

Terrence Deacon on 'Language Origins: What Coevolved, What Devolved, and What's Universal'

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Preview

1. Coevolution of language and the brain
2. Shortcomings of natural selection
3. Relaxed selection
4. Language as a process of relaxed selection

Niche Construction

- * Wikipedia: “Process in which an organism alters its own (or other species’) environment, often but not always in a manner that increases its chances of survival.”
- * Adapting to an environment that you yourself created
- * Possibly as important as natural selection for evolution
- * Feedback loop – organisms ‘inherit’ a modified environment

Examples

- * Beavers – dams drastically alter their environment
- * Humans
 - * Yam cultivators in West Africa > cleared forests > standing water > mosquitos > malaria > sickle-cell alleles
 - * Language! – Specifically, ‘symbolic communication’

Coevolution

- * Selective pressure on language is much greater and faster than the selective pressure on the brain
- * Languages adapt to our uses for them
 - * More effective communication
 - * More efficient communication
 - * Evolution of syntactic complexity (Guy Deutscher)
 - * Evolution of morphological complexity (David Gil)

Language Acquisition

- * Language structures must be *child-friendly*
- * Language structures have evolved *specifically* to be learnable by humans
- * Languages are therefore inherently *learnable*
- * [Strongly suggests that there's no such thing as the poverty of the stimulus]

Evolving for Language

- * Old cognitive functions which had previously evolved for other purposes were recruited for language
 - * [Suggests that there isn't a specific 'language module' in the brain, and that language isn't autonomous]
- * Primate v. human brains
 - * Size doesn't matter (mice would be super intelligent)
 - * Proportional sizes of different brain areas does matter
- * Competitive process for neural connections
 - * Larger areas outcompete smaller ones

Vocalizations

- * Innate v. conscious – humans have both
 - * Innate – controlled by midbrain
 - * Conscious – controlled by cortex; transmit directly to motor cortex (bypassing the innate ones)
- * Dual vocalization channels
 - * Can interrupt each other (try to talk while sobbing)
- * Previously unrelated structures were recruited for language in a synergistic way

Natural Selection

- * Hard to explain extreme adaptations and complicated structures (e.g. a peacock's tail; language)
- * Natural Selection v. Sexual Selection
 - * The best traits for sexual selection are often the riskiest
 - * Only the luckiest survive to actually reproduce
- * *Descent of Man*
 - * Darwin was desperate to explain complexity
 - * $\frac{3}{4}$ of the book was spent on sexual selection

Synergistic Complexity Problem

- * Wallace – How did the psychological preference for sexual prestige evolve in the first place?
 - * Showed that Darwin's approach was a *reductio ad absurdum*
- * Sexual selection actually seems to drive different sexes apart physiologically
- * How do you select for this kind of incredible complexity?

Redistribution of Functions

- * When a species' behavior changes, a certain gene may no longer be useful
- * Pseudogene – the gene wanders in its function and accumulates noise
- * Previously, selective pressures would have prevented this gene from changing greatly

Example: Vitamin C

- * Almost all animals produce vitamin C on their own
- * Humans are a rare exception – why?
- * Our line actually did use to produce vitamin C
- * We started eating fruits like oranges – completely satisfied our need for vitamin C
- * The gene which produces vitamin C can now change, with no adverse effects on the population

Redistribution of Functions

- * With the gene changed, the species is now dependent on the new behavior!
- * Individuals must now compete for this new resource, which is always necessarily limited
- * A whole slew of cognitive functions and behaviors were put to task towards this goal – getting enough vitamin C
- * What used to rely on just one gene (the one producing vitamin C) now relies on dozens of different acquired behaviors, skills, and cognitive mechanisms
- * The task is now *distributed* over many areas of the brain

Example: Color Vision

- * Humans used to have color vision...
- * ...but then we lost it.
- * Then our gene for vision got duplicated!
- * One gene was allowed to vary, while the other continued its normal function
- * The new gene became a third type of color cone...
- * ...and we got our color vision back!

Relaxed Selection in Action: Songbirds

- * Species of songbird bred in captivity for about 250 years
- * Song no longer plays a role in who mates with who
- * Song is extremely phonologically complex
 - * Numerous subsongs which interact to form complex songs
- * Song is acquired from their parents, and combines features of each
- * *Must* learn their song from other individuals, or it's defective

Wild Songbirds

- * The non-domesticated counterpart to the captive birds, separated by 250 years of selective breeding
- * Can produce their song in isolation, even with no other individuals to learn it from
- * Highly redundant and boring phonology
- * Utilizes very different brain structures

Acquisition of Wild Birdsong

- * In wild birds, learning biases and singing biases interact and come to match each other over time
- * A bird's innate auditory biases select for its own subsongs
- * The process iterates until the bird's song matches its innate preference for what the song should be like
- * Self-organizing effect

Acquisition of Domesticated Birdsong

- * Degradation of natural selection – the innate song is no longer selected for, and the innate bias is lost
- * Now, the only thing driving acquisition is auditory experience (not innate biases)
- * The only auditory experience you have is what you hear from others
- * When the strong innate biases disappear, anything other bias can step in and take over
- * The individual offloads control of the sound structure to something else

Genetic Degradation Hypothesis

- * Domestication allowed the finches to have greater control over their birdsong
- * In domesticated birds, many genes become pseudogenes – species becomes genetically simpler
- * Other cognitive structures took over control of the birdsong acquisition process
- * Shift from genetic inheritance to epigenesis, learning, and social interaction
- * Note: Without some selective pressure, the birdsong will probably degrade and fade away entirely – niche construction plays a role here

Language!

- * Perfectly analogous to birdsong
- * Language is transmitted socially – no longer just genetically predisposed vocalizations
- * Previous prosodic systems that were used for calls were recruited for language
- * Recent research shows that language recruits areas all over the brain, not just Broca's and Wernicke's
- * This is precisely what we would expect from relaxed selection

Self-Domestication

- * Humans despecialized vocalizations, which then created specialized language systems
- * Niche creation – language then created selective pressures to keep language going

Innateness

- * Even if there were an innate language bias, it would necessarily degrade, just like the birdsong
- * There will still be ‘universals’ of language and highly predictable features, which evolve for a variety of reasons
- * Better to think in terms of *universal constraints*

Constraints on Language

- * Semiotic constraints
 - * Recursive structure
 - * Predication structure
 - * Quantification
 - * Predication embedding constraints
- * Processing constraints
- * Communication constraints
- * Sensorimotor schemas and phylogenetic biases

Man, the Degenerate Ape?

- * Are we a self-domesticated species – a degenerate ape?
- * We have a great deal of pseudogenes compared to other species
- * Previous paradigm: Natural selection drives evolution
- * New paradigm: *Relaxed* selection spurs evolution too
- * How many aspects of our behavior and environment have been released from selective pressures? (a lot!)

What relaxed selection?

- * Tool use! – Appears to be timed with rise of language
- * Required social cooperation
- * Required socially inherited knowledge

Economics of Tool Use

- * Tool use immediately increased our *production* – the first time in our evolutionary history this had ever happened
- * Relatively speaking, the productive output of our species jumped tremendously
- * This first-ever process of capital accumulation immediately relieved us of a great deal of selective pressure
- * Triggered a cultural and productive boom (Great Leap Forward), allowing for ever greater expansion of capital and production
- * This cumulative wealth relieved early man of most of their most pressingly felt selective pressures

The Evolving Human

- * Process is still ongoing – selective pressures are becoming less and less
- * We are now able to coopt many different regions of the brain to new tasks
- * The more regions of the brain we utilize for a task, the smarter we are (polyglots, polymaths, synesthesiacs, etc.)