of the interaction varies. Since there is no limit in principle to the number of pedagogical foci which may be introduced, an innumerable range of patterns of interaction may be produced.

Sensitivity to initial conditions

In nonlinear systems, small inputs can lead to dramatically large consequences and very slight differences in initial conditions produce very different outcomes. This property can help us understand to some extent the phenomenon whereby the same teacher, teaching the same lesson to two parallel groups of similar ability can find that radically different lessons result. Small differences in variables can have an enormous impact on lesson development. For example, Coughlan and Duff (1994) demonstrate that the same task-as-workplan does not yield comparable results in terms of task-in-process when performed by several individuals, or even when performed by the same individual on two different occasions.

Systems adapt using feedback from the environment and from themselves

Feedback is well known to be a very prominent feature of L2 classroom interaction (van Lier 1988: 32). An interesting example of how interactants adapt interactional systems is the case of task-based interaction. In the extract below, 'Blocks' is a task based on the 'information gap' principle. The students were in pairs separated by a screen and in front of each student were five wooden building bricks of differing shapes and colours. The teacher arranged the bricks of one of the students into a certain pattern and it was then the task of that student to explain to his/her partner how to arrange the other set of bricks so that they were laid out according to the pattern. A time limit of sixty seconds was imposed after which the teacher arranged the other student's bricks into another pattern and the activity was carried out once more (Warren 1985: 57).

Extract 6

- 1 L1: ready?
- 2 L2: ready
- 3 L1: er (.) the blue oblong above the red oblong, eh? the yellow oblong.
- 4 L2: (.) alright. (.) >faster, faster.<=
- 5 L1: =the: red cylinder (.) beside the (.) blue oblong,
- 6 L2: (.) left or right?=
7 L1: =right.
- 8 L2: (.) right yeah () OK.
- 9 L1: (1.0) the the red cube (.) was: (1.0)
- 10 L2: the red cube?
- 11 L1: (.) the red cube was (.) behind the (.) blue oblong.
- 12 L2: (.) blue oblong, (.) blue oblong. yeah.
- 13 L1: and the: (.) red cube was (.) er behind the (.) red oblong.

(Warren 1985: 275)

In this extract we can see the learners' orientation to the time limit set for completion of the task (1 minute), in that L2 says "faster, faster" in line 4. In this extract we see L2 telling L1 when he has finished a particular stage (lines 4, 8 and 12) and this enables L1 to commence giving the next item of information as soon as L2 has finished

noting the previous one. This procedure clearly minimizes gap; in lines 8, 10 and 12, L2 appears to repeat what L1 has said in order to confirm his understanding of L1's utterance, to display the stage that L2 is at in the process of noting the information, and to delay L1 in order that he should not begin the next item of information until prompted to do so. This is particularly evident in line 12, in which L2 repeats L1's utterance twice before giving confirmation of completion.

The types of turns are constrained by the nature of the task, as are turn order and even turn length, because of the time limit. The basic organisation of turn-taking and sequence is that L1 makes statements to which L2 will provide feedback, clarification or repetition requests or repair initiation. On the one hand, the learners are engaged in developing turn-design features which are appropriate to the accomplishment of the task, e.g. confirmation to minimise gap. An interactional system evolves using external feedback from the environment, i.e. the nature of the task which has been given to the learners and the physical presence of the screen. On the other hand, we can also see the interactants provide internal feedback (in line 4) which then impacts on how the interaction is conducted. Although the discussion above was of 'a system', it would be preferable to talk of classroom interaction as consisting of a number of 'nested', interconnecting systems which all influence each other.

Complex adaptive systems display both homogeneity and heterogeneity

Seedhouse (2004) suggests that it is necessary to portray any instance of L2 classroom interaction as having a *complex personality*, as simultaneously displaying both

homogeneity and heterogeneity and as functioning on a number of different levels at the same time; this property is called *complementarity* (Gribbin 1991: 118). Seedhouse (2004) presents a model which provides a means of explicating and conceptualising this, termed a *tri-dimensional view of context*, since it involves three perspectives on context represented in decreasing circles (see figure 3).

INSERT FIGURE 3 NEAR HERE

There is always a tension between a description of an extract of L2 classroom interaction as a unique occurrence, locally produced by the participants, between a description of it as an example of interaction within a particular L2 classroom context and between a description of it as an example of institutional L2 classroom discourse. Seedhouse (2004) examines a classroom extract and show how all three levels of context are simultaneously manifested in the extract. The analysis is intended to illustrate how the interaction displays both homogeneity (typical institutional features) and heterogeneity (uniqueness) at the same time.

Extract 7

- 1 T: what did I dream? Can you remember?
- 2 L1: you turned into a toothbrush
- 3 T: can I have a full sentence, Hugo?
- 4 L1: that you turned into a toothbrush

- 5 T: OK. you (.)?
6 L2: you turned into a toothbrush.
7 T: you (.)?
8 L2: you turned into a toothbrush.
9 L3: you dreamed.
10 T: you dreamt.
11 L3: you dreamt.
12 T: everyone
13 LL: dreamt
14 T: OK. I dreamt that I turned into a toothbrush.

(Ellis 1984: 105)

At the *micro context* we focus closely and narrowly on the micro-interaction and at this level it is unique, a singular occurrence. Although the extract is clearly typical of both the L2 classroom and of a form and accuracy context the extract is nonetheless unique on a micro-level; even a teacher giving the same prompts would never receive exactly the same replies from the learners. At this level of context the emphasis is on heterogeneity and on the 'instanced' nature of the interaction.

When the perspective starts to broaden we can examine the particular combination of pedagogical focus and organisation of the interaction (*L2 classroom context*) which is currently in operation and see whether this instance may have something in common with other instances which are organized in a similar way. The above extract is typical of a

form and accuracy context in which the pedagogical focus is on the production of strings of correct linguistic forms by the students and personal meanings tend to be disregarded. We can see in lines 3 and 10 that the teacher initiates repair if the linguistic forms produced by the learner are not identical to those targeted by the teacher. The organisation of turn-taking and sequence is again related to the pedagogical focus. Since the teacher needs to prompt the learners to produce specific strings of linguistic forms, it follows that the teacher allocates turns to the learners and constrain the content of those turns.

When the perspective broadens further we can see the *institutional context* and at this level we view the interaction as an example of L2 classroom discourse, any instance of which manifests the three properties of L2 classroom interaction as introduced above. The first property is that language is both the vehicle and object of instruction. So we can see T both managing the interaction in the target language (vehicle) and treating learner responses as texts to be corrected (object). The second property is that there is a reflexive relationship between pedagogy and interaction. This extract demonstrates the very tight connections which can occur between the teacher's pedagogical focus and the linguistic forms and patterns of interaction which the learners produce. In line 2, L1 produces an answer which would be perfectly acceptable in conversation. However, this is not the target pattern of interaction which the teacher's pedagogical focus is aiming to produce, and the teacher does not accept the answer. The third property is that the linguistic forms and patterns of interaction which the learners produce are subject to evaluation by the teacher in some way. Here the evaluation is implicit as indirect negative evaluation which is understood in the multiple repair initiations by the teacher. At this level of context we

view the interaction as an example of L2 classroom discourse and the emphasis is on homogeneity.

The interaction in extract 7 displays the simultaneous homogeneity and heterogeneity which is one characteristic of a complex adaptive system.

There are universal properties of nonlinear systems: different systems behave in the same ways

The above analysis suggests that L2 classroom interaction displays many of the universal properties of nonlinear complex systems; the implications of this are discussed below. Clearly, human spoken interaction as a process is fantastically different from the formation of snowflakes or the behaviour of locusts. Nonetheless, complexity theory is uncovering similarities in system processes across the most disparate range of phenomena.

Conclusions and Implications

The research question posed was “does L2 classroom interaction exhibit the characteristics of a complex adaptive system?” The answer obtained by the ‘matching’ methodology employed is that this variety of interaction does indeed display these characteristics. However, Larsen-Freeman and Cameron (2008: 23) suggest that classification criteria for complex systems outside originating fields seem to be ‘deliberately vague’, and that it becomes more and more difficult to distinguish claims of classification from claims of

metaphorical similarity. At present, then, it is only possible to conclude that L2 classroom interaction gives some indications of behaving like a complex adaptive system in that it displays similar characteristics. However, a claim of classification is not proven. There is also the question of whether the findings of this study can be applied to spoken interaction in general. I pointed out above that L2 classroom interaction as a variety is particularly suitable for study as its peculiar characteristics provide evidence of an interactional system feeding back on itself. However, a counter-argument might be that L2 classroom interaction is therefore atypical of varieties of human spoken interaction in general. More research would need to be done into complexity theory in relation to other varieties of spoken interaction before the question of typicality could be determined.

There appear to be strong grounds for supposing that the process of spoken interaction does not necessarily proceed in a linear way. In other words, what a speaker says is not necessarily what a listener hears (the Chinese whispers effect). In the field of L2 teaching, a number of studies have shown that what the teacher aims to teach is not necessarily what the learners learn (e.g. Mondada and Pekarek Doehler 2004). However, participants in interaction behave as if interaction did always proceed in a linear fashion and this is a fundamental tenet of CA.⁸ Any first action in interaction is an action template which creates a normative expectation for a next action and a template for interpreting it. The second action displays an interpretation of the first action and itself creates an action and interpretational template for subsequent actions, and so on: "A turn's talk will be heard as directed to a prior turn's talk, unless special techniques are used to locate some other talk to which it is directed." (Sacks, Schegloff and Jefferson 1974: 728). So it could be argued that interactants (and CA analysts) are employing a

linear procedure to analyse and make sense of a process which may be non-linear. This suggests that a rewarding area of future research might be to investigate how linear and non-linear processes and procedures interrelate in spoken interaction.

What does this article have to say in relation to SLA? Larsen-Freeman and Cameron (2008) explain in detail the benefits of a complexity theory perspective as applied to the study of L2 learning, and I will not repeat their arguments here, but would like to add two points. This article presents evidence that L2 classroom interaction may be viewed as behaving as a complex adaptive system in its own right and that it has its own specifiable level of organisation. Viewed from a complexity theory perspective, the process of instructed SLA involves the interaction of a number of related complex adaptive systems, each of which has been studied in its own right: the human brain, languages, human society and social processes, human behaviour. To this we should add L2 classroom interaction as a system. Secondly, the sections on self-similarity and on holism have implications for SLA research. Specific interactional phenomena may be more fully understood by locating them in a description of the entire interactional architecture of the L2 classroom, rather than by isolating them. Such a perspective problematises approaches to research which extract individual variables (which are seen to have causative properties) from the whole system for quantification.

“Our aim is to get into a position to transform, in an almost literal, physical sense, our view of “what happened,” from a matter of a particular interaction done by particular people, to a matter of interactions as products of a machinery. We are trying to find the machinery.” (Sacks 1984: 26)

Sacks stated the aim of trying to find the machinery which generates human spoken interaction. Complexity theory would prefer to replace the machinery metaphor with something more organic, for example a web. However, if it turns out that this machinery functions in the same fundamental way as other complex adaptive systems, this would present the prospect of major progress in our understanding of spoken interaction as a system and also of the integration of the study of interaction into a much larger scientific project. Advances in the study of complex adaptive systems in any field could potentially have implications for our understanding of spoken interaction. The research agenda for the future should include the description of the organisation of other varieties of spoken interaction and whether they exhibit the characteristics of complex adaptive systems. The main implication in relation to teaching and learning issues relates to non-linearity. It was noted above that classroom language teachers are very familiar with this concept, in which you intend one thing to happen in class and something very different happens instead. The vast majority of curricula and lesson-plans are based on a linear or product model, with pre-specified objectives and post-evaluation of whether the objectives have been achieved. This study suggests that it is best not to be too regimented or prescriptive about this, but rather to retain some room to incorporate a process syllabus element, in which the interaction is able to follow emergent directions, issues and ideas as they arise.

References

Appel, J. 2007. 'Language teaching in performance.' *International Journal of Applied Linguistics* 17/ 3: 277-293.

Boyatzis, R. 2006. 'An overview of intentional change from a complexity perspective.' *Journal of Management Development* 25/ 7: 607-623.

Breen, M. 1989. 'The evaluation cycle for language learning tasks' in Johnson, R.K. (ed.): *The Second Language Curriculum*. Cambridge: Cambridge University Press, pp. 187-206.

British Council 1985. *Teaching and Learning in Focus. Edited Lessons* (Four Volumes). London: British Council.

Byrne, D. 1998. *Complexity Theory and the Social Sciences*. London: Routledge.

Carr, D. (ed.) 2006. *Teacher Training DVD Series* (Set of 15 DVDs). London: International House.

Coughlan, P. and P. Duff. 1994. 'Same task, different activities: Analysis of a second language acquisition task from an activity theory perspective' in Lantolf, J.P. and Appel, G. (eds.): *Vygotskian Approaches to Second Language Research*. Norwood, NJ: Ablex Press, pp. 173-194.

Coveney, P. and R. Highfield. 1995. *Frontiers of Complexity*. London: Faber and Faber.

Donato, R. 2000. 'Sociocultural contributions to understanding the foreign and second language classroom' in Lantolf, J.P. (ed.): *Sociocultural Theory and Second Language Learning*. Oxford: Oxford University Press, pp. 27-50.

Drew, P. and J. Heritage. (eds.). 1992. *Talk at Work: Interaction in Institutional Settings*. Cambridge: Cambridge University Press.

Edmondson, W. 1985. 'Discourse Worlds in the Classroom and in Foreign Language Learning'. *Studies in Second Language Acquisition* 7: 159-168.

Ellis, R. 1984. *Classroom Second Language Development*. Oxford: Pergamon Press.

Feigenbaum, M. 1984. 'Universal behaviour in nonlinear systems' in Cvitanovic, P. (ed.): *Universality in Chaos*. Bristol: Adam Hilger, pp. 49-84.

Feynman, R. 1965. *The Character of Physical Law*. London: Penguin.

Foster, P. 1998. 'A classroom perspective on the negotiation of meaning.' *Applied Linguistics* 19: 1-23.

Gell-Mann, M. 1994. *The Quark and the Jaguar*. New York: Freeman.

Gleick, J. 1993. *Chaos*. London: Abacus.

Gribbin, J. 1991. *In Search of Schroedinger's Cat: Quantum Physics and Reality*.
London: Black Swan.

Gribbin, J. 2004. *Deep Simplicity*. London: Penguin.

Hall, N. (ed.) 1991. *The New Scientist Guide to Chaos*. London: Penguin.

Have, P. ten. 2005. *Doing Conversation Analysis*. London: Sage.

Hawkins, J and M. Gell-Mann. (eds.) 1992. *The Evolution of Human Languages*.
Reading, MA: Addison-Wesley.

Heritage, J. 1984. *Garfinkel and Ethnomethodology*. Cambridge: Polity Press.

Hutchby, I. and R. Wooffitt. 1998. *Conversation Analysis*. Cambridge: Polity Press.

Johnson, K. 1995. *Understanding Communication in Second Language Classrooms*.
Cambridge: Cambridge University Press.

Johnson, N. 2007. *Two's Company, Three is Complexity*. Oxford: Oneworld Publications.

Kauffman, S. 1995. *At Home in the Universe*. Harmondsworth: Viking.

Kiefer, K. 2006. 'Complexity, class dynamics, and distance learning.' *Computers and Composition* 23: 125-138.

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

Larsen-Freeman, D. and L. Cameron. 2008. *Complex Systems and Applied Linguistics*. Oxford: Oxford University Press.

Levinson, S. 1983. *Pragmatics*. Cambridge: Cambridge University Press.

Lewin, R. 1993. *Complexity*. London: Phoenix.

Loewen, S. and J. Philp. 2006. 'Recasts in the Adult English L2 Classroom: Characteristics, Explicitness, and Effectiveness.' *Modern Language Journal* 90/ 4: 536-556.

Long, M. 1983. 'Inside the 'Black Box'.' in Seliger, H. and Long, M. (eds.): *Classroom Oriented Research in Second Language Acquisition*. Rowley: Newbury House, pp. 3-36.

Lorenz, E. 1993. *The Essence of Chaos*. London: UCL Press.

Mackey, A. (ed.) 2007. *Conversational Interaction in Second Language Acquisition*. Oxford: Oxford University Press.

Mainzer, K. 1997. *Thinking in Complexity* (3rd edition). Berlin: Springer-Verlag.

McHoul, A. 1978. 'The Organization of Turns at Formal Talk in the Classroom.' *Language in Society* 7: 183-213.

Mitchell Waldrop, M. 1994. *Complexity*. London: Penguin.

Mondada, L., & Pekarek Doehler, S. 2004. 'Second language acquisition as situated practice: Task accomplishment in the French second language classroom.' *Modern Language Journal* 88: 501–518.

Mori, J. 2002. 'Task Design, Plan and Development of Talk-in-Interaction: An Analysis of a Small Group Activity in a Japanese Language Classroom.' *Applied Linguistics* 23/ 3: 323-347.

Ohta, A.S. 2001. *Second Language Acquisition Processes in the Classroom*. Mahwah, NJ: Lawrence Erlbaum.

Oudeyer, P. 2005. 'From holistic to discrete speech sounds: the blind snowflake-maker hypothesis.' in Tallerman, M. (ed.) *Language Origins*. Oxford: Oxford University Press, pp. 68-99.

Palmer, S. 2008. 'The hunger, the horror.' *New Scientist* 198/ 2658: 42-45.

Platt, E. and F. Brooks. 1994. 'The acquisition rich environment revisited.' *Modern Language Journal* 78: 497-511.

Prigogine, I. and I. Stengers. 1984. *Order out of Chaos*. London: Heinemann.

Radford, M. 2007. 'Action Research and the challenge of complexity.' *Cambridge Journal of Education* 37/ 2: 263-278.

Richards, K. and Seedhouse, P.. (eds.) 2005. *Applying Conversation Analysis*. Basingstoke: Palgrave Macmillan.

Roebuck, R. 2000. 'Subjects speak out: How learners position themselves in a psycholinguistic task' in Lantolf, J. (ed.): *Sociocultural Theory and Second Language Learning*. Oxford: Oxford University Press, pp. 79-95.

Sacks, H. 1984. 'Notes on Methodology.' in J. Atkinson and J. Heritage (eds.): *Structures of Social Action*. Cambridge: Cambridge University Press, pp. 21-27

Sardar, Z. and I. Abrams. 1999. *Introducing Chaos*. Cambridge: Icon Books.

Seedhouse, P. 1996 *Learning Talk: A Study of the Interactional Organisation of the L2 Classroom from a CA Institutional Discourse Perspective*. Unpublished doctoral thesis, University of York, U.K.

Seedhouse, P. 1997. 'Combining Form and Meaning.' *English Language Teaching Journal* 51/4: 336-344.

Seedhouse, P. 2004 *The Interactional Architecture of the Language Classroom: A Conversation Analysis Perspective*. Malden, MA: Blackwell.

Seedhouse, P. 2005 'Task' As Research Construct.' *Language Learning* 55/ 3: 533-570.

Sinclair, J. and R.M. Coulthard. 1975. *Toward an Analysis of Discourse*. Oxford: Oxford University Press.

Tudor, I. 2003. 'Learning to live with complexity: towards an ecological perspective on language teaching.' *System* 31: 1-12.

Warren, M. 1985. *Discourse Analysis and English Language Teaching*. Unpublished masters dissertation, University of Birmingham, U.K.

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- 1 This article has benefited considerably from comments from anonymous reviewers.
 - 2 However, a reviewer has suggested that there is little evidence of participants being any more self-aware in interactional terms than in any other setting.
 - 3 I am grateful to a reviewer for pointing out that not all CA practitioners would see it as a starting point for other work.
 - 4 I should point out that I read the literature on complexity theory after finishing this project.
 - 5 Of course teacher utterances perform a number of social actions on a number of levels simultaneously, a point developed in the analysis of extract 4 below.
 - 6 I am grateful to a reviewer for suggesting that we need to know whether fractal characteristics continue at the clause or phrase level, at the level termed 'transaction' by Sinclair & Coulthard (1975), and in relation to complex chains of IRF.
 - 7 I am very grateful to a reviewer for making this point.
 - 8 I would like to thank Keith Richards for this observation.