

all these languages are written as well as spoken, most of them use an alphabet borrowed from another language





This map uses data from 'Ethnologue: Languages of the World', and shows the number of languages considered indigenous to each country that are still spoken there. Due to issues of language identification (see technical notes), it is possible to dispute the data used here, and a review of Ethnologue by Campbell and Grondona (2008) does just that; they claim "... the number of indigenous ('living') languages of different countries is inflated ...".However, the map presents a good picture of linguistic diversity. Papua New Guinea has nearly 10% (820) of the world's indigenous living languages, so that there are only an average of 7000 speakers per language living there. Indonesia (737), Nigeria (510), and India (415) also have a large number of native languages.At the other end of the scale, Belarus, Maldives, DPR Korea and Holy See each have only one indigenous living languages that are spoken there.



https://www.youtube.com/watch?v=I5f-5ty9Z_E&t=1s



Languages can be grouped into language families based on similarities and on shared linguistic ancestry.



Each of these languages is not anchored in biology, most human languages have likely already gone extinct, as they rely on the continuation of social learning and are stored in living societies (in absence of writing systems).



It has been estimated that ~43% of the world population is bilingual.

bei g bilingual affects white matter in the brain.





Note the higher granularity, more and smaller language groups in California, where until the arrival of the Spanish, there was no dominant group, no farming and no pottery!

Sign Languages



Sign languages are full-blown languages and offer amazing opportunities to learn about the nature of human language.



Most languages have no writing or other forms of notation.









Language may also serve as "multiplex" grooming, reaching more than one partner simultaneously



Chimpanzees in wooded savannah at Issa Valley in Western Tanzania grooming on a rock. Many mutual interactions.

Chimpanzees can spend over an hour a day grooming others.



Species-specific communication system

Human language evolves to make communication difficult! Human language is honest and costly signaling of group belonging" e.g. biblical shibboleth:



"Say now Shibboleth: and he said Sibboleth: for he could not frame to pronounce it right. Then they took him, and slew him at the passages of Jordan: and there fell at that time of the Ephraimites forty and two thousand." killed by Gileadites

The capacity to pronounce "sh" was a matter of life and death (in WWII the US GIs use lollapalooza to detect Japanese infiltrators.... "L/R")



Language accents can be a matter of life and death!

West Africa year 2000



Many Liberian refugees were killed in Côte d'Ivoire just because they had an English accent.

Language: cultural inheritance system

Rapid evolution (high mutation rate) Different rates Hybridization Horizontal gene flow *De novo* appearance Dominance effects Character Displacement (intentional shift to incomprehensibility).

Discontinuity Paradox

Human language appears qualitatively different from animal communication. Human language has to have come from somewhere evolutionarily.

Human language is an emerging function.

"How did we get from there to here?"

Levels of linguistic analysis

Phonetics – universal sound inventory properties (a, i, o, u, e, o, TH)
Phonology – principles of sound combination "sound structure" (*Pop-up*, *GHOTI*)
Morphology – principles of word formation (*absoff##in'lutely*)
Syntax – principles of phrase and clause formation (*The cat bit the bat*)
Semantics – lexical and propositional meaning (*white paper, wine, skin, noise, lie*)
Pragmatics – meaning in context (*social signs, body language, tone, context*)
Historical linguistics – discovering links between different languages.

example of semantics: meaning in the language itself. "I bought a car. It was expensive" example of pragmatics: the social rules you follow when talking to others. "meaning potential of an utterance".

Charles Hockett was an American Linguist and Anthropologist.



Charles Hockett









Charles Sanders Peirce was an American philosopher, logician, mathematician, and scientist who is sometimes known as "the father of pragmatism". He was educated as a chemist and employed as a scientist for 30 years. Today he is appreciated largely for his contributions to logic, mathematics, philosophy, scientific methodology, and semiotics, and for his founding of pragmatism. I wonder if he had agreed to viewing an animal track as a symbol, more likely an "index".



Arbitrariness
There is no relationship between the physical nature of the sign and nature of the reality to which it refers.
Example: alarm call systems



Cheney and Seyfarth pioneered work on monkey alarm calls in vervet monkeys



Vervet alarm calls: probably learned, e.g. leopard





Displaced reference It is possible to communicate about events removed in space and/or time from the immediate communicative situation. Example: honey bee waggle dance

















Chimpanzee males (here in the Taï Forest of Ivory Coast) regularly use large buttress roots for drumming. Such drumming can be heard ate distances of over 1 kilometer. Their drumming is often used to convince the group in which direction to move. It is in the infrasound range: under 20 kHz and thus not possible to record with a regular microfone.







Gibbons, the lesser apes of Southeast Asia and China all sing in pairs. There are 19 species of gibbons and 1 species of siamang. Their songs are not learnt but rather innate.







Guenons are a group of over 20 African monkey species, many with characteristic facial and body pigmentation patterns and active verbal communication among and between species.









Duality of patterning: Meaning from meaningless elements

These primitive elements have no intrinsic meaning in themselves, but combine in different ways to form other elements that do convey meaning.

putty-nosed monkey alarm calls (leopard call)^{$n \le 3$} + (eagle call)^{$n \le 4$} = [move farther]







Campbell's monkeys consistently combine call elements to vocalize in different contexts











Tree falls are regular events in tropical rain forests and when one of these giant trees falls, it makes a lot of noise, which prompts various animals to vocalize.

BOOM nonpredatory context social signal group cohesion





Use this link to explore more monkey vocalizations

http://www2.unine.ch/compcog/page-34654_en.html



Different species understand each other's alarm calls.

Diana females gave acoustically different alarm calls to different playback stimuli. Playbacks of eagle shrieks and Campbell's eagle alarm calls usually caused the Diana monkeys to give eagle alarm calls, some contact calls and a few alert calls, but no leopard alarm calls. Playbacks of leopards and Campbell's leopard alarm call, in contrast, usually caused the monkeys to give leopard alarm calls and a large number of alert calls, but no eagle alarm calls.



African elephant have an alarm specific for humans and honey bees.



African elephant have an alarm specific for humans and honey bees.



Bottle-nose dolphin use signature whistles. "Hi, I'm Bob" or are these names?

Vervet alarm calls: probably learned
Acoustics probably learned infants rarely produce alarm calls under 6 months when produced at 6 mos., similar to adult alarm calls
Usage probably learned at first, infants make "mistakes" but the mistakes are within category and caused by (a) inability to discriminate perceptually at a distance (b) fright or surprise at proximity of a non-predator

Vervet alarm calls: probably learned

Response probably learned 3- to 4-month-olds run to mother 4- to 6-month-old make mistakes over 6 months: respond like adults infants who look to an adult first respond more correctly than those who don't but mothers' responses to infants who respond incorrectly don't differ from responses to infants who respond correctly

Song learning in birds

All birds have a repertoire of 1-2 dozen innately produced calls These need not be learned – emerge also in birds hatched/reared in isolation More complex vocal patterns (e.g. **ritualized** courtship vocalizations) require a vocal learning period with input from (male) adults of the same species

White-crowned sparrows

Birds raised in isolation begin to experiment ("subsong") between 1-3 months ("sensitive period") By 3rd month, subsong crystallizes as schematic version of normal adult song Playing other species' songs to isolated birds has no effect on this schematic song If a bird hears its own species' song among others, it produces a "tolerable imitation"

Neuronal production, migration, and differentiation in a vocal control nucleus of adult female canary brain Goldman and Nottebohm (1983) **PNAS** Adult neurogenesis was (re)-discovered in the brain of adult female birds treated with testosterone, causing their brains to develop new circuits for song production.



Relaxed selection in domesticated song-birds leads to more complex song patterns.

Vocal learning in domesticated finches

longer vocal learning period than in wild type

Okanoya (2012)

more flexible learning under cross-fostering

Takahashi & Okanoya (2010) adults retain plasticity of juvenile vocal learning

Honda & Okanoya (1999), Woolley & Rubel (2002)

Basic language acquisition facts

Children raised in complete isolation do not acquire language, but do vocalize.

Deaf children in hearing families create home sign.

Children learn the language of their environment.

When the language of the environment is impoverished, children enrich and systematize it.







They're all either terrible at producing combinations or just can't/don't do it



Things to account for in human language "Over-complexity" (Saussure) ≈ redundancy Child innovations during the critical period Dedicated language areas in the brain Facial retraction & descent of larynx











Humans evolved a vocal tract that takes advantage of structures above the larynx as filter for the generation of a large number of vocal patterns.



Vocal anatomy and its phylogeny in anthropoids.

(A) The cycle of vocal fold vibration in wave fashion in humans.

- (B) Frontal section (gradation inversion, left) and a corresponding line drawing (middle) at the level of the dashed line on an excised and formalin-fixed larynx (right) in humans (courtesy of K. Sato).
- (C) Frontal MRI scan (left) and a corresponding line drawing (middle) at the level of the dashed line on vocal anatomy reconstructed from MRI scans (right) for a chimpanzee, Pan troglodytes. Blue indicates the underlying arytenoid cartilage and green the thyroarytenoid muscle.
- (D) Variation and phylogeny of the vocal membrane and
- (E) (E to M) MRI–CT frontal scans in the species labeled on (D). Transverse scale bar, 5 mm; vertical scale bar, 2.5 mm. Key: ab, body of the arytenoid cartilage; s, sulcus; ta, thyroarytenoid muscle; vef, ventricular fold; vf, vocal fold; vm, vocal membrane; and vp, vocal process of the arytenoid cartilage. The asterisk (*) indicates a posterior commissure of the vocal membrane and fold.

Was descent an adaptation for size exaggeration?

Would this confer that much of a selective advantage in a group of cohabiting, conspecific primate males?

Are there documented cases of male chimps gaining ascendency in the dominance hierarchy based on vocalization alone (rather than for example on charging displays)?



Chimpanzee Mike with empty cans at Gombe



Some researchers are suggesting that the descent of the larynx initially was caused by size exaggeration, favored by sexual selection....

However, human language is remarkably diametrically anchored in females and males, if anything, females outperform males in many language related aspects.

Human males have deeper voices, which represents a strong link between biological sex and spoken language, but is no indication that language was driven by the need of males to appear larger.





Air sacs disappear in late Homo

Late Homo lacks a bulla Homo heidelibergensis Homo neanderthalensis Homo sapiens points to loss between 3.3 MYA and 500 KYA



Experiments with learning of stone tool technology provide strong indication that in modern humans, teaching that combines demonstration and language is the most effective way to learn.



Performance across conditions and along chains. Values shown are the median model estimates and the corresponding 95% central credible intervals. More complex forms of communication, in particular verbal teaching, increased several measures of participant performance, including (a) the total quality of all flakes, (b) the number of viable flakes, (c) the proportion of flakes that were viable, (d) the rate at which viable flakes were made, (e) the proportion of the core knapped and (f) the probability that each hit resulted in a viable flake. The brackets marked with double asterisks indicate contrasts for which there is strong evidence of a difference (95% credible interval excluding 0), single asterisks indicate coses for which there is weak evidence of a difference (90% credible interval excluding 0). The red bracket in c indicates that the increase in performance from imitation/emulation to basic teaching is greater than the increase between all other adjacent conditions (g,h) Although verbal and gestural teaching increased the probability of a viable flake per hit and the proportion of flakes that were viable, performance did not decline along chains such that across conditions performance was similar by position 5. With reverse engineering, performance did not decline along chains, suggesting it was already at floor levels. Position 1 corresponds to the first participant, not the trained experimenter. (i) With verbal teaching, both the total number of utterances (left hand bars) and the probability a teaching utterance was correct (right hand bars) decreased along chains. Key: reverse engineering: blue (n ¼ 37), imitation/emulation: green (n ¼ 34), basic teaching; yellow (n ¼ 38), gestural teaching; orange (n ¼ 37), verbal teaching; red (n ¼ 38).



Apes use gestures such as during display or begging for food or sexual access, but famously do not "get" pointing.



Animal ritual behavior as key syntactic exaptation for language?



Animal ritual behavior as key syntactic exaptation for language?

Western Grebe nuptial dance at Lake Klamath, Oregon: fixed sequence of ritualized behavior in the context of courtship or competition for mates. Syntactic?

Summary

Language appears to be unique to humans: most enigmatic and diagnostic feature!!!! Many animal species have complex communication but seem to lack the generative grammar/productivity of human language. Language capacity transcends modality: vocal or signed

Exposure is critical for proper acquisition.

Many genetic and developmental factors can negatively affect language acquisition.

The capacity for language acquisition varies across life span

Language acquisition can shape the brain (e.g. bilingual and multilingual individuals).

Language is a human specific culturally transmitted inheritance system.

Language is a costly and honest signal of group membership.

Language is 100 ky to 2 my old.

Human vocal tract and brain anatomy have adapted with language.



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Was descent an adaptation for size exaggeration?

Homo sapiens is the only primates with a retracted lower face an acute basicranial angle a brain too big for the body size a descended laynx Is the latter really unrelated to the other three?

Fitch (2010:328)

"This raises the possibility that the original function of the descended larynx in early hominids might have been size exaggeration rather than speech: that the descended larynx was actually a preadaptation, later exapted into the complex articulation system we use today in spoken language.

Does this mean that, today, the descended larynx is not an adaptation for speech? Of course not. The size exaggeration and speech-specific hypotheses are independent and mutually compatible... Size exaggeration...might plausibly have provided a precondition for the descent of the larynx, but it cannot account for the vocal tract reconfiguration seen in human infants at age three months...."

Was vocal learning an adaptation for speech?

Claim: sexual selection for more varied, complex vocalization may have driven vocal learning

- females of several songbird species prefer males with larger vocal repertoires and more complex songs female whales are known to prefer novel male songs
- this could be a general adaptation exapted for speech
- Claim: selective pressure for identification of group members in highly social species cetaceans are known to use group identification signals
- could also be a general adaptation exapted for speech

The human story

Did humans self-domesticate?

If so, does this play a role in

changes in the human skull (cf. silver foxes)?

globularity

facial retraction (leading to an acute basicranium)

the emergence of a vocal learning period and complex communication (cf. society finches)?

Several aspects of human biology appear similar to those in domesticated species (with notable exception of the larger brain!!).

Transmission

While the system may have a biological component, it requires environmental (cultural) input to manifest.

honeybees white-crowned sparrows vervet monkey infants





In the wild, parrots only make species-specific vocalizations (>100 different ones) and are given names by their parents.







Lieberman et al. (2002)

Variables that influence the relative spatial position of the face, cranial base, and neurocranium: increased flexion of the cranial base longer anterior cranial base length shorter face (anteroposterior length) increased temporal and/or frontal lobe size "...increases in relative temporal and frontal lobe size probably cause relative elongation of the anterior cranial base in AMHS, and may also underlie increased basicranial flexion." (p. 1139)

Whistled Turkish



https://www.youtube.com/watch?v=SjcVLLdPCoU



Different dimensions of the debate

Discontinuity vs. continuity Nativism vs. neo-empiricism/emergentism Domain specificity vs. domain generality Saltation vs. gradualism (Macro)mutation vs. exaptation Cognition vs. communication

Discontinuity vs. Continuity

Discontinuity

Human language abilities are qualitatively different and therefore discontinuous from those of other species.

Continuity

The qualitative differences found in human language abilities are based on a long accumulation of quantitative differences.

Nativism vs. neo-empiricism

Nativism

Humans are born with a genetically and neurally determined blueprint for language (emphasis on "nature").

Neo-empiricism/emergentism

Language arises through a complex interaction of genetics and environment (emphasis on "nature" + "nurture").

Domain specificity vs. generality

Domain specificity

Principles of language apply <u>only</u> within the linguistic domain, and not to other cognitive systems (vision, attention, memory, motor control, etc.).

Domain generality (general cognition)

The principles that govern language (or analogs thereof) apply across cognitive domains.