Language Change through Natural Selection.

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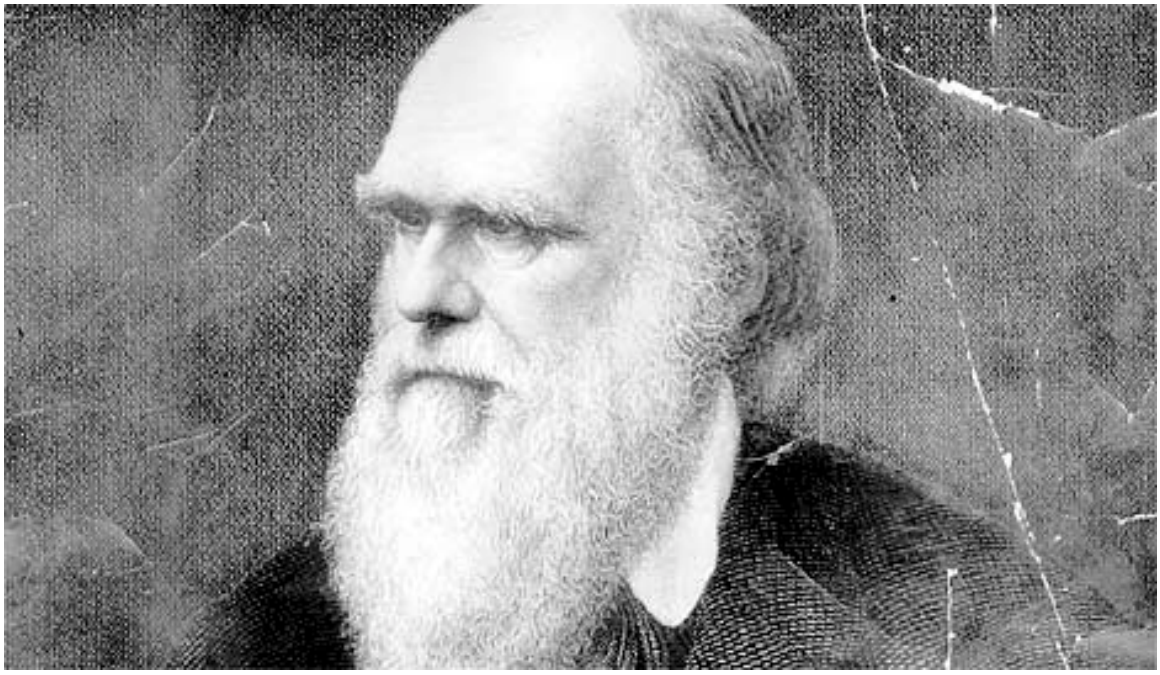

0. Introduction

Darwin described only a special case of natural selection when he was dealing with biological evolution. Ever since his theory was formulated and started to be tested in the biological sciences its enormous explanatory power became very appealing to other fields as well. Evolutionary models have been proposed and applied in many areas that involve systems changing over time and the transmission of information, such as culture, economics, politics, computer science, to name just a few. In Linguistics, many have formulated comparisons between evolutionary biology and the history of languages, more notably in the field of language filiation, using cladistic concepts such as family trees, parent-daughter relationships, taxa, etc. (see Lass, 1997 for a comprehensive bibliography). Many insights have been gained through such parallelisms between biological evolution and language change, especially sound change, which has been claimed to be regular and normally detached from the conscious control of the speaker and based solely on phonetic and articulatory grounds- the famous Neo-Grammarian hypothesis.

It is very tempting thus to see language change as a whole, based on some kind of mutation and selection process which evaluates variation by some measure of adaptive value which in turn would have an effect on the speech of a language user. Sets of features, such as phonemes, syntactic structures, or meanings , and their mutations can only have a direct effect on the speech of an individual, and only later, generalizations such as the notion of the Saussurean language, can be thought of as feature pools that are organized in similar patterns. These features then would need to be able to replicate themselves over time maintaining a cohesive grammar , that can be interpreted as the linguistic genotype of a speaker, which would have to be a seamlessly integrated, functioning and competitive system, able to be reproduced or transmitted again with extremely high fidelity, outcompeting other rival feature systems. All the features that are being transmitted are blind to the well being (proper operation) of the entire system, but at the

same time they could not be in fatal violation of a local network of features responsible for only a subpart in the process of (in our case) communication. And this evaluation metric of adaptive value can be viewed as the optimization of articulatory efficiency and communicative effectiveness, in the broadest sense possible, including social, psychological and cultural aspects thereof. In this sense then, the linguistic variation found today around the world would be nothing more than slightly different phenotypes of very similar genotypes of very similar genomes, in the human language gene pool that is available at any synchronic stage. Superfluous biological intra-species variation such as skin color, nose shape or middle toe length can then be paralleled to linguistic intra-human language variation such as !X_o‘, Latin, Esperanto, or ASL.

Thinking about all this, two automatic, almost spontaneous questions arise: First, what is the nature of these features, or elements, and how could they ever be paralleled or equated to the double helix encoded chromosomes delineating biological genes? And secondly, but equally alarmingly, what is the mechanism responsible for their replication (meiosis) and propagation (gamete fusion) from host to host? The next two sections will discuss answers already proposed for these two questions and the third and last one will entertain a slightly alternative answer to the second question about the nature of transmission. Fortunately, people have already thought about possible answers to these questions.

1. Memes and memetic evolution.

Oxford, zoologist Richard Dawkins in his 1976 book *The Selfish Gene* coined the term *meme* (haplological from mimeme) modeled after *gene.* Dawkins defines a meme as a unit of cultural inheritance, hypothesized as analogous to the particulate gene, and as naturally selected by virtue of its phenotypic consequences on its own survival and replication in the cultural environment and to elaborate:

> examples of memes are tunes, ideas, *catch phrases* (my emphasis), clothes fashions, ways of making pots or of building arches. Just as genes propagate themselves in the gene pool by leaping from body to body via sperm or eggs, so memes propagate themselves in the meme pool by *leaping from brain to brain* via a process which, in the broad sense, can be called imitation. If the scientist hears, or reads about, a good idea, he passes it on to his colleagues and students. He mentions it in his articles and his lectures. If the idea catches on, it can be said to propagate itself, spreading from brain to brain if memes in brains are analogous to genes they must be self-replicating brain structures, actual patterns of neuronal wiring-up that reconstitute themselves in one brain after another
>
> (Dawkins, 1976: pgs 192, 323)

The notion of memes as cultural analogues to genes (Dennet, 1995) has gained a broad popularity after the publication of Dawkins book. My emphasis, however, was on catch phrases as the only linguistically oriented example used in this passage. A catch phrase is comprised by several linguistic elements; it has phonetic content, semantic and pragmatic dimensions, abides to certain grammatical rules, it has to be instantiated in a particular context (environment) and so forth. So, if we adopt Dawkins hypothesis, is a catch phrase a single meme or a collection of memes? a meme complex so to say. Unlike memetics, linguistics is not a new field, and linguists through careful examination of human languages past and present, have gained much insight into the structures, intricacies and variations of such systems. So we can say with much certainty that, the same way a leg or a liver is not inherited directly, but is the result of complex interactions between genes with very localized and constraint effects, a catch phrase is not the result of the activation in a particular brain of a single meme but is a side effect of the interaction between several different memes that happen to have a positive effect on the speaker and her environment

(being understood, while generating the catchiness of the phrase). So then memes could be thought of as linguistic units that, in isolation, do not mean anything, but when combined together to form larger structures trigger positive feedback loops in the brains of speakers and listeners. So, a phonological feature such as [-HIGH] is something utterly meaningless equal to background noise unless it is integrated in a larger linguistic unit that can have a phenotypic effect. And by phenotypic effect, I mean the manipulation of the biological speech organs of the host organism, and subsequently its immediate environment (modulation of air pressure <speech>, or photons <visual languages>) including the receptor brains. So, then language change could be viewed as the result of copying errors in the process of meme replication from brain to brain, a notion not alien to traditional acquisition theories in linguistics (see Labov, 1994 among others) but seen here in a different light, detached from linguistic determinism and Language Acquisition Devices. Anything can be replicated by imitation as long as it has a positive effect on the host brain, the meme itself (its effectiveness in making self-copies), and the receptor brains (their conduciveness and co-operation in the replication process). This suggestion can be extremely powerful in entertaining an explanation of the origin of language as well, as the differential survival of replicators belonging to different memotypes, based on random copying errors that go through an evaluation (Natural Selection) process determined by the degree of optimization between energy expended (articulation) and energy gained (communicative effectiveness).The Principles and Parameters approach (a popular working theory in linguistics) then can be restated as a Memes and Memotypes approach. Memes are the raw materials that can be recombined or mutate (change spontaneously due to entropy) to generate slightly different memotypes. Then the success of these memotypes will depend on the benefits or disadvantages of their phenotypes. So all languages have memes (any kind of primitive linguistic element) drawn from a linguistic meme pool, but the way they are combined forming more and more elaborate and interwoven meme-complexes or multi-meme schemes and ultimately an entire memotype would be totally dependent on the optimization needs and pre-existing combinations in the brains of individuals. Aggregations of similar encephalic meme-organization patterns then can be called English or Berber. And the lines are not clear cut. The brain of a Berber speaker could contain the same exact memes that exist in the brain of an English speaker but organized a lot differently, reflecting the particular history of successful replications within a restricted domain of interactions. A transplanted Bedouin in a London subway would be under tremendous environmental pressure to integrate a massive amount of competing memes replacing or storing in parallel (bilingualism) competing memes from an alien memotype (English) , which, nevertheless, are in principle integratable and could co-exist with already established patterns (cf. biological hybrid species, Creoles, etc.) A Creole then would be nothing more than a massive exchange of competing allelo-memes (after the genetic alleles, short for allelomorphs) the same way that a short person has offspring with a tall person, or a blue eyed with a brown eyed one. Genes for shortness will have to compete with genes for tallness. In Sri Lanka Portuguese Creole memes for nasalized vowels had to compete with memes for raising the velum when vowels are produced. The results are unpredictable. They depend on the nature of the meme antagonism and the particular pre-existing variation and organizational patterns in the memome of a speech community.

To summarize the above discussion, memes are the elemental units that make up languages, and that languages change over time through the recombination and mutation, coupled with their differential survival (success at replication), of these memes and meme-complexes. Furthermore, memes are a-sexual replicators that spread from brain to brain through imitation, and hence their name. This theory is full of holes, but a major mega-hole in this whole hypothesis is what does it mean for a meme to replicate itself from one brain to another? What is the nature of this transmission based on imitation? What exactly is being imitated and how? Fortunately there is someone with an idea.

3. Neural Networking and free access to the information superhighway

Vienna based linguist Nikolaus Ritt, wrote in 1996:

> memes i.e. the elements that make up linguistic competences or languages are replicators. They are realised as *neural cell assemblies* (my emphasis) and derive their essential characteristics not primarily from their material substrate, but rather from the pattern they impose on that substrate. Each meme, each linguistic element, be it a phoneme, a morpheme, a syntactic structure, a word, a semantic feature, a frame or schema, whatever, owes its existence to a replication process by which it has been established as a copy of its ancestor meme(s).
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> excerpt from: Darwinising historical linguistics: applications of a dangerous idea. 1996.

This is of course fully compatible (and more elegantly worded) with the discussion so far, however, Ritt s proposal about memes ontological status as *neural cell assmblies* echoing Dawkins original neuronal wiring hypothesis is a very attractive explanatory attempt that I would like to discuss further in this section. If memes are just different neural configurations[1] then what is the mechanism that generates such configurations?

The only source of raw material for meme generation has to be the actual *genetic* make up of an organism. The availabilty of a complex nervous system (a brain) is a sine qua non. And even the existence of such an organ is not a sufficient condition either. Cats have a very complex brain too but no memes. Different brain states are of course generated in cats and mosquitoes and lizards but they are not given time to adapt in relation to other brain states and other brains or unpredictable environments, they cannot be detached from their causes differentiating their effect over time. Mosquitoe and feline brains are capable of learning, modifying and adapting their brain states to the environment and to other automated pre-wired stimuli that have been encoded over evolutionary time in their biological genes. But this learning is transient, ephemeral, non replicating. However, there is no immense chasm between a human brain capable of generating self replicating memes and the brains of other species. Some gradiency can be found in animal memes such as bird songs, dolphin and whale songs, playing and eating habits in highly social animals such as higher mammals, etc. These can be thought of as primitive memes, or pre-memes. Some glimpse of such primitive non-linguistic memes can be found in human habits such as the different ways of laughing or sneezing and how one person might adopt the way another laughs, even though laughing does not involve any kind of complex learning (it is in the genome of humans and other higher primates). However, it is beyond the scope of this paper to discuss the intricacies of brain evolution and the emergence of symbolic communication[2].

Then the mechanism of replication of similar brain states (neuronal configurations) (Ritt 1996: 31) would be an indirect one and not a direct one as with the replication of biological genes. This means then that the replication of that particular meme or complex of memes that caused the brain to be in that particular state can be completed when the infected brain assumes the same state of the meme host. This is tied of course to human physiology in the case of human languages having to do with speech production and perception (or visual processing in the case of signed languages). But causing a listener s brain to assume a particular brain state does not mean

[1] That does not mean that neurons (brain cells) can move around in a brain, but that the way they interact with each other, firing and networking is variable. (see Pinker, 1997 for more discussion).

[2] See Deacon (1997) for an interesting discussion on the co-evolution of brain and human language.

that the replication is successful and enduring. It has to offer an advantage to its new host in order for it to be stored in the brain for future use and future reconstitutions. But how is a child acquiring language capable of generating a complete grammar within only a few years of its life without having been exposed to all the memes of a meme pool? This is a question that the theory of universal grammar bypasses by claiming that some of the linguistic elements are actually genes specific to the genus Homo and its sole extant member. However an alternative solution to the paucity of the stimulus problem would be the hypothesis discussed also by Ritt (1996) that replication of linguistic memes is a bi-directional process so that children learn from adults and adults from children. The general cognitive development of children s brains reaches a point when it can generate its own random memes and then test them in an environment that seems to understand and like some of them and disfavor some others. Copying fidelity thus would be extremely low in a an experimenting brain but it would reach an equilibrium as it matures. By the very nature of the replication process a high rate of change is predicted but also a rapid spread of change as well. In biological replication, however, the medium is not unstable air waves or variegated photons but comparatively slow chemical reactions guaranteeing a higher degree of fidelity at the expense of slower rates of adaptation. With language and other meme based systems however, change is rapid with memes being selected for and against at high rates due to the inherent perturbed and unstable nature of its medium of transmission[3] This would explain why English has changed so much in a few hundred years but Englishmen so little in thousands of years. In the case of written languages though, this fluidity can be harnessed even paused in time. The language written in Linear A has no speakers, its memes are not replicating they are frozen in time. Latin memes are still around mainly through textbooks and in severely restricted locales in the environment such as school classrooms. And even written language replication is ripe with copying errors and quaint mutations especially before the advent of the press few hundred years ago. And they only had a couple of thousand years to mutate compared to geological epochs available to biological species around today.

To summarize this section, languages are aggregations of memes that have a direct effect on brain states and they have the potential of being mechanically replicated in a blind fashion every time a speaker alters the air pressure around her. The potential for successful replication is dependent upon the appeal that these sound waves would have to a recipient organism which by virtue of possessing a similar brain and speech/perception organs has automatic free access to them. If you do not have free access to a particular memome either you belong to a different species or you are doomed for extinction. Is that perhaps what happened to the Neanderthals?

3. Memetic variation in Greek: Do nasal+stop clusters make me happy or not?

In this last section I discuss a synchronic linguistic phenomenon in the standard dialect of Greek as spoken in the Athens area. In this dialect clusters such as /mp/ or /nt/ in a words like *kampos* field or *panteloni* pants are normally pronounced as /b/ and /d/, cf. (*ka~mpos>ka~mbos>ka~bos>kabos)* through a regular process of voicing assimilation and cluster simplification (Arvaniti & Joseph, 1998). What possible memes could be involved in a process like that? Here is hypothesized laundry list of memes involved in producing the word *kampos*.:

Some Greek memes: fieldness, flatness, velar closure, [low], labial closure, [round], [coronal], [continuant], [voice], noun, masculine, [lower your velum], singular,
[-mountainess], nominative, [stress], syntactic position, [previous word], phrasal intonation, [following word], silence, [background noise], [amplitude].

[3] Allowing for thousands of micro-mutations per millisecond.

This is by no means an extensive list of relevant memes every time a word is uttered but these should suffice for this example.[4] So every time a speaker says *kampos* these memes have to organize themselves in a neural configuration that would have as a result a particular manipulation of the speech organs that would produce some acoustic energy matching an acoustic template already preexisting in the meme pool of modern Greek. This neuronal configuration in sense is stored in the memomes of all native speakers of Greek. However every time the brain cells are organized in the *kampos* mode a feedback diode is activated as well. If by accident a meme such as [lower your velum] fails to activate a particular neuron at a particular instance of an utterance (which remember has to map onto a pre-existing multi-meme template) then a mutated acoustic signal will have been transmitted and at the same instance being subjected to automatic natural selection, first by its immediate environment within the neural configuration itself (is it compatible with it or is its inertness is fatal?) then with the rest of the brain (is it part of my working memotype or an alien intruder such as for example the sound of chocking?) and then after it has left its host body by the brains of the helpless bystanders that happen to have similar brains (excludes cats) and similar memotypes (excludes Berber speakers). So, if a speaker can get away with such a random error (communication is achieved leaving social status and other parameters unaffected) the feedback mechanism will tend to reinforce it capitalizing on its imitative attraction. Through an initial period or random variation a pattern might emerge, more people would be happy experimenting with such a pattern imitating and adopting it, a variation might stabilize and then perhaps decline in favor of one allele or another or continue to happily coexist in the brains of speakers always depending on the differential survival of self-replicating units.

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[4] Also traditional notation conventions in the linguistic literature are irrelevant here.

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