

PolyU Lecture Series --- 2021.5.1.

人与言

王士元

语言认知与神经科学研究中心

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Paul Gauguin, 1897.

D'où venons nous? 从何处来?
que sommes nous? 人是何物?
où allons nous? 向何处去?

从何处来？

赫胥黎 Huxley, T. H. 1863. Evidence as to Man's place in nature.



GIBBON.

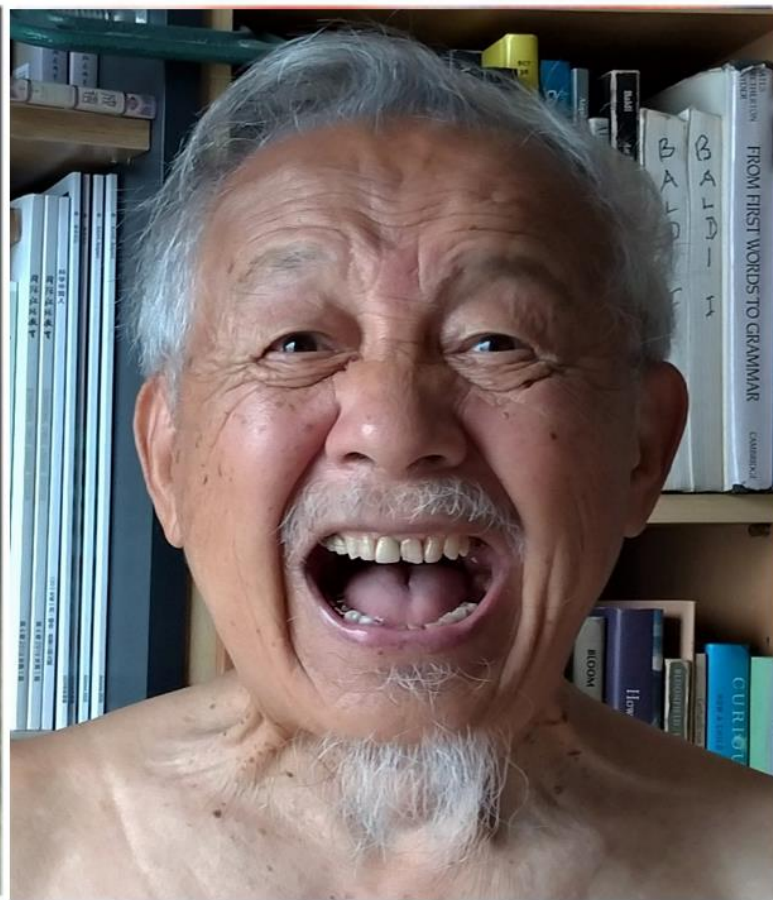
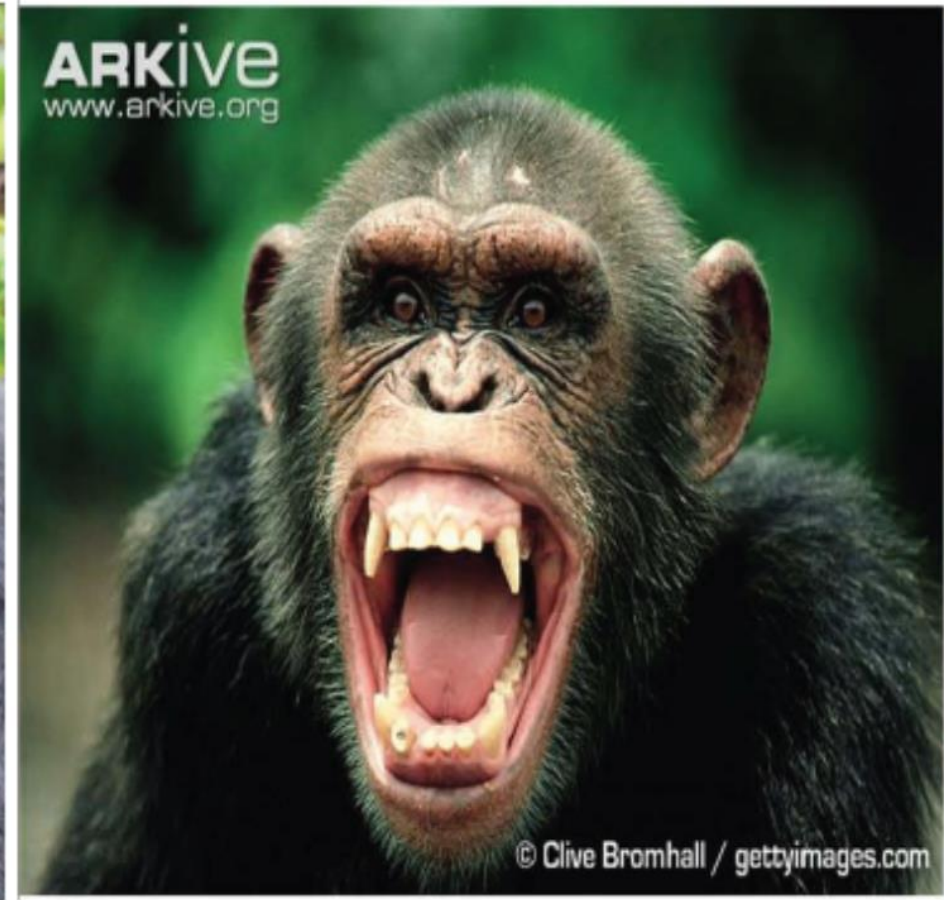
ORANG.

Skeletons of the
CHIMPANZEE.

GORILLA.

MAN.

Photographically reduced from Diagrams of the natural size (except that of the Gibbon, which was twice as large as nature), drawn by Mr. Waterhouse Hawkins from specimens in the Museum of the Royal College of Surgeons.



Gorilla

Chimpanzee

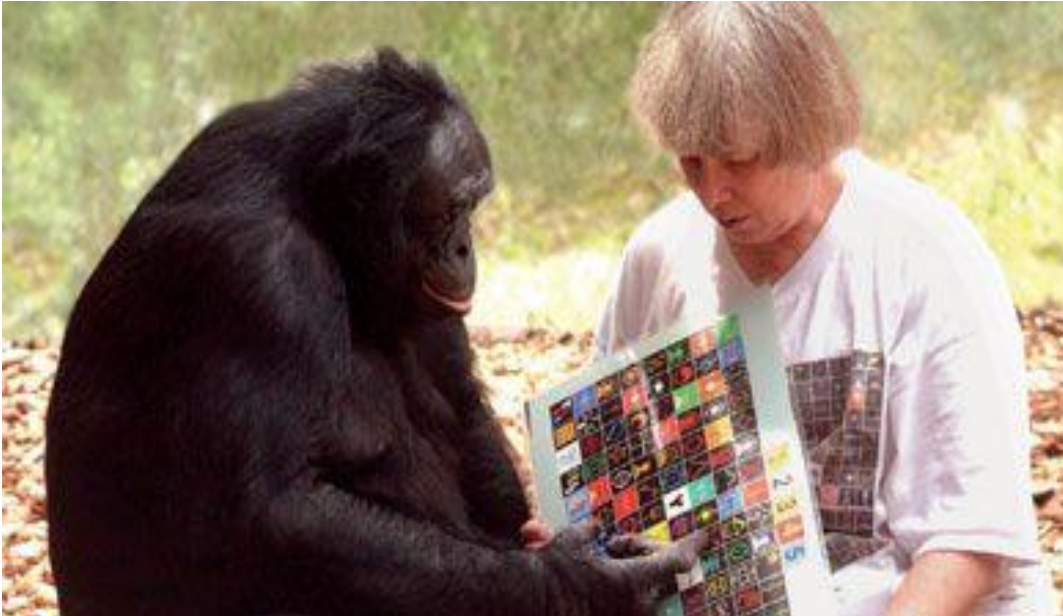
Homo

Quiz: Which two primates are the closest relatives?

哪兩個靈長類關係最接近？

While chimpanzees did not invent language, a natural question to raise is whether they can be taught language, given how close they are to us genetically. It became clear by mid-1900s that they cannot speak as we do because of neuro

Savage-Rumbaugh, S. and R. Lewin (1994). Kanzi: The Ape at the Brink of the Human Mind.

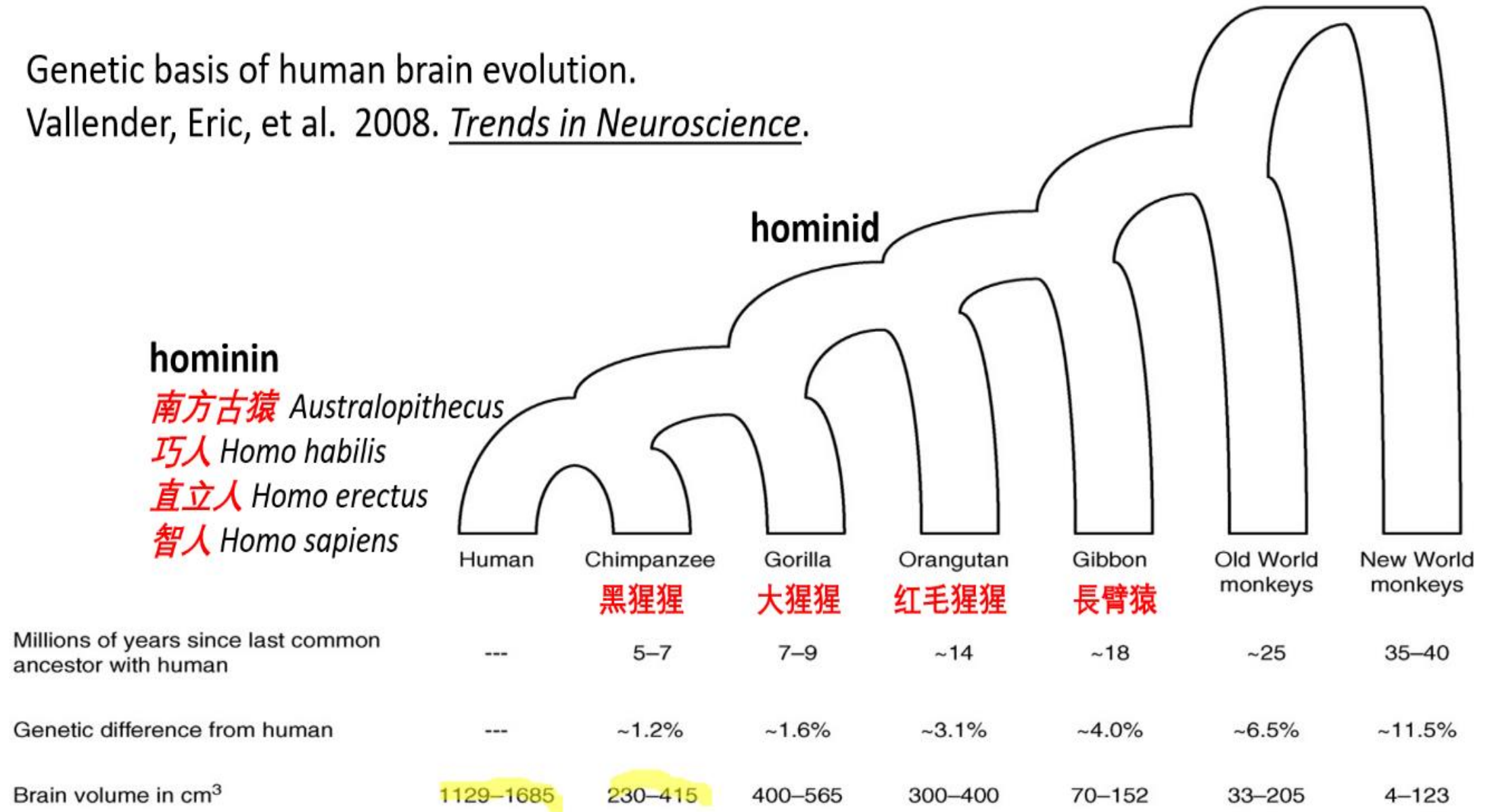


Jane Goodall 在非洲做了几十年的田野调查，首先给研究黑猩猩开了路。她1971的书，In the Shadow of Man 是经典之作。

De Waal, F. B. M. (2005). "A century of getting to know the chimpanzee." Nature 437(7055): 56-59 给这一世纪的研究做了很有用的总结。

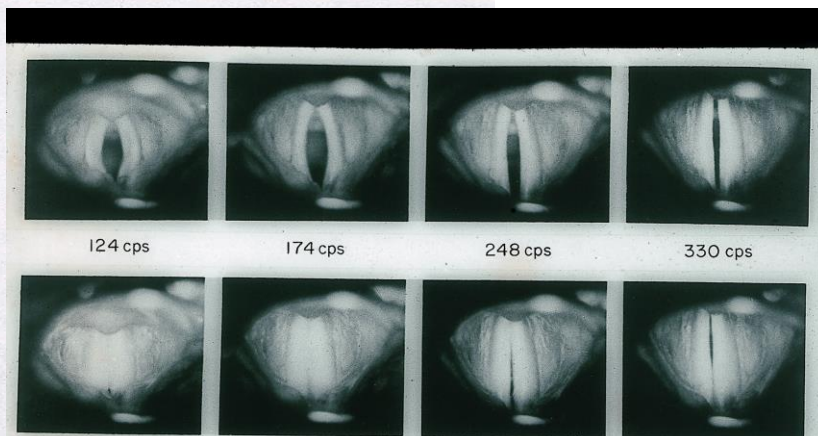
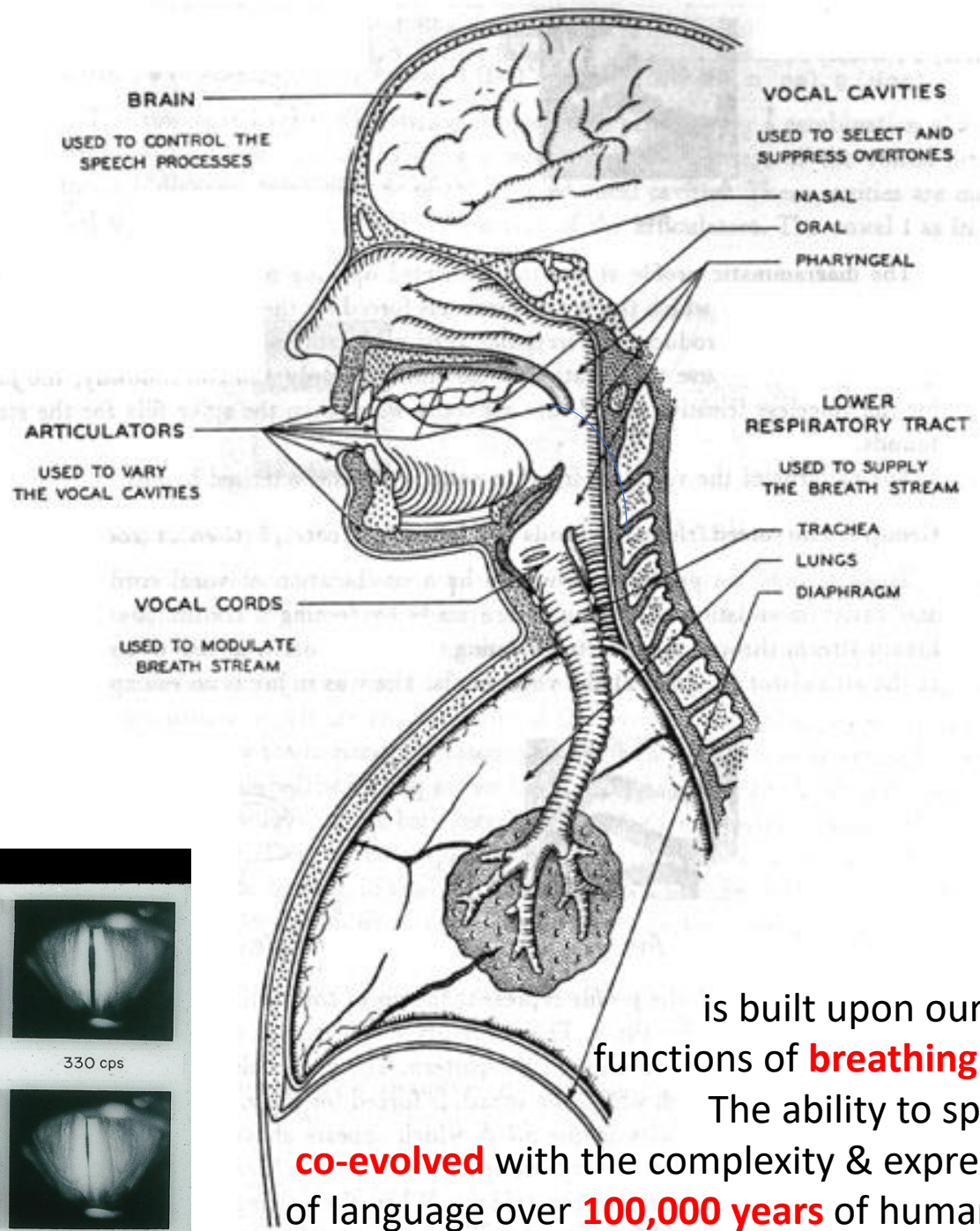
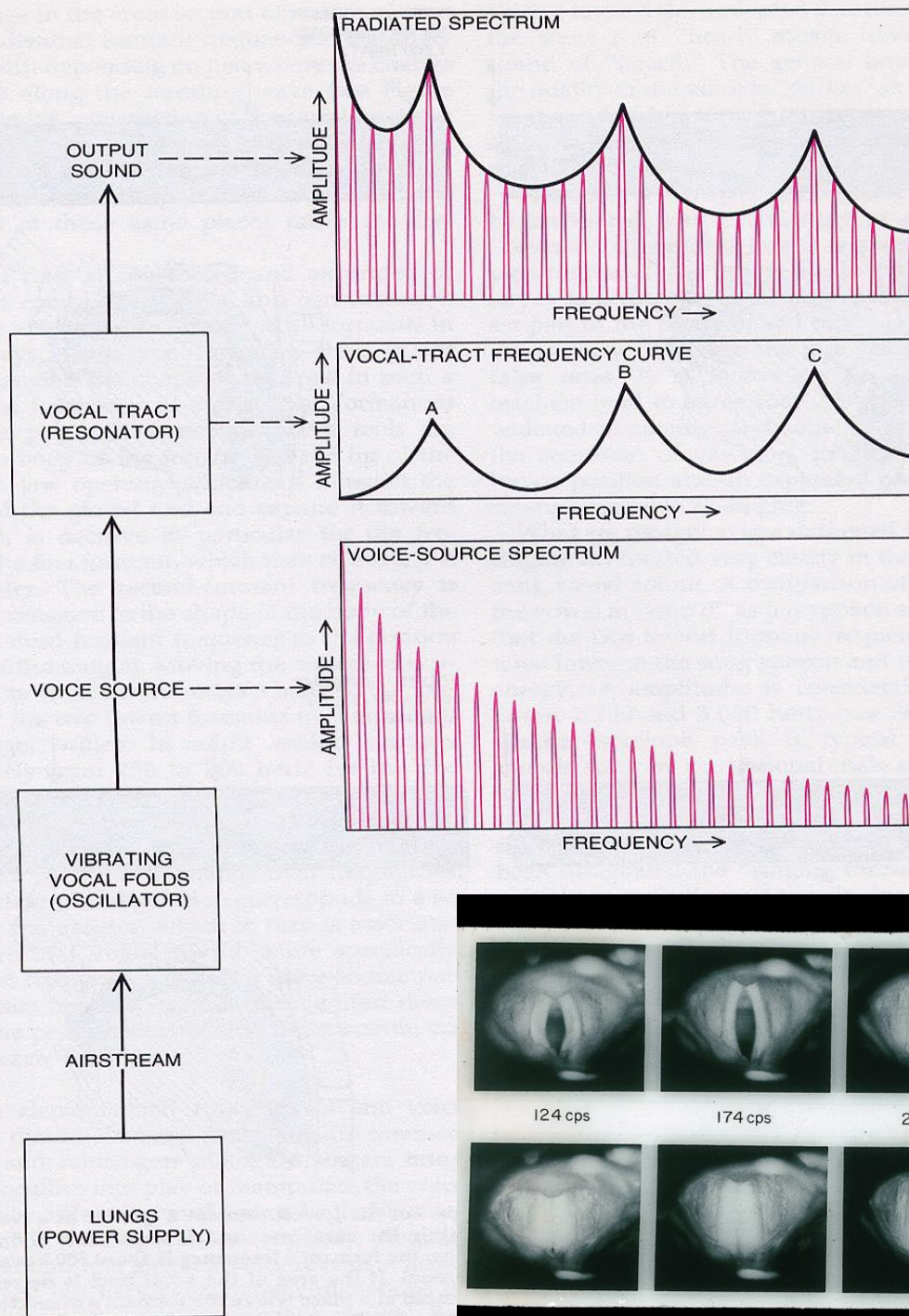
Genetic basis of human brain evolution.

Vallender, Eric, et al. 2008. Trends in Neuroscience.



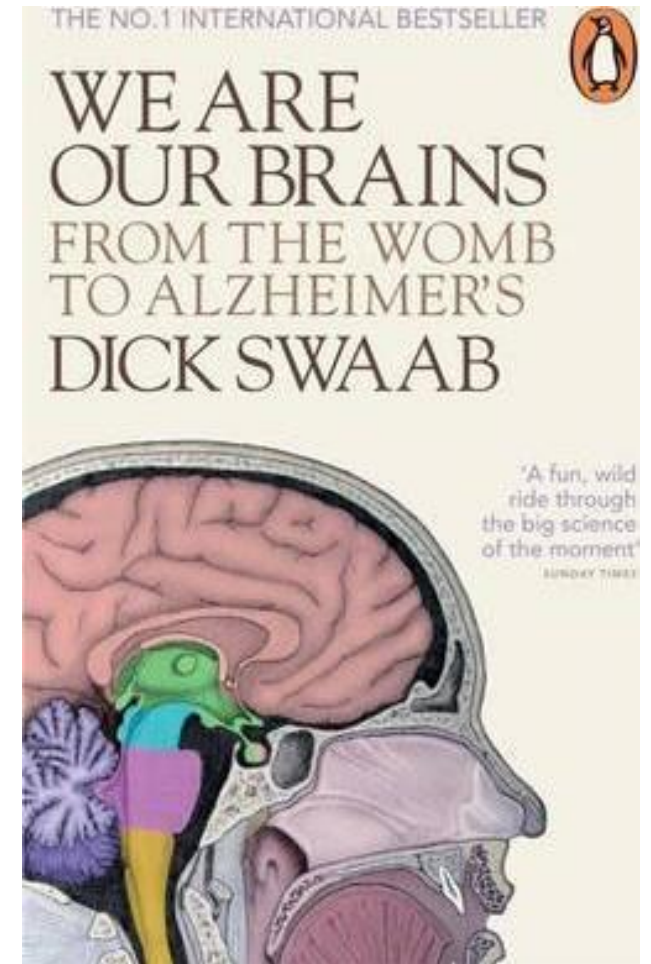
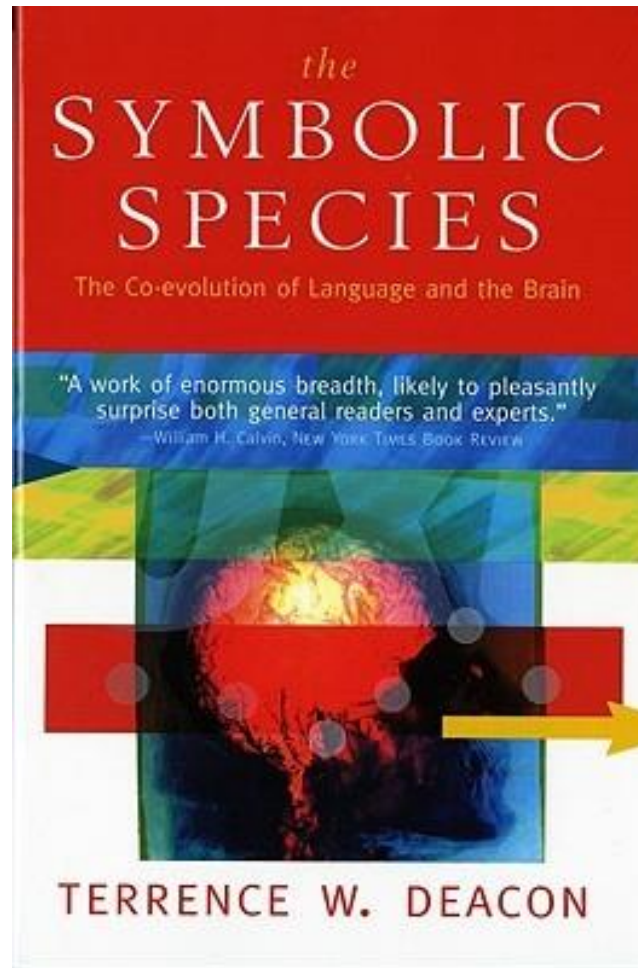
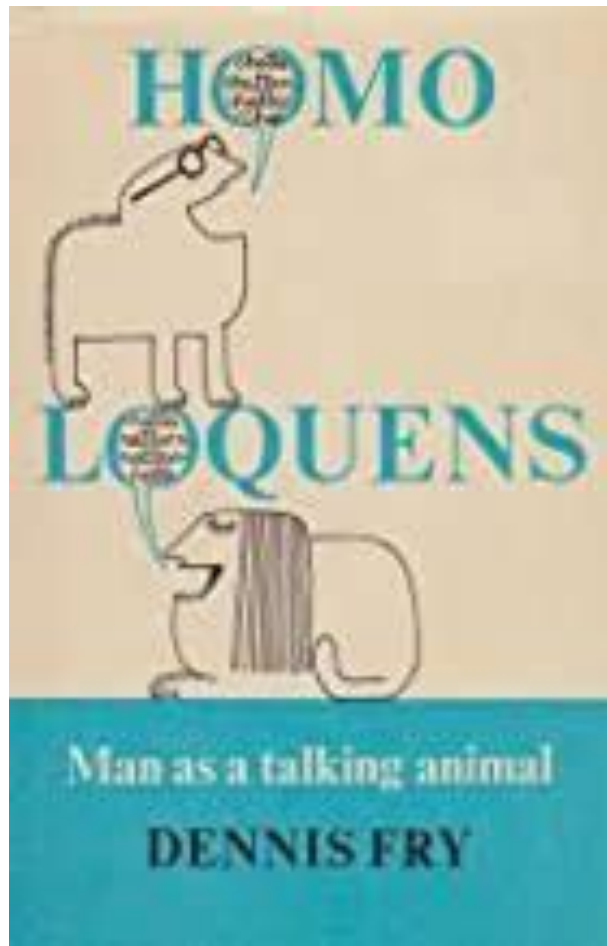


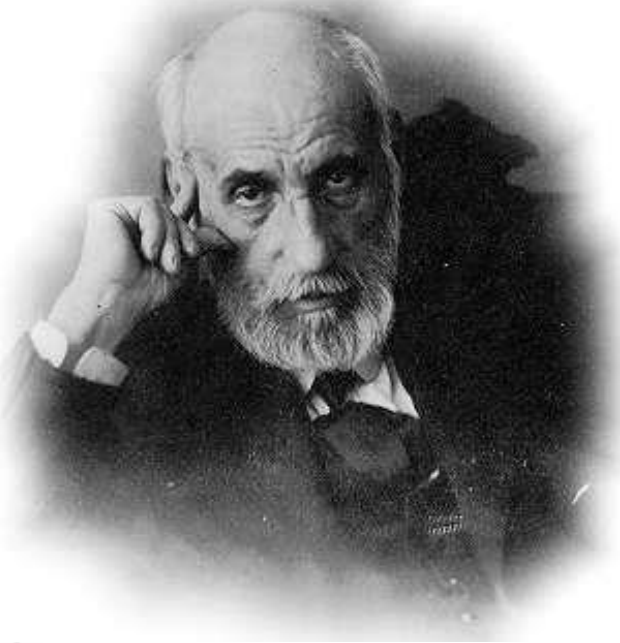
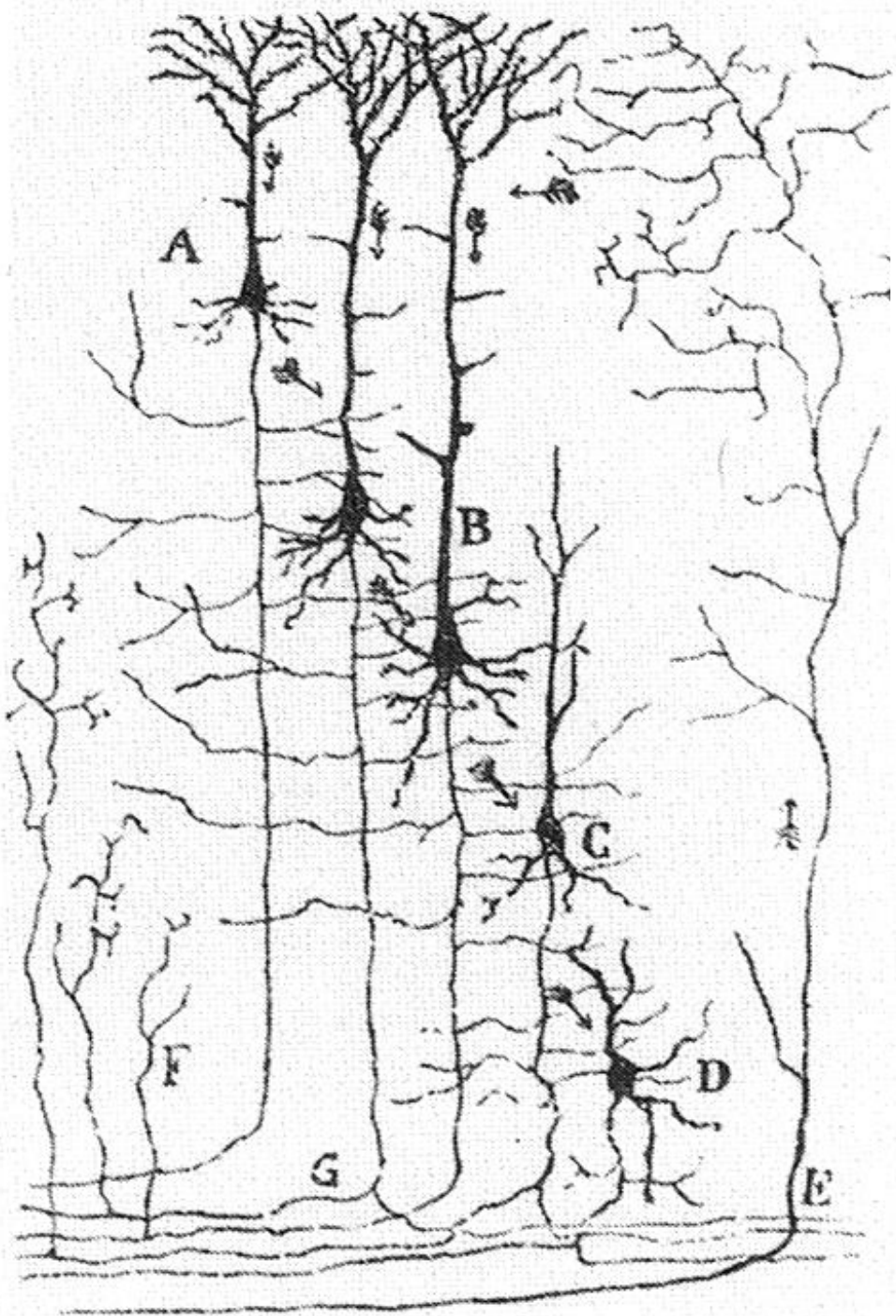
*Johanson, D. and E. Blake (2006). From Lucy to Language, Simon & Schuster.
Leakey, M. D. and R. L. Hay (1979).
"Pliocene footprints in the Laetoli Beds at Laetoli, northern Tanzania." Nature
278: 317-323.*



Speech is built upon our more basic functions of **breathing** & **chewing**. The ability to speak fluently **co-evolved** with the complexity & expressive power of language over **100,000 years** of human evolution.

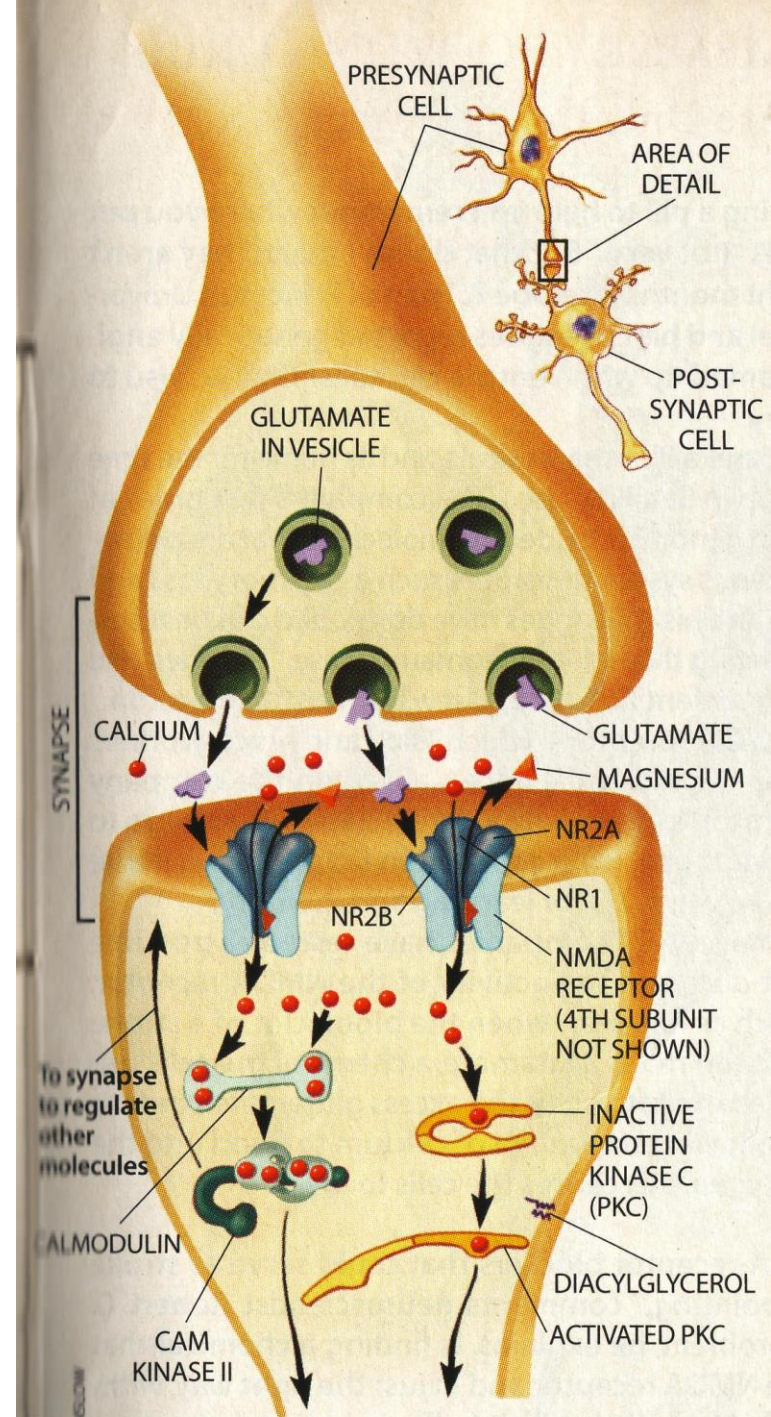
que sommes nous? 人是何物?





Cajal's hand-drawn images of nervous tissue stained by Golgi's method; pyramidal cells PFC.

J.Z. Tsien. 2007. The memory code. *Scientific American*. July.

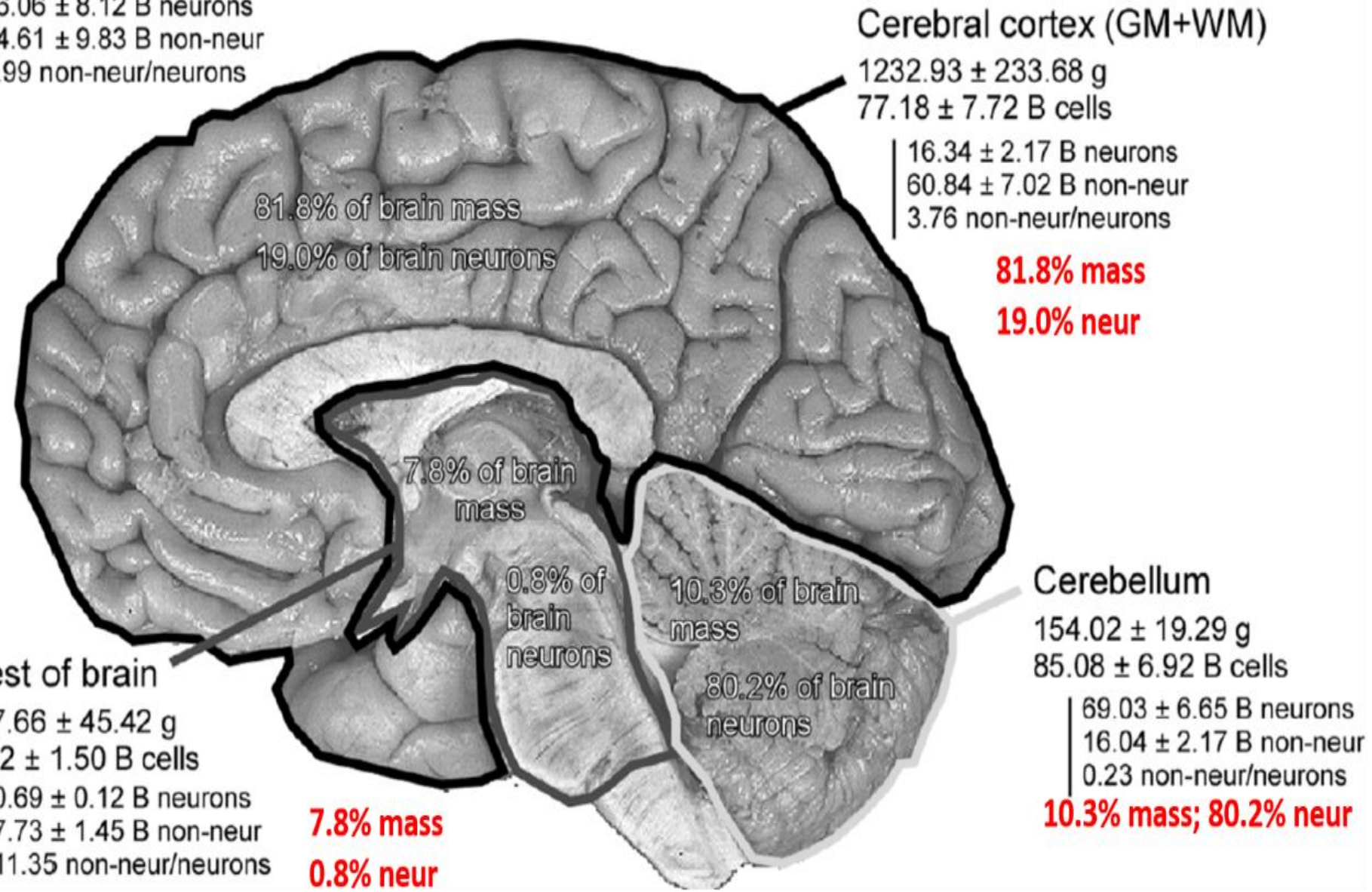


Whole brain

1508.91 ± 299.14 g
170.68 ± 13.86 B cells

86.06 ± 8.12 B neurons
84.61 ± 9.83 B non-neur
0.99 non-neur/neurons

Azevedo, F. et al. 2009. Equal numbers of neuronal and nonneuronal cells make the human brain an isometrically scaled-up primate brain. *Journal of Comparative Neurology* 513:532-41.



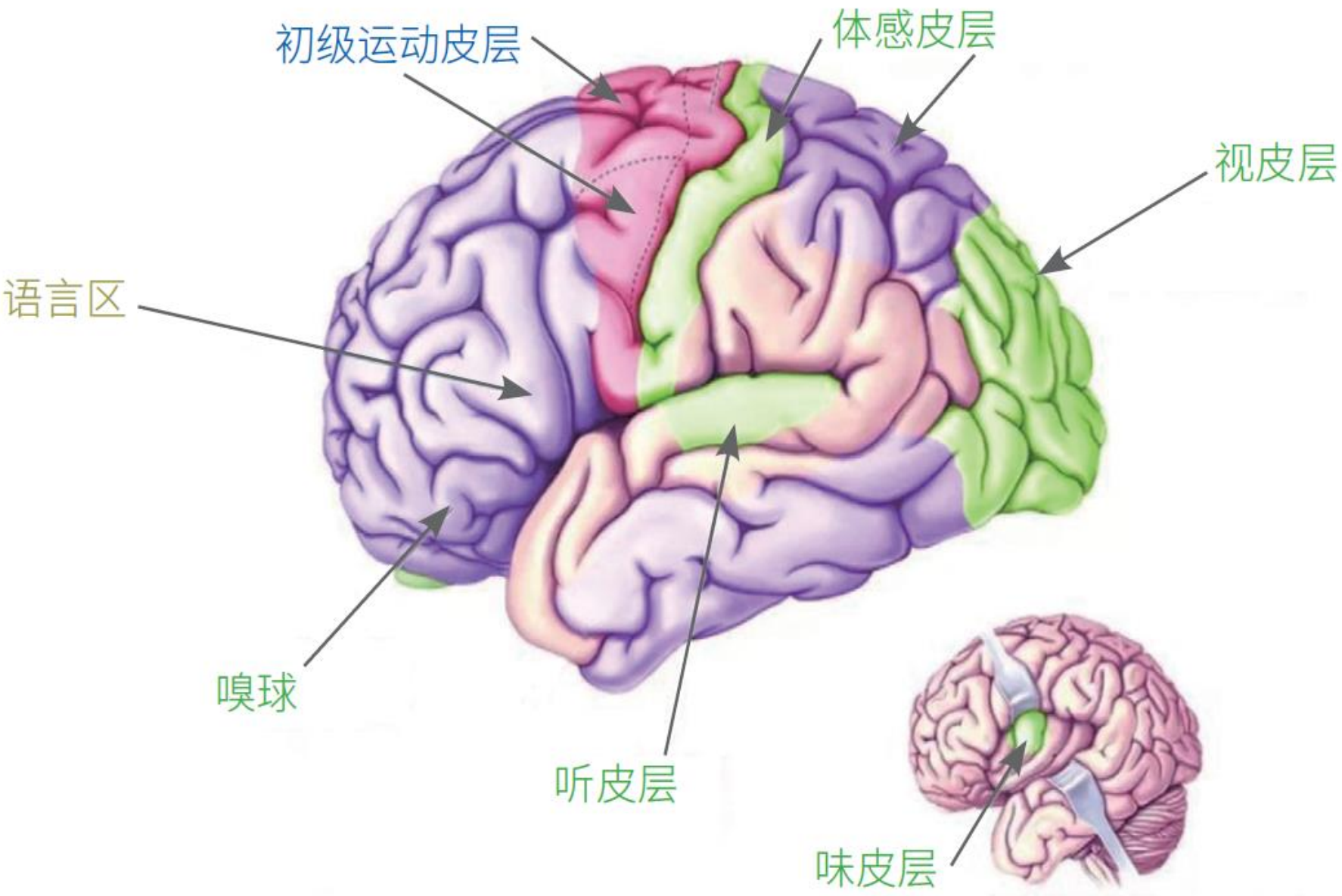
蔡元培. 1928.

中央研究院

历史语言研究所集刊。发刊词。



- “同是动物，
- 为什么只有人类能不断的进步，能创造文化？
- 因为人类有历史，而别的动物没有。因为他们没有历史，不能够把过去的经验传说下去。。。
- 为什么只有人类能创造历史，而别的动物没有？
- 因为人类有 **变化无穷的语言**”。



蒲慕明 Poo, Muming.

脑科学研究的三大发展方向.

中国科学院,上海生命
科学研究院,神经科学
研究所. 智库观点
34 :7. 2019.

图 1 大脑皮层的各个区域负责不同的脑功能

SPEAKING A HEARD WORD

MOTOR CORTEX

運動皮層

弓狀束

ARCUATE FASCICULUS

Reprinted in 王士元 2008.
語言湧現: 發展與演化.
中央研究院 語言學研究所.

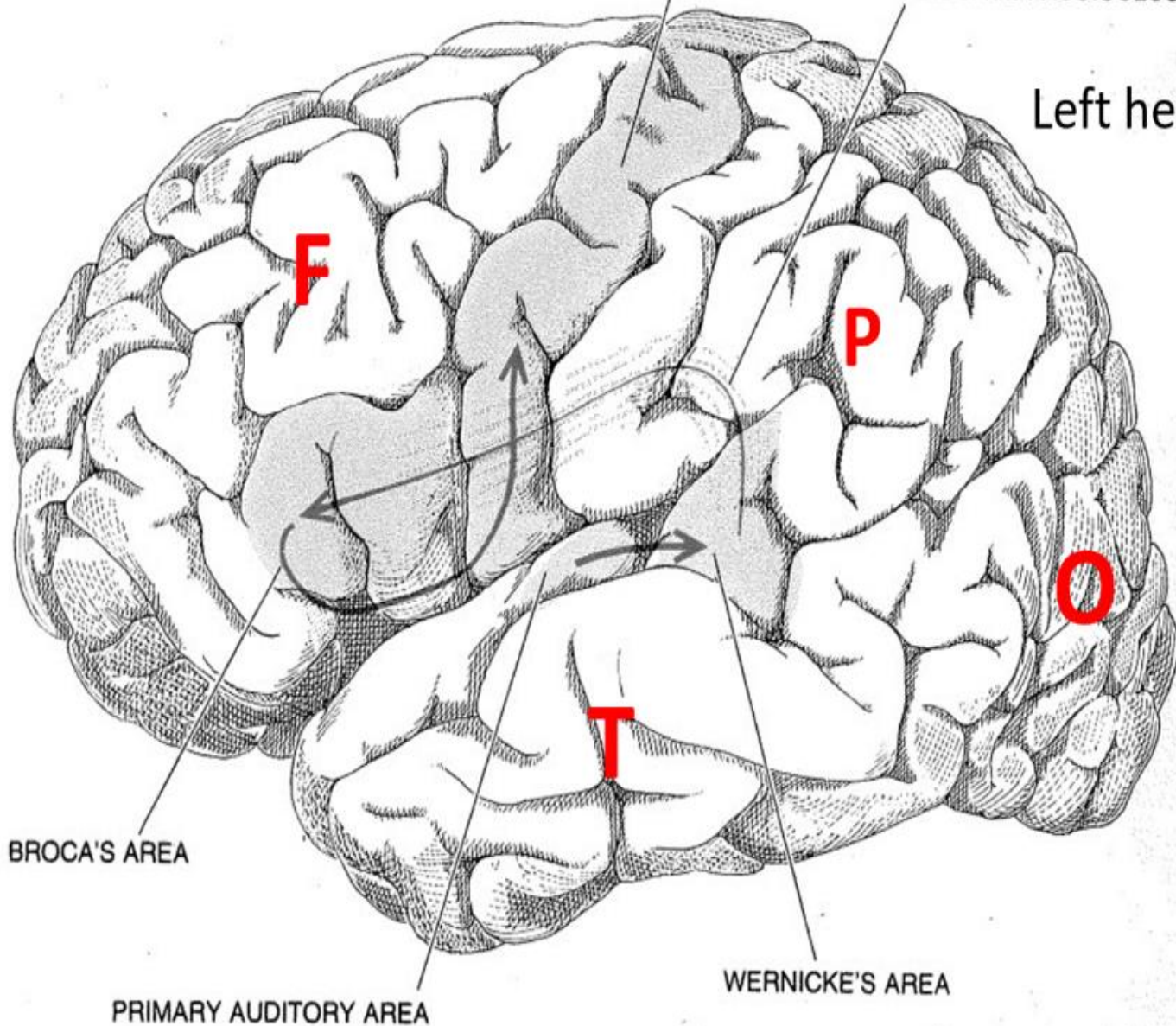
Left hemisphere & its four lobes:

Frontal, 額葉

Parietal, 頂葉

Temporal, 顳葉

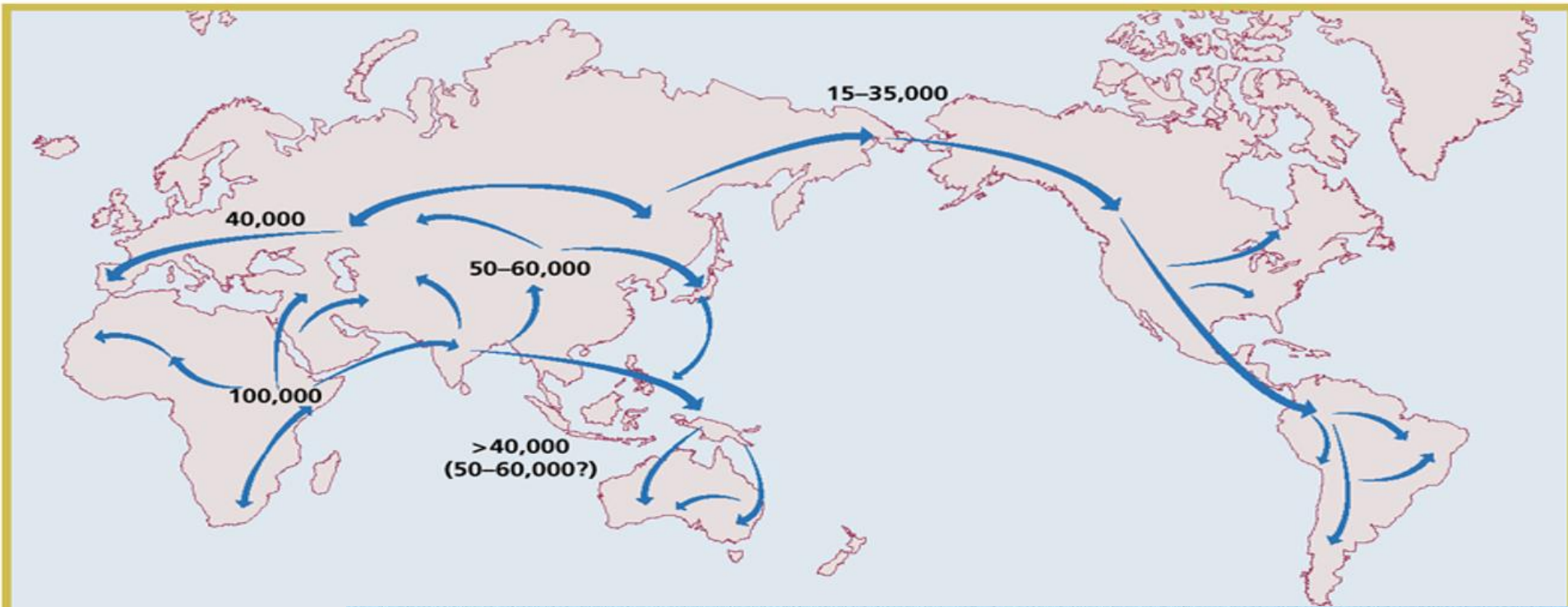
Occipital. 枕葉



Geschwind, Norman. 1979.

Specializations of the human brain.

Scientific American 241.158-68.

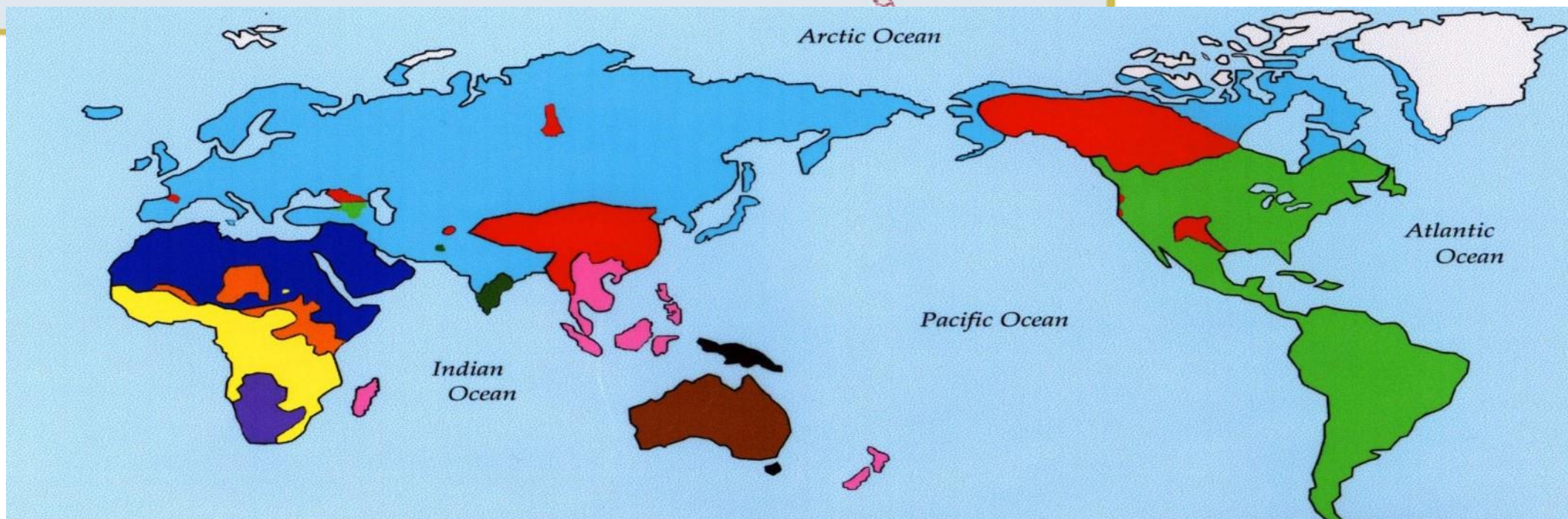


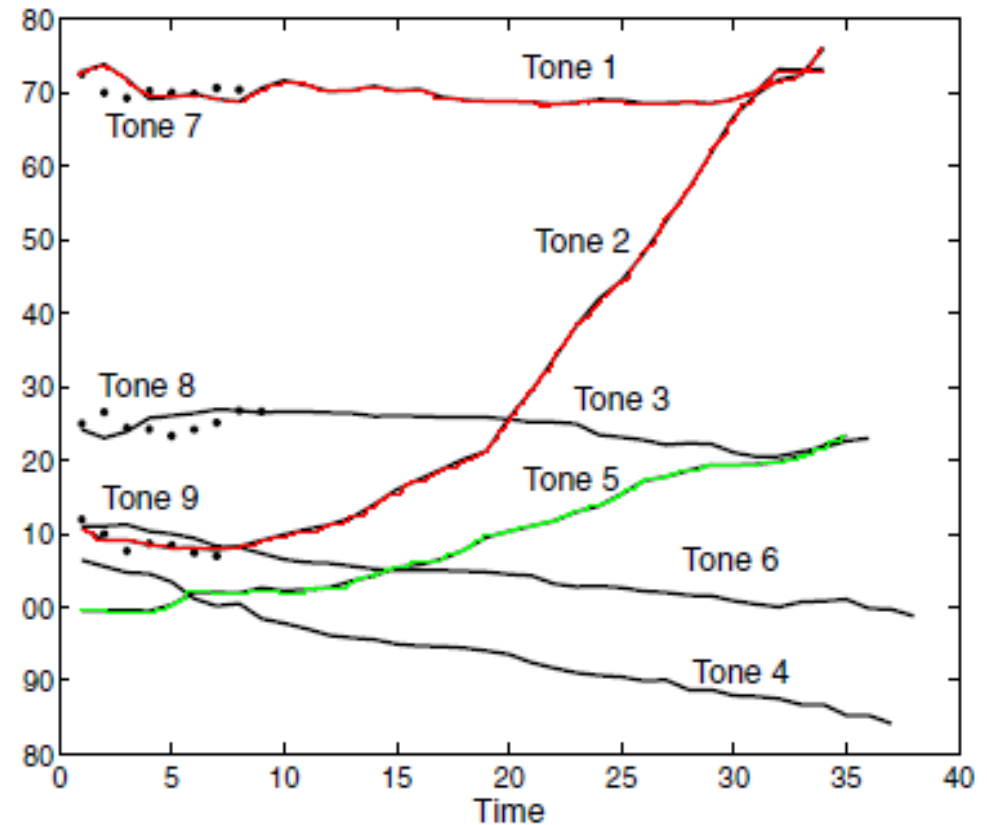
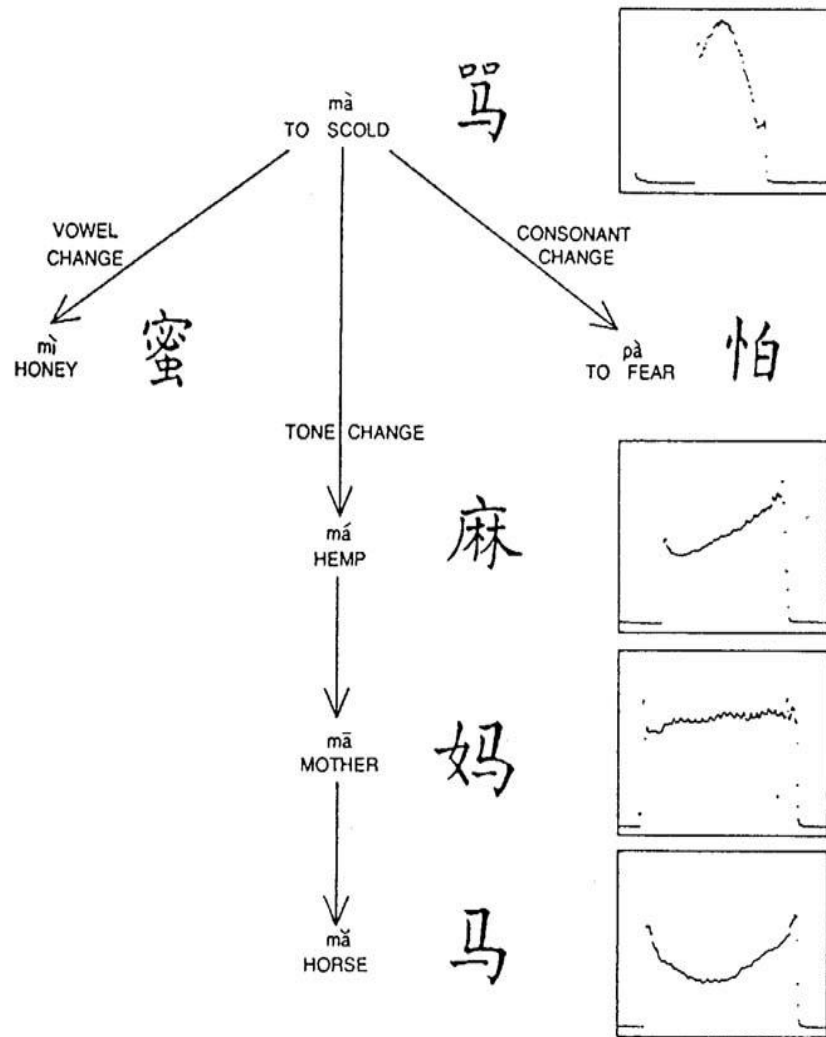
数十万年前，现代人走出非洲征服了整个地球。

Cavalli-Sforza & Feldman.
Nature Genetics 2003.

世界上现有数千种语言。J.Greenberg归纳成十几种超大语族。

英语（蓝）
汉语（红）



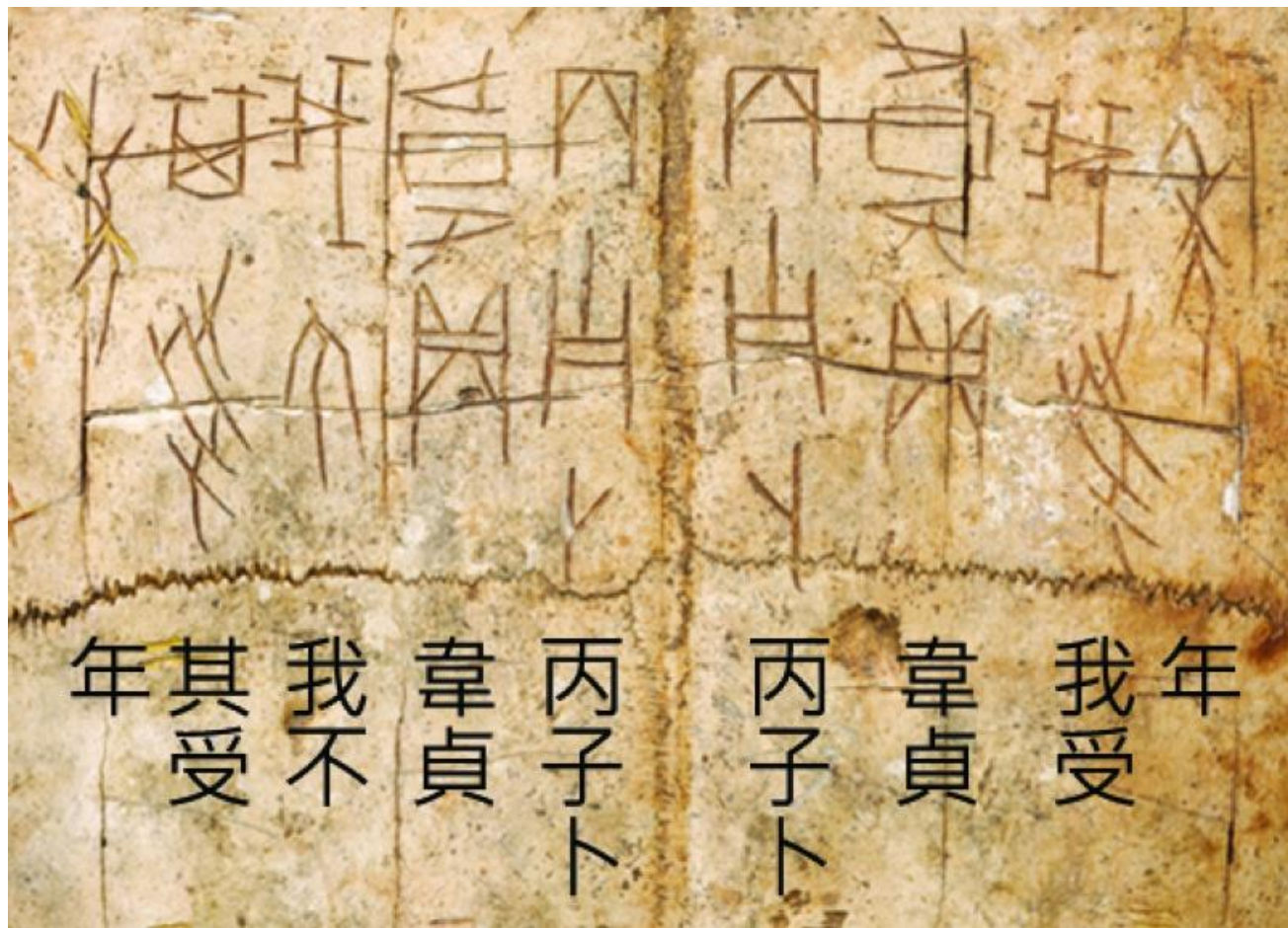


Cantonese tones in the monosyllable /i/ uttered in isolation. The solid lines are for long tones on unchecked syllables, while the dotted lines are for short tones on checked syllables. (Adapted from Peng & Wang, 2005)

W.S-Y.Wang.Feb.1973.
Scientific American.



《乙編》第867號，「韋」是貞人。



Radical Positions

Left	洋	water	松	wood
Right	切	knife	頂	head
Top	草	grass	竿	bamboo
Bottom	煮	fire	盟	vessel
Outside	圓	encircle	裏	clothing
Inside	斑	graph	瓣	melon

六书中绝大部分是形声字，优点是既表音又表意。

赵元任，语言问题。1980： 149

施氏食狮史

石室诗士施氏，嗜狮，誓食十狮。氏时时适市视狮。十时，适十狮适市。是时，适施氏适市。氏视是十狮，恃矢势，使是十狮逝世。氏拾是十狮尸，适石室。石室湿，氏使侍拭石室。石室拭，氏始试食十狮尸。食时，始识是十狮尸，实十石狮尸。试释是事。

“Stone house poet Mr. Shih was fond of lions and resolved to eat ten lions. The gentleman from time to time went to the market to look for lions. When at ten o’clock he went to the market, it happened that ten big lions went to the market. Thereupon, the gentleman looked at the ten lions and , relying on the momenta of ten stone arrows, caused the ten lions to depart from this world. ...” *English translation from Chao, Y.R. 1955. Meaning in language and how it is acquired. Cybernetics, Transactions of the Tenth Conference, ed. by H.v. Foerster, et al. 49-83. New York.*

赵元任，语言问题。1980：149。

施氏食狮史

石室诗士施氏，嗜狮，誓食十狮。氏时时适市
视狮。十时，适十狮适市。是时，适施氏适市
。氏视是十狮，恃矢势，使是十狮逝世。氏拾
是十狮尸，适石室。石室湿，氏使侍拭石室。
石室拭，氏始试食十狮尸。食时，始识是十狮
尸，实十石狮尸。试释是事。

入声字 -p -t -k

	BJ Pinyin	HK Jyutping	Japanese Kana	Korean Hangul
千山 鸟飞绝	jue2	zyut	ぜつ zetsu	절 jeol
万径 人踪灭	mie4	mit	めつ metsu	멸 myeol
独钓 寒江雪	xue3	syut	せつ setsu	설 seol

Eom, I.-S. (2002). "The origin of Sino-Korean Coda-l."
Korean Linguistics **11**: 101-117.

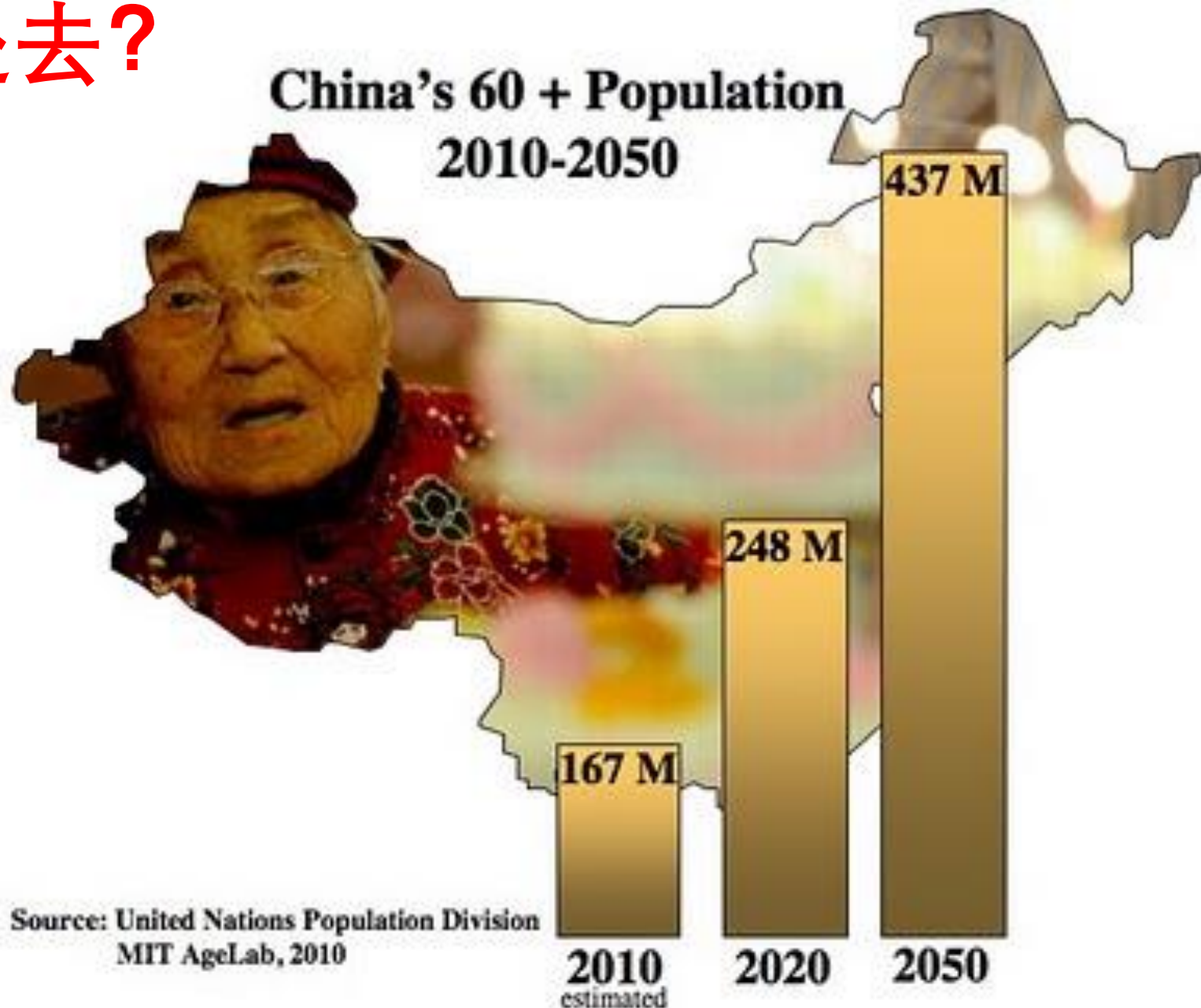
汉语方言数目词的对应

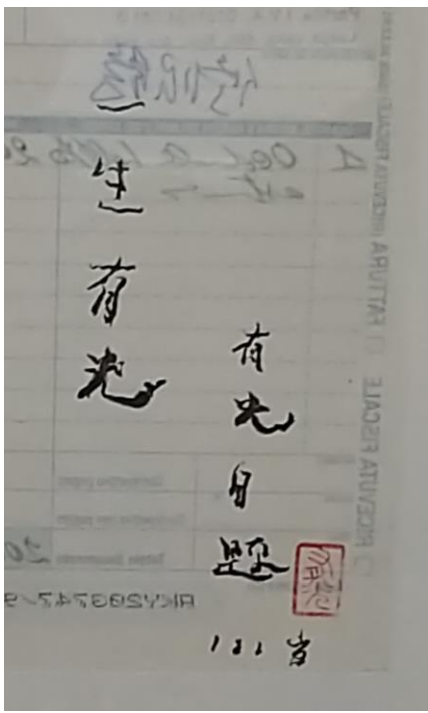
	GZ	BJ	SH	XM	Japanese
1	jat ^{IVu}	yi ^{Iu}	yi? ^{IVu}	tsit ^{IVv}	ichi
2	ji ^{IIIv}	er ^{III}	ni ^{IIIv}	li ^{IIIv}	ni
3	saam ^{Iu}	san ^{Iu}	se ^{Iu}	sã ^{Iu}	san
4	sei ^{IIIu}	si ^{III}	si ^{IIIu}	si ^{IIIu}	shi
5	ng > m ^{IIv}	wu ^{II}	ng ^{IIv}	go ^{IIIv}	go
6	luk ^{IVv}	liu ^{III}	lu? ^{IVv}	lak ^{IVv}	roku
10	sap ^{IVv}	shi ^{Iv}	ze? ^{IVv}	tsap ^{IVv}	ju

... où allons nous? **向何处去?**

科技在日新月异地进展。
人工智能战胜了世界的
围棋冠军，计算机用光
纤要比现在的电脑快好
多倍，嫦娥去月球、祝
融去火星

**可是地球上还有些非
常迫切的问题！**





Zhou Youguang,
周有光,
1906 – 2017.
Advocate of
Hanyu Pinyin.
111 years.

The longest human
lifespan is that of
Jeanne Calment
of France (1875–1997),
who lived to the age of
122 years, 164 days.



Professor Charles Kuen Kao (高錕) was born in Shanghai in 1933. He is the recipient of a Nobel Prize in Physics in 2009, & was known as the “Father of Fibre Optics”.

He had **Alzheimer’s Disease**, as did his father.

可惜再先进的科技，都无法帮我们阻止如此精明的大脑退化。





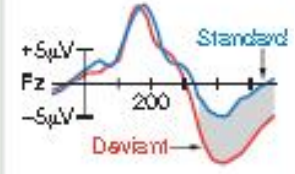
细胞总在死亡，所有的生物都不能不老。人口老化是全世界迫切的问题。我们正试图用脑成像的科技，通过语言来研究大脑，及早发现退化的征兆，帮助维持大脑的健康。

Inexpensive

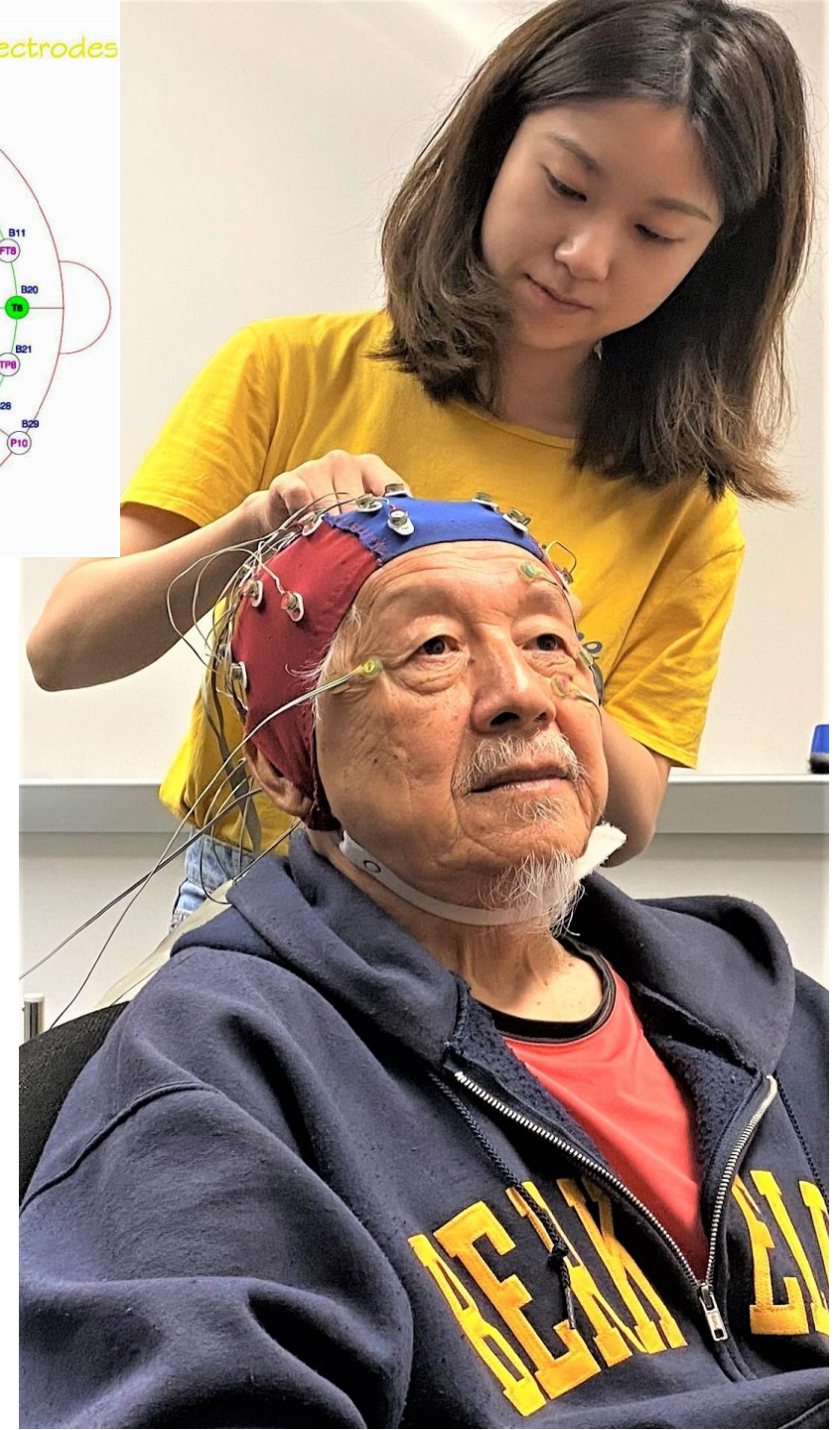
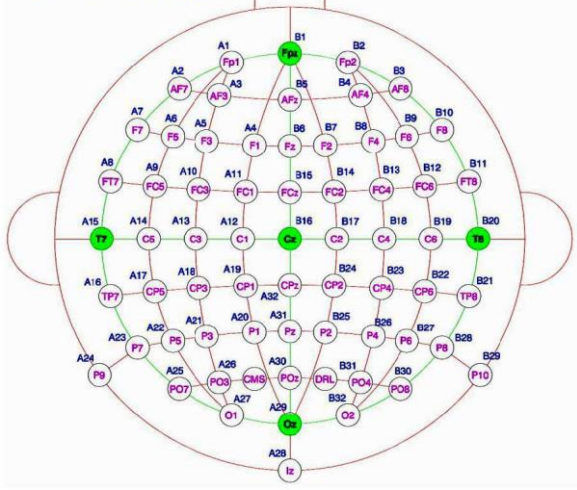


EEG/ERP: Electrical potential changes

- Excellent temporal resolution
- Studies cover the life span
- Sensitive to movement
- Noiseless



BioSemi Layout 64+2 electrodes

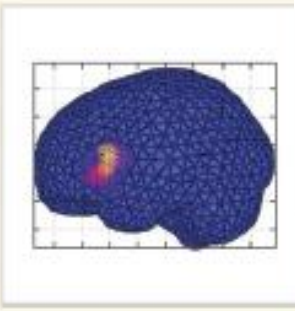


Expensive



MEG: Magnetic field changes

- Excellent temporal and spatial resolution
- Studies on adults and young children
- Head tracking for movement calibration
- Noiseless

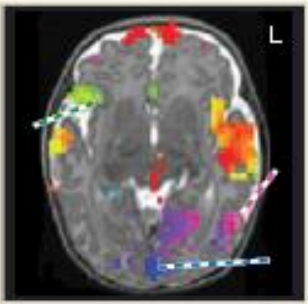


Expensive



fMRI: Hemodynamic changes

- Excellent spatial resolution
- Studies on adults and a few on infants
- Extremely sensitive to movement
- Noise protectors needed



Moderate



NIRS: Hemodynamic changes

- Good spatial resolution
- Studies on infants in the first 2 years
- Sensitive to movement
- Noiseless

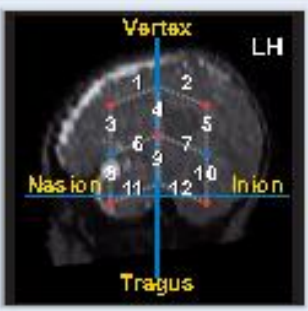


Figure 1
Our neuroscience techniques now used with infants and young children to examine their brain responses to linguistic signals.

高更的三个问题，我们 **从何处来？ 人是何物？ 向何处去？** 都和语言有著密不可分的关系，因为语言是人类最重要的指标，不仅是区别人类和动物的分水岭，也是人工智能还无法让电脑掌握的能力。人类发明了语言，语言也反过来造就了人类。自从达尔文提出演化论起，许多学科在这三个问题上都已取得不少研究成果。我今天把这些多学科的成果做了蜻蜓点水式的讨论。知识总是在进步的，今日的理论，很可能明日就被新的发现或想法所取代，这一点是我们必须始终留意的。

DREAM BIG ! AIM HIGH !

我非常赞同海报上的这两句话。一定要怀抱富有意义的梦想，才能设定目标迈步前进。语言是人类最伟大的发明，帮我们整理思路、增强记忆、促进群体的团结合作、超越时空累积智慧。可是我们对语言的了解却远远不够，

如：婴儿如何习得母语？之后又怎样学习多种外语？大脑怎样操作语言？语言如何在种种不同的情境下退化或消失？要回答这些问题，我们必须运用多学科的视角、采取最先进的科技，来研究这些重要及有趣的语言课题。希望今天短短的演说，能激励更多年轻同学投身这方面的工作。