Language evolution: the earliest words and sentences

Gabrić, Petar

Philipps Universität Marburg

LANGUAGE EVOLUTION: THE EARLIEST WORDS AND SENTENCES

Petar Gabrić

Philipps-Universität Marburg

OUTLINE

1. DEFINING THE KEY TERMS
    a. evolution, language, language evolution
    b. exaptation, embodiment
2. A GRADUAL ACCOUNT OF SPOKEN LANGUAGE ORIGINS
    a. the protolanguage hypothesis and the like
    b. concepts (semantics)
    c. one-word stage
    d. two words, three words...
3. Conclusions

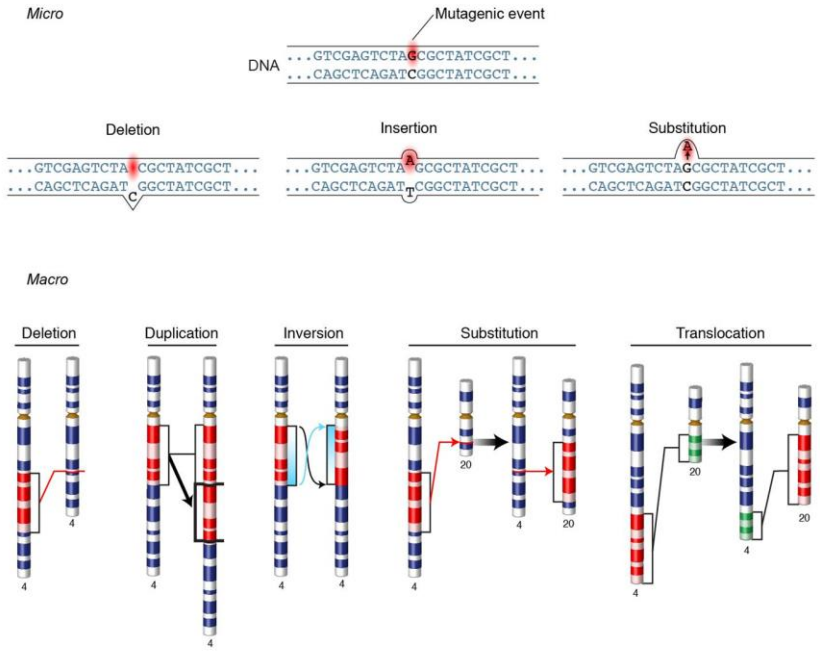
1. Defining key terms
EVOLUTION (1)

microevolution and macroevolution

mutations = source of genetic variation

natural selection,
genetic drift,
gene flow,
etc.

Genome.gov



1. Defining key terms
EVOLUTION (2)

Wikipedia

Palaeoanthropology and archaeology
- fossils, DNA, artefacts

Limitations:
- small „samples”,
- current fossil and artefact records are not representative,
- limitatio
- etc.

1. Defining key terms
EVOLUTION (3)

LETTER

https://doi.org/10.1038/s41586-018-0299-4

Hominin occupation of the Chinese Loess Plateau since about 2.1 million years ago

Zhaoyu Zhu[1,2]*, Robin Dennell[3]*, Weiwen Huang[2,4], Yi Wu[5], Shifan Qiu[6], Shixia Yang[4,7], Zhiguo Rao[8], Yamei Hou[2,4], Jiubing Xie[9], Jiangwei Han[10] & Tingping Ouyang[1,11]

Proceedings of the Geologists' Association 128 (2017) 697–710

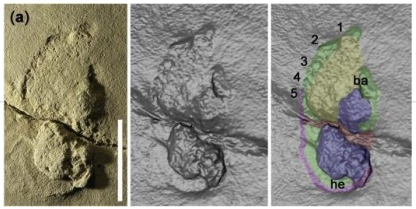
Contents lists available at ScienceDirect

Proceedings of the Geologists' Association

journal homepage: www.elsevier.com/locate/pgeola

Possible hominin footprints from the late Miocene (c. 5.7 Ma) of Crete?

Gerard D. Gierliński[a,c,j], Grzegorz Niedźwiedzki[b], Martin G. Lockley[c,d], Athanassios Athanassiou[e], Charalampos Fassoulas[f], Zofia Dubicka[g], Andrzej Boczarowski[c,h,i,j], Matthew R. Bennett[k], Per Erik Ahlberg[b,*]



PALEOANTHROPOLOGY

U-Th dating of carbonate crusts reveals Neandertal origin of Iberian cave art

D. L. Hoffmann,[1]* C. D. Standish,[2]* M. García-Diez,[3] P. B. Pettitt,[4] J. A. Milton,[5] J. Zilhão,[6,7,8] J. J. Alcolea-González,[9] P. Cantalejo-Duarte,[10] H. Collado,[11] R. de Balbín,[9] M. Lorblanchet,[12] J. Ramos-Muñoz,[13] G.-Ch. Weniger,[14,15] A. W. G. Pike[2]†

Philipps Universität Marburg

1. Defining key terms
EVOLUTION (4)

SUPERFAMILY	FAMILY	GENUS
Hominoidea	*Hylobatidae*	*Hylobates*
	Pongidae	*Pan* *Gorilla* *Pongo*
	Hominidae	*Homo*

SUPERFAMILY	FAMILY	SUBFAMILY	TRIBE	GENUS
Hominoidea	*Hylobatidae*			*Hylobates*
	Pongidae	*Ponginae*		*Pongo*
	Hominidae	*Gorillinae*	*Gorillini*	*Gorilla*
		Homininae	*Panini*	*Pan*
			Hominini	*Homo*

1. Defining key terms
EVOLUTION (4)

SUPERFAMILY	FAMILY	SUBFAMILY	TRIBE	SUBTRIBE	GENUS
Hominoidea	*Hylobatidae*				*Hylobates*
	Pongidae	*Ponginae*			*Pongo*
	Hominidae	*Homininae*	*Gorillini*		*Gorilla*
			Hominini	*Panina*	*Pan*
				Hominina	*Homo*

SUPERFAMILY	FAMILY	SUBFAMILY	TRIBE	GENUS
Hominoidea	*Hylobatidae*			*Hylobates*
	Pongidae	*Ponginae*		*Pongo*
	Hominidae	*Gorillinae*	*Gorillini*	*Gorilla*
		Homininae	*Panini*	*Pan*
			Hominini	*Homo*

The Evolution of the Book in Medieval and Renaissance Society

Search ...

TOP STORIES

The Instagram evolution of Angela Merkel

German Chancellor Angela Merkel joined Instagram just a week ago, and already, she's getting spammed and attacked by Russian trolls. DW's social media team charts the chancellor's week-long Instagram crash course.

S1.E13 - Steven Spielberg (2020)

Documentary

The Evolution of Steven Spielberg

Steven Spielberg was famously rejected from his top choice of film school but has gone on to become one of the most influential directors of all time. IMDb takes an in-depth look at

AAAS Become a Member

Science Contents News Careers Journals

How the English language has evolved like a living creature

1

By Michael Erard | Nov. 1, 2017 , 5:25 PM

Philipps Universität Marburg

1. Defining key terms
LANGUAGE (1)

= part of humans' communication system not evidenced in other known living beings

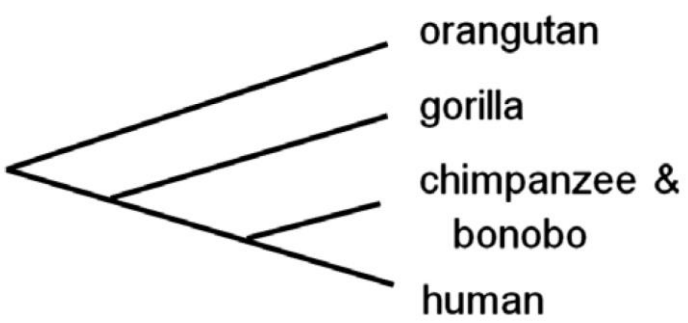
concepts – semantic memory
words (phrases) – lexicalization
syntax
sentences – compositional (syntactic) semantics
utterances
productivity

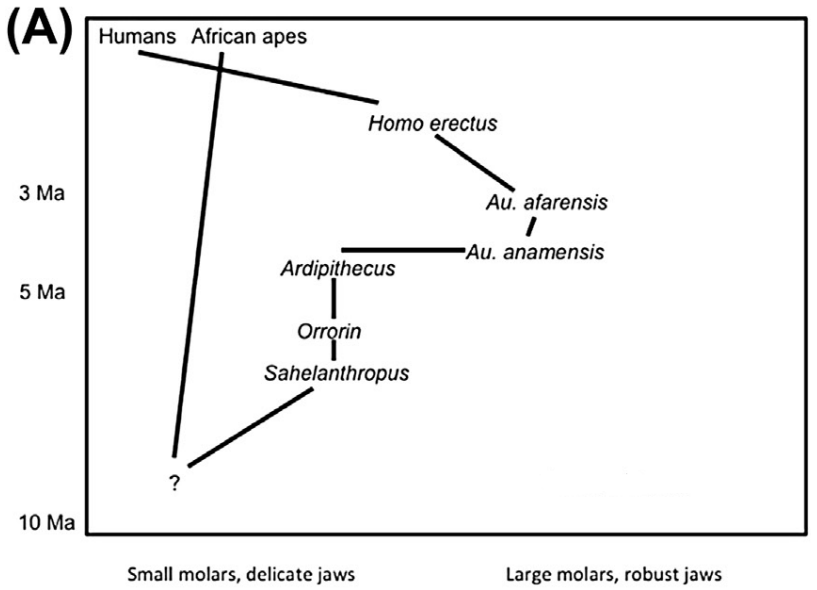
Language is, of course, grounded upon many more notions.

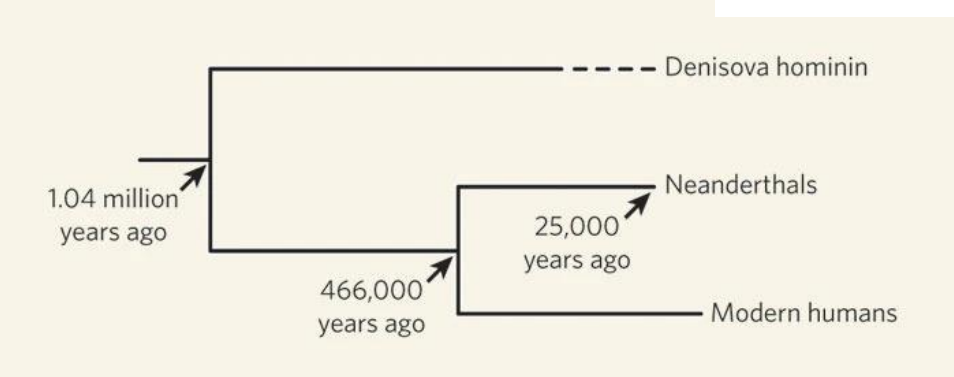
1. Defining key terms
LANGUAGE EVOLUTION (1)

- Historical linguistics is time-limited.
- Humans are the only known living beings possessing language.
- In normal circumstances, all humans acquire at least one language before a certain developmental phase and the language is (primarily) spoken.
  - Language has emerged no later than the *Homo sapiens* speciation, but not before the split between humans and chimpanzees.
  - If language did not emerge as a „package", it is plausible that some linguistic capacity might have been extant in the last common ancestor of humans and neanderthals.

1. Defining key terms
LANGUAGE EVOLUTION (2)

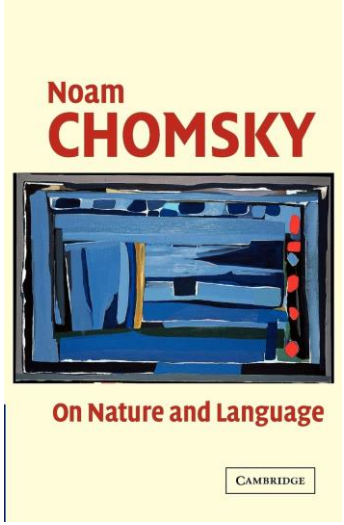




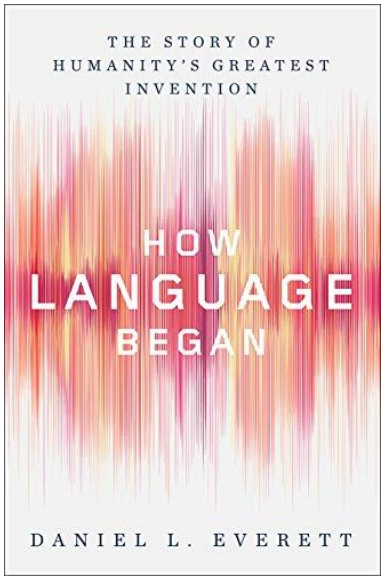


Groves, C. P. (2018). The latest thinking about the taxonomy of great apes. International Zoo Yearbook, 52(1), 16–24.
Brown (2010). Stranger from Siberia. Nature 464, 838–9.

1. Defining key terms
LANGUAGE EVOLUTION (3)



- Mutations and culture
- N. Chomsky: a „mutation-based" account of language evolution
- D. Everett: cumulative culture



1. Defining key terms
EXAPTATION (1)

- **Exaptation** = the process of the emergence of structures and/or functions from pre-existing structures and/or functions

Anatomy

Bird feathers

Heat regulation, display, flight

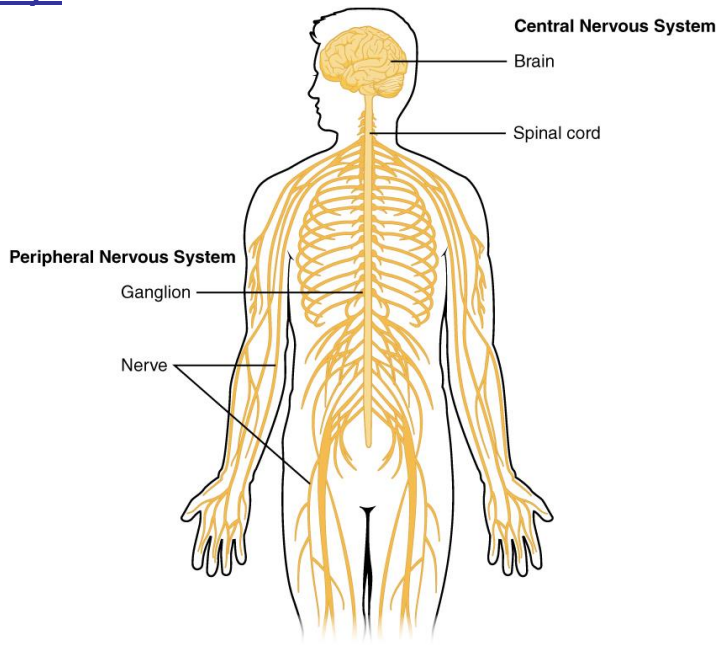
Behavior

Mouth licking in wolves and domestic dogs

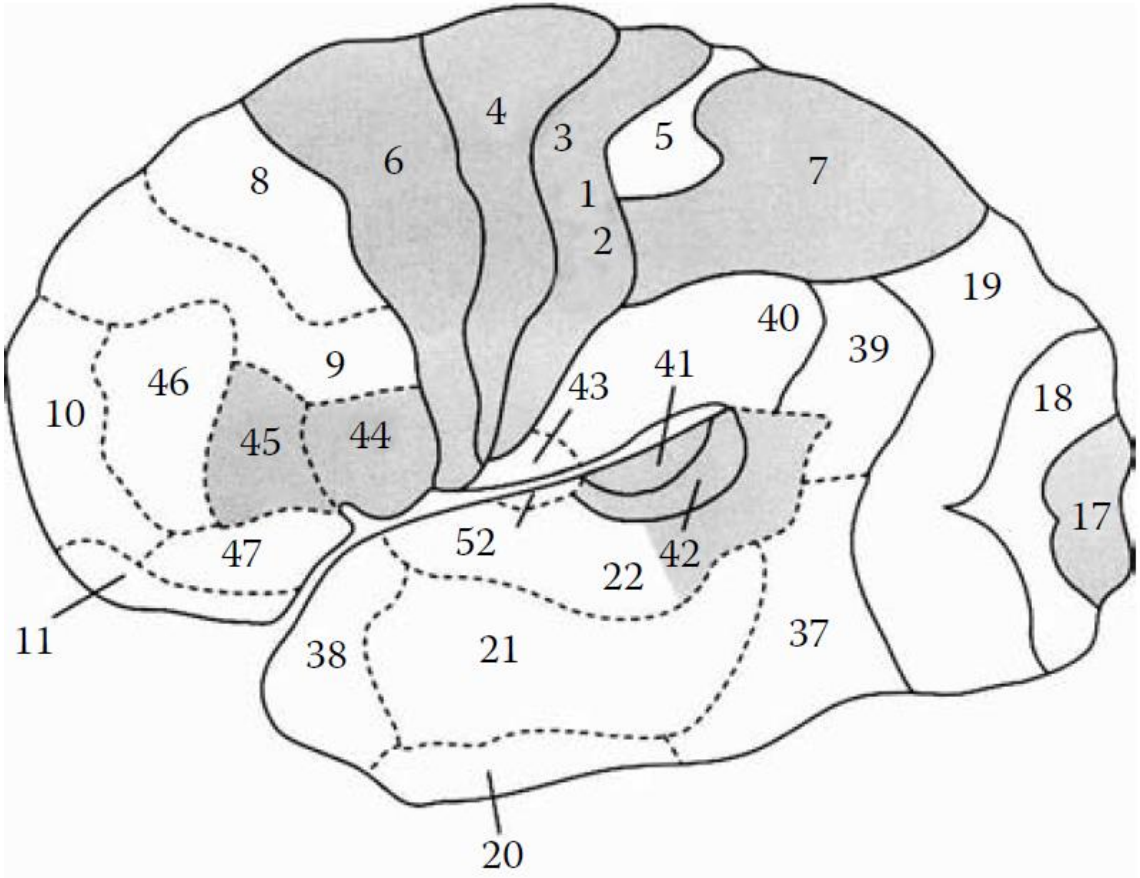
Begging for food, signal for submissiveness

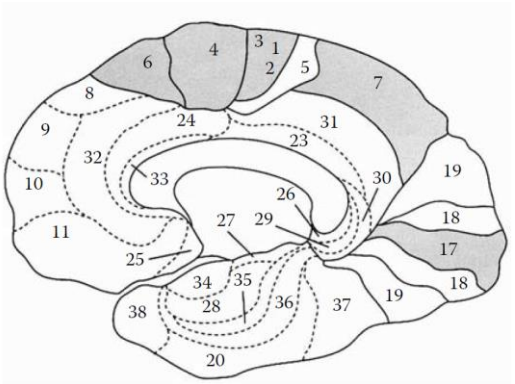
1. Defining key terms
EXAPTATION (2)

- In the context of speech and language evolution, we are talking about the exaptation from pre-existing cognitive functions (and brain structures).



1. Defining key terms
EXAPTATION (3)





Mildner (2015). The Cognitive Neuroscience of Human Communication. Psychology Press.

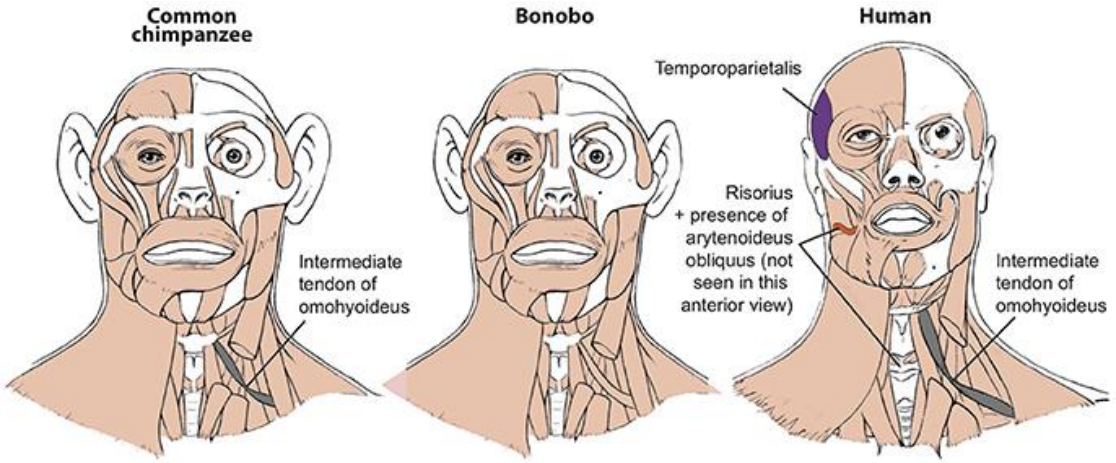
1. Defining key terms
EXAPTATION (4)

- Motor brain areas are involved in speech production via activation of motor plans and muscle articulators, as well as movement coordination.

- Motor areas are also probably involved in speech perception (e.g. the motor theory of speech perception).

1. Defining key terms
EXAPTATION (5)

- continuity



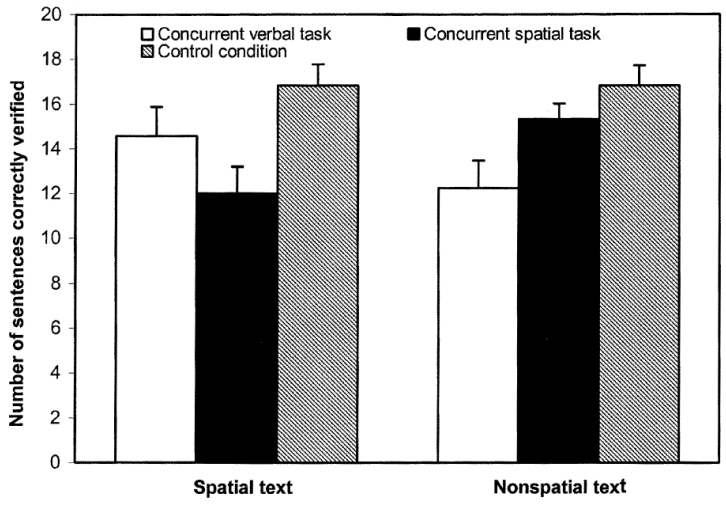
R. (2018). First detailed anatomical study of bonobos reveals intra-specific variations and exposes just-so stories of human evolution, bipedalism, and tool use. Frontiers in Ecology and Evolution, 6, 53

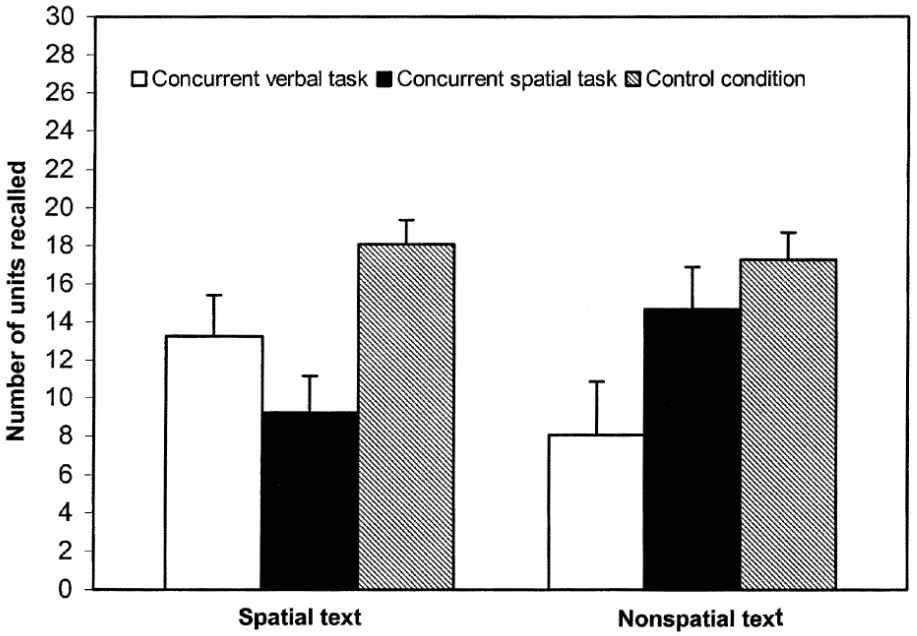
1. Defining key terms
EXAPTATION (6)

- Concerning language evolution, most likely candidates for exaptation are:
  - 1. sensorimotor processing (including visuospatial processing)
  - 2. declarative and procedural memory
  - 3. executive functioning and general working memory

1. Defining key terms
EXAPTATION (7)

- De Beni et al. (2005): role of verbal and visuospatial working memory in text comprehension
  - Listening of „spatial" and „non-spatial" texts with concurrent cognitive tasks

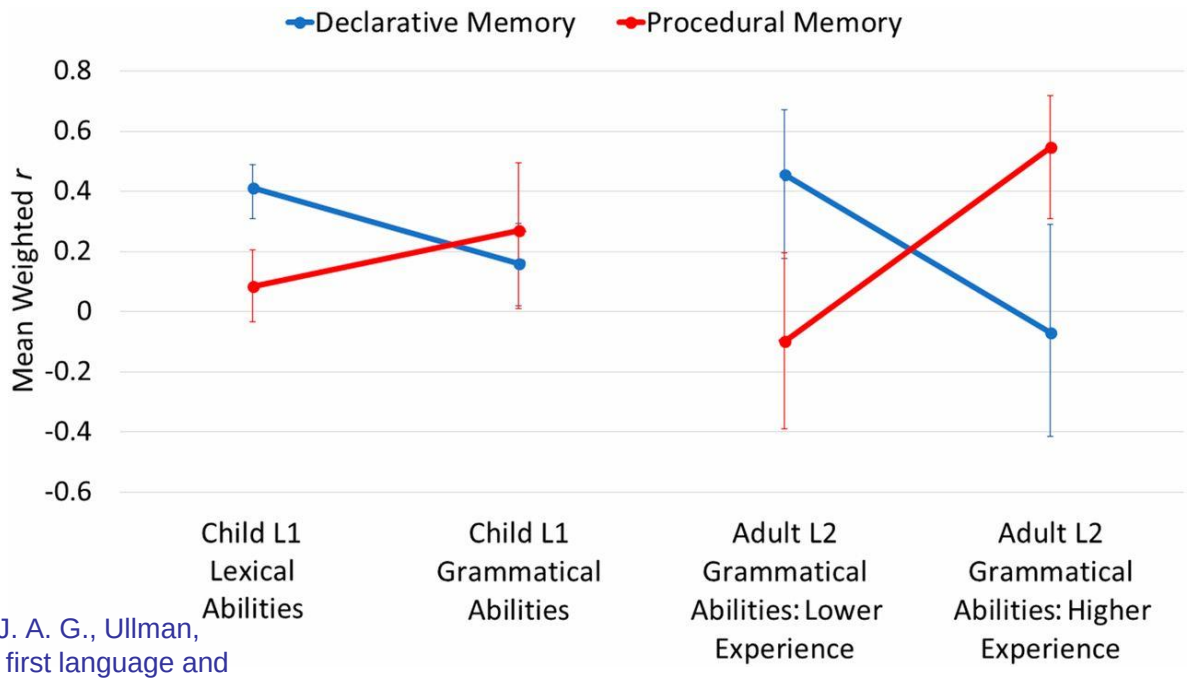




De Beni, R., Pazzaglia, F., Gyselinck, V., Meneghetti, C. (2005). Visuospatial working memory and mental representation of spatial descriptions. European Journal of Cognitive Psychology, 17(1), 77–95.

1. Defining key terms
EXAPTATION (8)

- Hamrick et al. (2018): procedural and declarative memory



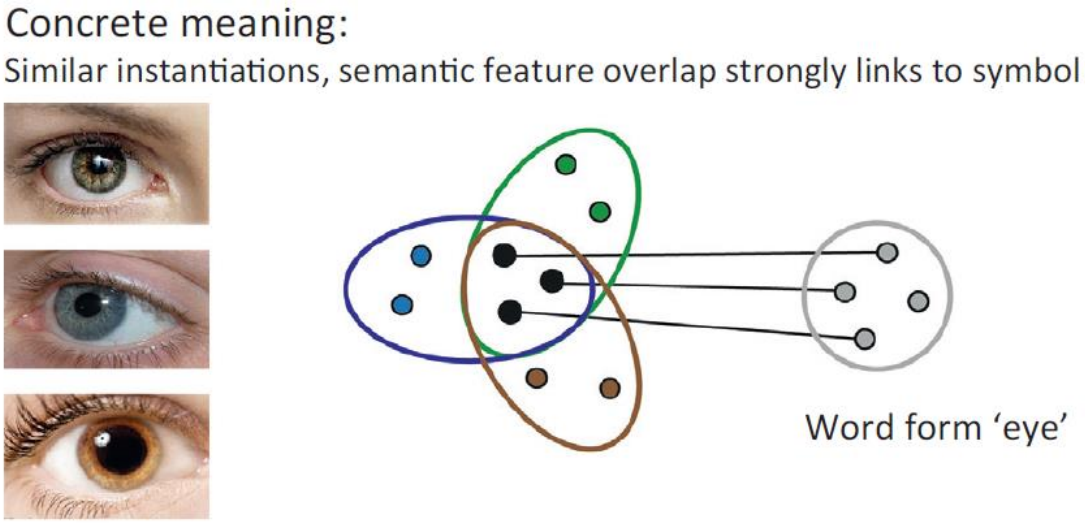
Hamrick, P., Lum, J. A. G., Ullman, M. T. (2018). Child first language and adult second language are both tied to general-purpose learning systems. Proceedings of the National Academy of Sciences of the United States of America, 115(7), 1487–1492.

1. Defining key terms
EMBODIMENT (1)

- Embodiment
- Modular theories

1. Defining key terms
EMBODIMENT (2)

- Concept modality vs. amodality



Pulvermüller, F. (2013). How neurons make meaning: brain mechanisms for embodied and abstract-symbolic semantics. Trends in Cognitive Sciences, 17(9), 458–70.

1. Defining key terms
EMBODIMENT (3)

- Concreteness and abstractness are not categorical, but gradual measures.
- Compared to abstract words, concrete words are
  - recognized faster,
  - recalled faster and more accurately,
  - used more often,
  - shorter,
  - etc.

- Cognitive Linguistics: abstract semantics arises from concrete semantics via mechanisms of metaphor and image schemas

1. Defining key terms
EMBODIMENT (4)

1	Prefixation is ten times more likely to occur in abstract nouns.
2	Suffixation is four times more likely to occur in abstract nouns.
3	Abstract nouns show higher rates of consonant clustering.
4	Abstract nouns are longer both in total syllables and in phonemes.
5	Compounding (e.g., *bulldog*) is twice as likely to occur in concrete nouns.
6	Concrete nouns are most commonly monomorphemic.
7	Concrete nouns typically hold first syllable stress.
8	Abstract nouns show more variable syllable stress patterns and are more likely to carry non-initial stress as word length increases.
9	Etymologies of concrete and abstract nouns differ significantly. Abstract nouns are most often derived from Latinate. Concrete nouns are more frequently of Germanic origin.
10	Abstract nouns have fewer similar-sounding neighbors (i.e., sparse phonological and orthographic neighborhood density).

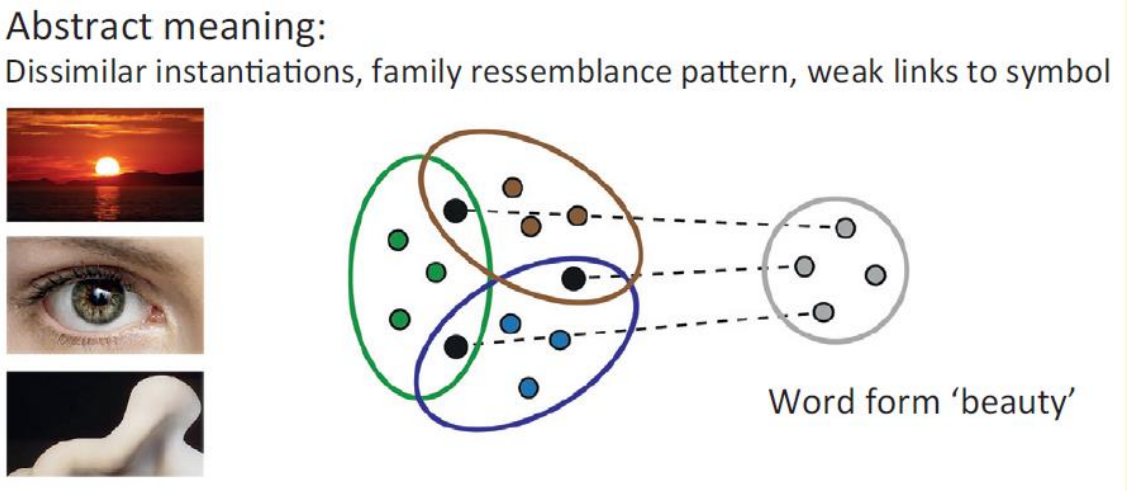
doi:10.1371/journal.pone.0042286.t001

- abstract words appear to be cognitively more demanding and more linguistically marked than concrete words from a number of aspects

Arbitrary Symbolism in Natural Language Revisited: When Word Forms Carry Meaning. PLOS ONE 7(8): e42286.

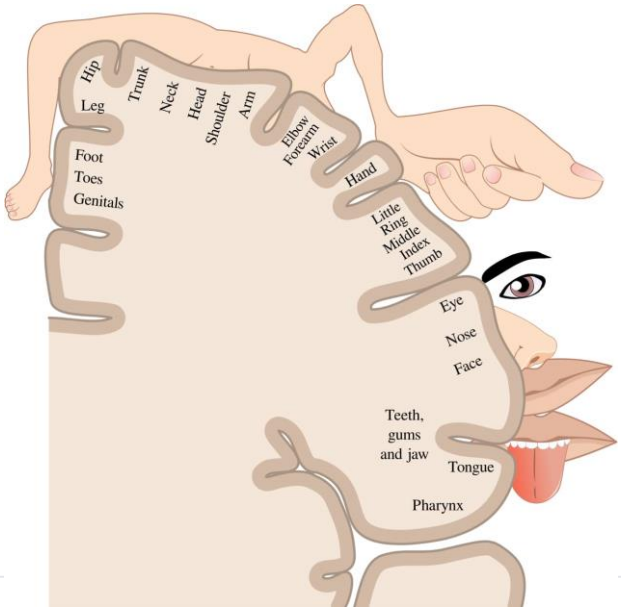
1. Defining key terms
EMBODIMENT (5)

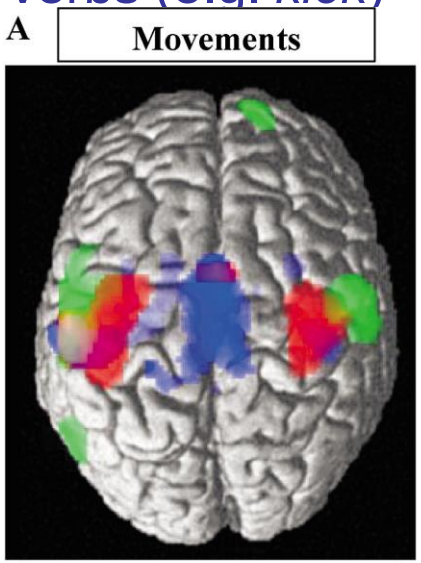
- Concrete words are processed bilaterally with a „modest leftward asymmetry", while abstract words appear to be left-lateralized (Binder et al. 2005; Mildner 2015: 199).

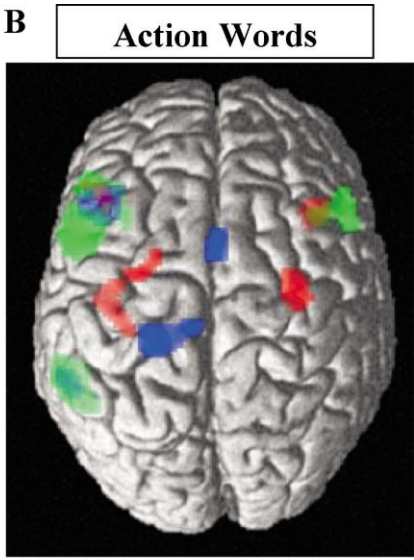


1. Defining key terms
EMBODIMENT (6)

- Neurophysiological studies show somatotopic activation of words related to face/mouth, hand/arm and foot actions.
- Hauk et al. (2004, *Neuron* 41(2)): fMRI, silent reading of face (e.g. *lick*), hand (e.g. *pick*) and foot action verbs (e.g. *kick*)

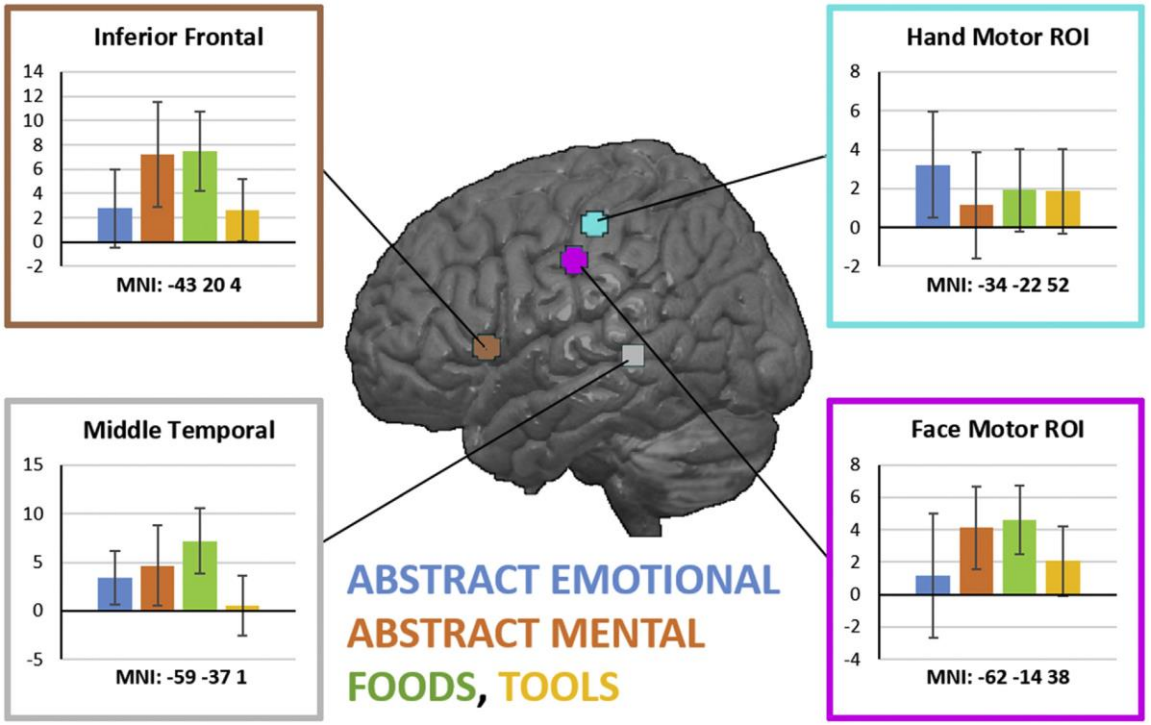






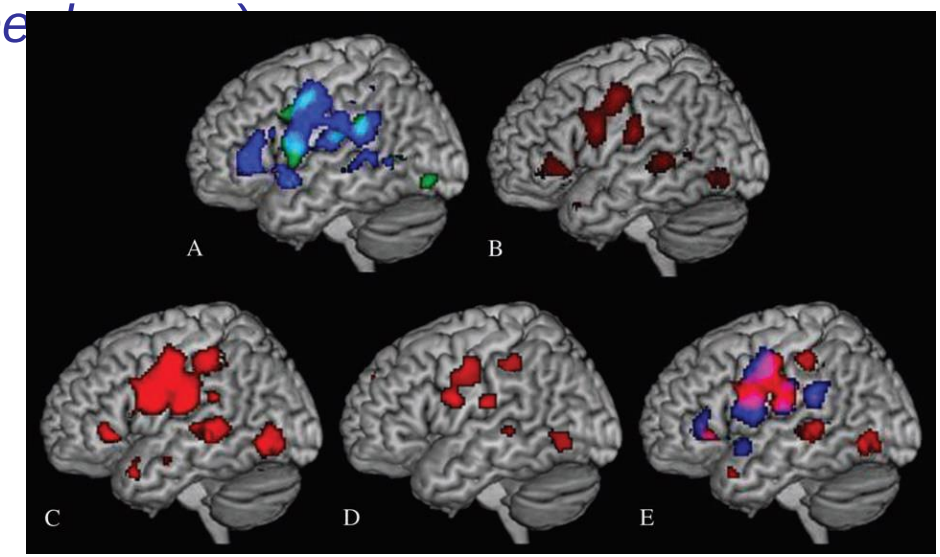
1. Defining key terms
EMBODIMENT (7)

- Dreyer & Pulvermüller (2018, *Cortex* 100): fMRI, passive reading of four different semantic noun types



1. Defining key terms
EMBODIMENT (8)

- Abstract words are also relatively embodied, namely in motor and emotional brain regions.
- Moseley et al. (2012, *Cerebral Cortex* 22): fMRI, passive listening of emotional (e.g. *dread*, *spite*), face (e.g. *gnaw*, *chew*) and hand verbs (e.g. *pe*



1. Defining key terms
EMBODIMENT (9)

- As semantic processing, syntactic processing is also associated with distributed neural activation in the frontotemporoparietal areas.
  - left-hemispheric middle and superior temporal, inferior-posterior parietal, as well as inferior frontal brain regions
  - left-hemispheric lateral premotor cortex, sometimes extending more posteriorly into the primary motor area and more anteriorly into the middle frontal gyrus
  - „The involvement of the motor system in sentence processing is not only due to phonological and articulatory mapping […] because it also provides a grounding node for certain kinds of conceptual-semantic information.” (Ghio & Tettamanti 2016: 647)

1. Defining key terms
EMBODIMENT (10)

- Synchronic embodiment can suggest phylogenetic exaptation (Occam's razor).

- The alternative, modular, hypothesis is problematic:
  - It would imply that there were two phases of language evolution (language emergence and language embodiment).
  - It would imply that there was a significant brain reorganization in the wake of various genetic mutations.
  - It doesn't explain why some linguistic phenomena are more embodied than others.
  - It is unclear how a modular language system would have functioned.

2. Gradual evolution of language PROTOLANGUAGE (1)

- Bickerton (1990): „protolanguage” and „language fossils”
- Protolanguage is compatible with gradualism.
- „In syntax one can define living fossils as constructions which exhibit rudimentary syntax/semantics, not accounted for by the principles of modern (morpho)syntax, but which nonetheless show some continuity with it.” (Progovac 2016: 3)
- Language fossils are not adequately defined.
- The methodologies in these studies are primarily introspective, and are further problematic and non-transparent.

2. Gradual evolution of language PROTOLANGUAGE (2)

- Language fossils:
  - language-taught captive apes
  - children under the age of two
  - feral children
  - pidgins
  - Riau Indonesian
  - Pirahã
  - spontaneously emerging sign languages
  - Contemporary languages contain „living fossil” structures in their lexicons.

2. Gradual evolution of language PROTOLANGUAGE (3)

- Jackendoff & Wittenberg (2014): „[W]e are adopting the unfamiliar and sometimes painful methodology of assuming as little syntactic structure as possible."

a. **One-word grammar**

[$_{\text{Utterance}}$ Word] [*Traditional notation*: Utterance → Word]

b. **Two-word grammar**

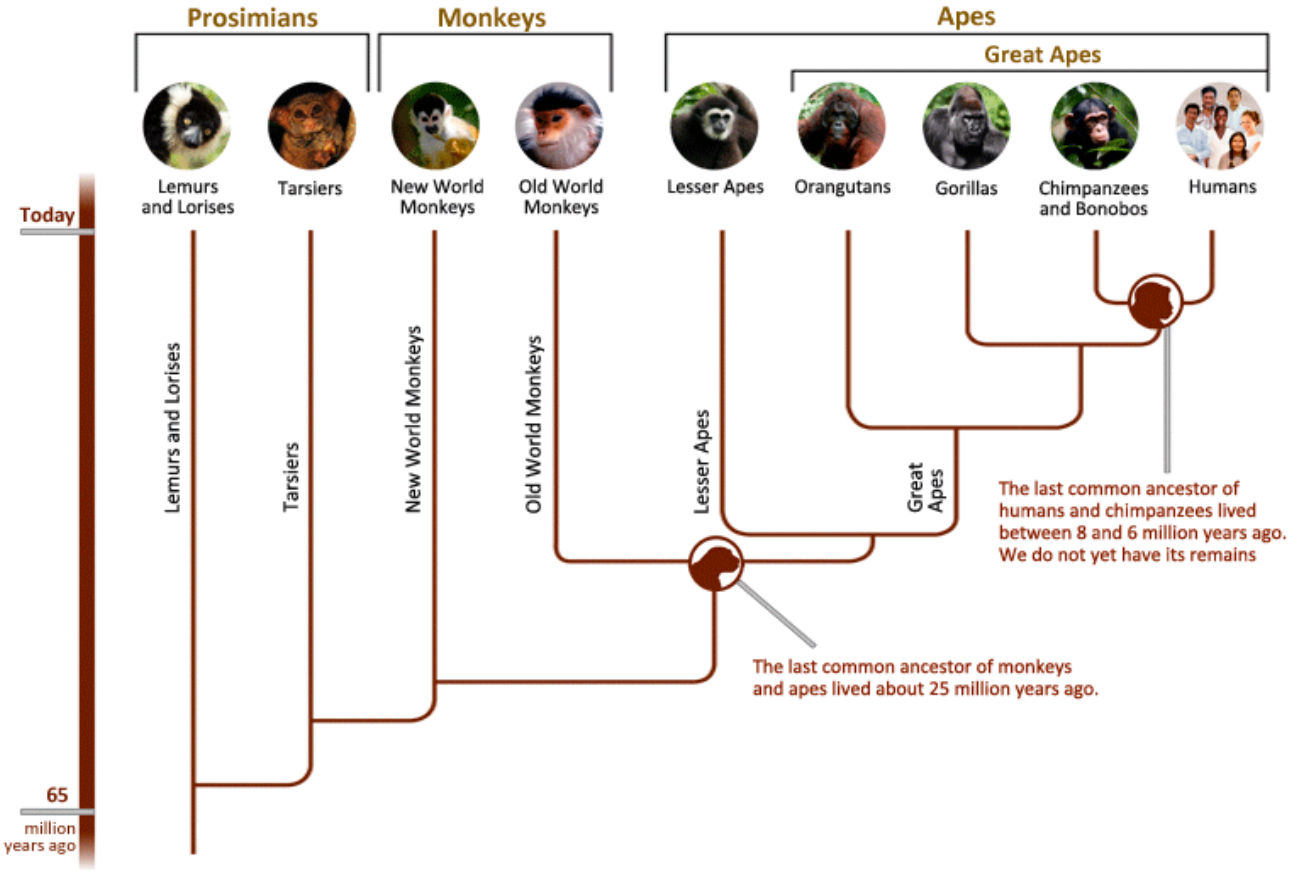
[$_{\text{Utterance}}$ Word (Word)] [Utterance → Word (Word)]

c. **Concatenation grammar**

[$_{\text{Utterance}}$ Word*] [Utterance → Word*]

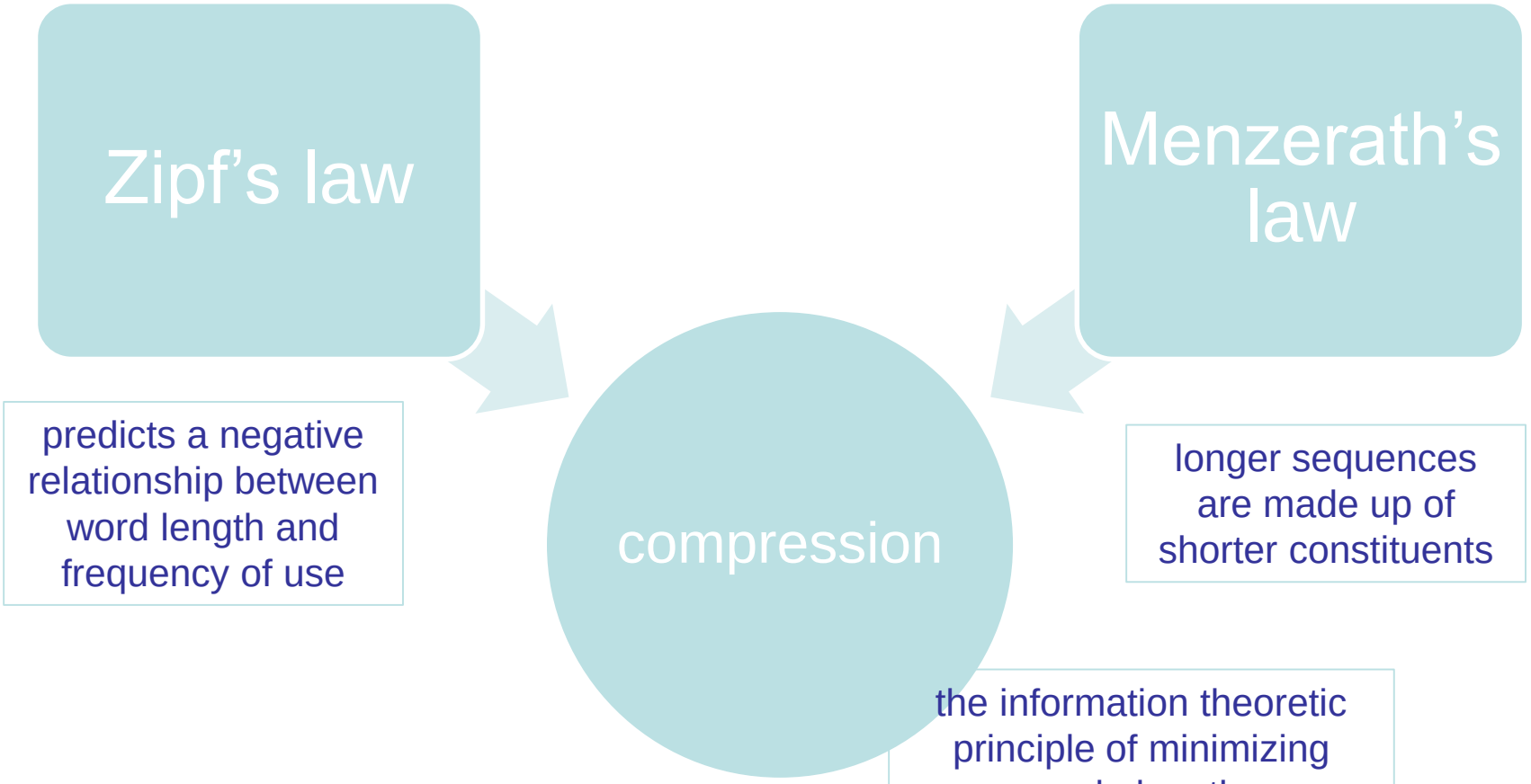
2. Gradual evolution of language CONTINUITY (1)

- Continuity vs. discontinuity



Smithsonian Institution

2. Gradual evolution of language CONTINUITY (2)



2. Gradual evolution of language
CONTINUITY (3)

- Language is unique.

- Absence of evidence about the existence of a particular phenomenon in a sample doesn't imply nonexistence of the phenomenon in the sample, let alone nature (!).
- The available data on animal behavior doesn't straightforwardly show that animal communication lacks productivity.
- It is not clear why qualitative/quantitative differences between language and animal communication systems should be taken as arguments for discontinuity.

2. Gradual evolution of language
CONTINUITY (4)

- Language is phylogenetically independent on animal communication systems because language is „unique”, and language is „unique” because it appears sure to the naked linguist’s eye that language has certain features which are lacking in animal communication systems.

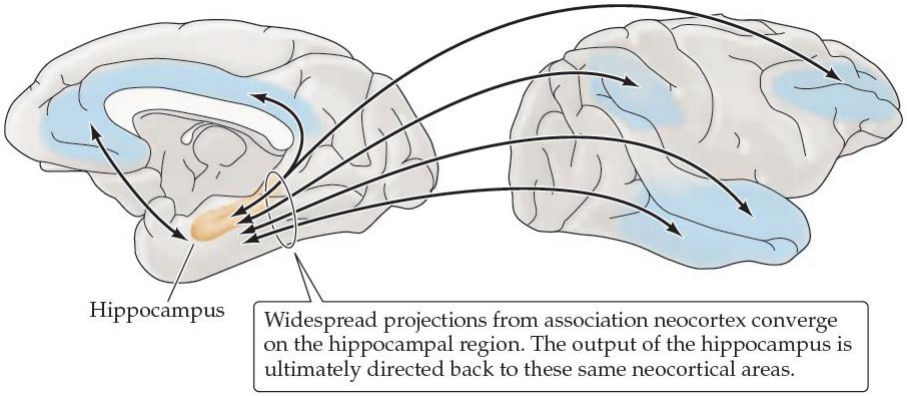
- „[T]here is no fundamental difference between man and the higher mammals in their mental faculties.” (Darwin 2013: 29–30)

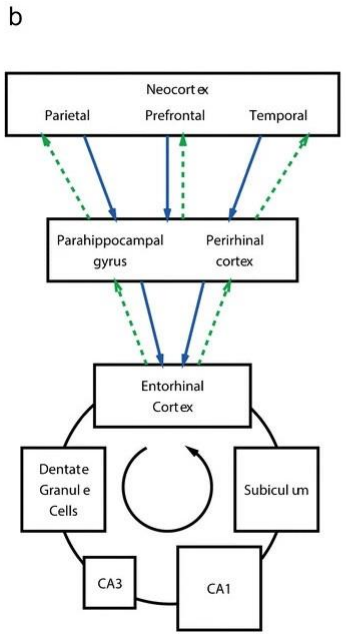
2. Gradual evolution of language CONTINUITY (5)

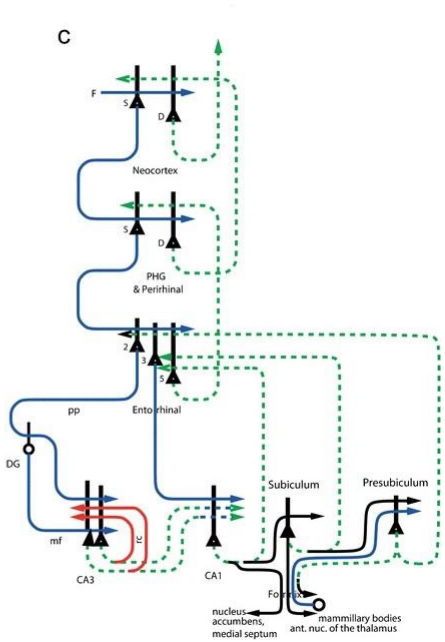
- the streetlight effect (or drunkard's search principle)

2. Gradual evolution of language SEMANTIC MEMORY (1)

- Concepts and the mental lexicon



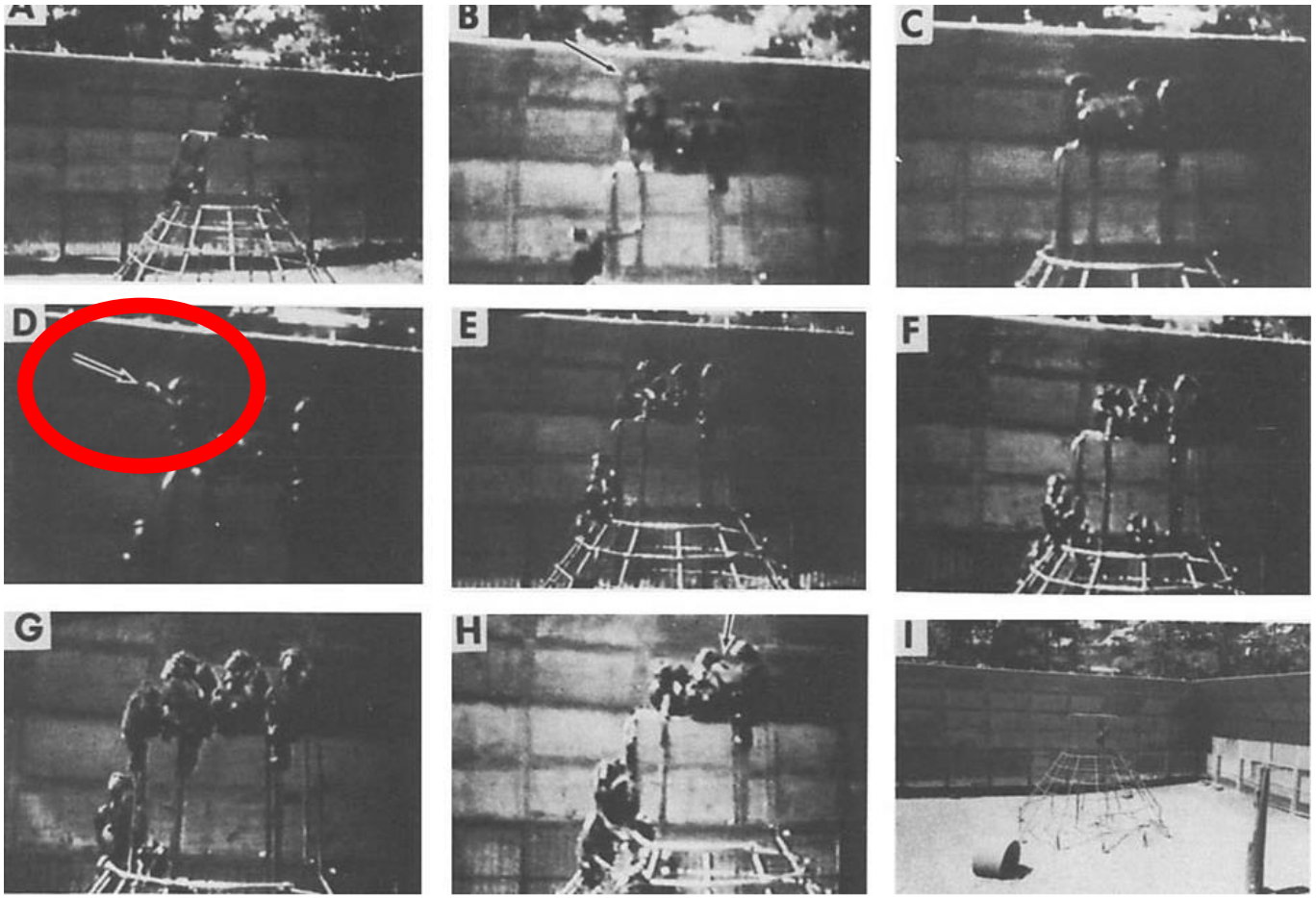




2. Gradual evolution of language
SEMANTIC MEMORY (2)

- Categories: hypernymy and hyponymy (and co-hyponymy)
- Synonymy
- Antonymy
- Meronymy
- Metonymy
- Etc.

2. Gradual evolution of language
SEMANTIC MEMORY (3): chimpanzees



Brunch & Gust (1986). Effect of solar eclipse on the behavior of a captive group of chimpanzees (Pan troglodytes). Am J Primatol 1986;11(4):367-373.

2. Gradual evolution of language
SEMANTIC MEMORY (4): Japanese tits

2. Gradual evolution of language
SEMANTIC MEMORY (5): Kanzi

- Kanzi
- When asked to „Put some water on the carrot”, he responded by tossing the carrot outdoors; since it wa

his action resulted in water getting on
applied the water indirectly. This meth
carrot” appeared to be deliberate on K
during the test did he toss food or othe
noteworthy that no one could recall ev
behavior to Kanzi as a means of puttir
Moreover, at other times during the te
raining, he readily used both the hose and the faucet at the sink as a means of obtaining water if a request required him to do so, indicating that he knew how to obtain water.

Savage-Rumbaugh et al.(1993). Language comprehension in ape and child. *Monographs of the Society for Research in Child Development*, 58(3–4), i+iii+v-vi+1–252.

2. Gradual evolution of language
ONE-WORD STAGE (1)

a. **One-word grammar**

[$_{\text{Utterance}}$ Word] [*Traditional notation*: Utterance → Word]

b. **Two-word grammar**

[$_{\text{Utterance}}$ Word (Word)] [Utterance → Word (Word)]

c. **Concatenation grammar**

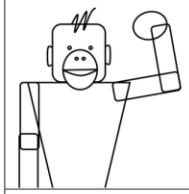
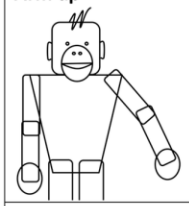
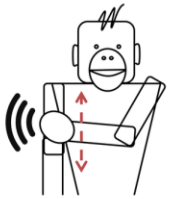
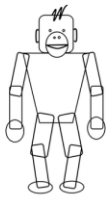
[$_{\text{Utterance}}$ Word*] [Utterance → Word*]

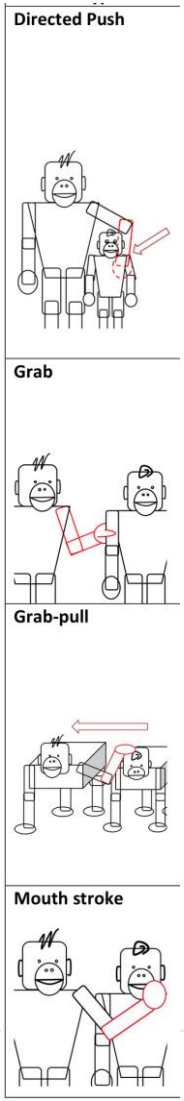
2. Gradual evolution of language
ONE-WORD STAGE (2)

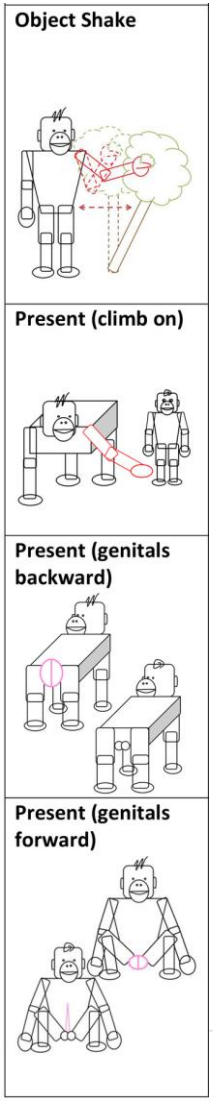
- One-word utterances in language
- There is no language with only one-word utterances.

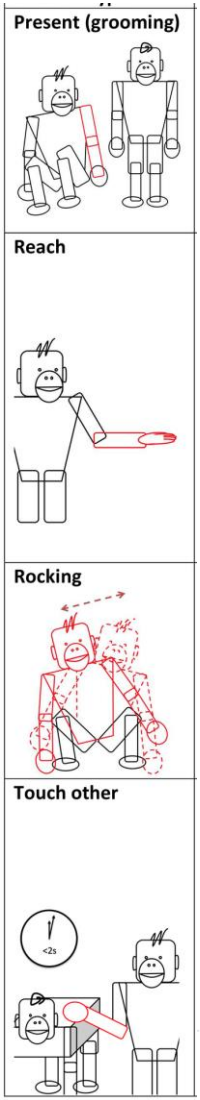
2. Gradual evolution of language
ONE-WORD STAGE (3): chimpanzees

- G

Gesture Type	Bonobo ASOs	Chimpanzee ASOs
Arm raise 	<u>Climb on you</u> 34% Initiate grooming 22% Initiate copulation 20% Initiate GG-rubbing 16% Contact 6% Climb on me 2% *Ambiguous* [9(50): f=3.13, df=12,96 p=0.0009]	Acquire object 48% Move away 19% Move closer 15% Stop behaviour 11% <u>Climb on you</u> 7% *Ambiguous* [χ2=65.71, df=14 p<0.0001]
Arm up 	Contact 80% Climb on me 20% *Tight* [3(15): f=85.14, df=12,24 p<0.0001]	-
Big loud scratch 	<u>Initiate grooming</u> 100% *Tight* [10(41): f=893.1, df=12,108 p<0.0001]	<u>Initiate grooming</u> 82% [1] Travel with me 16%[1] Follow me 2% Climb on me 1% *Tight* [f=45.33, df=14, 238 p<0.001]
Bipedal stance 	Initiate copulation 50%, Initiate GG-rubbing 50% *Loose* [4(12): f=4.46, df=12,36 p=0.0002]	-







Graham et al. (2018). Bonobo and chimpanzee gestures overlap extensively in meaning. PLOS Biology, 16(2): e2004825

2. Gradual evolution of language
ONE-WORD STAGE (3): chimpanzees

- Climb on you/me
- Initiate grooming
- Initiate copulation
- Initiate genito-genital rubbing
- Reposition
- Stop behavior
- Follow me
- Move away/move closer
- Acquire object

2. Gradual evolution of language
ONE-WORD STAGE (4): vervets

- Alarm calls for five predators: leopard (*Panthera pardus*), martial eagle (*Polemaetus bellicosus*), African rock python (*Python sebae*), babbons (*Papio*) and unfamiliar humans

David Schenfeld from Flickr

Seyfarth, R. M., Cheney, D. L., Marler, P. (1980). Monkey responses to three different alarm calls: evidence of predator classification and semantic communication. *Science*, 210, 801–803.

Snake Alarm Call

Gismo Enclosure encounter a Puff adder

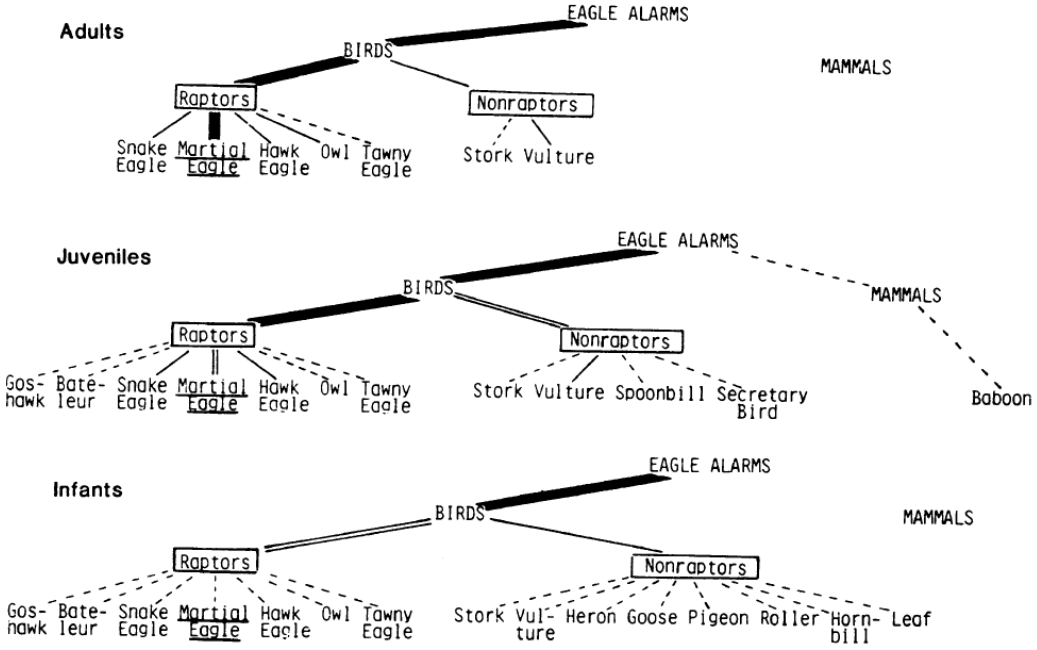
2. Gradual evolution of language
ONE-WORD STAGE (4): vervets

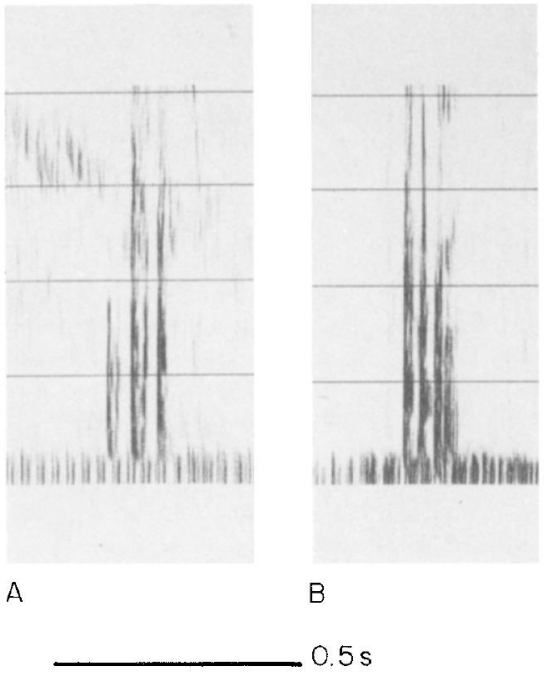
- Alarm calls for five predators: leopard (*Panthera pardus*), martial eagle (*Polemaetus bellicosus*), African rock python (*Python sebae*), babbons (*Papio*) and unfamiliar humans
- Vervet alarm calls are semantic (denotative) and symbolic (in Saussurean sense)

David Schenfeld from Flickr

2. Gradual evolution of language
ONE-WORD STAGE (5): vervets

- Vervet alarm calls appear to be at least partially learned (vs. innate).





2. Gradual evolution of language
ONE-WORD STAGE (6): vervets

- There are other similar examples in other animals, and not only mammals:
  - White-faced capuchins (*Cebus capucinus*)
  - Pale-winged trumpeter (*Psophia leucoptera*)
  - Male domestic chickens (*Gallus gallus domesticus*)

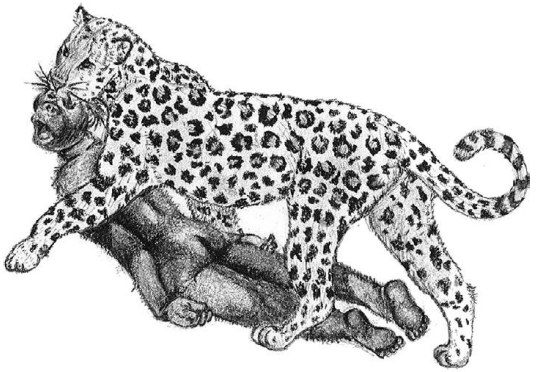
2. Gradual evolution of language
ONE-WORD STAGE (7)

- Analogies in human languages

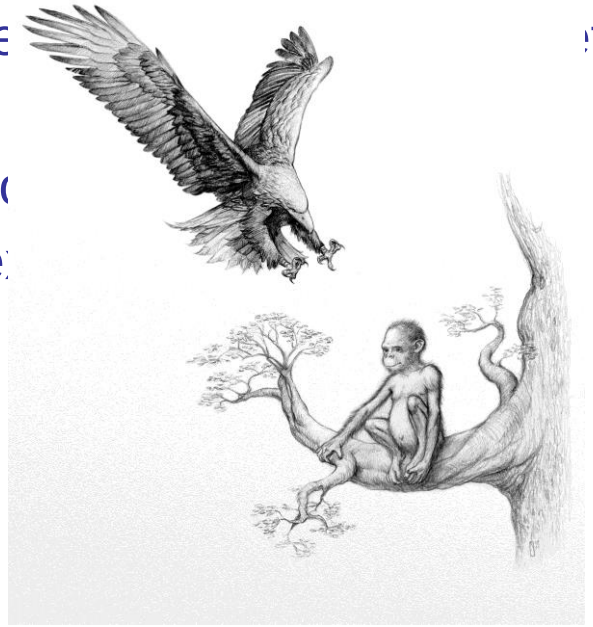
- Fire!
- Thief!
- Killer!
- Snake!
- Spider!
- Hornet!

- Help!

2. Gradual evolution of language ONE-WORD STAGE (8)



- Predation threat: yes...
- Ala vocal
  the tter de
- Pr
- Le vs. ab



2. Gradual evolution of language
TWO-WORD STAGE (1)

- A two-word stage without syntax
- Wha
  - H
  - P
    p
  - Two lexical items:
    - The two concepts are somehow related within the proposition

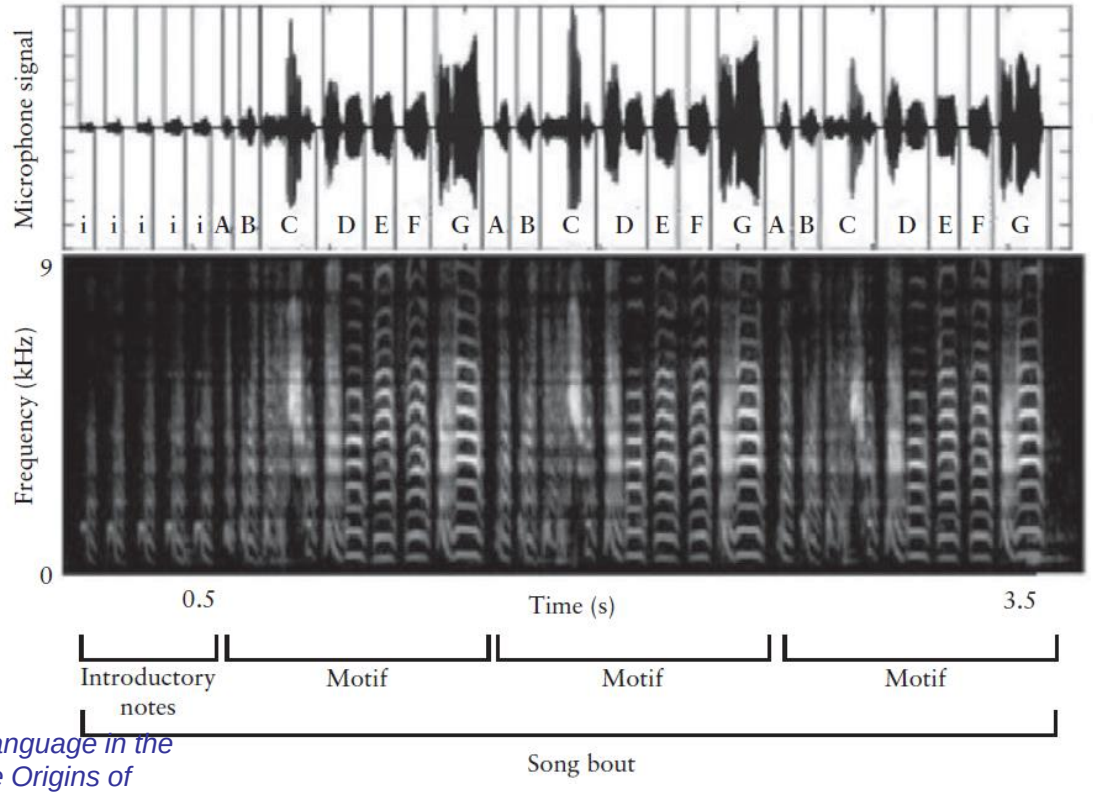
Elephant kill* or *Kill elephant	**'X killed elephant.'**
/	~~'Elephant killed X.'~~

Nuts many* or *Many nuts	**e.g., 'I found many nuts.'**
Hyena carrion or *Carrion hyena*	e.g., 'Hyenas are feasting on the carrion.'

    - If this is true, then the two words used could only be used with one (predetermined) semantic role.

2. Gradual evolution of language
TWO-WORD STAGE (2): animal syntax

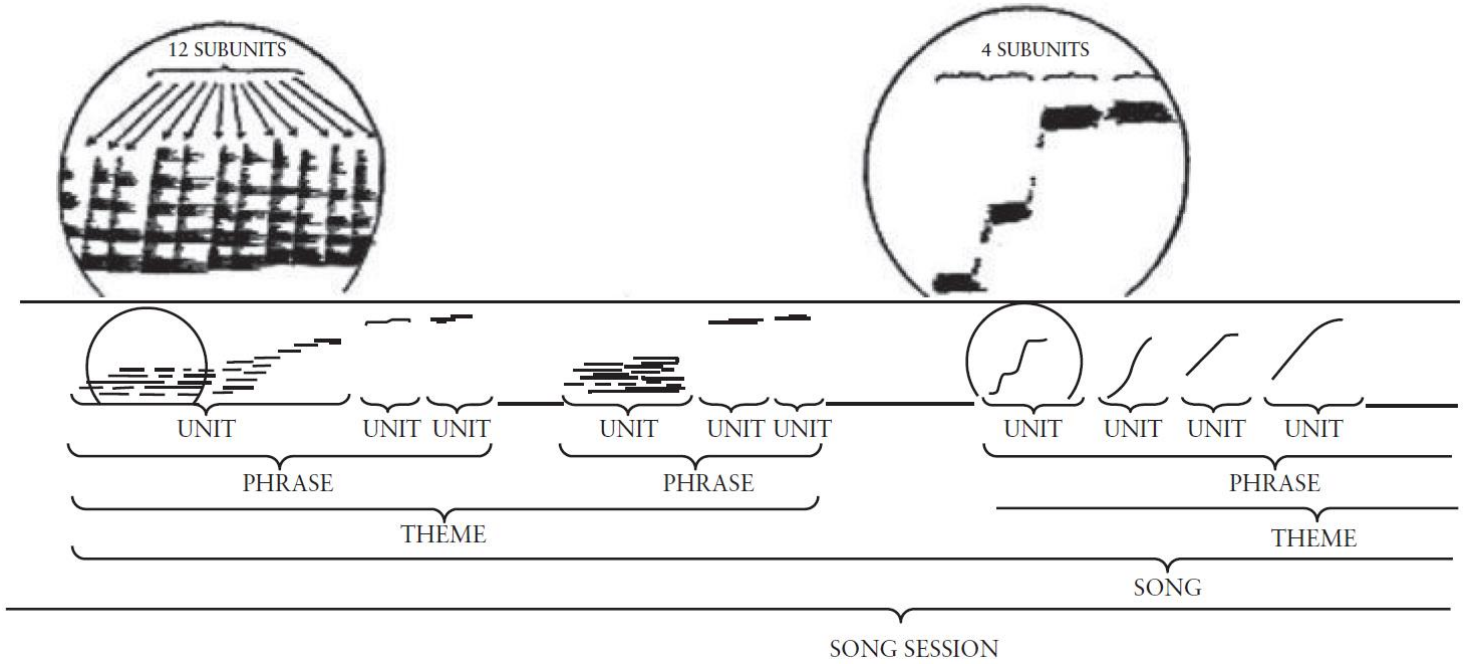
- Bees, ants, frogs, songbirds, whales...



Hurford, J. R. (2007). *Language in the Light of Evolution 1. The Origins of Meaning*. New York: Oxford University Press.

2. Gradual evolution of language
TWO-WORD STAGE (3): animal syntax

- Bees, ants, frogs, songbirds, whales...



Hurford, J. R. (2007). *Language in the Light of Evolution 1. The Origins of Meaning*. New York: Oxford University Press.

Boesch (1991). Symbolic Communication in wild chimpanzees?. Human Evolution 6(1).

2. Gradual evolution of language
TWO-WORD STAGE (4): chimpanzees

2. Gradual evolution of language
TWO-WORD STAGE (5): chimpanzees

- Reduplication = repetition of a stem or its part within a word for semantic or grammatical purposes

- 1. Intensification
- 2. Larger in quantity (e.g., grammatical number)

- „Serbo-Croatian”*: Tip je glup-glup.* = lit. ‘The guy is stupid-stupid.’
  - *raznorazan* (ADJ) = lit. ‘diverse-diverse’
  - *danodnevno* (ADV) = lit. ‘on a day-daily basis’
- Italian: *niente di niente* = lit. ‘nothing of nothing’
- Indonesian: *pagi* ‘morning’, *pagipagi* ‘early morning’

2. Gradual evolution of language
TWO-WORD STAGE (6): chimpanzees

- Amalgamation, fusion
- Compounding

- principle of no synonymy

- Because 1a in the combinatorial expression would be non-meaningful, the b element can be said to code information on both change in travel direction and resting.
- Problem: temporal delay between the two components – considerable?

2. Gradual evolution of language
TWO-WORD STAGE (7): Japanese tits

- Suzuki et al. (2016) claim to have found semantic syntax in the Japanese tits (*Parus minor*)

ABC	• scan for danger
D	• approach the caller
ABC-D	• scan and approach
D-ABC	• mostly no change in behavior

Sergey Yeliseev

Suzuki, T. N., Wheatcroft, D., Griesser, M. (2016). Experimental evidence for compositional syntax in bird calls. *Nature Communications*, 7, 10986.

2. Gradual evolution of language
TWO-WORD STAGE (8): Kanzi

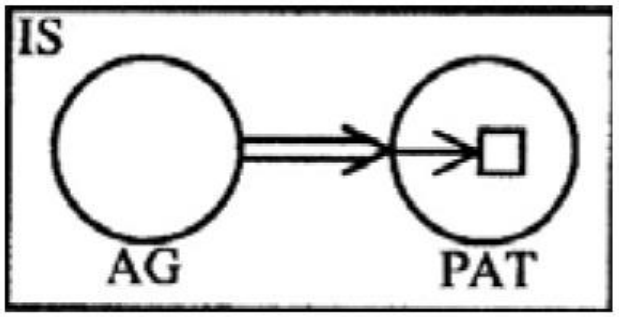
- Kanzi: bonobo
- *Can you put your shirt on your ball?*
- *I think we need to give the balloon to Kelly.*
- *Can you put some toothpaste on your ball?*

- *put*, *give*, and *get*
- *slap*, *show*, *open*, *make your doggie bite your ball*, etc.

Savage-Rumbaugh et al.(1993). Language comprehension in ape and child. *Monographs of the Society for Research in Child Development*, 58(3–4), i+iii+v-vi+1–252.

2. Gradual evolution of language
TWO-WORD STAGE (9): Transitivity

- Semantic vs. syntactic transitivity
- Semantic transitivity is not a categorical, but a gradual phenomenon.
  - Prototypical semantic transitivity: a volitional agent acts on a patient by changing his state or position
  - The typical agent is human?
  - The typical patient is inanimate?



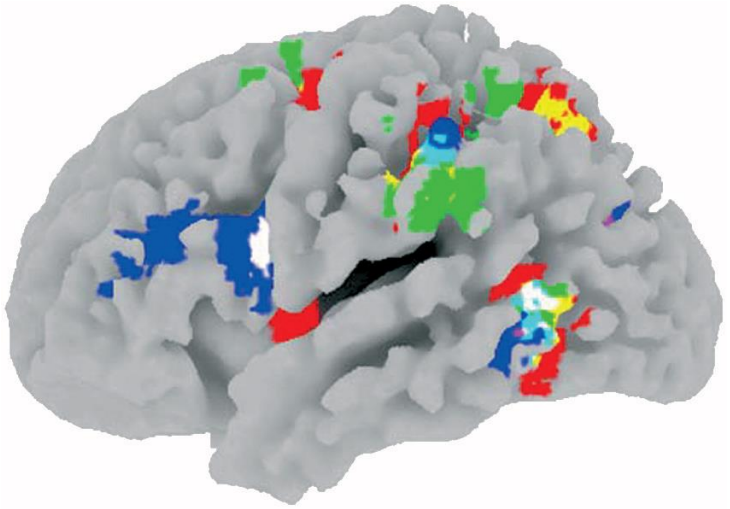
2. Gradual evolution of language
TWO-WORD STAGE (10): Transitivity

- Core transitive verbs: verbs which code prototypical semantic events (basic transitive coding)
  - *He broke the window.* vs. *I feel love.* vs. *She is crossing the street./She was sleeping all night.*
- Core transitive verbs are considered to be a linguistic universal and to show „a high degree of formal homogeneity".

2. Gradual evolution of language
TWO-WORD STAGE (11): Transitivity

- Tettamanti et al. (2005, *J Cogn Neurosci 17(2)*): fMRI, passive listening of sentences with face, foot and hand-related actions („abstract" sentences as controls)
  - Non-transparent reporting of the stimuli
  - *La ho accompagnata io.* / *Calcio il pallone.* / *Marco calcio il pallone.*
  - It appears they compared transitive constructions which were semantically transitive in the experimental set and intransitive in the control set.

2. Gradual evolution of language
TWO-WORD STAGE (12): Transitivity



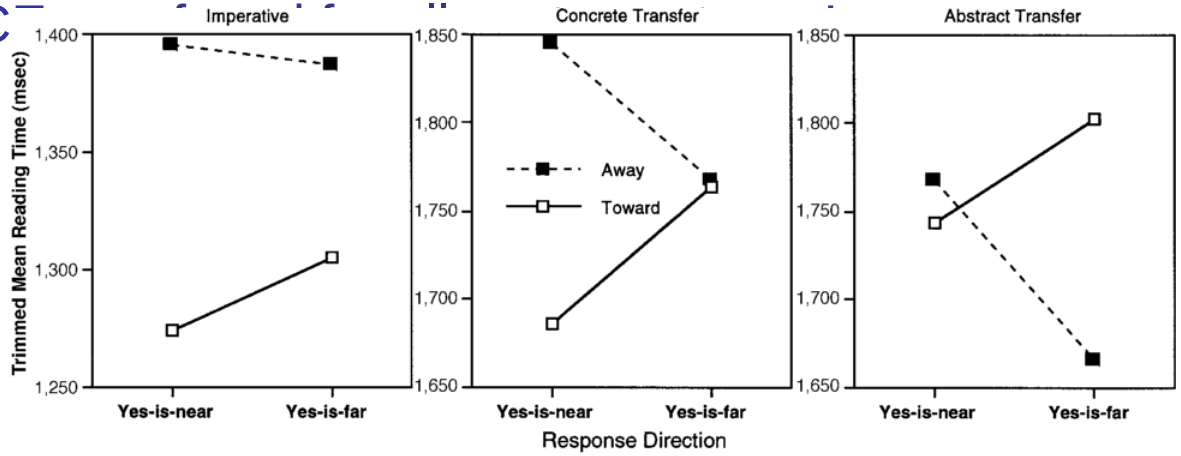
- The degree of semantic transitivity mediates the neurophysiological response.
- Embodiment of syntactic transitivity?
- Is the embodiment effect due to the entire transitive scenario or due to the meaning of particular components (e.g. verbs)?

2. Gradual evolution of language
TWO-WORD STAGE (13): Transitivity

- Ferretti et al. (2001): transitive verbs prime typical agents (*arresting–cop*), patients (*arresting–criminal*) and instruments (*stirred–spoon*), but not locations (*swam–ocean*)
  - A short SOA (250 ms) was used, indicating an automatic neural connection.
  - Results suggest that we can really talk about the embodiment of semantic transitivity in previous studies as it would be difficult to separate the effects of verb meaning, and agents and patients (and instruments).

2. Gradual evolution of language
TWO-WORD STAGE (14): Transitivity

- Glenberg & Kaschak (2002, *Psychon Bull Rev* 9(3)): ACE, hand actions and transfer sentences differing in the direction of action/transfer
  - Imperative sentences (?)
  - sentences denoting transfer of concrete objectssentences denoting „transfer of abstract entitites
  - AC



2. Gradual evolution of language
TWO-WORD STAGE (1): Word order

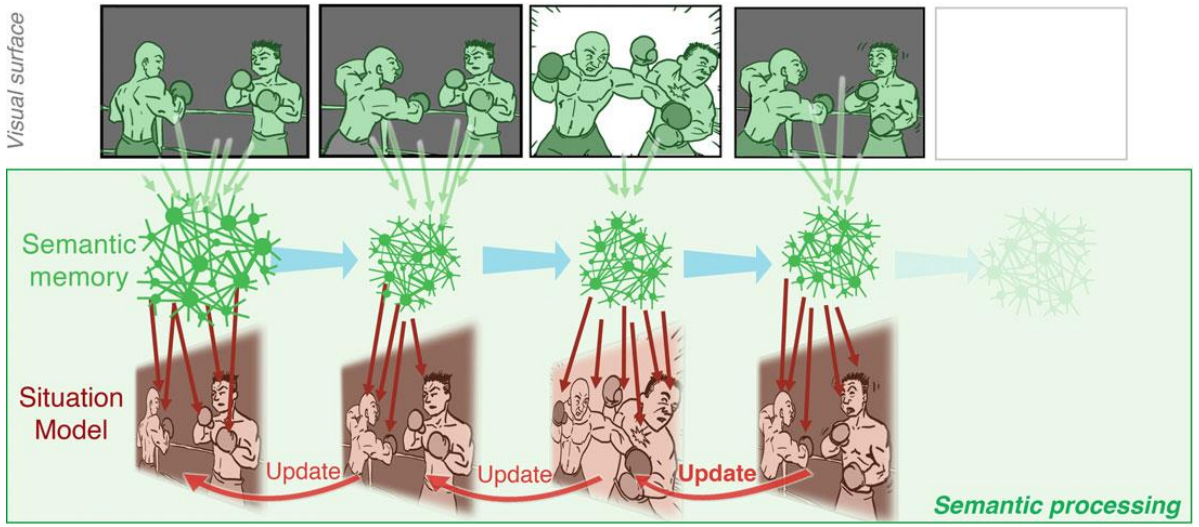
- basic word order
- a controversial approach
- SOV and SVO are dominant word orders in sign languages as well.
- Al-Sayyid Bedouin Sign Language

RED RIJEČI	UDIO
SOV	41,03 %
SVO	35,44 %
nema	13,73 %
VSO	6,90 %
VOS	1,82 %
OVS	0,80 %
OSV	0,29 %

2. Gradual evolution of language
TWO-WORD STAGE (2): Word order

- subject saliency and verb–object juxtapositioning
- According to Kemmerer (2012, *Language and Linguistics Compass* 6(1)), subject saliency reflects how the brain understands core transitive events in which the agent is the head of a causal chain affecting the patient.

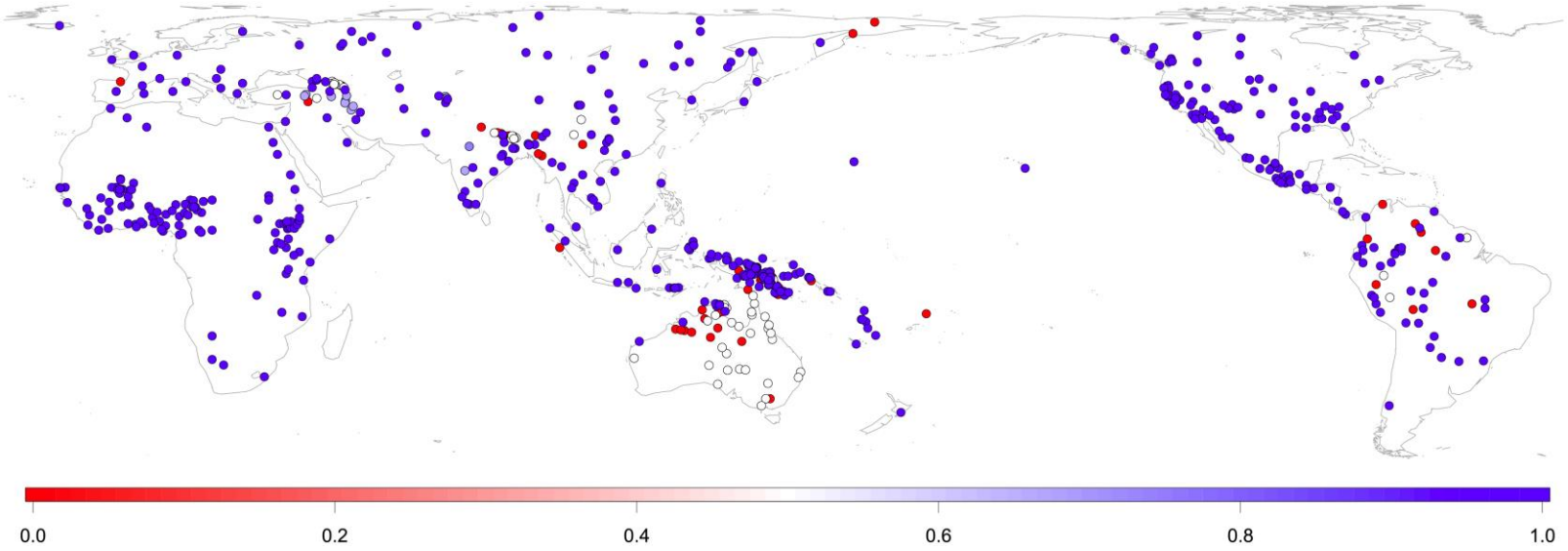
2. Gradual evolution of language
TWO-WORD STAGE (3): Word order



- Agent saliency is evidenced in empirical studies:
  - information about the agent compared to the patient facilitates prediction of action in the future,
  - agents are longer viewed in visual depictions than patients,
  - visual depictions primed by agents are processed faster compared to depictions primed by patients,
  - etc.

2. Gradual evolution of language
TWO-WORD STAGE (4): Word order

- Nominative-accusative languages are cross-linguistically more frequent compared to ergative-absolutive languages



Bickel,et al. (2015). The neurophysiology of language processing shapes the evolution of grammar: evidence from case marking. *PLoS ONE*, 10(8), e0132819.

2. Gradual evolution of language
TWO-WORD STAGE (5): Word order

TABLE 1

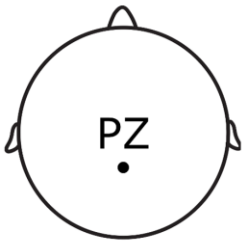
FREQUENCIES OF DOMINANT ALIGNMENT TYPES

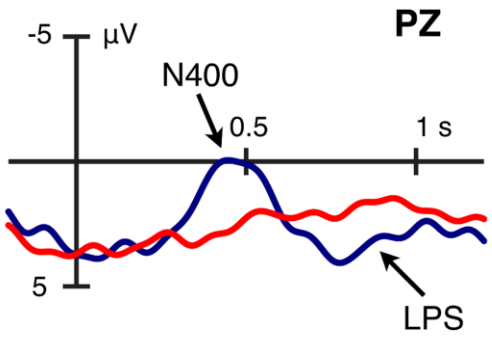
Area	Acc.	Erg.	St.-act.	Hier.	3-way	Neutral	Unknown	Total
Africa	16					4		20
Ancient Near East	2	2	1					5
Europe and Caucasus	6	3	1					10
Northern Asia	9	2	1					12
S and SE Asia	3	3	1			3		10
New Guinea	26	5	1			1		33
Australia	8	11		2	1			22
Oceania	4	2	1					7
Western North America	22	4	5			1		32
Eastern North America	4		7	2				13
Mesoamerica	5	1	1	2			1	10
South America	11	1	4			1	3	20
Total	116	34	23	6	1	10	4	194
Total as %	59	18	11	3	0.5	5	2	100

Nichols J (1993) Ergativity and linguistic geography. *Australian Journal of Linguistics*, 13, 39–89.

2. Gradual evolution of language
TWO-WORD STAGE (6): Word order

- Bornkessel et al. (2004): ERP, reception of dependent object clauses in which the syntactic and semantic roles are ambiguous until the end of the sentence





… dass Betram Surferinnen gratuliert **hat**
… *that Bertram surfers congratulated has*

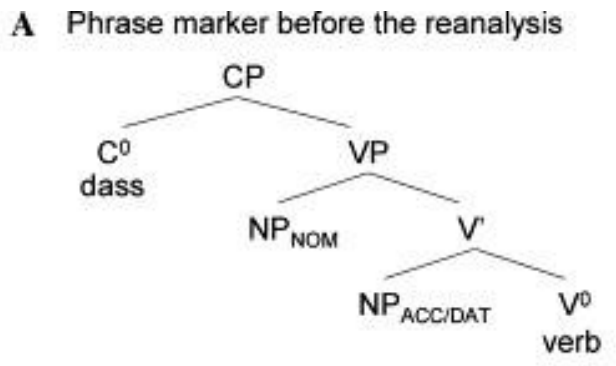
… dass Betram Surferinnen gratuliert **haben**
… *that Bertram surfers congratulated have*

0 ms

Bornkessel et al. (2004). Multi-dimensional contributions to garden path strength: dissociating phrase structure from case marking. *Journal of Memory and Language*, 51, 495–522.

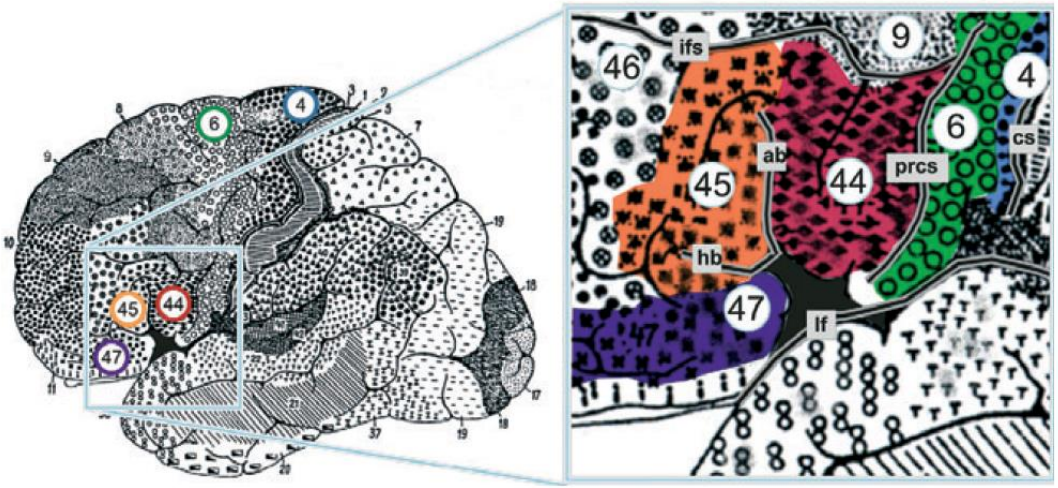
2. Gradual evolution of language
TWO-WORD STAGE (7): Word order

- Bornkessel et al. (2004)
  - a combination of a biphasic negativity after 400 ms and late positivity in the latter sentence type
  - Results suggest that the first argument is automatically processed as an agent until further analysis shows otherwise.



2. Gradual evolution of language
TWO-WORD STAGE (8): Word order

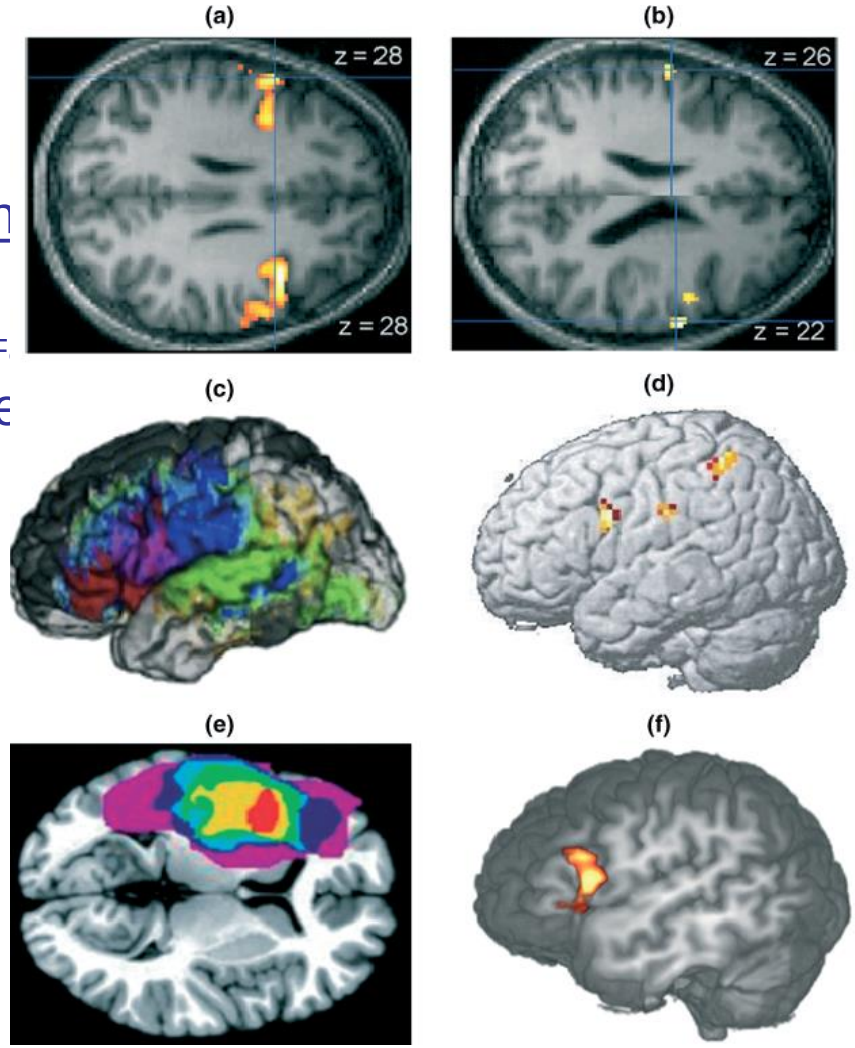
- Kemmerer (2012) speculates that the two dominant word orders reflect the ways in which Broca's area processes actions in general.
- Broca's area is a very controversial topic and it appears that today nobody really knows precisely what Broca's area is, nor where it is.



2. Gradual evolution of language
TWO-WORD STAGE (9): Word order

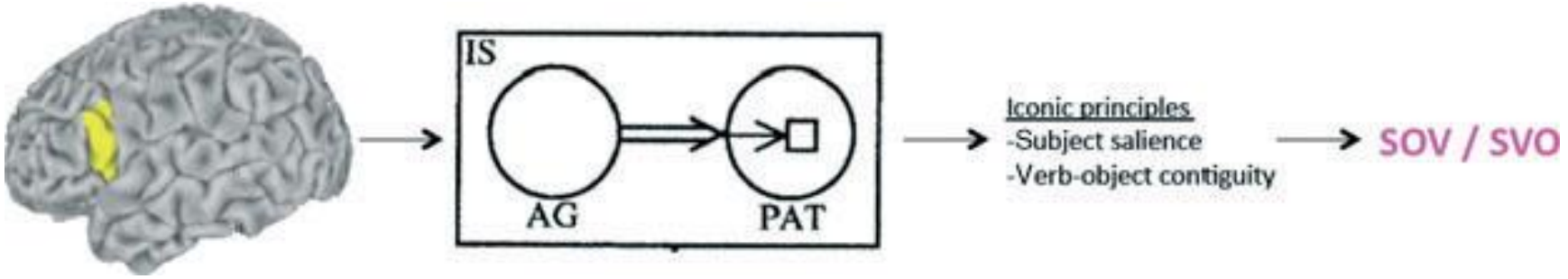
- Broca's area is highly multifunction
  al. 2017), production of nonverbal
  nonverbal action understanding (F
  music (Elmer et al. 2018), visuospatial pe
  language, etc.

- common functional denominator



2. Gradual evolution of language
TWO-WORD STAGE (10): Word order

- In short, SOV and SVO would reflect the temporal structure of the causal action chain which is coded in Broca's area, and which is enabled through a phylogenetically older system of sequential and hierarchical organization of bodily movements and actions.



CONCLUSIONS

- It is unclear whether we can deduce anything concerning language evolution from the presented data.
- A number of linguistic phenomena show a certain degree of embodiment, i.e. functional connection with sensory and motor brain areas.
- Using Occam's razor, I suggested that synchronic embodiemnt suggests phylogenetic exaptation.

CONCLUSIONS

- If the exaptation hypothesis is true, it would be more plausible that the first linguistic phenomena which evolved were the ones which show the highest degrees of embodiment in modern humans.
- Thus, e.g., concrete concepts, and specifically, action concepts were more likely to be lexicalized than abstract concepts in the context of evolution.

CONCLUSIONS

- One-word stage?
- One-element utterances, typically alarm and food calls, have been evidenced in a range of species whose phylogenetic origins predate human origins. Thus, one-element utterances, including utterances containing word-like denotative structures, appear to be a phylogenetically relatively ancient phenomenon.

- Problematically, it is unclear whether the communication systems in the described „one-word" animals don't have syntactic components elsewhere.

CONCLUSIONS

- Similarly, some other linguistic phenomena are present in other taxa as well, such as syntax, as well as both semantic and non-semantic combinatoriality of elements.

- If not all cases can be explained by convergent evolution, this suggests that there are, from humans' perspective, evolutionarily primitive systems which have been reused for language.

CONCLUSIONS

- Studies on transitivity have emphasized the mechanisms of subject and agent saliency.
- Converging data suggest that when transitive constructions were introduced into language, it is more likely that the first element in the expression would have expressed an agent, rather then there being a free word order.
- This further suggests that if there were two-word utterances which were coded in a transitive frame, the first noun-like word would have likely expressed the agent, not the patient.
- Transitive coding was not necessarily present in the proposed two-word stage and utterances not governed by rules are thinkable.

CONCLUSIONS

- Be that as it may, syntactic transitivity seems nevertheless associated with semantic transitivity, which possibly hints to some phylogenetic implications.

- BA 45 might have played an important evolutionary role in the abstraction/schematization of existing, relatively embodied, scenarios and rules, which possibly led to syntax.

CONCLUSIONS

- What's with phonetics and phonology?

Language evolution: syntax before phonology?

Katie Collier[1], Balthasar Bickel[2], Carel P. van Schaik[3], Marta B. Manser[1] and Simon W. Townsend[1]

[1]Institute of Evolutionary Biology and Environmental Studies, [2]Department of Comparative Linguistics, and [3]Anthropological Institute and Museum, University of Zurich, Zurich, Switzerland

CONCLUSIONS