COMPETING MODELS OF LINGUISTIC CHANGE

EVOLUTION AND BEYOND

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OLE NEDERGAARD THOMSEN
Roskilde University

THE RELEVANCE OF AN EVOLUTIONARY MODEL
TO HISTORICAL LINGUISTICS

WILLIAM CROFT
University of New Mexico

1. *Introduction*

Evolutionary models have become increasingly popular in linguistics and more generally in the social sciences in the past decade or two. These models have been applied to the human sciences, including linguistics, in at least three different ways.

The first way involves attempts to explain contemporary human behavior, including social structures, in terms of the biological evolution of human cognitive, social and behavioral traits. In the social sciences, this application of evolution is associated with sociobiology and evolutionary psychology. Sociobiology argues that human social behavior has a biological basis and seeks evolutionary explanations for it. Evolutionary psychology largely does the same for human psychological traits (cognitive and emotional). In linguistics, this application of evolution is represented by research on the 'evolution of language', that is, the evolution of the human cognitive and social capacity for language, something which is lacking in our nearest primate relatives (as well as all other organisms). While the term 'evolution of language' has become esconced to describe this research programme, it is not entirely accurate. This research programme, including sociobiology and evolutionary psychology, is really a *biological* approach to the study of human society, behavior and cognition. It is evolutionary because biology is evolutionary.

A second way in which evolutionary models have entered linguistics, and also archeology and physical anthropology, is the study of the correlation between genetic analyses of human populations, archeological evidence, and language classification. All three strands of data are relevant to the study of the origin and diversification of humans across the earth. Of course, the correlation is not perfect: people can shift their language, and craft traditions represented in the archeological record can diffuse. And some of the data, particularly the linguistic genetic classifications, are controversial. Nevertheless, there is sig-

nificant correlation between genetic, archeological and linguistic diversification, and this has led to interesting results for at least relatively recent history such as the Austronesian and Bantu dispersals. It would not be possible to establish such correlations without there being some significant parallels between biological evolution and language diversification. Indeed, some techniques from genetics are being experimented with in historical linguistics (see Section 7).

The third way in which evolutionary models have entered linguistics investigates these parallels with the aim of developing an evolutionary model of language change (not 'evolution of language'). That is, constructs, mechanisms and processes that are postulated by evolutionary theory for biology are applied to language change. The application of such concepts ranges from the occasional analogy or metaphor to a systematic explication of language change in evolutionary terms. The use of biological metaphors or analogies, while valuable for illuminating the character of some linguistic phenomena, is ultimately limited. Metaphors and analogies cannot clearly identify what biological evolution and language change should be expected to have in common. Only a systematic evolutionary framework can offer a genuinely evolutionary theory of language change.

The crucial feature of a systematic evolutionary framework that can be applied to language change — or more generally to cultural transmission — is that the essential properties of evolution must be abstracted from the biological mechanisms and processes postulated by evolutionary biologists. That is, we must identify what type of abstract process evolution is, independent of a phenomenal domain such as biology. Then we can investigate whether that abstract process is instantiated in language change or other types of cultural transmission. In fact, a number of biologists and philosophers of biology have proposed abstract evolutionary analyses. The one that has inspired the most interest in the social sciences is probably that of Richard Dawkins, which goes under the name of 'memetics'. Another model that is closely related to Dawkins' work, but differs in significant ways, was developed by David Hull (1988, 2001) and is called the 'generalized analysis of selection', or GAS. Hull's abstract model is applied systematically to language change in work by this author (Croft 2000; see also Croft 2002, 2003a, b, to appear; Baxter & al. 2006).

In the course of presenting the evolutionary model of language change, I have been asked the question — by both friendly and hostile questioners, "The evolutionary model you describe sounds fine as it is, but does it really change the way we do historical linguistics?" In other words, it could be the case that an evolutionary interpretation of historical linguistic phenomena at best simply validates what historical linguists already do anyway. In this chapter, I argue that in fact an evolutionary model, in particular the model developed in the aforementioned publications, can alter how we do historical linguistics in a variety of ways. Hull's generalized analysis of selection is explicated in Section 2. Its relevance to the study of language and language change is presented in Sections 3–4, and its instantiation in language change is given in Section 5. In Sections 6–9, I address the relevance of the evolutionary model to historical linguistics.

2.   *The generalized analysis of selection (GAS)*

The evolutionary model is basically a framework for the analysis of 'change by replication' (Hull 1988:410). Change occurs in (at least) two varieties: as *inherent* change or change *by replication*. 'Inherent change' is the transformation of the properties of a single entity over time. 'Replication' is a process that produces copies of an entity that largely preserves the structure of the original entity in the replicate (Hull 1988:408). Replication can lead to change if the copying process introduces changes; that is, the replication process is not perfect.

Copying with possible changes is only the kernel of a much more complex process. It is this more complex process which is found in biological evolution, and is assumed in GAS. First, the replication process that is interesting from an evolutionary point of view allows iteration: copies are produced from copies indefinitely, forming 'lineages' as a result (Dawkins 1989:13; Hull 1988:409, 410). Second, the changes in the copying process are cumulative in the lineage of replications (that is, later replications do not automatically 'revert' to the original's structure; Dawkins 1989:14, 1982:85). The result of this iterated copying process is a set of 'replicators', with variation occurring in that set.

In biological evolution, the paradigm replicator is the 'gene'. It is a structured entity that is copied in biological reproduction. Changes can occur in the replication process, by random mutation or (in sexual reproduction) by recombination. The term 'replicator' was used by Dawkins (1989: chap. 2), in his proposed model for biological evolution. Dawkins intended for his model to be a generalized framework, instantiated in other empirical phenomena where change by replication takes place. In particular, he coined the term 'meme' to describe an entity that is replicated in cultural transmission (Dawkins 1989: chap. 11), and spawned a theory of 'memetics'. An evolutionary model of language change is a memetic model, but Hull's generalized analysis of evolution differs in certain crucial ways from the memetic theory of Dawkins and his followers.

Replication leads to change, but change occurs at two levels in replication processes. There is change that occurs in a lineage of specific replications: an example of this would be a mutation in a gene that is replicated from one generation of organisms to the next. This process is 'altered replication' (Croft 2000:23). Altered replication leads to variation in the set of replicators. But there is also change in the overall set of replicators: for example, proliferation of the mutated gene at the expense of the original gene in the population of organisms, that is, the increase in frequency of one variant gene ('allele') at the expense of another allele. This process is 'differential replication': some replicators are copied differentially compared to other replicators. Differential replication presupposes variation — and hence, altered replication.

In biological evolution, the most important process of differential replication is 'selection'. (Another process, 'drift' in the biological sense, will not be discussed here.) In selection, a distinct process from that which causes change in lineages causes differential replication in a set of replicators. In biological evolution, selection of genes is a consequence of the interaction of organisms with their environment. One mechanism for biological selection is 'natural selection', in which organisms more adapted to the environment survive and reproduce at a greater rate, leading to the differential replication of their genes. Other selection mechanisms have been proposed in biological evolution, in particular 'sexual selection', in which some organisms are selected for mating by other organisms of the opposite sex, thereby leading to differential replication of their genes.

Hull (1988:409, 2001:59–61) generalizes the analysis of the selectional process as 'environmental interaction'. Environmental interaction involves an 'interactor' interacting with its environment in such a way as to *cause* differential replication of the relevant replicators. (Dawkins plays down the role of the interactor, calling it a 'vehicle' for the gene (1982:82) and describing it as a "survival machine" for genes (1989:19); but Hull argues, correctly in my view, that environmental interaction is as important as replication in selection (Hull 1988:413). This is perhaps the major difference between memetics as practiced by Dawkins and his followers and Hull's generalized analysis of selection.) In biological evolution, the paradigm case of the interactor is the organism, as noted in the last paragraph, but Hull argues that many entities associated with a replicator or set of replicators can function as interactors if their interaction with the environment causes differential replication (1988:417, 2001:61).

Evolution is therefore a two-step process: (i) replication which produces variation among replicators, and (ii) environmental interaction by interactors which causes differential replication (selection) of replicators. Selection can

happen only if there is variation among the replicators. Thus, evolutionary change requires replication, variation (altered replication), and selection (differential replication). This is the essential model of change by replication developed by Hull, the 'generalized analysis of selection', or GAS, as mentioned in the introduction.

There is a further level of organization in the biological evolution of sexual organisms which also forms a part of GAS. Organisms form 'species', and it is usually said that species are what evolve. A species is defined as a 'population' in evolutionary biology. The population model replaces the 'essentialist' definition of a species previously assumed in biology (Mayr 1982:265–72). In the essentialist definition, membership in a species is defined by a set of *essential* properties (structural and/or behavioral). However, distinct species share the same supposedly essential properties in many cases, and in other cases, members of the same species are extremely diverse and no essential properties can be identified. Above all, species evolve and in so doing lose supposedly essential traits.

The solution to the problem of essentialist definitions in biology is to redefine species as a 'population'. The term 'population' has a specific meaning in biology. A population is defined by some *relational* property between members, not inherent properties of members. In the case of species, the relational property is interbreeding among the members, and more importantly, reproductive isolation from members of other species (Hull 1988:102). A population is therefore unified by interbreeding. (Reproductive isolation is often not complete, and not all members of a population interbreed with one another, but isolation and interbreeding are complete enough in most cases, and when they are not, population cohesiveness is weak, as predicted.)

Interbreeding, of course, produces new members of the population. Interbreeding also leads to replication of the relevant replicators — the genes of the offspring are replications of the parents' genes. Successful interbreeding leads to differential replication of the relevant replicators. Interbreeding also provides another mechanism for altered replication, that is, the production of variation: recombination of genes from the two parent organisms. Thus, a species defined as a population is tightly interwoven with the processes of replication, variation, and selection.

A population of interactors is therefore defined by 'intercourse' between members, and isolation from intercourse with other populations. (The term 'intercourse' is introduced here to describe the specific sort of interaction that binds together populations.) Moreover, this intercourse brings about replication in the case of the interactors we have described in biological evolution. The population of organisms is also a historical entity, that is, an entity bounded in

space and time. A population comes to exist when its ancestral population splits, and it continues to exist until it goes extinct, or it itself splits into new populations. In biology, a species is a token or a particular, not a type, to use the philosopher's terminology.

GAS is an abstract model of change by replication. GAS is not a metaphor or analogy derived from biological evolution, to be applied to language change or cultural transmission. GAS stands above phenomenal domains. GAS in itself does not specify how it is instantiated in a particular phenomenal domain. (It may even be the case that there are two distinct selection processes operating at once in a single phenomenal domain.) The only constraint imposed by GAS is that every element of it must be instantiated. The thing that evolves must be a historical entity. There must exist variation in the thing that evolves. All the roles defined by GAS must be instantiated: replicator, interactor, environment. Finally, there must be causal mechanisms linking those roles in the way specified by the generalized analysis of selection. In particular, variation must arise via altered replication, and environmental interaction by the interactors must cause differential replication of the relevant replicators.

GAS also does not specify what the causal mechanisms are that bring about selection in a particular domain. Causal mechanisms must be identified that produce novel variants (altered replication), not to mention the even more fundamental mechanisms that lead to normal (identical) replication. Likewise, causal mechanisms must be identified that cause differential replication. These causal mechanisms are specific to the empirical phenomenon in which change by replication takes place. In this sense, for example, GAS is not necessarily incompatible with theories of mechanisms of language change in historical linguistics. GAS tells us where we must look for such mechanisms; it does not tell us what we should find.

In Sections 3–5, I argue that language change does satisfy the conditions for GAS. Language can be conceived of as a historical entity (Section 3). Variation exists in language, and in fact, variation is one of the central facts of language that must be accounted for, not just by a theory of language change but by a theory of language in general (Section 4). Finally, I describe the 'theory of utterance selection', or TUS (Section 5), which is a specific instantiation in language change of the roles and causal relations among roles specified in GAS.

3.   *Language change and language*

One cannot define a theory of language change without some hypothesis of what a language is. There are of course several theories of language currently proposed in linguistics. But it is most useful to begin by examining

two popular layperson's views of what a language is. These will turn out to reflect the intuitions behind two more technical views of the nature of a language.

In the first view, a language is basically like a reference grammar plus dictionary: it is a stock of items and a system of rules for combining those items into sentences of the language. This lay view of a language has been formalized in linguistics as a grammar plus lexicon: a system of rules and oppositions that organizes basic elements — morphemes as well as words — syntagmatically (into sentences) and paradigmatically (into contrasting sets of words and morphemes). More precisely, of course, linguistic theory distinguishes between a 'grammar' — the system — and a 'language' — the set of sentences admissible by the grammar. In theory, a language (= set of sentences) may be consistent with more than one grammar. In practice, however, most linguists assume there is a single correct grammar for a set of sentences, and much effort is devoted to identifying what is "the" grammar of the language. This is the view of a language (and grammar) that underlies the structuralist approach to a language and the generative approach which succeeded it (now often referred to as 'formalism').

There is a serious objection to this view of language, however: it is not a real empirical entity. In philosophical terms, it is neither a token nor a type. It is not a token in that it does not represent an actual set of sentences or an actual speaker's mental structures. An actual set of sentences will include "ungrammatical" utterances, and is finite as well (the set of possible sentences admissible by any serious candidate for a 'formal' grammar of a natural language is infinite). An actual speaker's mental structures will vary from other speakers' mental structures in many respects, in part because of different exposure to the language, even among "native" speakers. Nor is a grammar in this sense a type: the laws of Hungarian, for example, only apply to the Hungarian language, not to language in general.

The defense of this view is that linguists must make do with an idealization, in this case the famous idealization of Chomsky's: "Linguistic theory is concerned primarily with an ideal speaker-listener, in a completely homogeneous speech-community, who knows its language perfectly" (Chomsky 1965:3). More recently, some of this variation is instead attributed to a periphery, but there is a core that is invariant and moreover true of all languages — that is, a type in the philosophical sense. There are counterarguments to this defense, both empirical and theoretical. There is no a priori way to distinguish between what is supposed to be core and what is supposed to be peripheral. The periphery is also regular in behavior and must be explained (this argument has been put most forcefully by 'construction' grammarians,

e.g. Fillmore & al. 1988; Kay & Fillmore 1999). Even the core is highly varia-ble in a broad cross-linguistic perspective (this argument has been put most forcefully by typologists; see Croft 2001, 2003a and references cited therein). Finally this idealization in fact abstracts away from one of the most important facts of language, namely its variability. Theoretical analysis should be direct-ed towards explaining this fact, rather than idealizing away from it.

In the second view, a language is a historical entity. A language such as Hungarian arose at a certain time in a certain place, spread out over a certain area and persisted over a certain time, and (will) come to an end at a certain place and time, either through extinction or by splitting into two or more daughter languages. In this definition of a language, a language is a token, an empirically real entity; language as a type would be defined over the structures and processes common to languages so defined. In this definition of a lan-guage, a grammar is the actual knowledge that a specific speaker has about his or her language — also an empirical entity. Thus, neither a language nor a grammar is idealized in the way that these two entities are under the first definition described above. This definition of language is a plausible and defensible one from an intuitive point of view. The task facing a historical linguist is to take this lay view of what a language is and turn it into a technical concept on which a theory of language change can be built. In fact, adopting this view of a language is the first step towards formalizing it in an evolution-ary model of language change.

4.   *Variation in language*

The definition of a language as a historical entity makes language a real empirical phenomenon. It is also intended to capture a basic fact about lan-guage: variation. Variation is pervasive in the linguistic system, in terms of phonological form (phonetic variation), semantic function (semantic-pragmatic variation), and in the grammatical pairing of the two (morphosyntactic varia-tion). Variation is also an essential ingredient to an evolutionary theory of language change. For this reason, we will examine variation in language in somewhat greater detail.

Variation is manifested in three distinct ways in language: first-order variation in occasions of language use (individual utterances), second-order variation in socially-valued variants (sociolinguistic variables), and third-order variation across dialects and languages (typological patterns and implicational universals). I begin by illustrating the three orders of variation for phonological form, before turning to semantic-pragmatic and morphosyntactic variation.

The phonetic realization of phonological units is highly variable. Ohala writes, "One of the major discoveries of phonetics for the past century is the tremendous variability that exists in what we regard as the "same" event in speech, whether this sameness be phones, syllables, or words" (Ohala 1993:239). This variation is manifested across the entire phonological spec-trum, as illustrated in detail in Ladefoged and Maddieson's *The Sounds of the World's Languages* (Ladefoged & Maddieson 1996). For example, certain languages are standardly described as utilizing just the dental or alveolar place of articulation, such as French and English respectively. However, in one study, 20–30% of French speakers produced an alveolar [t] while a similar proportion of English speakers produced a dental [t̪] (Ladefoged & Maddieson 1996:23). Labov (1994) presents many examples of variation of vowel produc-tions by individual speakers on different occasions of use (see for example Labov 1994: chap. 6).

These are all examples of first-order variation. Labov, and the socio-linguistic tradition he played a great role in launching, also notes that this vari-ation can acquire social value, such as the seminal study of the [Ø] and [ɹ] variants of the sociolinguistic variable (r) in New York City (Labov 1966, summarized in Labov 1994:86–94). Socially-valued variants represent second-order variation: variants available in the speech community for use by speak-ers. Socially-valued variants may then be propagated (or go extinct) in a speech community.

Finally, if the speech community splits, different variants may become established in the different communities. This is third-order variation: lin-guistic differences across dialects and languages. An example of interdialectal variation is found in Californian vs. British English "interdentals". Californian English speakers use true interdentals in a word such as [θ̪ɪŋk] whereas British English speakers use a dental fricative [θɪŋk] (Ladefoged & Maddie-son 1996:20). More generally, the same phonological units will undergo independent changes in independent communities. Again, a few examples from Ladefoged and Maddieson will illustrate the pervasiveness of the variation in the phonetic realization of sounds. For example, many languages distinguish dental and alveolar stops, particularly in India, Australia, and the Americas. Most such languages contrast a laminal dental [t̪] vs. an apical alveolar [t] as in Toda [pot̪] 'ten' vs. [pɑːt] 'cockroach'; but Temne contrasts an apical dental vs. a laminal alveolar (Ladfoged & Maddieson 1996:21–23). Most such languages also have greater affrication of apical alveolars than laminal dentals, as in Isako; but Dahalo has greater affrication of the laminal dentals (op. cit.:25). Many languages have so-called retroflex stops, but while the Dravidi-an languages have true subapical retroflex stops, e.g. Toda [mɑɖ] 'head', Ewe

and even Hindi have apical postalveolar articulations, e.g. Ewe [édà] 'he cooks' (op. cit.:25–26).

Variation is also pervasive in linguistic function, that is, the meaning conveyed in an utterance. The information communicated by particular words and constructions is extremely variable across individual occasions of use. Every experience that is communicated is different from every prior experience communicated, even when we use the same words and constructions as we have used on prior occasions of use. Grice described the unique meaning conveyed on a particular occasion of use as 'utterer's occasion meaning' (Grice 1989 [1967]:90); Clark calls it 'speaker's meaning' (Clark 1996:126). Attempts have been made to construct a rigid division which would exclude the variable portions of a speaker's conveyed meaning and leave an invariant semantic representation: essence-accidence, dictionary-encyclopedia, analytic-synthetic, conventional-nonconventional, semantic-pragmatic. However, these attempts to make linguistic meaning invariant have run against seemingly insurmountable problems.

A very telescoped version of the argument is given in this paragraph (see Croft 2000, sect. 4.3 for a more extended version). Psycholinguistic experiments indicate that the "essential" properties of a meaning vary according to occasion of use; what is invariant is the total encyclopedic knowledge of speakers (Barsalou 1987, 1993:31–35). Even proper names, which do not have a "dictionary meaning" other than designating a historical individual, have evolved linguistically in response to their encyclopedic meaning (e.g. *napoleonic*; Haiman 1980:350). A dictionary definition (set of analytic statements) can be definitional only in terms of some theory that we have about the phenomenon (Quine 1961; Murphy & Medin 1985; Gelman & Coley 1991). That theory contains an unspecifiable number of background assumptions (Searle 1979); that is, the theory is encyclopedic. Hence the conventional meaning of words and constructions must be extremely rich. Further, in choosing words and constructions in an utterance, speakers must construe the experience to be communicated as the same in some respect as prior experiences for which those words and constructions have been used. But this is a matter of conceptualization by the speaker, who can draw on any feature of his or her experience (Croft & Cruse 2004, chap. 3). In other words, the meaning of a word or construction must encompass all of the encyclopedic knowledge behind its use, and represents choices the speaker makes in framing the experience to be communicated. This is just another way of saying that the variation in utterer's occasion meaning is part of linguistic meaning.

Finally, there is also grammatical variation; that is, there are many ways to 'the same thing'. Putting the question this way presupposes a view of gram-

mar as a sign system or a system of symbolic units, as in Construction Grammar, Cognitive Grammar, and also Head-driven Phrase Structure Grammar. This contrasts with the structuralist and generative view of grammar as a system of formal structures encapsulated in a grammatical component that is autonomous (self-contained; Croft 1995) relative to the semantic interpretations of those structures. Space prevents me from giving a more general defense of the symbolic or semiotic, sign-based view of grammar (see *inter alia*, Fillmore, Kay & O'Connor 1988; Kay & Fillmore 1999; Langacker 1987; Goldberg 1995; Croft 2001; Croft & Cruse 2004, part 3). However, an argument can be made that the notion of syntactic variation (or absence thereof) does not make sense except in terms of ways of 'saying the same thing'.

Consider the following pairs of English sentences that differ in word order:

(1)   a. *I like beans.*
       b. *Beans I like.*

(2)   a. *After doing the dishes, I read the paper.*
       b. *I read the paper after doing the dishes.*

English is commonly described as having an invariant SVO word order, represented by 1a. It is also commonly described as allowing variation in the placement of adverbial clauses, as in (2a–b). In this standard account, (1b) is analyzed as a special construction (called 'topicalization' after its transformational description), with a special discourse or informational function (see e.g., Prince 1981), but (2a–b) are not treated as distinct constructions. How different are the facts in (1a–b) and (2a–b), really? There is certainly some functional differentiation between preposed and postposed adverbial clauses (see Chafe 1984; Ford 1993). Conversely, there is also some overlap in the uses of (1a–b). The difference in variability of word order depends solely on the degree of generality of the grammatical description. At a lower level of generality, English has constructions whose word order is invariant: Basic Declarative (1a), Topicalization (1b), Preposed Adverbial Clause (2a), and Postposed Adverbial Clause (2b). At a higher level of generality, English has constructions with variable word order: a Declarative or Clausal construction subsuming (1a–b), and a Complex Sentence (Adverbial) construction subsuming (2a–b). The common description of English as invariantly SVO is really an arbitrary statement in terms of the pure order of formal elements.

One can evaluate grammatical invariance independent of the generality of the syntactic description only by comparing how speakers grammatically encode 'the same thing'. Any such study will show that in fact there is a great deal of variation, whose significance for syntactic change will be clear to most historical linguists (Croft 2005). Morphosyntactic variation can be illustrated here using the Pear Stories narratives (Chafe 1980). Twenty undergraduates described the same short movie to an experimenter who pretended not to have seen the movie. Certain events in the movie were described by most of the subjects. Example (3) gives the expressions for the nineteen subjects who reported this particular event (false starts, fillers, pauses and parenthetical statements are edited out; punctuation indicates intonation unit boundaries):

(3)   a. *anyway, a guy comes by leading a goat.*
       b. *And a man comes along with a goat,*
       c. *along comes a man with a donkey.*
       d. *a man came along with a goat,*
       e. *a man goes by with a goat,*
       f. *and you see a guy leading a goat,*
       g. *A man with a goat comes by,*
       h. *a man with a goat comes by.*
       i. *somebody...walks by with a goat or something.*
       j. *and this man is pulling a goat.*
       k. *A man with a goat, was in the distance and walked by.*
       l. *you see this man, dragging this goat,*
       m. *And this man came by, walked by, and he's leading a goat,*
       n. *a man with a goat, ...well he walked by,*
       o. *someone came along first.*
       p. *you see a younger Chicano man, coming across from the back of the picture frame, and he's leading a brown and white goat.*
       q. *Somebody went past him with a goat.*
       r. *and a man comes by leading a goat.*
       s. *And a man walked by with a goat,*

We will focus on two grammatical functions found in these utterances, the expression of the presentative informational function (the man appearing on the scene) and the expression of the comitative circumstantial relationship (between the goat and the man). The constructional variation for the presentative is given in (4–9) (DIR = directional, PRN = pronoun, LOCPRED = locative predication; numbers in brackets indicate frequency in the sample):

(4)   Basic [13]:   *a* NOUN [8]/*This* NOUN [2]/*Someone*[1]/ *Somebody* [2] VERB...
(5)   Inversion [1]:   DIR VERB *a* NOUN...
(6)   Dislocation [1]:   *a* NOUN, PRN VERB......
(7)   Presentative [2]: *You see a* NOUN [1]/*this* NOUN [1] VERB-*ing*...
(8)   Coordinate [1]:   *a* NOUN LOCPRED *and* VERB...
(9)   Presentative/
       Coordinate [1]:   *You see a* NOUN VERB-*ing and* PRN VERB

The presentative construction ranges from a basic SVO construction with an indefinite subject (no prosody is indicated) to a variety of other strategies. The strategies in (4–6) and possibly (7) are highly conventionalized, and hence represent second-order variation. The strategies in (7–9) are much less conventionalized; (8–9) probably represent first-order variation, created on the fly on that occasion of use. All represent grammatical variation in English. The first-order variation is a typical grammaticalization path of presentatives from complex sentence structures (cf. Lambrecht 1988).

The same is true of the expression of the comitative, given in 10–13:

(10) Preposition [11]: *with* Y: embedded [4]/extraposed [6]/both (with inversion) [1]
(11) Participle [4]:   *dragging* [1]/*leading* [3] Y
(12) Coordinate [2]:   *and* X *is leading* Y
(13) Predicate [1]:   X *is pulling* Y

The prepositional comitative is highly conventionalized (nevertheless it varies in its position). Yet the comitative relation manifests first-order variation as well, with either a subordinate participial phrase or coordination presumably created on the fly. In one case (3j), the relation between the man and the goat is the main predication used in the utterance. The first-order variation is again a typical path of grammaticalization for the comitative (Heine & Kuteva 2002: 139–40, 287).

Although various linguists, in particular sociolinguists and functionalist linguists, have argued for the centrality of variation in language (Weinreich, Labov & Herzog 1968; Bailey 1973; Heine, Claudi & Hünnemeyer 1991; Bybee, Perkins & Pagliuca 1994), it has proven more difficult to develop a model of language and language change that incorporates this idea. In the next section, I argue that Hull's generalized analysis of selection, GAS, can fill this gap.

5.   *The instantiation of GAS in language change*

The two preceding sections have argued that language and language change have the basic characteristics that make it amenable to an evolutionary model. A language can be defined as a historical entity, and that entity can be characterized as having variation as one of its basic properties. In order to develop a technical model of language change as an instantiation of selection, we must identify the roles and causal relations of the generalized analysis of selection in language. This model is presented in Croft (2000, esp. chap. 2), and is summarized here.

In language, probably the most salient instance of replication occurs in language use. Every time we open our mouths to speak, we replicate grammatical structures — sounds, words and constructions — that have occurred in prior utterances to which we have been exposed. Hence the paradigm replicator is a linguistic structure in an utterance. This entity has not played a major role in grammatical theories, which have dealt with idealizations — the phoneme /p/, or the periphrastic future construction, rather than specific realizations of /p/ or the future construction occurring in particular utterances. A significant exception is variationist sociolinguistics, in which the basic data are tokens of linguistic structures; these are called the 'variants' of a linguistic 'variable'. These variants are sampled from the utterances in a speech community, quantified and correlated with various social and linguistic factors. The term 'lingueme' is coined in Croft (2000:28) to describe this entity.

By taking the replicator as a lingueme, this evolutionary model is fundamentally 'usage-based': replication is language use. Replication, that is, language use, produces variation, namely first-order variation in form, meaning, and their pairing in grammar (Section 4). The recognition of this variation is the first step in constructing a model of change by replication.

Change occurs at two levels in replication processes, as noted in the explication of GAS (Section 2). Altered replication is change that occurs in a lineage of specific replications. A linguistic example would be replication of /p/ as [f] instead of the original [p]. Altered replication is innovation or actuation in language change. Differential replication is change in the relative frequency of replicators in a set. To continue the linguistic example, this would be proliferation of [f]'s at the expense of [p]'s, that is, the increase in frequency of one variant of a linguistic variable in the speech community at the expense of another variant. Differential replication is propagation in language change.

In GAS, differential replication is caused by environmental interaction. The interactor's interaction with the environment causes differential replication of the relevant replicators. In language change, the paradigm interactor is the speaker, or perhaps more precisely, the speaker's grammar (knowledge about his or her language). We cause the differential replication of linguemes every time we open our mouths to speak: we produce certain variants in our utterances instead of certain others. The choice of variants depends on what is being talked about and above all who is being spoken to. This is the environment for speaking. The effect of differential production of variants — differential replication — is an increase in the frequency of certain variants and the decrease of others.

In this instantiation of GAS in language change, the lingueme is identified as the paradigm replicator, the speaker (or speaker's grammar) as the paradigm interactor, and the replication process is conversation, that is, the production of utterances in language use. This instantiation of GAS is called the 'theory of utterance selection', or TUS (Croft 2000:25–20). We now turn to the definition of the populations into which replicators and interactors are organized.

In the explication of GAS in Section 2, I elaborated on the problems with the essentialist definition of a species because they are paralleled exactly by problems in defining a language. It was noted that some species are distinct yet have the same essential traits. Many languages are distinct although they share the same linguistic properties and are therefore mutually intelligible (examples include Bulgarian and Macedonian, and Danish and Norwegian). Other species are unified despite great diversitiy in essential traits. Some languages are considered to be a single language even though the varieties spoken are so diverse that members of the speech community cannot understand each other (examples include the Chinese language and, increasingly, English). Finally, languages like species evolve and change their linguistic features (for example, changes in English over the past several hundred years). These phenomena all pose problems for a language defined in terms of structural properties or even in terms of mutual intelligibility.

The linguistic equivalent of the population definition of a species is a population definition of a language, or more precisely, the speech community. (Recall that biological populations are defined over organisms, that is, interactors, and interactors are speakers, not linguemes.) A speech community is a group of speakers who engage in intercourse, that is, talk to each other, and more critically, are communicatively isolated from speakers in other speech communities. Of course, communicative isolation is never complete; but nor is reproductive isolation between biological species, especially plants. Intercourse (in the linguistic sense) between speaker populations is undoubtedly of a greater degree than interbreeding across species. Nevertheless, this is a difference of degree, not kind. This definition of a language spoken by a

speech community is therefore more 'social' than 'linguistic' (see e.g., Dixon 1980, chap. 2; Chambers & Trudgill 1998, chap. 1).

Conversation is the production of utterances. Hence, conversation leads to replication of linguemes. In particular, the production of utterances involves the recombination of linguemes from prior utterances heard and internalized by the speaker: most utterances are novel combinations of words and constructions. This recombination process is what is usually referred to as the creativity of language. Some of these novel combinations turn out to be the innovations for new constructions in grammaticalization (see examples (7–9) and (11–13) above), or of new word senses, or of new words themselves (e.g. derivational innovations). Hence the recombination process is a major source of innovations in language change. Finally, the production of utterances in conversation causes differential replication of the relevant linguemes. Hence the population definition of a speech community is tightly integrated with the processes of replication, innovation (altered replication) and propagation (differential replication) — exactly as is the population definition of a species.

Once we have identified a speech community — a population of speakers — then we may identify other associated populations or population-like entities. A language can now be defined as a population of utterances, that is, the population of utterances produced by members of a speech community. A population of utterances is different from a set of sentences, the definition of a 'language' in the first lay view of language described in Section 3. A population of utterances is a historical entity, consisting of the corpus of actual utterances produced, whereas a set of sentences admitted by a grammar is infinite and not a historical entity. A population of utterances is thus the formalization of the second lay view of what a 'language' is. It is born at a particular place and time, and extends over space and time until it splits into new populations or goes extinct. A population of utterances is interconnected in that the linguemes in a particular utterance are replicated from prior utterances in the same population.

The other important population is the 'lingueme pool', that is, all the linguemes occurring in a language. This is the dataset that is sampled in variationist sociolinguistic research, yielding frequencies of variants in particular speech communities. The linguemes in a lingueme pool form lineages which trace the history of the sounds, words, and constructions of the language. These histories are sound changes, word etymologies, and grammaticalization chains of constructions — the basic facts of language change.

In earlier presentations of this work to audiences, it has sometimes been objected that reducing a language to a population of utterances which evolves via shifts in lingueme frequencies misses the human role in language change.

In fact, one of the purposes of this model of language change is precisely to put people back into language. The main alternative view, that a language is an infinite set of mostly never-uttered sentences generated by an idealized grammar that no speaker has in her head, excludes the human role in language change. First, the evolutionary model represents a language as an actual historyical entity, spoken by actual human beings. Second, in the generalized analysis of selection, the interactor plays an equally important role as the replicator. The human speaker is an interactor. (There are also other entities that can function as interactors, but this is beyond the scope of this contribution.) Third, utterances themselves — the entities that make up a language — are not just strings of linguistic forms but acts of communication between people engaging in social interaction. The lineages of replication — sound changes, etymologies and grammaticalization chains — are not just forms either, but histories of human relationships and interactions. In order to understand the mechanisms of language change, one must examine social interactions and human relationships, not just linguistic forms and their frequencies. Finally, a language in this sense is larger than any one person can know, speaker or linguist, because it is the totality of utterances produced in a speech community over the course of its existence. But the fact that any speaker's knowledge *about* (not *of*) his or her language is partial is a crucial aspect of how variation and change are central to language.

We now turn to the question of the relevance of the evolutionary model — more specifically TUS — to the practice of historical linguistics.

6.   *Relevance (i): Basic theoretical issues in language change*

When the question is framed as "How can the evolutionary model change *the* way we do historical linguistics?", it presupposes that there is one way in which historical linguistics is done. In fact, there are a number of different theories of language change currently proposed, many of which are incompatible with each other and some of which are incompatible with TUS. There are also empirical arguments against some of these theories. An evolutionary framework allows us to frame the questions that should be asked of these theories, and offers insights into the empirical failings of certain of these theories.

First, the evolutionary framework requires that the object of study be a historical entity, that is, a spatiotemporally bounded token, not an idealized natural kind. This corresponds to the second view of language in Section 3. While the view of language as a historical entity is something which historical linguists all presumably accept, there is a corollary that is not so obvious, and is brought out by the evolutionary approach. For the past century, structuralism

(and its successor, generative grammar) has focused attention on the linguistic system, and further, has idealized that system to a type. However, language change is not a change in a linguistic system. The only real place for a linguistic system to reside is in a speaker's head. Change does occur in that system, but that change is ontogeny — acquisition of a grammar (knowledge about the language) and any further changes in the grammar during adulthood (as allowed, indeed predicted, by the usage-based model of grammar). Language change *across* speakers is not an ontogenetic phenomenon. It is a population phenomenon, formalized specifically as a population of utterances in TUS. This is the corollary that is not so obvious: language change is an evolutionary process in a population.

A second corollary is that language change is change by replication, not inherent change. Again, the structuralist (and generative) focus on a linguistic system makes language change look like inherent change: vowels in a system move around the vowel space, rules are reordered, paradigms are restructured. But these descriptions are effects, not the underlying process. The underlying process is replication, specifically altered replication of vowel sounds, constructions and word forms in utterance production. Of course, the altered replication occurs as a result of mental processes in the speaker producing the utterance. As noted in the last section, the speaker as interactor plays as important a role in the evolutionary model of language changes as the replicator. But for language change to take place, the mental process has to be realized as innovation in an utterance — that is, the relevant lingueme must be replicated — so it can then ultimately be differentially replicated (propagated) across speakers in a speech community.

The evolutionary framework also allows us to compare more directly different theories of language change. One way in which theories of language change differ is in the instantiation of the roles defined by the generalized analysis of selection. As noted above, GAS does not specify what entities in a particular phenomenal domain play the roles of replicator, interactor, or environment, as long as the preconditions are met (historical entity, variation) and the causal relations between the roles specified by GAS are instantiated appropriately. TUS is one instantiation of GAS in language change. It is a usage-based evolutionary model: language change occurs in language use. But it is not the only instantiation. The 'child-based' model of language change, advocated in most formalist theories, can be analyzed as a selection model with a different instantiation of the roles in GAS. In the child-based model, the grammars are the replicators, not the interactors, in selection. A grammar is replicated when a child learns a language. Altered replication takes place when a child intuits a different grammar from that of her parents, based on the input

she receives. The selection process is biological: the younger generations on the whole outlive the older ones, and so their grammars prevail. Language change is the replacement of the old grammars by the new ones.

The child-based model suffers from a number of problems, however. The first problem is that the parents' grammars do not provide a causal mechanism for altered replication of the grammar by the child. One must appeal to the input to the child — that is, language use. In this respect, the child-based model is similar to the usage-based model. The chief difference between the usage-based model and the child-based model is that in the child-based model, language change is driven by children's behavior, whereas in the usage-based model, language change is driven by adults' behavior. There is empirical evidence to support the usage-based model over the child-based one here. First, the sort of language changes that are attested in historical linguistics are not the same as those found in child language behavior (Dressler 1974; Drachman 1978; Vihman 1980; Hooper 1980; Slobin 1997:313–314; Bybee & Slobin 1982:36–37). Second, children are remarkably good at intuiting the same grammar as their parents even though they are almost never given direct negative evidence. This is called the 'no negative evidence' problem in child language acquisition (Bowerman 1988; Pinker 1989). Whatever the solution to this problem is, it indicates that acquisition of the adult language by children is remarkably robust, and does not appear to be the cause of language change. Third, children as a social group do not become agents of linguistic change (that is, driving forward the propagation of an innovation) until adolescence (Labov 1982; Ravid 1995; Kerswill 1996), and by that time, the child language acquisition process has largely ended (see the studies in Slobin 1985–1997).

If these empirical objections to the child-based model are valid, then a 'usage-based' model would offer a superior explanation for the process of language change. One objection to the usage-based model is the claim that by adulthood, linguistic knowledge is sufficiently fixed that adults could not be the agents of language change, either for innovation or propagation. However, as was argued in Section 4, one of the fundamental facts of language is its variability. First-order variability (in language use) and second-order variability (socially-governed variation) are present for all speakers; even third-order variability (cross-linguistic variation) is present to multilingual speakers. Variation is found in a speaker's production as well. One could attempt to model variable speaker productions in terms of the speaker possessing distinct homogeneous grammars, but a speaker's productions vary in so many grammatical dimensions that there would soon be a combinatorial explosion of grammars in her head. Moreover, interactive activation networks offer a plausible model of variable grammatical knowledge in a single speaker's mind (Elman & Mc-

Clelland 1984; Elman & al. 1996). For these reasons, in the usage-based model, speakers' grammars reflect variation directly, as weighted values of linguistic variants. If one accepts the variable model of grammatical knowledge, then changes to the grammar would involve shifting weights of linguistic variants most of the time and qualitative changes relatively rarely. Such shifts are much more plausible models of adult-driven language change, both empirically and theoretically. (Moreover, the historical evidence points overwhelmingly to the gradualness of language change, which means that adult speakers usually do not have to negotiate large-scale qualitiative grammatical changes in their lifetimes.) In sum, then, TUS is an empirically more defensible instanttiation of GAS in language change than the child-based model.

The evolutionary framework also allows us to compare TUS to Keller's 'invisible hand' model of language change (Keller 1994). Keller's invisible hand model of language change is a usage-based model, like TUS but unlike the child-based model just discussed. Keller's model is a carefully worked out and detailed model of language use and the mechanisms that lead to altered replication (innovation) in language change, which was largely adopted by TUS (see Croft 2000:71–76). Keller's invisible hand model differs from TUS in that the invisible hand model is essentially a one-step process but TUS, like other evolutionary models, is a two-step process.

In TUS the first step is replication, including altered replication: a speaker produces a new copy of a lingueme in an utterance, and that copy may differ from prior copies in the lineage in linguistically significant respects. The second process is selection: given second-order (social) variation, a speaker chooses among variants. In the invisible hand model, a speaker makes a linguistic choice based on what Keller calls the 'ecological conditions' of an utterance: given the conversational situation, the speaker's current knowledge state, and the goals of the speaker (and hearer), the speaker produces a particular utterance form. Keller argues that under similar ecological conditions, speakers will make the same linguistic choice, such as a particular type of innovation. The cumulative effect of all the speakers in a community making this choice will be a language change. Keller calls this a 'phenomenon of the third kind': speakers have intentions about the specific linguistic choices they make on an occasion of use, but an unintended effect of the — cumulative — choices of speakers is a language change.

One of Keller's paradigm examples is pejoration (I use an American English example here in place of his German one). For cultural reasons, reference to certain bodily functions, e.g. in *go to the toilet*, inevitably develop negative connotations. Speakers individually choose an alternative expression, in American English *go to the bathroom*, to avoid those connotations. The

cumulative effect of these speaker's choices is a language change in American English from *go to the toilet* to *go to the bathroom* (*go to the toilet*, of course, was itself formerly a euphemism).

Keller's model is a one-step model in that only one process is posited: a speaker produces a particular utterance form based on her ecological conditions on the occasion of use. The "second step" is just a cumulation of individual independent acts. However, the invisible hand model also suffers from a number of empirical problems. One problem is that a speaker's decisions in choosing an utterance form on a particular occasion of use are not independent acts. A speaker is conforming to the linguistic conventions of the speech community, and that is a replication process: she is repeating a particular behavior that has previously been used to solve a communication problem in the community (see below). That replication must be involved is clear even with the pejoration example. Independent individual choices may explain why a speaker will avoid saying *go to the toilet*, but it will not explain why speakers converge on the replacement *go to the bathroom* rather than some other euphemism. The convergence is a result of replication, first, altered replication of *go to the X* from *toilet* to *bathroom*, then (differential) replication of the innovation *bathroom* by other speakers. Hence, an individual's action is different in type from the one implied by Keller's invisible hand model, namely replication, not independent production.

Another problem is that there are two widely attested characteristics of language change (and cultural transmission as well) that are compatible with a two-step process but not a one-step invisible hand process.

First, one can have innovation without propagation, or "false starts". For example, Hopper & Traugott (2003:83) note that causal *since*, a meaning originally innovated from temporal *since*, occurred sporadically even in very early sources of English:

(14) *Temporal meaning*:
   þa   siþþan   he irre   wæs & gewundod   he ofslog
   then after/since he angry was & wounded   he slaughtered

   micel   þæs   folces
   much   of.that troop
   "Then after/since he was angry and wounded, he slaughtered many troops." (c. 880, Orosius 4 1.156.11)

(15) *Causal meaning:*

Ac   ic þe   wille nu   giet getæcan   ðone weg siððan
but   I thee   will now still teach   that way since

ðu   ongitst þurh   mine lare   hwæt   sio   soðe
thou seest through my teaching what   that   true

gesælð   bið   &   hwær   hio   bið
happiness is   and where   it   is
"But still I will now teach you the way since you see that true happiness comes through teaching, and where it is." (c. 880, Boethius 36 104.26)

But the causal meaning is not widely attested until the 15th century (Hopper & Traugott 2003:83). These facts imply that innovation occurred sporadically, but propagation was an independent step in the language change process and did not occur until the 15th century.

Second, when propagation does occur, it is socially structured, as many sociolinguistic studies demonstrate. An innovation gradually spreads through the speech community following social network and class patterns. This behavior also indicates that propagation is a second, independent process, and moreover that it is also driven by replication (speakers choosing variants according to the social status that those variants possess).

The evolutionary model allows us to see that language change occurs in a population through replication. It also combines with empirical evidence in historical linguistics to argue for a two-step, usage-based model of language change.

7. *Relevance (ii): Biological concepts and techniques in historical linguistics*

The preceding section argued that the basic structure of the generalized analysis of selection (GAS) makes a substantial contribution in clarifying, and in some cases deciding, basic questions in the theory of language change. If the evolutionary approach to language change is a fruitful theory, then one would expect that there may be other results in biological evolutionary theory that would be of use to historical linguistics. Of course, one must be cautious in making comparisons and inferences. Only those aspects of evolutionary processes that appear to follow directly from GAS are likely to be of relevance to language change. (And we cannot rule out the possibility that GAS may

have to be revised or elaborated as it is extended to other types of change by replication.)

One tool of evolutionary biologists has already come into use, namely algorithms and computer programs for constructing and evaluating phylogenetic classifications of languages. Phylogeny reconstruction programs have been used by historical linguists (and others) to address questions of subgrouping in well-established families such as Indo-European (Lohr 1999, 2000; McMahon, Lohr & McMahon 1999; Ringe, Warnow & Taylor 2002; McMahon & McMahon 2003). This research is in its earliest stages, but the first results are quite suggestive. It is likely that other quantitative methods developed by evolutionary biologists and population geneticists will be applicable to parallel linguistic questions.

There are also qualitative phenomena or theoretical concepts that appear to follow from GAS and find natural parallels in language change. Several of these are discussed in some detail in Croft (2000, 2002); some are briefly described here. Certain concepts found in orthodox neo-Darwinian theory (also known as 'the evolutionary synthesis') have relevance to historical linguistic questions. For example, a species is defined as a reproductively isolated population, but of course not all members of a species interbreed with each other. A much smaller population unit plays a significant role in biological evolution, namely the 'deme', a local group with equal likelihood of mating with each other. A deme resembles a social network in this respect, in particular that a social network forms the group with which a speaker has regular face-to-face contact and therefore the majority of his or her conversations (Croft 2000:19–20, 168–70).

A basic fact of population lineages is that they can diverge and, in certain circumstances, converge. Divergence is a result of isolation and biologists have identified a variety of isolating mechanisms, the most important of which is geographical separation. Since conversation, like sexual reproduction, is a spatially highly localized phenomenon (at least until recently), geographical separation is also a significant isolating mechanism, and there are other similarities among other isolating mechanisms (Croft 2000:199–200). Also, isolated biological populations tend to undergo different types of changes (even speciation), or not to participate in other changes, a phenomena claimed to occur also in linguistically isolated populations (Andersen 1988; Trudgill 1989, 1992, 1996; see Croft 2000:190–94). Finally, hybridization, which occurs commonly in plant species, occurs via a process called 'introgression': a hybrid individual breeds back into one of the original populations, introducing genes from the other population into the first population. 'Interference' in language operates in the same way: an at least partly bilingual individual

acquires knowledge of a lingueme through speaking with individuals from another speech community, and introduces the foreign lingueme into the original speech community by using it in conversation with other members of the original speech community (Croft 2000:180, 198, 201). These parallels are not accidental or arbitrary; they are corollaries of the behavior of populations of interactors and the replication processes they cause.

A further set of concepts have emerged in 'post-synthesis' debates in evolutionary biology. These are phenomena that have been claimed by biologists to require revision of basic tenets of the neo-Darwinian synthesis of Darwinian evolutionary theory and population genetics that was developed in the early twentieth century. Some of these phenomena have striking parallels in language change. It is quite possible (though also quite speculative) that these phenomena are properties of similar processes of replication and selection (Croft 2002:82–88).

For example, one characteristic of many biological organisms is their flexibility in interaction with the environment, including a high degree of plasticity and environmental influence in development. It has been speculated that flexibility evolved as a response to a constantly changing environment. Language is also highly flexible as a communication device. A simple example is that any deictic or indexical expression can be used for any possible referent. Yet speakers use a variety of non-conventional communication devices to establish reference and other aspects of meaning (Clark 1996:77–81), and can manipulate convention itself in framing an experience with a choice of words and constructions. Flexibility in language probably also arose because of a constantly changing environment, namely that every experience is different (Croft 2002:84–85; see Section 4).

A number of phenomena in biological evolution do not appear to be the result of adaptation through natural selection. Biological structures that evolved for one purpose get co-opted for another function; this is 'exaptation'. Exaptation is also found in language change (see Section 8 below). One also finds non-adaptive or vestigial traits in biological organisms. These are presumably due to the fact that a single gene or complex of genes plays a role in the ontogenetic development of a complex of traits of an organism: thus, selection of one trait means the other traits have to come along with it. This phenomenon is in turn attributed to the extreme conservatism of the replication process. One finds the equivalent in language change, in particular in the process of grammaticalization. For example, once periphrastic constructions like *be going to* and *used to* acquire tense-aspect-mood functions, the copula *be* and the infinitival *to* become vestigial traits of the construction: although they are reduced (*I'm gonna quit* or *I useta work here*), they haven't gone away, and

sometimes lead to syntactic oddities, such as the question form *Did you used to work here?* (with apparent double marking of past in *Did* and *used*). These non-adaptive and vestigial grammatical traits, or "crazy syntax" as it has been called, may also be due to the extreme conservatism of convention in replication (see Givón 1979: chap. 6; Croft 2002:86–87).

Finally, the direction of evolution in biology and language is curiously parallel as well. Biological evolution is globally undirected; there is no "progress". However, at a spatially and temporally local scale, there is directed change: an organism is increasingly adapted to a niche that it has entered or has been created. It has been suggested that the reason for global 'stasis' (absence of directed change) is because the earth's niches have been "filled up"; evolution is simply the constant rejigging of the relationships between organisms as well as responding to cyclic fluctuations in the environment (climate, etc.; Hull 1988:461, citing Gould 1977:19). Language is similar. All contemporary languages are general-purpose communicative systems; we do not see any global "progress" in language history. (This may of course have been different when the human language capacity first emerged; but the same is true of the first emergence and spread of life on earth, Hull 1988:461.) Instead, we see local cycles of grammatical, phonological, and semantic change as a result of fluctuation among the same competing motivations. This is perhaps because as general-purpose communication systems, the communicative niches have been "filled up": what we observe in language change is the constant rejigging of relationships among constructions (Croft 2000:79–84).

These observations of qualitative parallels between biological and linguistic evolution are highly suggestive at this point. But they suggest that an evolutionary model of language change will be productive in understanding some otherwise mysterious or at least unexplained aspects of language change.

8.   *Relevance (iii): Mechanisms of language change*

GAS does not specify the causal mechanisms for replication (including innovation) and selection (propagation) in any particular instantiation. The causal mechanisms are domain-specific and therefore not part of an abstract model of change by replication. This might suggest that GAS cannot have much relevance for theories of causal mechanisms of language change — one of the most important components of a theory of language change. In fact, it does have major relevance, in focusing our attention of certain aspects of language change that have traditionally been overlooked, in the analysis of types of mechanisms, and in the search for new mechanisms.

Before delving into mechanisms of language change in an evolutionary perspective, an important observation can be made: GAS also implies that the

causal mechanisms of biological evolution are domain-specific and not part of GAS. For example, some functionalist linguists argue that functional motivation (including semantic, pragmatic, and processing motivations) must be a major mechanism for the propagation of change, since in biological evolution, adaptation is a major mechanism for selection (propagation of fitter variants; see for example Haspelmath 1999). However, all of the empirical evidence in language change indicates that social factors, not functional ones, are the causal mechanisms for the propagation of a change. In fact, this is a false analogy with biological evolution that is not supported by GAS (Croft 2000: 39). There is no incompatibility with the empirical observations of sociolinguistics and the evolutionary model, because adaptation by natural selection is a domain-specific, biological mechanism.

Where does functional motivation play a role in language change, then? The only remaining option in GAS is the first step in the two-step process, innovation. There is an objection to this analysis also based on a biological assumption: altered replication must occur by a random process, since it does in biological evolution (genetic mutation). Yet many language changes, including many sound changes, many lexical semantic changes, and grammaticalization, are unidirectional, not random in direction. But GAS does not require altered replication to occur by a random mechanism. Directed altered replication is possible in GAS, and in fact I argue that it is the case in language change (Croft 2000; see below).

How is it possible that one can observe language changes that are propagated by a social mechanism and yet they consistently display unidirectional patterns in cross-linguistic comparison that are presumably motivated by functional/phonetic factors in innovation? All that is necessary is that the mechanisms for innovation and propagation be independent. If there is a tendency for innovation of nasal vowels to be lower in the vowel space, then as long as there is no correlation between who produces the nasal vowels and their tendency to produce them in a certain way, then whenever an innovation gets picked up and propagated, the end result will be the observed pattern of the predominant lowering of nasal vowels. This makes sense because presumably the auditory–articulatory structures giving rise to the tendency to lower nasal vowels will be true of all human beings regardless of social class, position in social networks, or historical era. Kroch makes the same point in discussing his Constant Rate Hypothesis, which represents essentially the same analysis in a different context:

> [...] the pattern of favoring and disfavoring contexts does not reflect the forces pushing the change forward. Rather, it reflects functional effects, discourse and processing, on the choices speakers make among the alternatives available to them

> in the language as they know it; and the strength of these effects remains constant as the change proceeds. (Kroch 1989:238)

Thus, one way in which GAS is relevant to the mechanisms of language change is to avoid invoking biological mechanisms — adaptation for selection, randomness for innovation — inappropriately.

GAS, or evolutionary models more generally, makes another, more important, contribution to causal mechanisms of language change. An evolutionary model has to account for stasis as well as change, specifically, normal or (more or less) identical replication. The same is true of a theory of language change, though this point is often overlooked. A theory of language change must also explain why languages do *not* change much of the time as well. A causal mechanism for stasis must be postulated. In language change, the chief causal mechanism for stability — indeed, the chief mechanism for language — is convention.

The most central fact about language is that it is a system of conventions. Language change represents the evolution of conventions. Normal replication is conformity to convention. Moreover, both of the two steps in the change process are defined in terms of linguistic convention as well. Altered replication — innovation — is breaking a convention. Differential replication — propagation or selection—is the adoption (or abandonment) of a convention by a speech community.

A convention is defined in (16), following Lewis (1969) and Clark (1999; adapted from Clark 1996:71):

(16) a. a regularity in behavior
      b. that is partly arbitrary
      c. that is common ground in a community
      d. as a coordination device
      e. for a recurrent coordination problem

Lewis' theory of convention is based on a model of cooperative joint action. Language use is an example of cooperative joint action, namely to communicate in order to achieve various social-interactional goals of the interlocutors (cf. Keller's 1994:106 'hypermaxim' of communication). Lewis' theory of convention provides a theory of the function of language and the role it plays in language stability and change. Any cooperative action requires coordination, that is, speaker and hearer have to find a way to align their individual actions in order to achieve a joint goal. In fact, Clark (1999) argues that language serves as a means to coordinate extralinguistic joint actions. Nevertheless, language use itself is a joint action requiring coordination. The joint action is

communicating a meaning. Clark (1999) uses a revised version of Grice's theory of meaning, formulated as a joint action; it is given in (17) (adapted from Clark 1996:131):

(17) A speaker MEANS something for someone when:
a. the communicative act includes (b) and (c)
b. the speaker presents an utterance to the addressee intending that what is meant is part of the communicative act
c. the addressee recognizes that what is meant is part of the communicative act

The definition of meaning in (17) makes clear that communication is a joint action, involving recognition by the hearer of the intentions of the speaker. For communication to succeed, speaker and hearer must (among other things) coordinate on the content of what is meant. This is the coordination problem that convention can be used to solve. Although a number of coordination devices are used in communication (see below), convention is one of the most important and distinctive of those devices.

We now return to the nature of convention by means of an example. One behavior that I exhibit as an English speaker is producing the string of sounds *butterfly* as a coordination device to solve the recurrent coordination problem of talking about butterflies. The employment of this behavior is common ground in the English speech community: we all know that we use *butterfly* for this purpose. And this behavior is partly arbitrary. For example, we could have used the string of sounds *Schmetterling* instead; that's what the German speech community does. Conventions are also form–function relations, the central concern of functionalist theories of grammar: the regularity in behavior is the form and the recurrent coordination problem is its (semiotic) function.

Convention is the foundation of the usage-based TUS. Conformity to convention is the absence of change. The absence of change is a phenomenon that requires explanation as much as change does. After all, language does not change rapidly in all of its dimensions, despite the ubiquity of variation in language use and in socially-governed linguistic variables. The absence of change is a particularly important phenomenon to explain in a usage-based theory such as TUS. In such a theory, replication occurs every time we talk, and since we talk so much and so often, the "generations" are very short in absolute time (though still much longer than for many biological organisms, such as bacteria and viruses). Hence, conformity to convention must be powerful in order to maintain language. In fact, the principle governing conformity to convention has been proposed a number of times in the history

of linguistics. Keller describes it as 'Humboldt's Law' and it corresponds to Jakobson's 'referential function'. Keller formulates the principle as one of his maxims of language use: "Talk in a way in which you believe the other would talk if he or she were in your place" (Keller 1994:99).

An evolutionary model also offers a perspective on the role of intentional behavior in language change. The role of intentional behavior is a vexed question in evolutionary theory, because it is often confused with the notion of teleological change. A teleological change is one in which the goal of the process is the change itself. Teleological changes are denied by evolutionary theory; indeed, one of the goals of evolutionary theory is to demonstrate the possibility that complex structures and behaviors can arise without their being intended, through the two-step process of variation and selection. On the other hand, many animals are intentional beings, in the sense of engaging in goal-directed behavior. But as Hull points out, the goal of their behavior is not evolutionary change in itself:

> For example, a rabbit strives to elude a fox chasing it just as surely as the fox strives to catch it. However, with respect to selection, neither organism is striving to change its future course of evolutionary development, although their behavior may well have this effect. (Hull 1988:471)

The same is true of language change. Language use is intentional behavior. What matters, however, is the goal of the intention. If the goal of language use were to change the language itself, this would be a teleological change. Historical linguists generally reject teleological changes (see for example Labov 1994, chap. 19; Lass 1997:352ff). Nevertheless teleological explanations are still invoked, leading Haspelmath to refer to the 'teleological fallacy' (Haspelmath 1999:188–189; see also Croft 2000:66–71).

However, language change may occur in the same way as evolutionary change with respect to the rabbit and the fox: speakers have communicative goals, and they are achieved by altered replication. For example, it has commonly been proposed that speakers innovate in order to be expressive for various reasons (e.g., to be noticed, to be amusing, to be charming, etc.; see Keller 1994:101; compare Jakobson's 'poetic function'). Expressiveness has been invoked in a variety of approaches to language change (e.g. Lightfoot 1991:160, 171; Heine 1994:259; Harris & Campbell 1995:54, 73). Another widely invoked principle for innovation is economy, proposed for a wide variety of phonetic and grammatical processes. Economy is usually interpreted as a psychological phenomenon, the saving of energy on the part of the speaker. However, economy is more likely to have a communicative motivation: saving the speaker's and hearer's time, rather than saving the speaker's

energy (compare Clark's 1996:69 immediacy premise; see Croft 2000:75). Finally, Keller observes that an important principle for innovation is to avoid misunderstanding (Keller 1994:94); this principle may be at least as significant as expressiveness (Croft 2000:75). Finally, the propagation of a change is generally hypothesized to result from another intentional goal, this time a social one: to identify with a social group (LePage & Tabouret-Keller 1985; prestige, covert prestige and accommodation are special cases of acts of identity, Croft 2000:73–74).

These two types of changes — teleological, and intentional but not teleological — do not exhaust the possible mechanisms of language change. A third type is an unintended byproduct of the intentional act of *not* changing the language, namely conforming to convention. This type is called 'non-intentional' in Croft 2000. The intention to conform to convention may lead to innovation because of the complexity of the encoding and decoding of language. For example, the phonetic realization of phonological articulations leads to complex co-articulation effects. When this is combined with the variability of speaker productions, the decoding of the auditory signal may lead to reanalysis of the mapping between phonological form and phonetic realization (see Ohala 1981, 1989, 1992, 1993). Likewise, the complexity of the morphosyntactic encoding of meaning, combined with the variability of the experiences communicated on particular occasions of use (Section 4), may lead to the reanalysis of the mapping between morphosyntactic form in constructions and the semantic content that they denote (Croft 2000, chap. 4–5).

This last process is form-function reanalysis, and four types of form-function reanalysis are proposed. In the first, 'hyperanalysis', a speaker analyzes out a semantic component from a syntactic element, typically a semantic component that overlaps with that of another element. For example, in some Bantu languages, the locative subject agreement marker has evolved to an impersonal marker. In Chichewa (18) (Bresnan & Kanerva 1989:3), locative agreement is still contentful, but in Zulu, it now has an impersonal function such as the existential in (19) (Doke 1930:296).

(18) *Mw- a- khal -a*   *a- nyani*   *m- mi- tengo*
     CL18.SBJ- PERF- sit -IND   CL2- baboon   CL18- CL4- tree
     "In the trees are sitting baboons."

(19) *ku- khona*   *izinja*   *emazweni*   *onke*
     CL17- be.present   dogs   countries.LOC   all
     "There are dogs in all countries."

In unpublished work, I argue that this process occurred because the locative meaning has been analyzed out of the agreement marker. The locative phrase can occur clause-finally, as in the Chichewa example above; in that case, there is a hyperanalysis attributing a circumstantial function to the locative phrase and hyperanalyzing out the locative meaning from the subject agreement affix. Hyperanalysis thus accounts for semantic bleaching and eventually the loss of the syntactic element.

In the second process, 'hypoanalysis', a semantic component is added to a syntactic element, typically one whose distribution has no discriminatory semantic value. Hypoanalysis is the same as exaptation (Lass 1990) or re-grammaticalization (Greenberg 1991). For example, simple presents often come to be restricted to subordinate clause contexts with future or subjunctive meaning, due to replacement by another verb form in main clauses. In this circumstance, the future or subjunctive meaning is sometimes hypoanalyzed and attributed to the former simple present form, as in modern Armenian (Bybee, Perkins & Pagliuca 1994:230–236; Haspelmath 1998a; example (20) from Fairbanks & Stevick 1958:118).

(20) *p'aymanóv*   *vor*   *ušadrutyámb varèk*   ·   *mekenèn*
     condition   that   carefully   drive.2SG   car
     "On condition that you drive the car carefully."

In the third process, 'metanalysis', a contextual semantic feature becomes inherent in a syntactic element while an inherent feature is analyzed out; in other words, it is simultaneous hyperanalysis/hypoanalysis. Metanalysis typically takes place when there is a unidirectional correlation of semantic features (one feature frequently occurs with another, but the second often does not occur with the first). Metanalysis underlies pragmatic inferencing in grammaticalization (Traugott & König 1991), such as the shift of English *since* from a temporal to a causal meaning alluded to above (Hopper & Traugott 2003:82–83). Most contexts in which a temporal connective is used also denote a causal relation, and so the temporal and causal meanings were metanalyzed (i.e. the connective acquired an inherent causal meaning, and the temporal meaning became contextual). Metanalysis also motivates the negative cycle: negative contexts are frequently emphatic, and the emphatic marker replaces its emphatic meaning with a negative one.

In the fourth process, 'cryptanalysis', a covertly marked semantic feature is reanalyzed as not grammatically marked, and a grammatical marker is inserted. Cryptanalysis typically occurs when there is an obligatory transparent grammatical marker (e.g., a regular plural affix) available for the covertly

marked semantic feature (e.g., an irregular plural form). For example, the Uzbek irregular 1st and 2nd person plural pronouns *biz* and *siz* are optionally reinforced with the nominal plural suffix *-lar* (*bizlar, sizlar*; Sjoberg 1963:89–90). Cryptanalysis also accounts for pleonasm (for example, pleonastic and paratactic negation) and reinforcement.

Form–function reanalysis describes syntagmatic processes in innovation, namely form–function mappings in constructions. There are also paradigmatic contrasts in form–function mappings in the organization of linguistic elements — words and constructions — in a speaker's mind. In Croft (2000), the phenomenon of extension or spread — the use of a grammatical form or construction for new, semantically closely related functions — is also hypothesized to result from a non-intentional mechanism. The basic unit of a grammar is a form-meaning pairing (a sign or construction, in the generalized sense of the latter term). The paradigmatic organization of grammatical forms and constructions is therefore determined by semantic as well as syntactic relations. In typological theory, the semantic map model is used to represent the semantic relatedness of forms and constructions (Croft 2003a; Haspelmath 2003; see also its use in Radical Construction Grammar, cf. Croft 2001).

Grammatical forms and constructions are extended by the mechanism of 'intraference', the language-internal equivalent of interference. In external interference, bilingual speakers establish an interlingual identification of forms with overlapping functions in two different languages (Weinreich 1968:7). The result is introduction of a new form with a particular function, or the addition of a new function to a linguistic form (a calque of the usage of the equivalent form in the other language). Intraference is the same process within a language: instead of interference from a form with a similar function from a second language, there is intraference from a form with a closely related function in the same language. Besides various types of extension of forms and constructions, intraference also accounts for analogical leveling (where one stem in an irregular paradigm is extended to replace other stems in the paradigm) and the elaboration of idioms, as in the comment by a Deadhead on the Grateful Dead's leader Jerry Garcia's death: *It pulled my life rug out from under me.*

In sum, the evolutionary model, in particular GAS, helps historical linguists avoid false analogies and teleological mechanisms; focuses attention on the need to explain why languages do not change; and thereby points out the possible existence of nonintentional mechanisms of change such as form-function reanalysis and intraference.

9. *Relevance (iv): An integrated theory of language change — and of language*

All of the contributions of an evolutionary model to historical linguistics described in the preceding sections are useful. But perhaps the most important contribution of an evolutionary model is to provide an integrated framework for language change, and ultimately for language.

One major division in the study of language change has been the division between 'internal' and 'external' causes of language change. One interpretation of the division represents 'internal' changes as innovations that arise in a speech community without impact from social contact with another community. These innovations are usually explained with the types of intentional mechanisms described in the preceding section. 'External' changes are innovations that arise as a result of contact with another speech community.

TUS breaks down this division in several ways. Most fundamentally, in both 'internal' and 'external' innovations, the basic phenomenon is (altered) replication: a speaker is altering the convention of the speech community. The only difference is how the altered replication is brought about. I have proposed that the mechanism for 'external' altered replication, interference, is mirrored by essentially the same process in 'internal' altered replication, namely intraference, as described in the preceding section. Finally, even 'internal' to a society, the relationship between speaker and speech community is one-to-many, as sociolinguists have argued since Fishman (1972a, b; see also Clark 1996:100–12, 1998). Speech communities are defined by domains of social activity and shared expertise, in 'monolingual' as well as multilingual societies. Speakers belong to multiple speech communities, and so there is always contact between these communities. The codes used in each domain overlap to a great extent although they also differ. There is always 'interference' between the codes used in the multiple speech communities in a society. In other words, in terms of social organization, internal social structure is not much different from external social relations, and the processes of language change are therefore not that different.

Perhaps the most significant division in historical linguistic theory is that between the socio-historical research programme and what might be called the 'traditional' (originally philological) research programme. The socio-historical research programme examines contemporary sociolinguistic variation as change in progress as well as historical changes, and proposes social explanations for language change. The 'traditional' research programme examines linguistic changes directly through documents, or indirectly through the comparative method and various techniques to infer diachronic processes from typological universals (Croft 2003a: chap. 8). The explanations offered in this research

programme range from 'structural' or 'formal' explanations to functional explanations. Examples of the latter explanations are the intentional and nonintentional mechanisms discussed in Section 8. The two research programmes appear to be either in direct conflict or to have little to do with each other.

The evolutionary model presents a solution to this problem that preserves the empirical discoveries and valid explanations of both research programmes. In GAS, evolution is a two-step process. TUS hypothesizes that the socio-historical and 'traditional' research programmes are studying two different steps of the process. The 'traditional' research programme studies innovation. In the theory presented here, I have argued that innovation is 'functional', in that it arises from the relationship between linguistic form and its meaning or function (or in the case of phonological innovation, the relationship between phonological form and its phonetic realization). The socio-historical research programme studies propagation. Socio-historical linguistics has long argued that propagation is social, that is, it arises from the social structure of speech communities, and the social relations between speech communities (Labov 1994; 2001 summarizes the research). TUS hypothesizes that there is a strict separation of causal mechanisms for innovation and propagation (see Croft 1995:524): innovation is functional; propagation is social, in the senses defined above. This 'evolutionary synthesis' is one of the strongest features of this approach to language change.

But the evolutionary model offers an even more important synthesis from a theoretical point of view. Language change has been separated from the synchronic study of language since the rise of structuralism. The result is a view of historical linguistics as a sort of appendage to the study of language, isolated as a separated subdiscipline of linguistics and perhaps inevitably slipping to the periphery of programs of academic study and training in linguistics. The reason for this is that the first lay view of language, as an idealized and invariant system, has no place for language change, except as a perturbation of the system from outside. In this view, language change is not an essential part of the language system.

In the evolutionary approach to language change, change is an essential part of language. This is because in the evolutionary model, variation is an essential property of language. The centrality of variation is not just a theoretical postulate of the evolutionary model, but a pervasive empirical fact of language, as I argued in Section 4. Taking variation as a central fact of language allows for a straightforward synthesis of synchrony and diachrony in language. Language change is simply linguistic variation at a broader scope, and more specifically, linguistic variation that trends in a particular direction

for some length of time. The different orders of variation represent its manifestation in different phases in the process of language change. First-order variation is the origin of variation in language use. Second-order variation is the progression of the variation to conventional status in the speech community. Third-order variation is the fixation of different variants as contrasting conventions of different speech communities.

I am not arguing that the distinction between synchrony and diachrony be erased entirely. But the evolutionary approach closes the gulf between the two. Synchronically, a language is a time-slice of a population of utterances, thin enough to represent the language encountered (and produced) by a single speaker; and we recognize the variation it contains. Diachronically, we have the entire population of utterances and the lingueme lineages — sound changes, etymologies, constructional changes — it contains. By recognizing that synchronic language is variable, we can integrate language change and language itself.

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