

## **Workshop Proposal: Language and Complex Systems**

In Melanie Mitchell's definition (2009:13), a complex system is "a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution." The new science of complex systems, also known as complex adaptive systems (CAS) or dynamical systems, got off the ground in 1984, the year that the Santa Fe Institute was founded for the study of complex systems, particularly in physics and biology but with significant social science applications as in economics. Complex systems also had some early discussion in linguistics. Lindblom, MacNeilage, and Studdert-Kennedy published a 1984 paper on self-organizing processes in phonology; Paul Hopper presented his seminal paper called "Emergent Grammar" in Berkeley in 1987; Ronald Langacker published a chapter on "A Usage-Based Model" for cognitive linguistics in 1988. Applications to linguistics have often not specifically mentioned complex systems or, as in Larsen-Freeman and Cameron (2007), treated complex systems as a metaphor for what happens with language. More recently Kretzschmar (2009) has demonstrated how complex systems do constitute speech in *The Linguistics of Speech*, focusing on non-linear distributions and scaling properties, and at last year's NAW presented a well-attended paper on complex systems and sociolinguistics. In this workshop, we wish to introduce the basic ideas of complex systems to sociolinguists, and to present three applications of complexity to particular problems of interest to sociolinguists in order to show the practical benefits of a knowledge of complex systems in our field.

After a general introduction to language and complex systems, Salikoko Mufwene will discuss "The Emergence of Complexity in Language: An Evolutionary Perspective." This presentation will introduce sociolinguists to the complexity model that Mufwene (2001, 2008) has adapted from evolutionary biology for use on language. This talk has particular reference to creole language and to globalization. Allison Burkette will then discuss "Complexity in Historical Studies." Her talk will show sociolinguists how speech changes over time within a community according to the prediction of complexity theory (as in Burkette 2001, 2009). A knowledge of complex systems thus can influence how sociolinguists conduct apparent time studies, including how complexity constitutes the underlying pattern that leads to what sociolinguists understand as the "S-curve" of linguistic change. Finally, Bill Kretzschmar will discuss "Complex Systems and Sociolinguistics." This final presentation has three goals, to show 1) how complexity theory improves our understanding of samples collected by sociolinguists; 2) how practices of measurement affect the apparent complexity of our data sets; and 3) how complexity can help sociolinguists to make better community grammars.

### **Introduction to Language and Complex Systems**

Bill Kretzschmar, University of Georgia

Complex systems are made up of massive numbers of components interacting with one another, and this results in self-organization and emergent order. For speech, the "components" of a complex system are all of the possible variant realizations of linguistic features as they are deployed by human agents, speakers and writers. The order that

emerges in speech is simply the fact that our use of words and other linguistic features is significantly clustered in the speech communities in which we actually communicate. Order emerges from such systems by means of self-organization, but the order that arises from speech is not the same as what linguists study under the rubric of linguistic structure. In both texts and regional/social groups, the frequency distribution of features occurs as the same pattern: an asymptotic hyperbolic curve (or "A-curve"). Practitioners of "grammaticalization" and "construction grammar" (e.g. Ellis and Larsen-Freeman 2009) have begun to use these distributional facts for descriptions of formal systems. However, it is important to consider perception as well as production of features. Speakers perceive what is "normal" for groups and text types according to the A-curve: the most frequent variants are perceived as "normal," less frequent variants are perceived as "different," and since particular variants are more or less frequent among different groups of people or types of discourse, the variants come to mark identity of the groups or types by means of these perceptions. That is, the notion of the existence of any language or dialect is actually an "observational artifact" that comes from our perceptions of the available variants (along with nonlinguistic information), as mediated by the A-curve. Formal linguistic systems are thus not the direct result of the complex system, and sociolinguists must use complexity to mediate between the language production observed in the community and the grammars we describe.

### **The Emergence of Complexity in Language: An Evolutionary Perspective**

Salikoko S. Mufwene, University of Chicago

An increasing number of linguists (including the present author) and other scholars especially interested in the evolution and/or the ontogenetic development of language have claimed that languages are complex adaptive systems. These have been characterized as reflecting complex dynamics of interactive agents, experiencing constant instability, and in search for equilibrium in response to changes in the ecologies of their usage. Putatively, thanks to self-organization, transitional moments of apparent stability obtain during which patterns and systems emerge, and evolutions obtain from the alternations of periods of instability and stability in seemingly unpredictable ways. In this paper I address the following questions: 1) How many interpretations of 'complexity' apply to language(s)? 2) What and/or who are the interactive agents that produce the above characteristics? 3) From the point of view of language evolution, how did complexity emerge in language(s) and in what particular order? 4) What kind(s) of evidence support(s) the various interpretations of 'complexity' that are conceivable? 5) How does complexity in language compare with complexity in other non-linguistic phenomena? 6) What causes the "chaos" that prompts languages to reorganize themselves into new systems? 7) How can population approaches to language contribute to answering these questions?

### **Complexity in Historical Studies**

Allison Burkette, University of Mississippi

The discussion of how the passage of time contributes to an open complex system begins with a historical examination of lexical variation, an examination that highlights the

internal and external forces that contribute to the great number of components characteristic of a complex system. Linguistic Atlas data provide an ideal field on which to view the general distributional principles of linguistic data (i.e. how linguistic variation assumes its A-curve shape over time). Using one Atlas database, responses elicited for the target item 'sofa', as an example, we will look at the shape of lexical variation and at the ways in which the physical history of the sofa form contribute to that variation. Once we see where the variation comes from, we can look at the actual movement of 'sofa' variants along the A-curve over time using relevant entries from the Corpus of Historical American English (COHA). Finally, we will demonstrate the ways in which the same principles illustrated by the 'sofa' responses apply not only to other lexical target items but also to phonological and grammatical variables, as well as to discourse-level variables, thus bridging the gap between the analysis of Linguistic Atlas survey data and traditional sociolinguistic data. Specifically, the principles of complexity discussed here have several implications for apparent-time studies, including new ways to conceptualize saliency, the distribution of linguistic variables across social categories, stance-taking, and the enactment of cognitive schemas by means of linguistic choices, demonstrated here by the application of these principles to actual sociolinguistic data.

### **Complex Systems and Sociolinguistics**

Bill Kretzschmar, University of Georgia

Complexity theory is something that sociolinguists not only *can* use but *should* use in order to improve the relationship between the speech we observe in communities and the generalizations we make from it. First, the scaling property of complex systems tells us that there are no representative speakers, and so our observation of any small group of speakers is unlikely to represent any group at a larger scale. This suggests the importance of sampling for new studies, and use of the non-linear underlying distribution to interpret data we have already gathered. Second, we need to use enough speakers and enough categories for analysis to see underlying complex distributions. Sociolinguists have often made binary distinctions or used limited indexes to classify variation, which can conceal complexity. We can use the "Gini Coefficient" from economics to offer a benchmark for improved standards of sampling and categorization. Finally, underlying complex distributions follow the 80/20 rule, i.e. 80% of the word tokens in a data set will be instances of only 20% of the word types, while the other 80% of the word types will amount to only 20% of the tokens. The 80/20 rule can help sociolinguists to make better grammars, because it offers a natural condition of linguistic data with which to negotiate between generative and structural types of grammars. All three of these applications of complexity to sociolinguistics help us to understand and interpret our existing studies better, and suggest how new studies can be made more valid and reliable.

### **References**

- Burkette, Allison. 2001. The Story of Chester Drawers. *American Speech* 76: 139-157.  
Burkette, Allison. 2009. The Lion, the Witch, and the Armoire: Lexical Variation in Case Furniture Terms. *American Speech* 84: 315-339.

- Ellis, Nick, and Diane Larsen-Freeman. 2009. *Language as a Complex Adaptive System*. Oxford: Wiley-Blackwell.
- Hopper, Paul. 1987. Emergent Grammar. *Berkeley Linguistics Society* 13: 139-157. (viewed at <http://home.eserver.org/hopper/emergence.html>)
- Kretzschmar, William A., Jr. 2009. *The Linguistics of Speech*. Cambridge: Cambridge University Press.
- Langacker, Ronald. 1988. A Usage Based Model. In Brygida Rudzka-Ostyn, ed., *Topics in Cognitive Linguistics* (Amsterdam: John Benjamins), 127-161.
- Larsen-Freeman, Diane, and Lynne Cameron. 2007. *Complex Systems and Applied Linguistics*. Oxford: Oxford University Press.
- Lindblom, Bjorn, Peter MacNeilage, and Michael Studdert-Kennedy. 1984. Self-organizing Processes and the Explanation of Phonological Universals. In B. Butterworth, B. Comrie, and O. Dahl, eds., *Explanations for Language Universals* (New York: Mouton), 181-203.
- Mitchell, Melanie. 2009. *Complexity: A Guided Tour*. Oxford: Oxford University Press.