

# Transdisciplinary Connections: An Example

Ed Bostick, Regents' Distinguished Professor of Teaching & Learning,  
Professor of Biology, Kennesaw State University

I am fortunate to have been granted some time and money to work on a project this year and have chosen to work on "Interdisciplinary Connections and Applications." Some of my project work involves the discovery of new connections between disciplines and other work is devoted to evaluation and elaboration of well-known connections. This essay is intended to illustrate one of the longest and best-known transdisciplinary connections (interdisciplinary, except with a bigger-than-usual gap between disciplines): that between linguistic and biological classification and evolution. Charles Darwin used linguistic evolution as a metaphor or comparative model for his theory of natural selection and many teaching biologists use the language model as an introduction to the biological model.

The metaphor is therefore a useful teaching tool and I hope that this essay will be pedagogically useful to my teaching colleagues. I am also interested in the "deeper" connections and parallels between biological and linguistic evolution. Comparable forces of selection and processes of change over time are involved in both models. Isolation plays an important role in both models. Are the close parallels between the two models coincidental or is there an as yet unnamed paradigm that explains all evolutionary models: biological, linguistic, economic, sociological, political? Do all complex systems have an inherent tendency to change and adapt over time? Indeed, adaptability and homeostasis may be an emergent property of complexity.

## Linguistics As Metaphor For Biological Evolution

"The formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously parallel." (Darwin, 1883). *Biological and linguistic classification and evolution are similar in that:*

**Classification is hierarchical.** In algebraic terms, both use a system of sets and sub-sets, of smaller less inclusive groups included within larger more inclusive groups. In biology, Kingdoms include Phyla include Classes include Orders include Families include Genera include Species include various sub-specific categories (subspecies, varieties, forms, etc.). The language hierarchy is less distinct but usually follows the pattern: Families include Subfamilies include Languages include Dialects.

**Classification system implies similarities.** In both systems of classification, inclusion within the same category implies a certain degree of similarity. In biology, subspecies of the same species are very similar, varying only slightly. Species within the same genus show discontinuous variation around a com-

mon mean. In linguistics, dialects of the same language are usually so similar that they are mutually intelligible (Southern American English - New England English) whereas different languages of the same language family are mutually unintelligible but markedly similar in grammar, vocabulary, word order, and other language properties (French - Spanish).

**Classification system implies kinship and descent.** There is a common assumption in both biological and language classification: Similarity indicates kinship (except for convergence...see below). Close similarity indicates close kinship: less similarity indicates less kinship. Thus, dogs, foxes, wolves, and jackals (canine mammals) are thought to be more closely related to each other than to cats, tigers, jaguars, and lions (feline mammals) but both groups are thought to be more closely related to each other than to pythons, box turtles, iguanas, and alligators (reptiles). Similarly, French, Spanish, Italian, and Rumanian (Romance Indo-European) are thought to be more closely related to each other than to Russian, Polish, Ukrainian, and Bulgarian (Slavic Indo-European) but both groups are thought to be more closely related to each other than to Tibetan, Burmese, and Chinese (Sino-Tibetan).

**Classification is often subjective and arbitrary.** The "species concept" is a difficult subject in both biology and linguistics. The demarcation of biological species and subspecies is often subjective. The species concept for dogs is very broad, allowing for much variation (Chihuahuas to Great Danes) while the species concept for goldenrods is much narrower. (A few more leaf hairs per square centimeter may result in the classification of a different species.) Biological taxonomists are themselves classified into "lumper" and "splitter" categories on the basis of the magnitude of their species concepts.

Language classification is similarly arbitrary. At what point do we draw the line between a dialect and a language? Because language is such an important cultural element, it politically and socially empowers its speakers. Such decisions often ruffle ethnic and political feathers, as in the examples of Spanish and Catalan, French and Provençal, Standard English and Ebonics.

**Variation is systematic (geographic and, in language, social).** If two populations of the same biological species become isolated from each other to the extent that interbreeding is prevented for a long period of time, then adaptation of each population to its local environment will presumably result in speciation. Each population will be genetically, physiologically, and morphologically distinct and distinguishable from its sister population. Similarly, if speakers of a common language (Latin, for example) become geographically isolated

for a long period of time, then the common language spoken by those populations will change locally into dialects of the ancestral language and eventually into *bona fide* languages (French, Spanish, Italian, Rumanian). Linguistic isolation may be social instead of geographical as in Standard London English vs. Cockney, the blue-collar dialect of East London.

**Spontaneous change is the source of variation.** In biological evolution, spontaneous changes are genetic/hereditary and are called mutations. Spontaneous language changes also occur and are the “grist” of language evolution. Biologists understand what mutations are and how they occur. Many changes are truly spontaneous and cause alteration of DNA chemistry or chromosomal aberrations. Mutations may be caused by environmental substances or conditions (mutagens). Linguists do not fully understand what causes linguistic mutation and there is no linguistic term analogous to mutation or mutagen. A clear difference between biological and linguistic mutation is that the former is heritable and the latter is not. Linguistic change is culturally transmitted. In biological terminology, language evolution follows the “Lamarckian” model. (Jean Baptiste de Lamarck, 19th century French natural historian closely associated with a theory of inheritance of acquired characteristics).

**Pace of change is usually slow but may be rapid under certain conditions.** Rapid change may take place under conditions of environmental stress. Thus, biological evolution tends to be most rapid in stressful environments and linguistic evolution tends to be rapid during periods of economic and social strife (wartime, depression). Both types of evolution may be slow and gradual (the typical Darwinian model) or rapid and jumpy (the “punctuated equilibrium” model of Gould and Ethridge, 1977).

**Selection of favorable variants occurs.** In neo-Darwinian terms, superior variants procreate at a greater rate than inferior variants, thereby enhancing their genes’ frequencies in the gene pool. Or, in simpler language, “Whoever makes the most babies wins the evolutionary race.” Certainly, linguistic variations are subject to linguistic selection, although this phenomenon remains vaguely described by language experts. Linguistic selection seems to be mainly social rather than biological. In many cases, “upper-class” language is selected over the language of the lower classes. A persistent anecdote attempts to explain the lispings “theta” of Castilian Spanish as having begun by courtiers’ speech in imitation of a king with a congenital lisp. Later, commoners began to lisp in imitation of the upper class courtiers.

**Subspecific categories may be predecessors of specific categories and vice versa.** In biology: subspecies, varieties, races may evolve into separate species and species may diverge into several subspecies. In language: dialects may evolve into languages and languages may diverge into several dialects.

**Reduction/simplification occurs.** One of the persistent controversies in 19th and early 20th Century botanical classification was the position in the classification system of cer-

tain woody plant families: the Oaks, Willows, Walnuts, and Birches, among others. These trees have very simple unisexual flowers without petals and, because of this simplicity, were once thought to represent ancestral primitive prototypes. Anatomical and paleontological investigation revealed that these plants were probably descended from complex ancestors with showy flowers. Thus, they are really highly-evolved groups and are by no means ancestral. Languages often show simplification or “streamlining.” Modern English has mostly discarded the declensions of nouns and conjugations of verbs characteristic of Old English. Who can say why, especially since this trend may not have occurred in other languages (Russian, for example)?

**Fossilization occurs.** Paleontological fossilization occurs when an ancient organism leaves a trace of its existence in the form of a track, burrow, mold, cast, petrification, or preserved body. We are able to examine fossils and to construct tentative evolutionary sequences by examining similarities and differences within a fossil series. Linguistic “fossilization” occurs in two ways:

1. Ancient manuscripts fossilize languages in their ancestral forms. By comparing these texts to modern language, we are able to discern evolutionary trends in vocabulary, spelling, word order, and grammar.
2. Oral language often preserves archaic words and pronunciations which enable linguists to discern relationships among modern and ancient languages. One example of this “forensic” linguistics is the hypothesis that the Indo-European ancestral language originated somewhere in eastern Europe. Part of the evidence for this is that Indo-European had words for “trout,” “salmon,” “birch,” “river,” but no vocabulary for “ocean,” “seaweed,” “shark,” or “palm tree.”

**Extinction occurs.** Both species and languages are becoming extinct at a rapid rate. In both cases, current extinction rates are being enhanced by human activities. Biological species’ extinction rate has been estimated by E.O. Wilson (1992) at 27,000 per year (74 per day, 3 per hour). There are about 6,000 languages: 5,000 are predicted to become extinct within the next two hundred years...an extinction rate of 25 per year (Woolfield, 1996). Endangered species and languages are capable of being revived with proper conservation and attention. We may compare the revival of the Whooping Crane to Israel’s revival of Hebrew. “Extinction is forever” is the rule for biological species but not necessarily so for extinct languages, although there are no examples of extinct languages being revived other than for scholarly purposes.

**All extant forms are more or less complex and are the results of long evolutionary histories.** The “caste system” of biology is largely a thing of the past. Organisms formerly spoken of as “primitive” (bacteria, algae, protozoa, ferns, mosses, fungi) are now recognized as having a long evolutionary history of adaptation to Earth’s environments. Such organisms, although simple in construction, are really quite

complex in physiology and genetics. In contrast, so-called "primitive" languages which were formerly those spoken by "primitive" people are now recognized as being as complex and rich as "advanced" languages. Most Native American languages have grammars and vocabularies more complex than European languages.

**Hybridization occurs.** Successful intra- and inter-specific breeding, producing fertile offspring may represent an important biological evolutionary event. In general, biological hybridization only occurs between fairly close relatives, usually members of the same species or (more rarely) of the same genus. Hybrid and artificial languages exist. Hybrid languages are called "pidgins" or "creoles". Examples are "Tok Pisin" of New Guinea (a hybrid of English and local languages) and "Spanglish" of Miami. Several artificial hybrid languages have been constructed with varying degrees of acceptance. The most prominent of these is Esperanto, a Romance-based language devised during the 19th Century.

**Convergence occurs (rarely in language evolution).** In biological evolution, convergence or convergent evolution is commonplace. If habitats, environments, or life styles are similar, then unrelated groups will often develop similar characteristics in adaptation to similar conditions. Thus, wings have appeared in the unrelated birds, pterosaurs, bats, and insects. Torpedo-shaped bodies have developed in many fish, reptiles, mammals (dolphins), and birds (penguins). Succulence and spininess have appeared in many unrelated desert plants.

Convergence is extremely rare in language evolution and is even more coincidental than biological convergence. Curiously, the word for "dog" in one of the Australian aboriginal languages is "dog". Another example is the widespread use in many distantly related languages of the second person plural as polite address to an individual (Spanish "tu" and "usted", Hungarian, Swedish, Quechua, Tamil).

**Monophyletic (Single origin)? or Polyphyletic (Multiple origins)?** An abiding question in both fields pertains to the original origin of life and language. Did life appear on one occasion and all modern life descend from that single organism? In this scenario, our ancestry could truly be depicted as a "family tree" with a single trunk. Or did life arise many times in the past so that our ancestry is properly depicted as a "family herb garden"?

Similarly, a continuing linguistic controversy is the possibility of a single ancestral human language from which all other languages have developed. Linguists are handicapped in their search for ancient ancestral languages because of the lack of written records. Ancient orally-transmitted languages may leave their traces in modern languages but many linguists doubt that their comparative method is useful after many thousands of years.

**Biological and linguistic evolution may be closely correlated.** Linguistics, anthropology, and biology are currently struggling with the theory that human language classification categories may correlate closely with human racial lin-

eages. (Cavalli-Sforza, 1991; Greenberg & Ruhlen, 1992; Ruhlen, 1994; ). These authors assume a monophyletic African origin of humans as well as their language. They propose an original "Proto-Sapiens" language which diverged along with racial divergence in early humans. In this model, Proto-Sapiens diverged into "African" and "Non-African", with the former developing into modern sub-Saharan languages and the latter developing into "Asian" and "Eurasian" branches. Eurasian later evolved European, Indian, Siberian, and Amerindian languages. It is an intriguing idea but many linguists consider the evidence unconvincing.

#### REFERENCES

- Cavalli-Sforza, L.L. 1991. "Genes, People, and Languages." *Scientific American* (November): 104-110.
- Darwin, C. 1883. *The Descent of Man and Selection in Relation to Sex*. Random House Edition, New York.
- Gould, S.J. and N.Ethredge. 1977. "Punctuated Equilibria: The Tempo And Mode Of Evolution Reconsidered." *Paleobiology* 3:115-151.
- Greenberg, J.H. & M. Ruhlen. 1992. "Linguistic origins of Native Americans." *Scientific American* (November): 94-99.
- Ruhlen, M. 1994. *The Origin of Language: Tracing the Evolution of the Mother Tongue*. John Wiley & Sons, New York.
- Wilson, E.O. 1992. *The Diversity of Life*. W.W.Norton, New York.
- Woolfield, A. 1996. "The Conservation Of Endangered Languages." Centre for Theories of Language and Learning; University of Bristol, U.K. <http://www.bris.ac.uk/Depts/Philosophy/CTLL/article.html>