City University of Hong Kong

2016.9.12

Language & the Brain:

an overview of Changes across the Life-span.

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Historical Perspective.

Hippocrates, Vesalius, 19th century pioneers.

Cognition, Neuroscience & Imaging Technology.

Neurons, synapses, neurotransmitters.

Speech, perception, memory. Cognitive neuroscience of language, CNL.

Language emergence in infancy and childhood.

Fetal development & language in the early years.

Cognitive decline in the sunset years.

Cerebral ageing & cognitive ageing. Neurodegeneration & pathology.

Demographic shift, world epidemic, & multidisciplinary response.

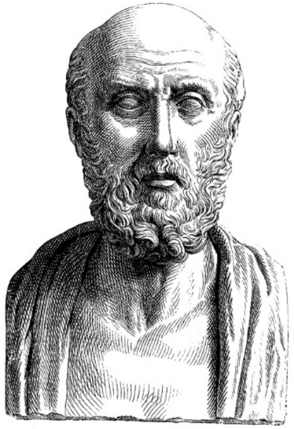
Pdf available, email wsywang@polyu.edu.hk.

*Language and the **heart** metaphor:*

小**心**.	To be careful.
好**心**.	Kind hearted
心配する.	To worry.
Kokoroに.	In the heart.
Stare a **cuore**.	To care about.
Grazie di **cuore**.	Thanks from the heart.
У него золотое **сердце**.	He has a heart of gold.
Делаю от всего **сердца**.	I'm doing it with all my heart.

Harvey, William. 1628. “*De Motu **Cordis***” = "*On the Motion of the **Heart** and Blood*“

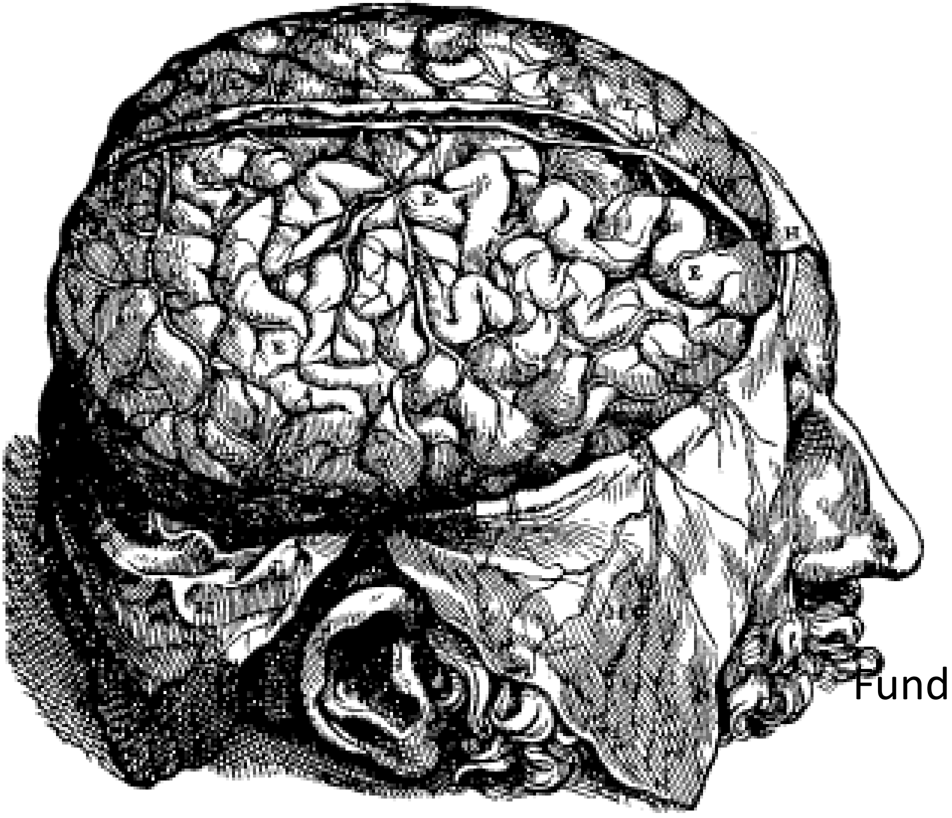
Other metaphors for emotions involve liver, kidney, spleen “to vent his spleen”, intestine “断肠”, etc.

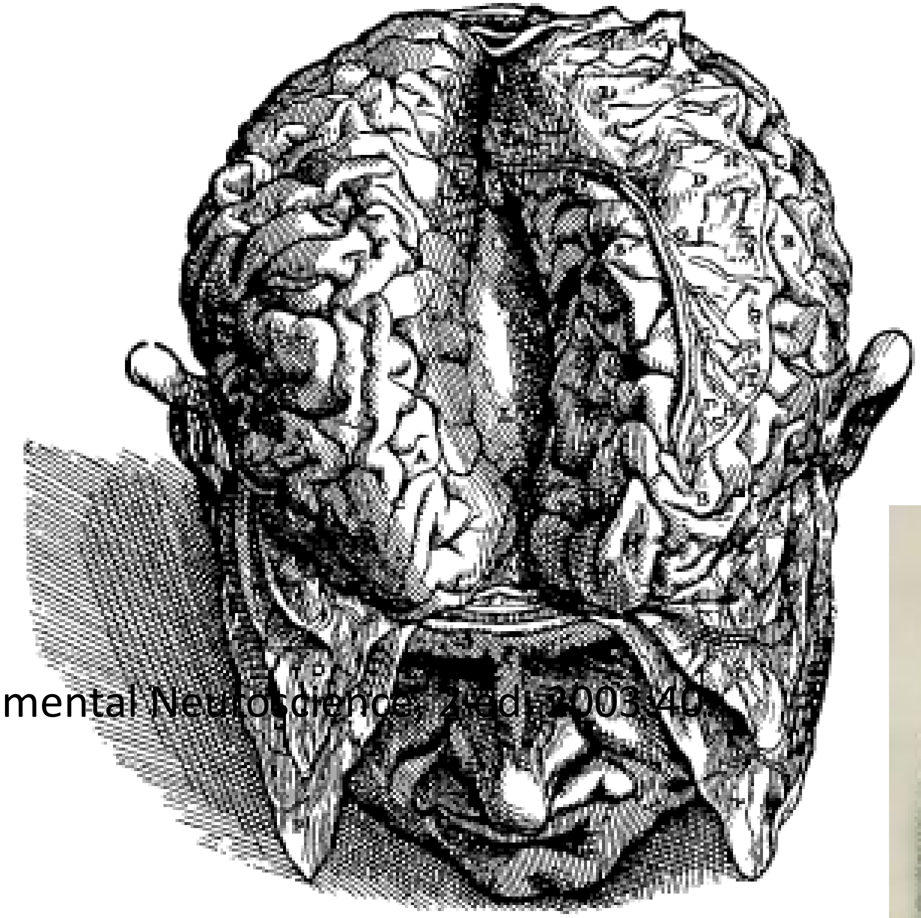


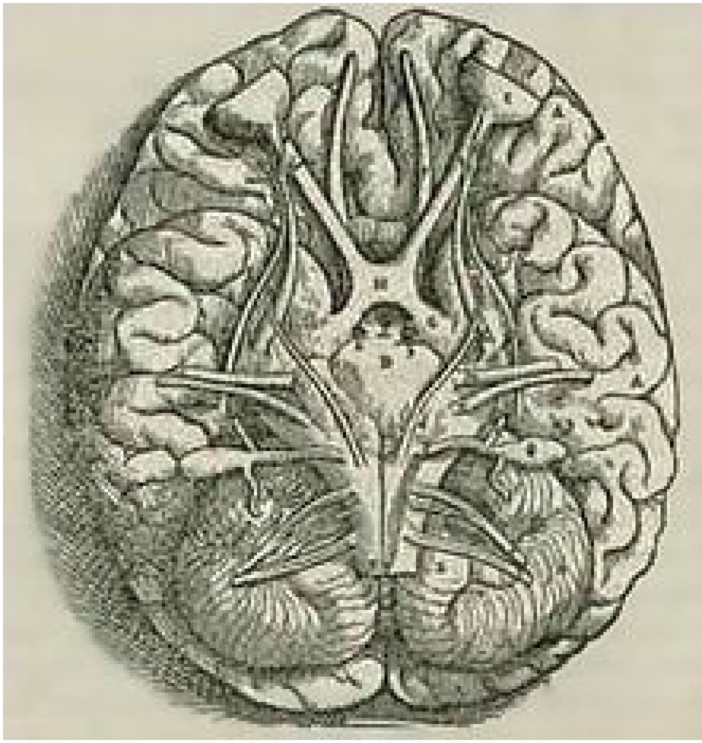
Hippocrates.

“Father of Western Medicine”.

Men ought to know that from nothing else but the **brain** come joys, delights, laughter and sports, and sorrows, griefs, despondency, and lamentations. And by this, in an especial manner, we acquire wisdom and knowledge, and see and hear and know what are foul and what are fair, what are bad and what are good, what are sweet and what are unsavory ... And by the same organ we become mad and delirious, and fears and terrors assail us ... All these things we endure from the brain when it is not healthy ... In these ways I am of the opinion that the **brain exercises the greatest power in the man**." *quoted in Syntactic Complexity, T.Givon & M.Shibatani, eds.2009:509.*

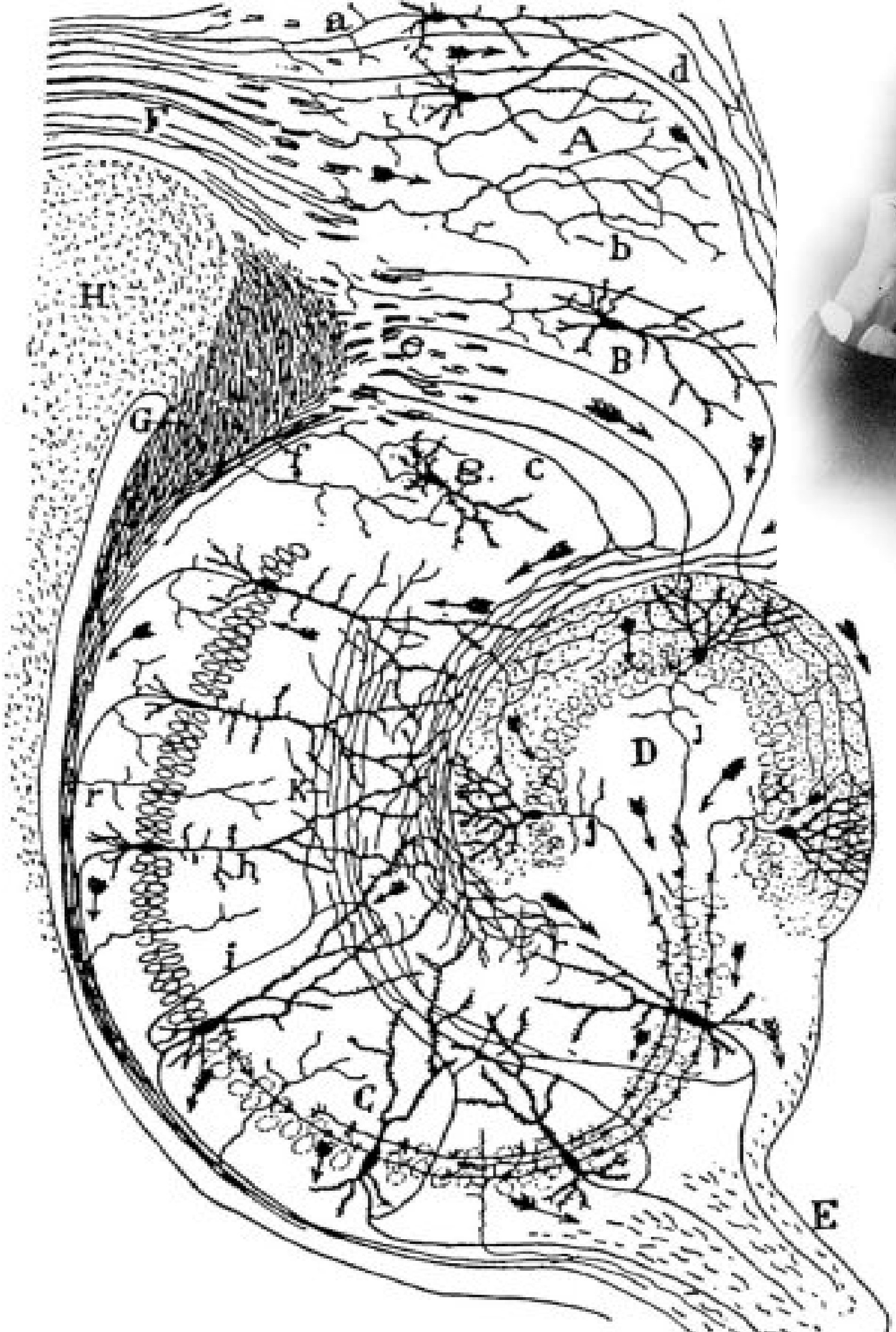


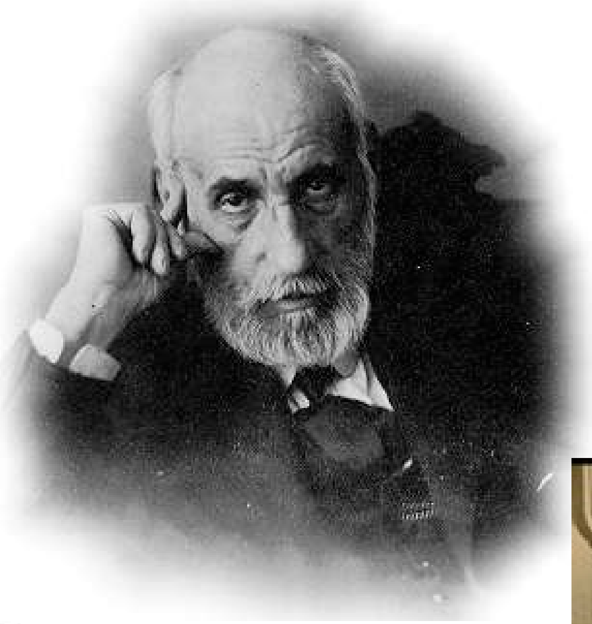




Fundamental Neuroscience, 2 ed. 2003:40.

‘This is from perhaps the most important book in the history of medicine, the "*Fabric of the Human Body*", published in 1543 by Andreas Vesalius.’ <u>*Fundamental Neuroscience*</u>, 2 ed. 2003:40.



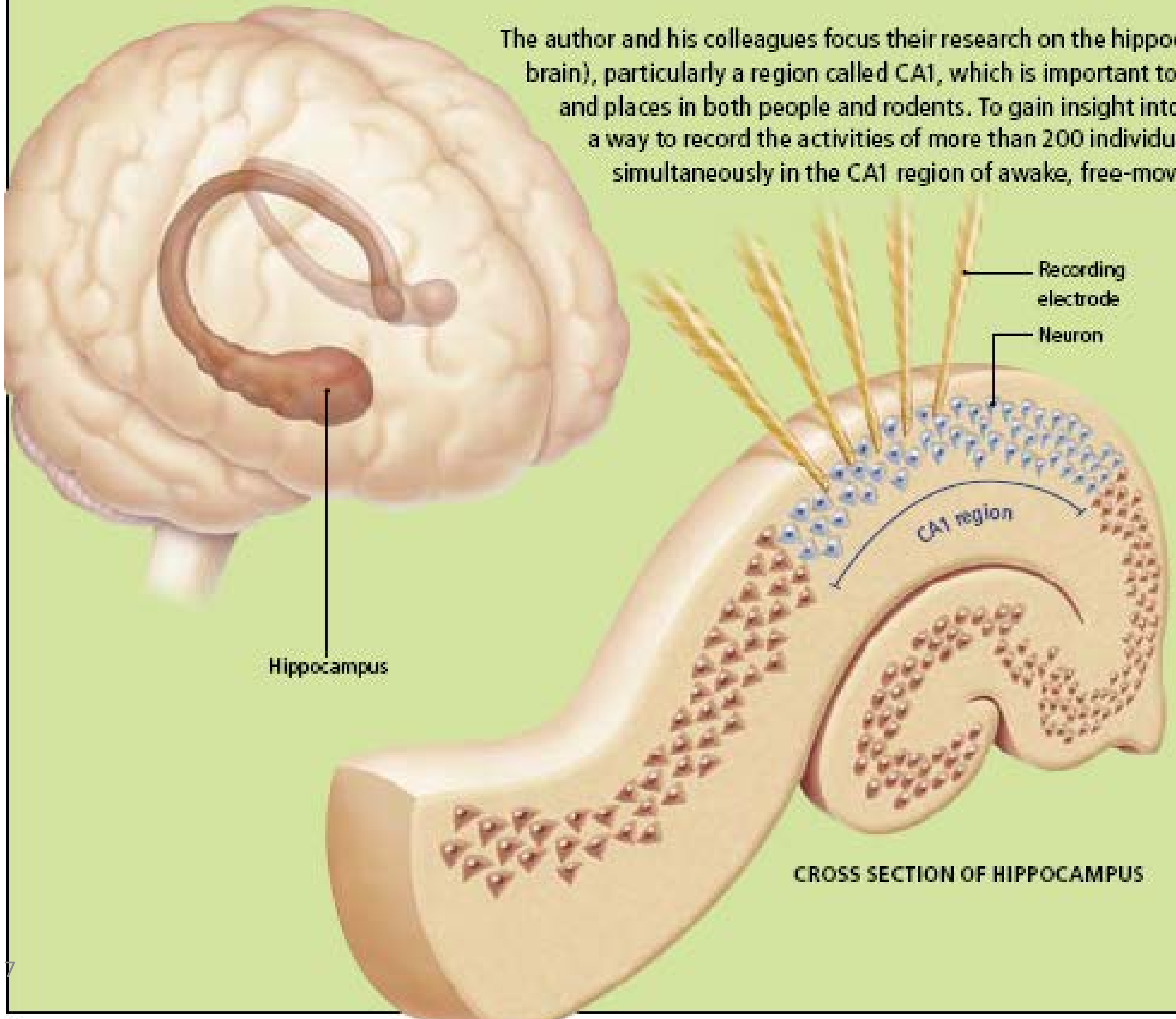


R.S.Cajal

1852-1934
Nobel Prize 1906

A SEAT OF MEMORY

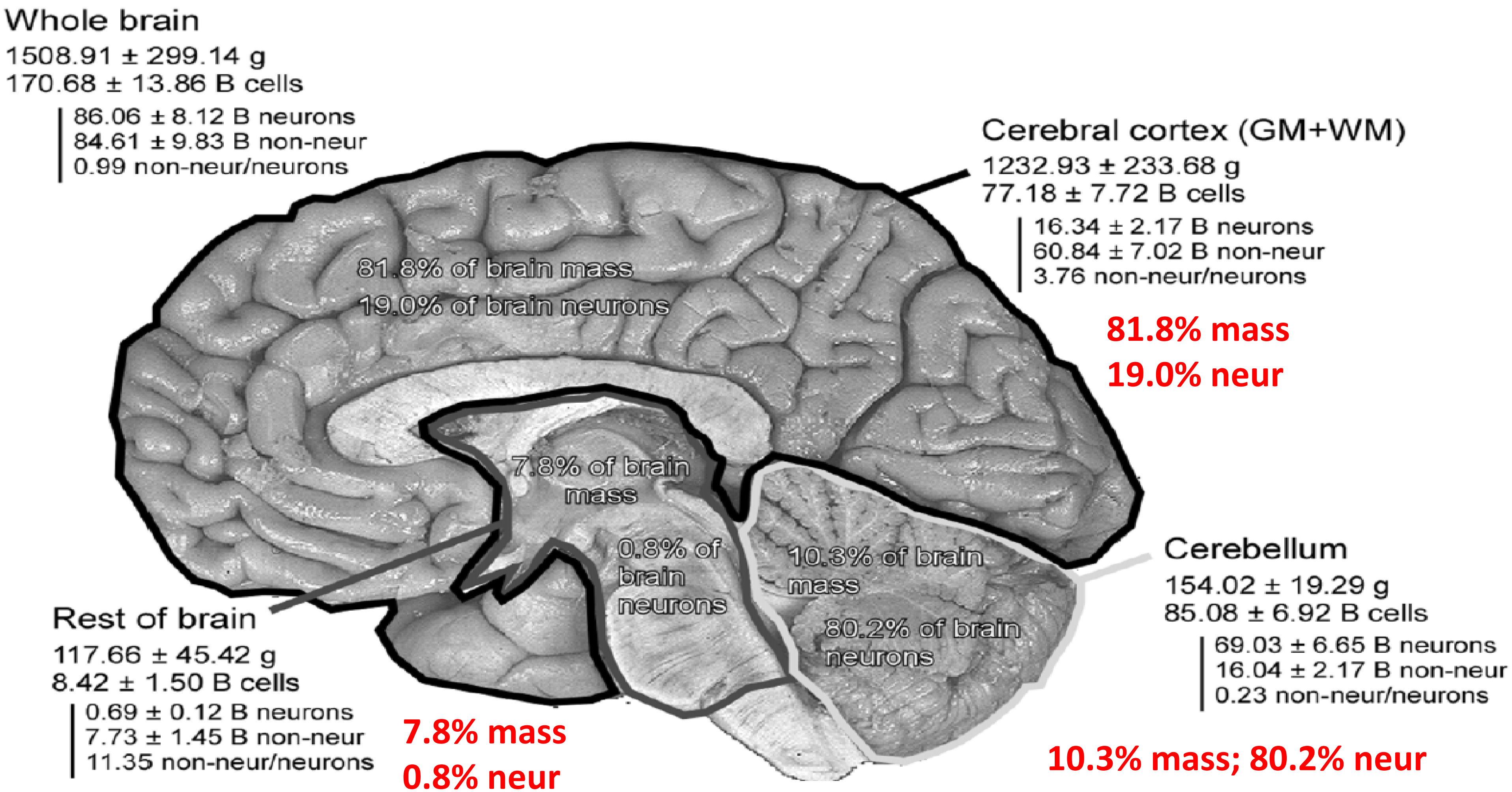
The author and his colleagues focus their research on the hippocampus (shown in human brain), particularly a region called CA1, which is important to forming memories of events and places in both people and rodents. To gain insight into the process, they developed a way to record the activities of more than 200 individual nerve cells, or neurons, simultaneously in the CA1 region of awake, free-moving mice.



Tsien, J.Z. The Memory Code. *Scientific American* 2007.

▼ CA1 neurons branch dramatically, a feature well captured in this micrograph depicting mouse nerve cells coaxed to produce a yellow fluorescent protein.

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.



81.8% mass
19.0% neur

7.8% mass
0.8% neur

10.3% mass; 80.2% neur

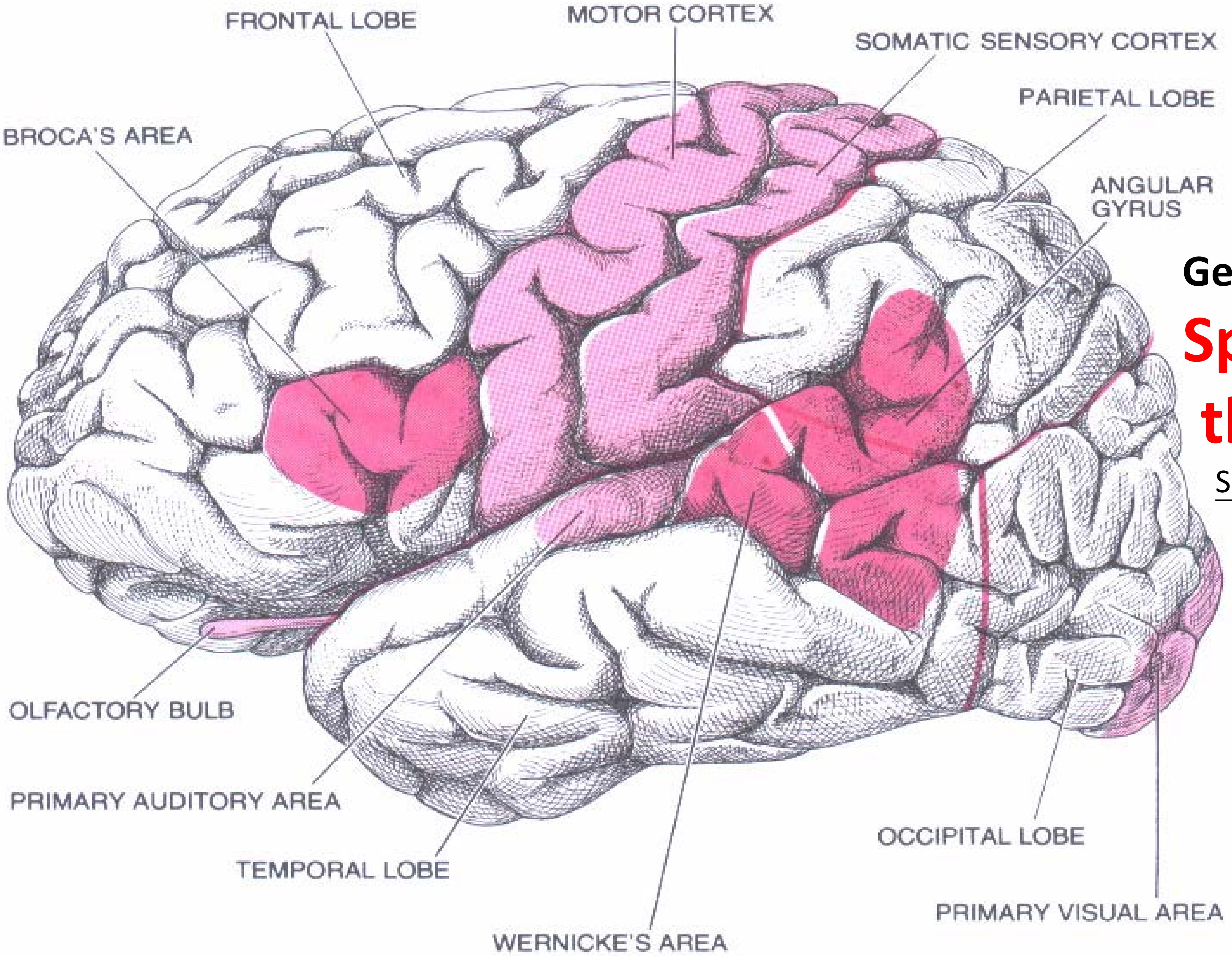
Three pioneers in studies of

Language & Brain

Paul Pierre Broca
(1824-1880)

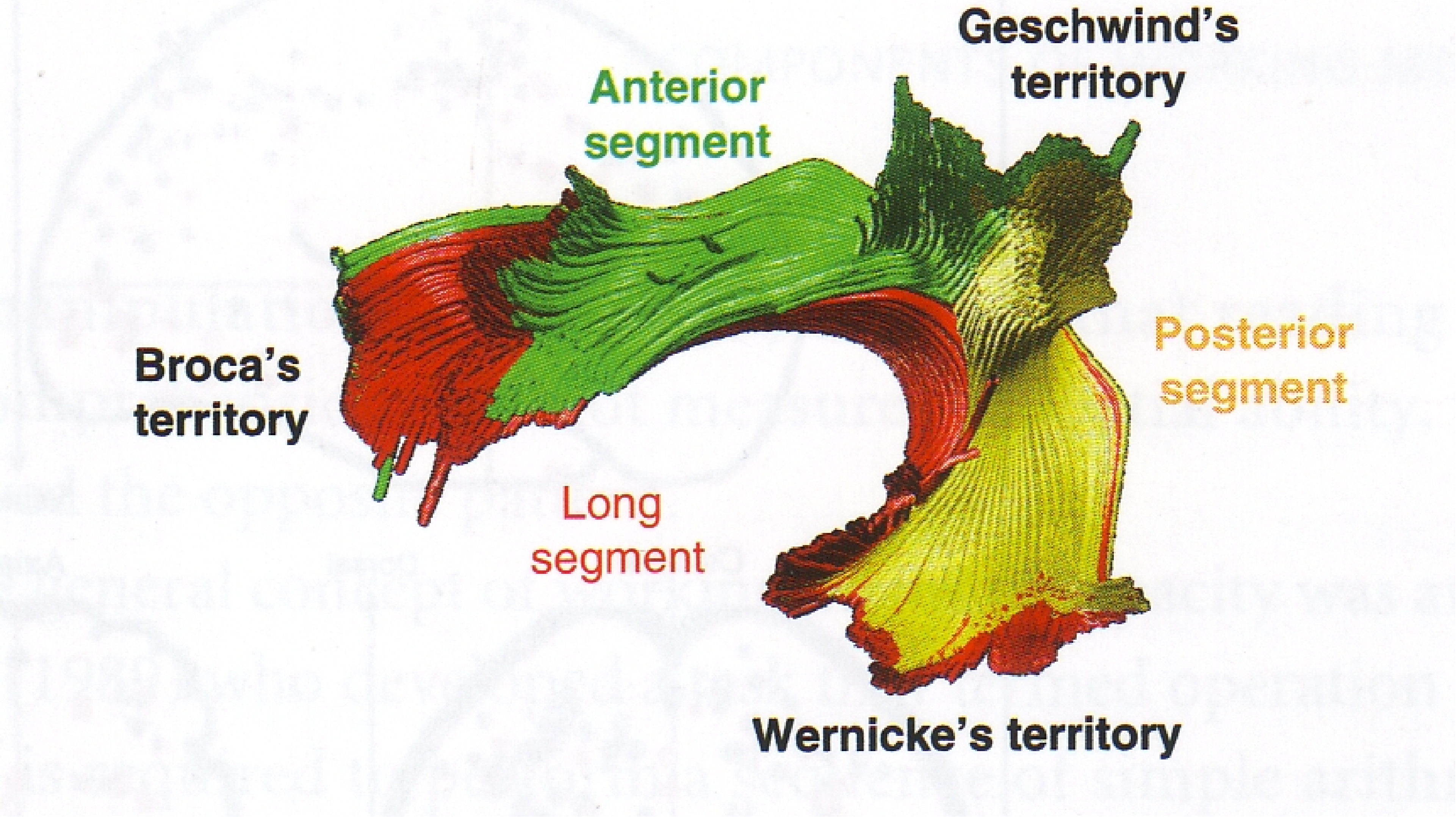
Carl Wernicke
(1848-1904)

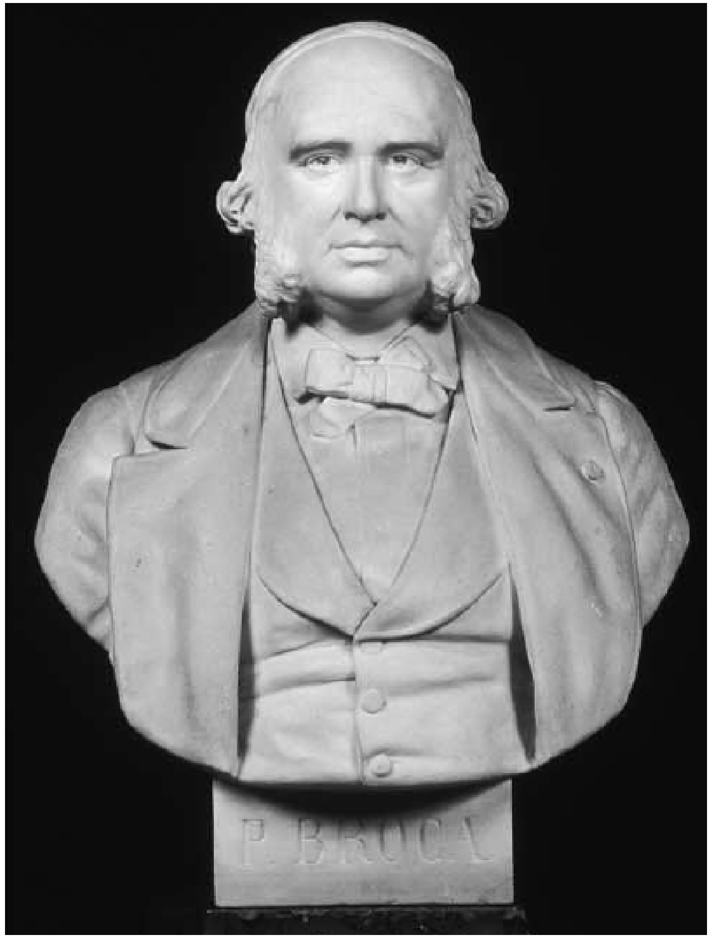
Jules Dejerine
(1849-1917)



Geschwind, Norman. (1979). **Specializations of the human brain**. Scientific American, *241:*158-168.

Catani, Marco, Derek K. Jones & Dominic H. ffytche. 2005.
Perisylvian Language Networks of the Human Brain. Ann Neurol ; 57.8-16.





Broca, Paul. 1824-80.

Nouvelle observation d'aphémie produite par une lésion de la moitié postérieure des deuxième et troisième circonvolution frontales gauches. *Bulletin de la Société Anatomique 36. 398-407 (1861).*

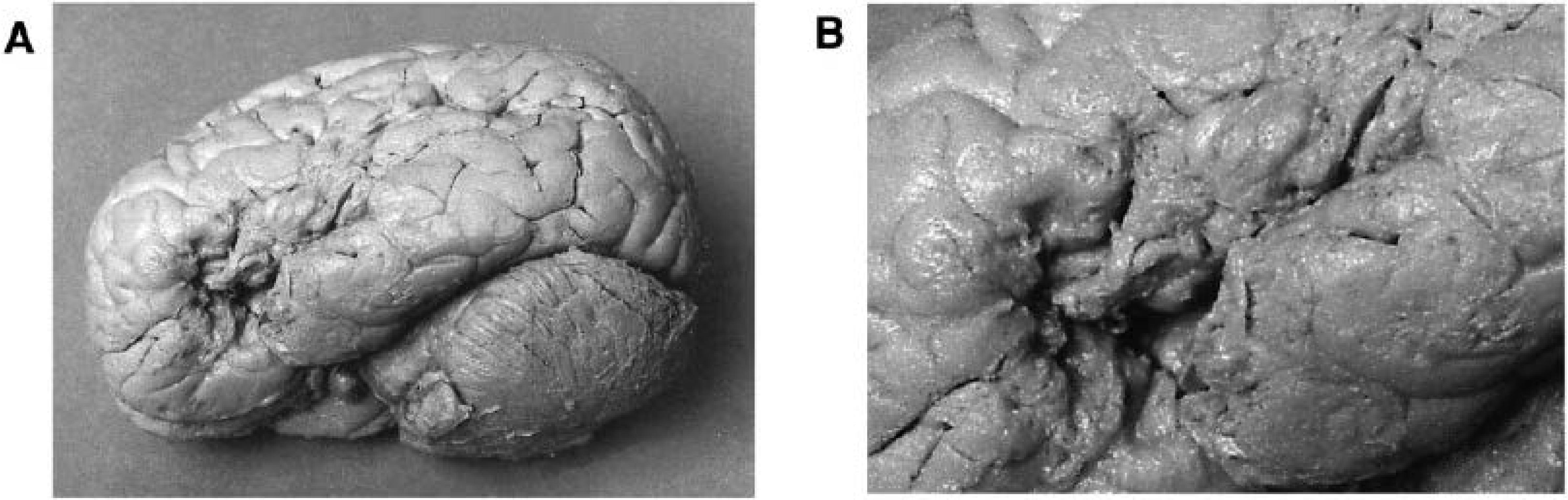
"The integrity of the third frontal convolution (and perhaps of the second) seems indispensable to the exercise of the faculty of articulate language ...

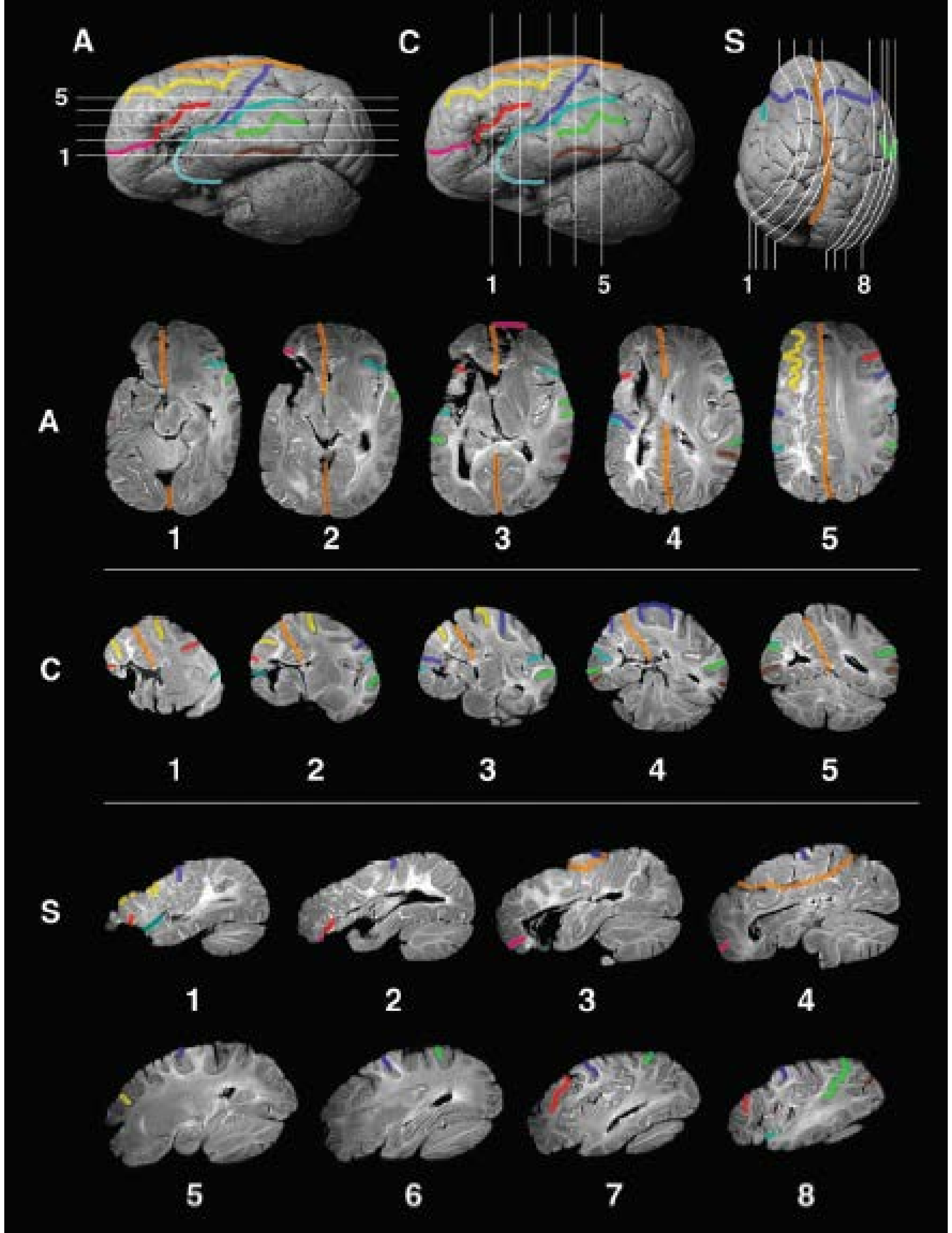
I found that in my second patient the lesion occupied exactly the same seat as with the first - immediately behind the middle third, opposite the insula and precisely on the same side."

Translation taken from Dronkers et al 2007.

Dronkers, N. F., O. Plaisant, M. T. Iba-Zizen & E. A.Cabanis. 2007. Paul Broca's historic cases: high resolution MR imaging of the brains of Leborgne and Lelong. *Brain* 130.1432-41.

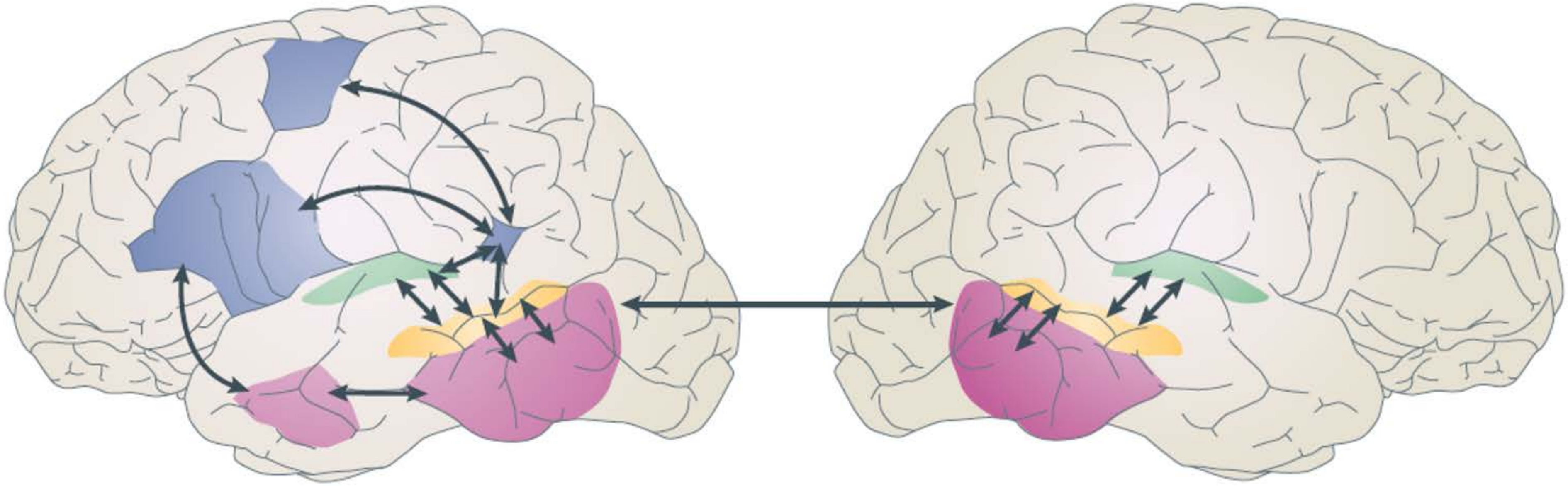
1436 *Brain* (2007), **130**, 1432–1441 N. F. Dronkers *et al.*





Dronkers, N. et al. 2007.
Paul Broca's historic cases: high resolution MR imaging of the brains of Leborgne and Lelong. Fig.4, 1436. *Brain* 130.1432-41.

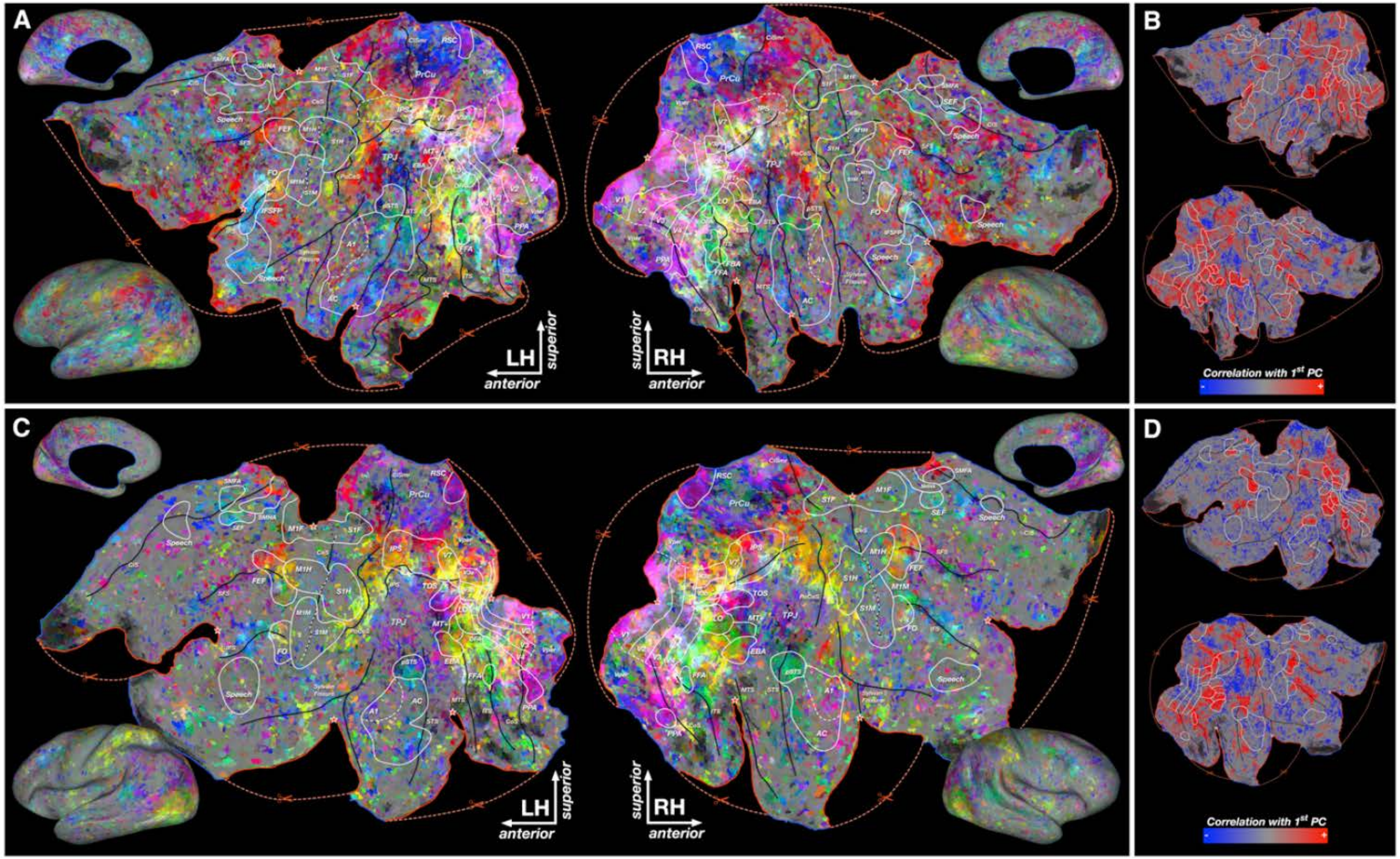
"Sagittal, axial & coronal slices through the brain reveal lesions in the left inferior frontal gyrus, deep inferior parietal lobe & anterior superior temporal lobe. In addition, there is extensive subcortical involvement including the claustrum, putamen, globus pallidus, head of the caudate nucleus and internal and external capsules. The insula is completely destroyed. The entire length of the superior longitudinal fasciculus is also obliterated, along with other frontal-parietal periventricular white matter. The medial subcallosal fasciculus is also affected."

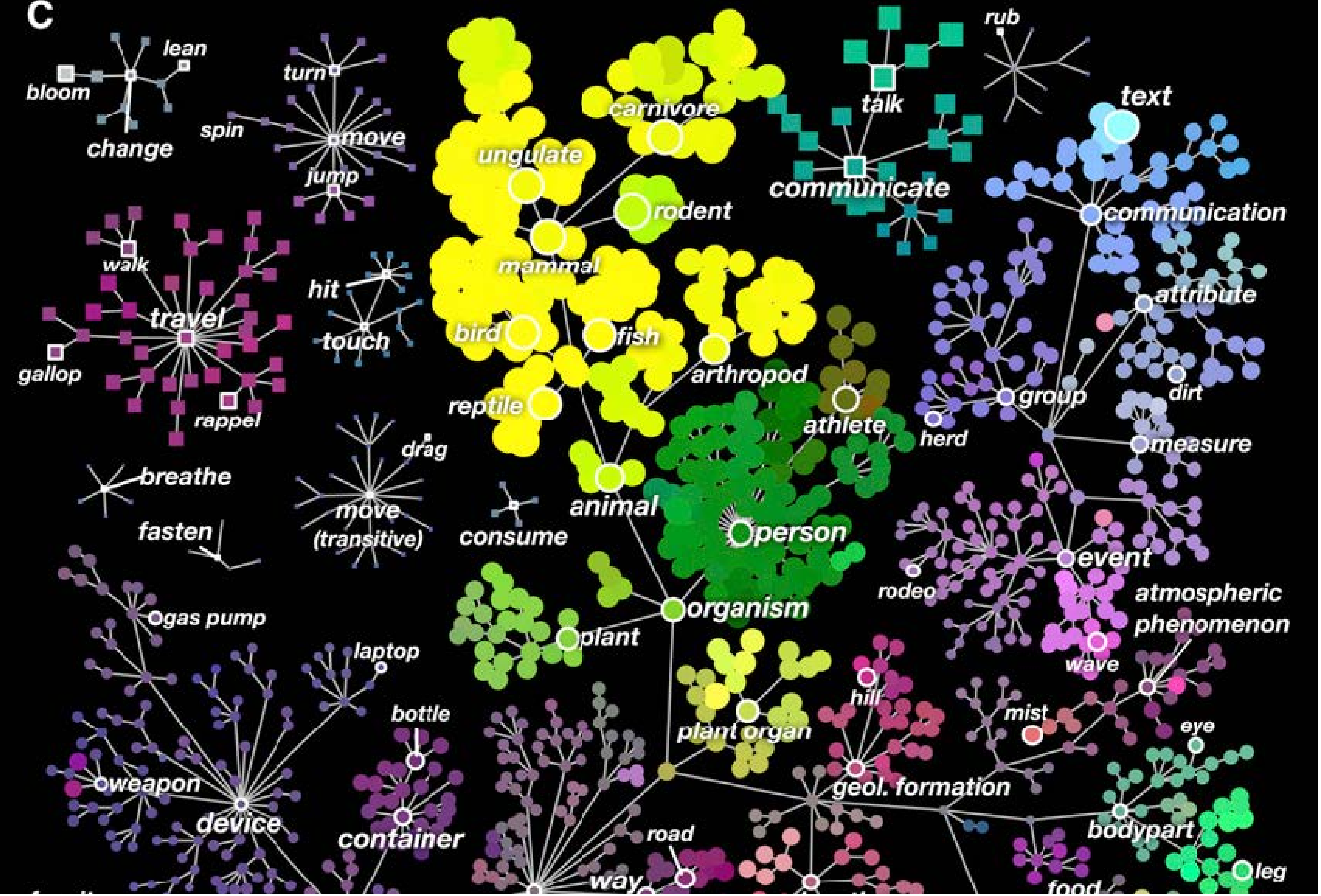


Hickok, G. & Poeppel, D. 2007. *Nature Reviews | Neuroscience 8*: 393-402.

Green regions depict areas on the dorsal surface of the STG involved in spectrotemporal analysis. Yellow regions in the posterior half of the STS are involved in phonological processes. Pink regions represent the ventral stream, which is bilaterally organized with a weak left-hemisphere bias. The more posterior regions of the ventral stream, posterior middle and inferior portions of the temporal lobes correspond to the lexical interface, which links phonological and semantic information, whereas the more anterior locations correspond to the proposed combinatorial network. Blue regions represent the dorsal stream, which is strongly left dominant. The posterior region of the dorsal stream corresponds to an area in the Sylvian fissure at the parietotemporal boundary, which is a sensorimotor interface, whereas the more anterior locations in the frontal lobe, probably involving Broca's region and a more dorsal premotor site, correspond to portions of the articulatory network. anterior inferior temporal sulcus; anterior middle temporal gyrus; posterior inferior frontal gyrus; premotor cortex.

Huth, A.G., et al. 2012. A Continuous Semantic Space Describes the Representation of Thousands of Objects and Action Categories across the Human Brain. _Neuron, 76_, 1210-1224.





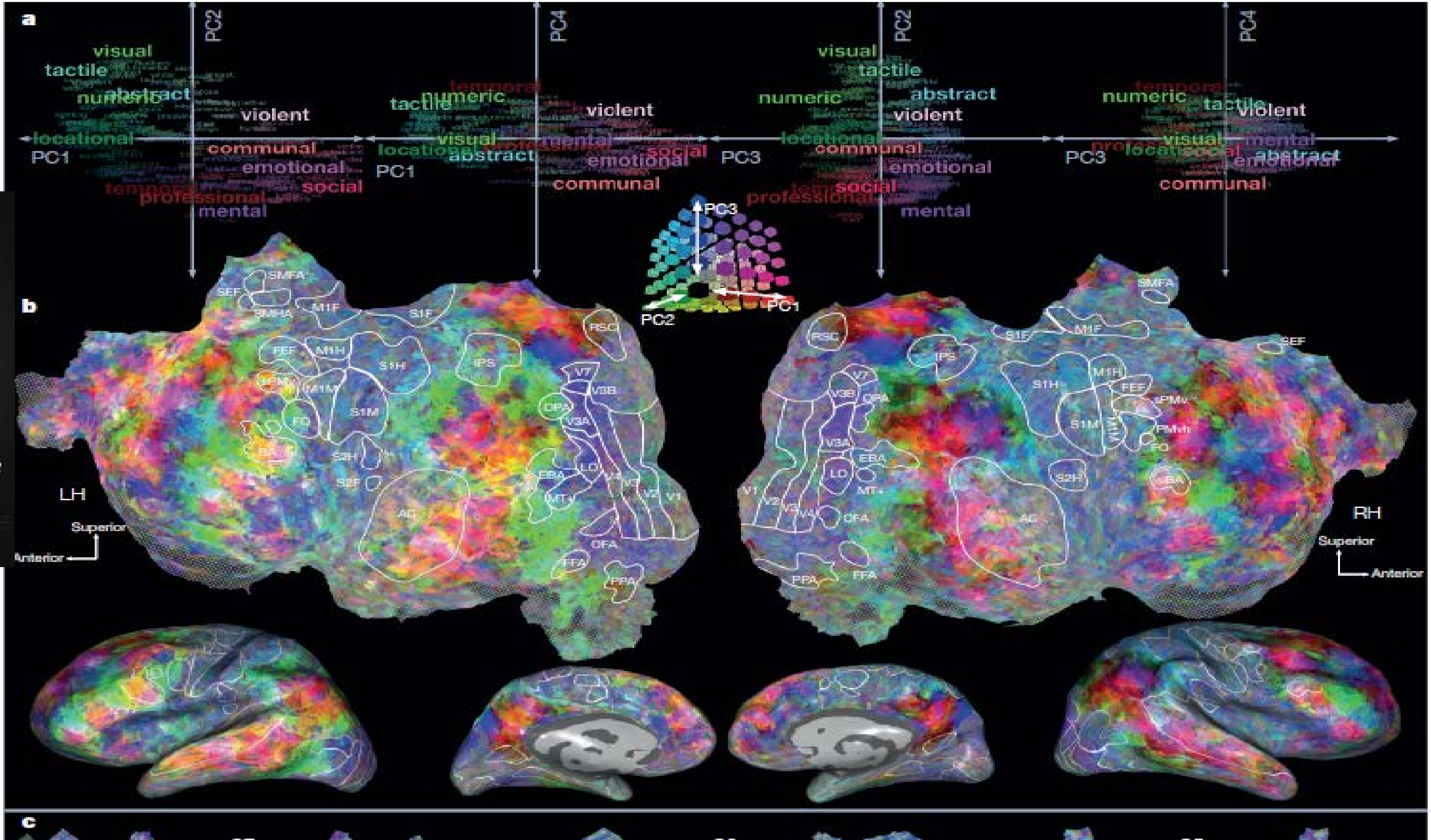
Huth, A.G., et al. 2012.

A Continuous Semantic Space

Neuron, *76*:1210-24.

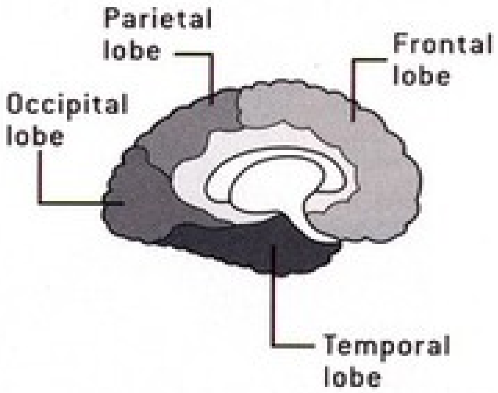
Figure 4C.

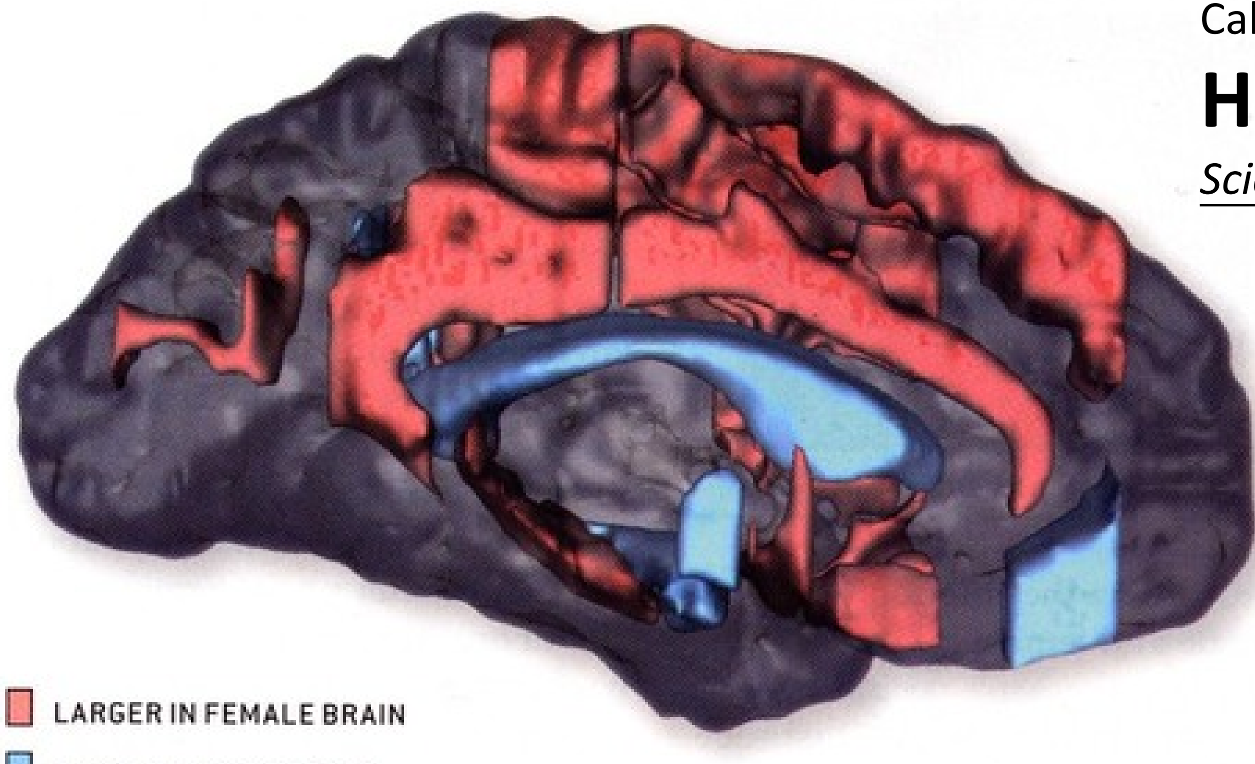
Huth, A.G., et al. (2016). Natural speech reveals the semantic maps that tile human cerebral cortex. *Nature 532* 453-472.



SIZABLE BRAIN VARIATION

Anatomical differences occur in every lobe of male and female brains. For instance, when Jill M. Goldstein of Harvard Medical School and her co-workers measured the volume of selected areas of the cortex relative to the overall volume of the cerebrum, they found that many regions are proportionally larger in females than in males but that other areas are larger in males (*below*). Whether the anatomical divergence results in differences in cognitive ability is unknown.





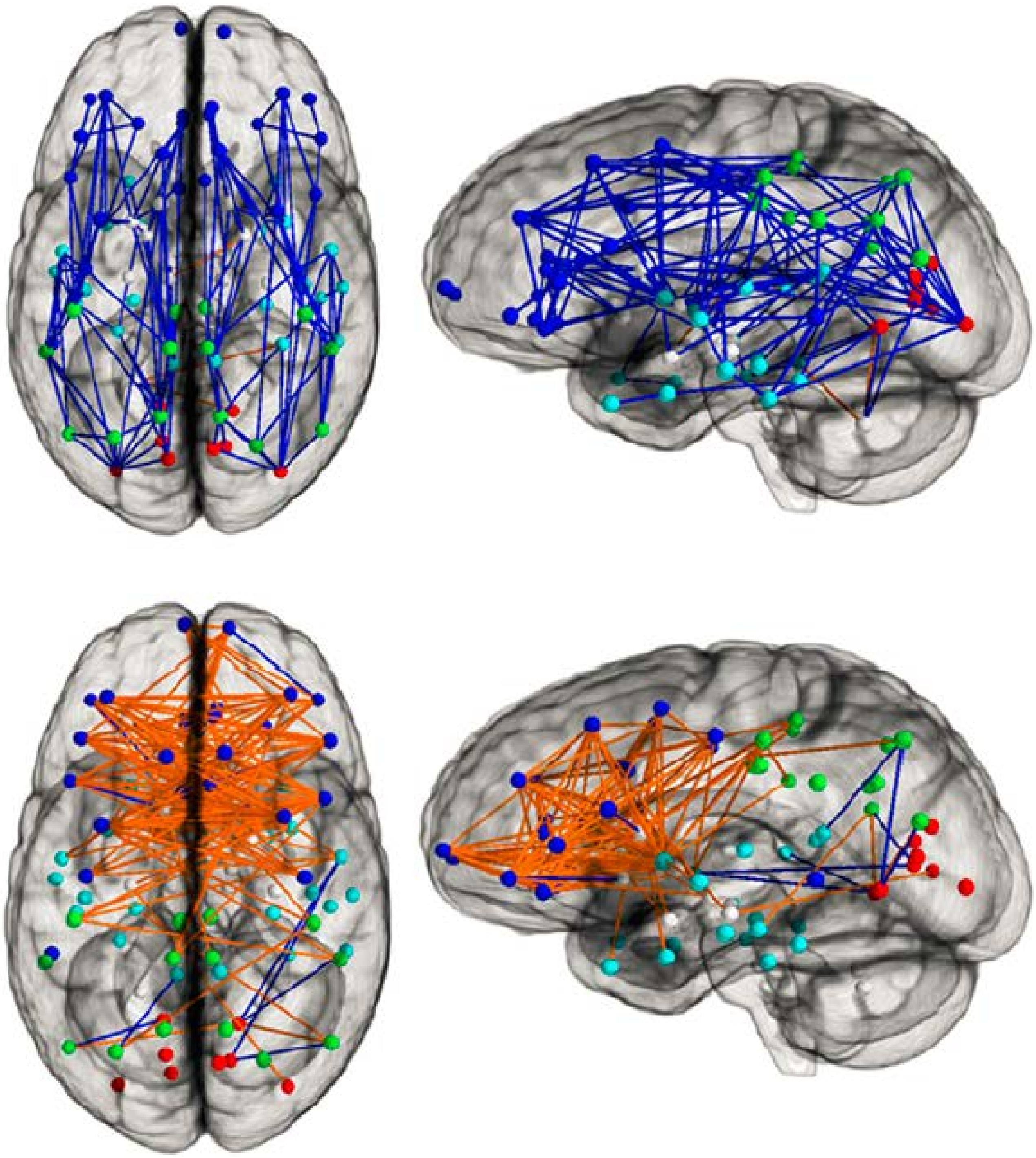
LARGER IN FEMALE BRAIN

LARGER IN MALE BRAIN

Cahill, Larry. (2005).

His brain, her brain.

Scientific American, *292*(5), 40-47.



Ingalhalikar, et al. 2013.

Sex differences in the structural connectome of the human brain.

PNAS1316909110.Fig.2A.

WITELSON, S. F. & W. PALLIE. 1973. Left hemisphere specialization for language in the newborn Neuroanatomical evidence of asymmetry. *Brain* 96.641-46.

infant brain
2 days old

The size of the left-right difference in the neonates was proportionately at least as large as that in the adult sample. A possible sex difference in left-right asymmetry of the planum in neonates was also observed. The anatomical difference was not as marked for males as for females within the first few days of life.

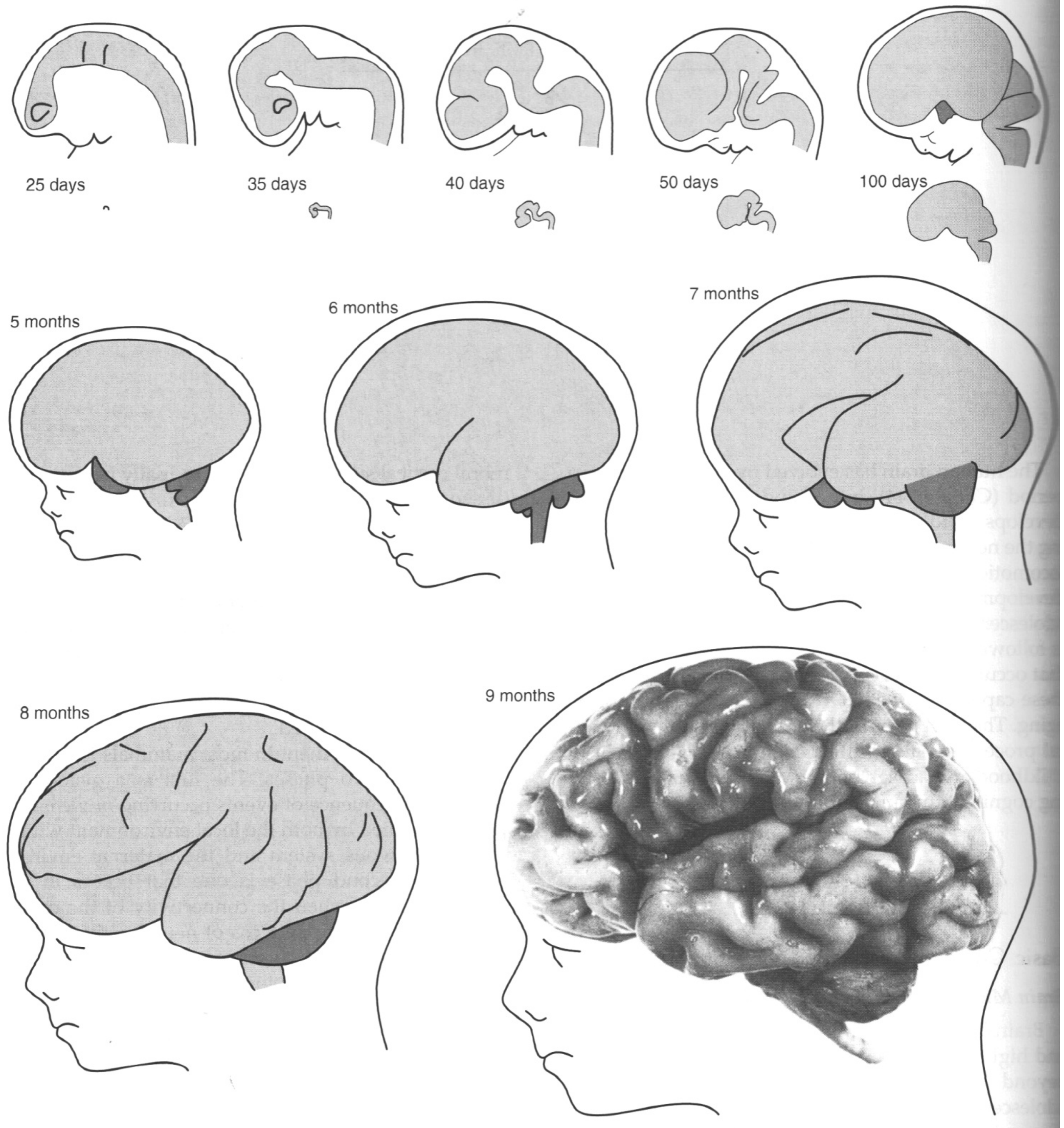
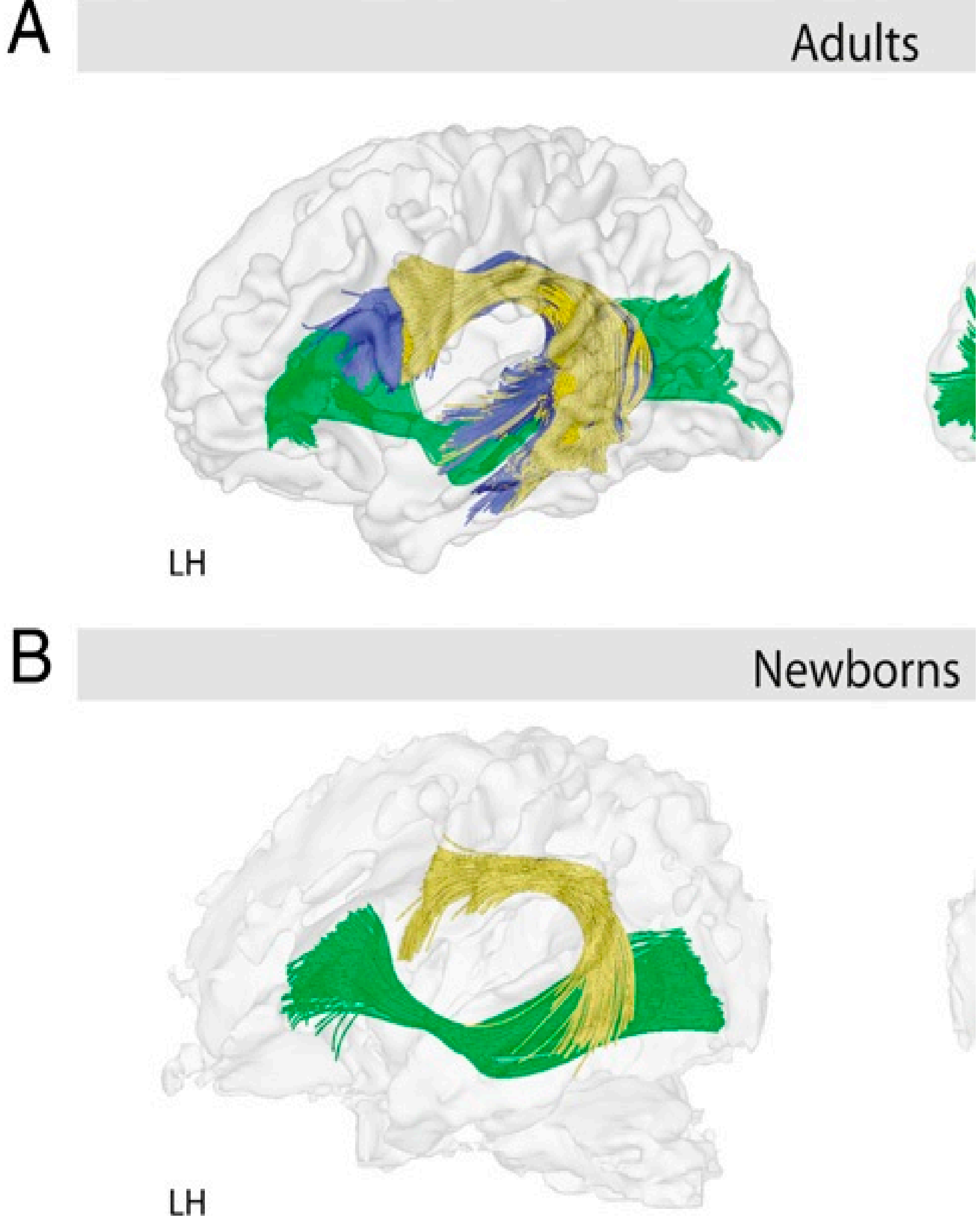


FIGURE 45.1 The size and form of the human brain as it develops through gestation and early infancy.

Squire, Larry, et al. (Ed.). (2008). *Fundamental Neuroscience, 3rd ed.* Academic Press. p.1040.

May et al. 2011. Language and the newborn brain: does prenatal language experience shape the neonate neural response to speech? *Frontiers in Psychology* Article 222.

"…*The peripheral auditory system is mature by* 26weeks *gestation, and the properties of the womb are such that the majority of* low-frequency sounds *(less than 300Hz) are transmitted to the fetal inner ear. The low frequency components of language that are transmitted through the uterus include* pitch*, some aspects of* rhythm*, and some phonetic information ... Fetuses respond to and discriminate speech sounds. Moreover, newborn infants show a preference for their* mother's voice *at birth ... Finally, ..., newborn infants born to monolingual mothers prefer to listen to their* native language *over an unfamiliar language from a different rhythmical class...."*



Perani, Daniela, et al. 2011.

Neural language networks at birth.

PNAS 108.16056–61.

“Four orofacial gestures of a fetus at approximately 28 weeks GA.

(Top left) Grimacing;
(Top right) Finger sucking;
(Bottom left) TP to the side;
(Bottom right) tongue thrust. ”

Keven, N. & K.Akins. 2016.

Neonatal Imitation in Context: Sensory-Motor Development in the Perinatal Period.

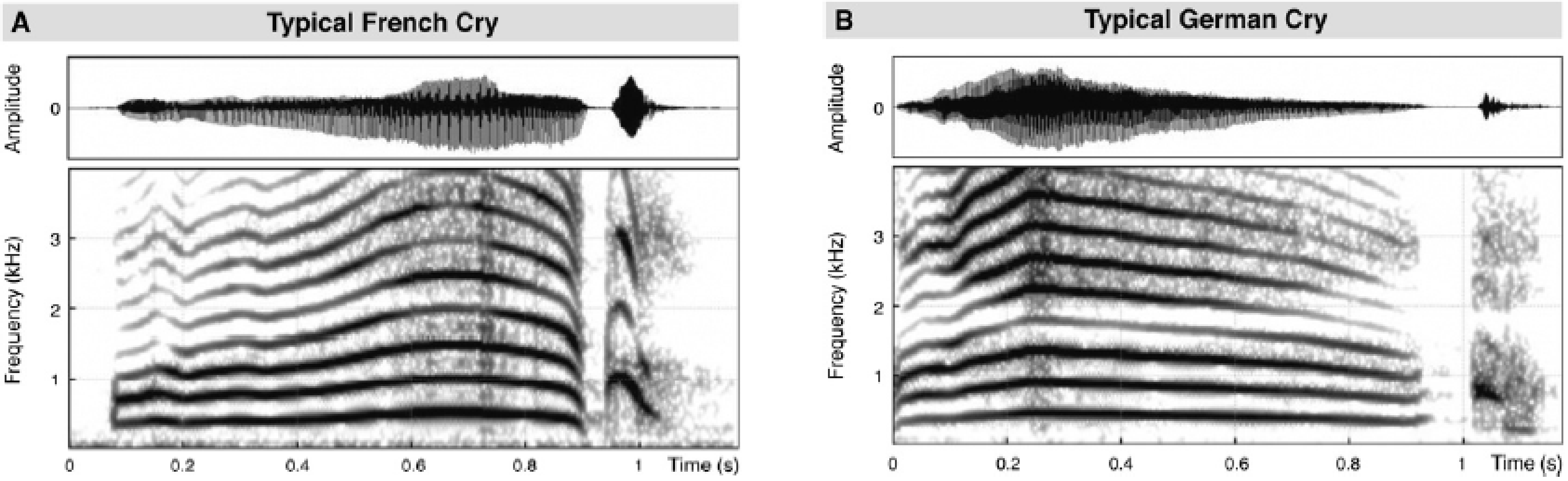
Behavioral and Brain Sciences Fig.2.

Meltzoff, A.N. & M.K.Moore. 1977. Imitation of facial and manual gestures by human neonates. *Science* 198.75-78.

Meltzoff, A.N. & R.W.Borton. 1979. Intermodal matching by human neonates. *Nature* 282.403-4.

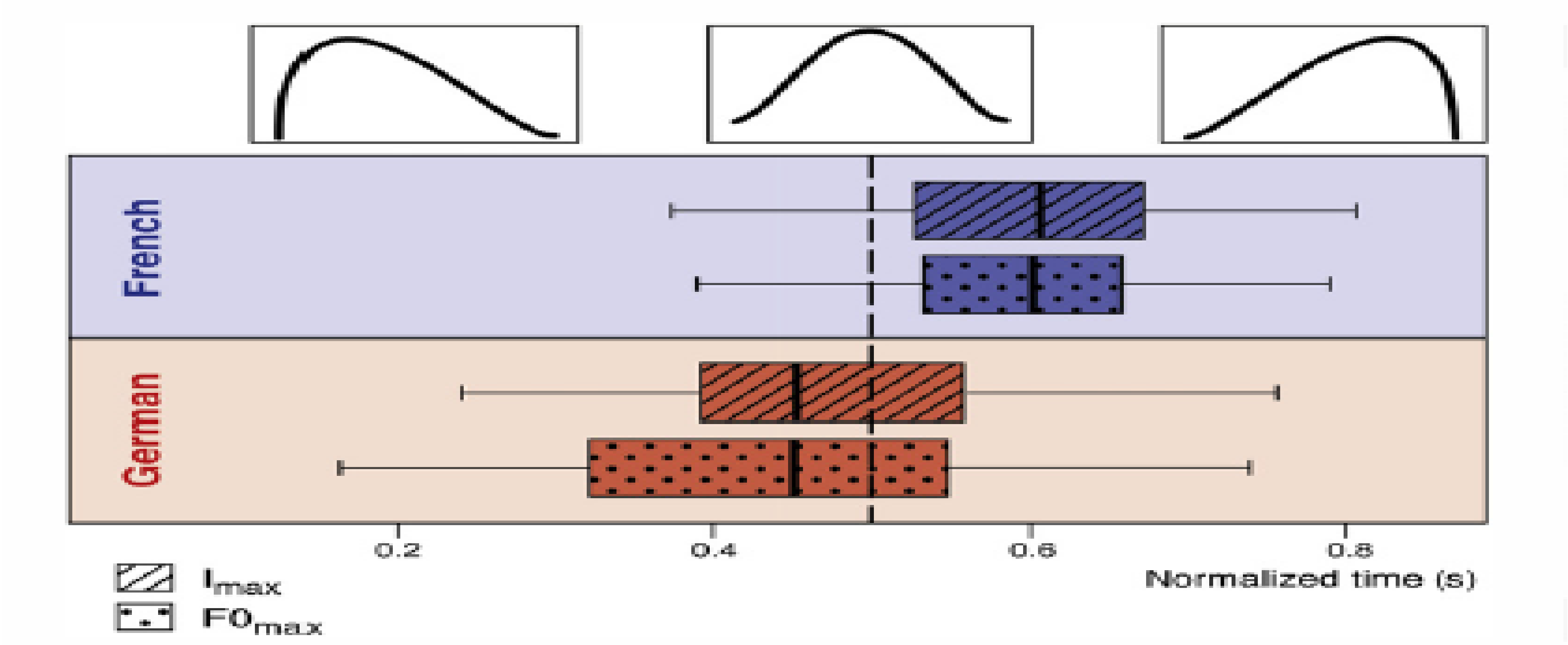
Meltzoff, A.N. & J.Decety. 2003.
What imitation tells us about social cognition. Philos.Trans.Royal Society of London. Series B-Biological Sciences 358.491-500.

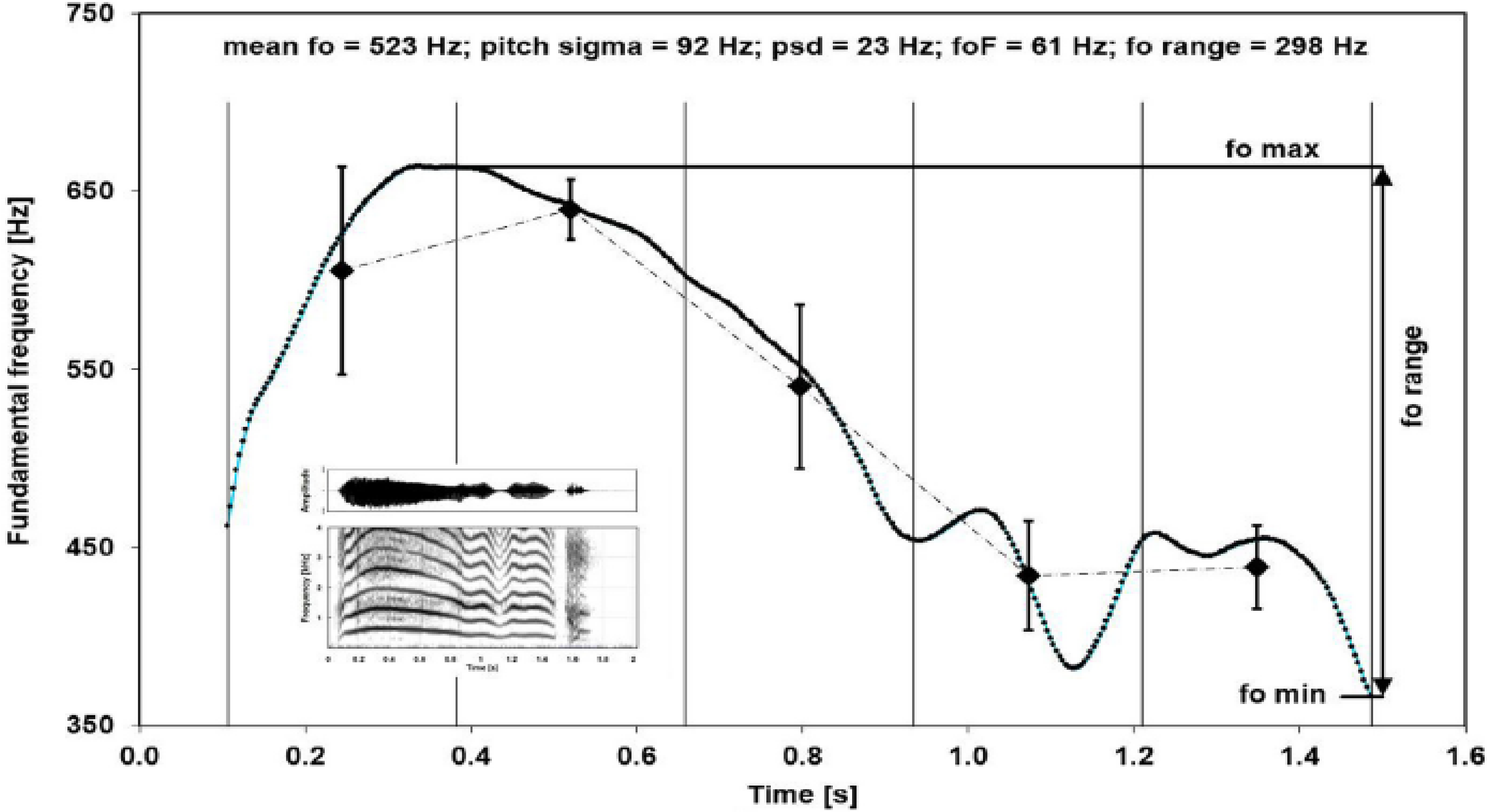
Meltzoff, A.N., P.K.Kuhl, J.Movellan & T.J.Sejnowski. 2009. Foundations for a New Science of Learning. *Science* 325.284-88.



Time Waveform and Narrow-Band Spectrograms of a Typical French Cry and a Typical German Cry. Taken from Mampe et al., 2009. Current Biology 19: 2

The data show an influence of the surrounding speech prosody on newborns' cry melody!


French
German
0.2
0.4
0.6
0.8
Normalized time (s)
I_{max}
$F0_{max}$



Fundamental frequency variation in crying of Mandarin and German neonates. *J of Voice* 2016.

Kuhl, P. K., et al. 2008.
Phonetic learning as a pathway to language. Phil. Trans. R. Soc. B 363.979–1000.

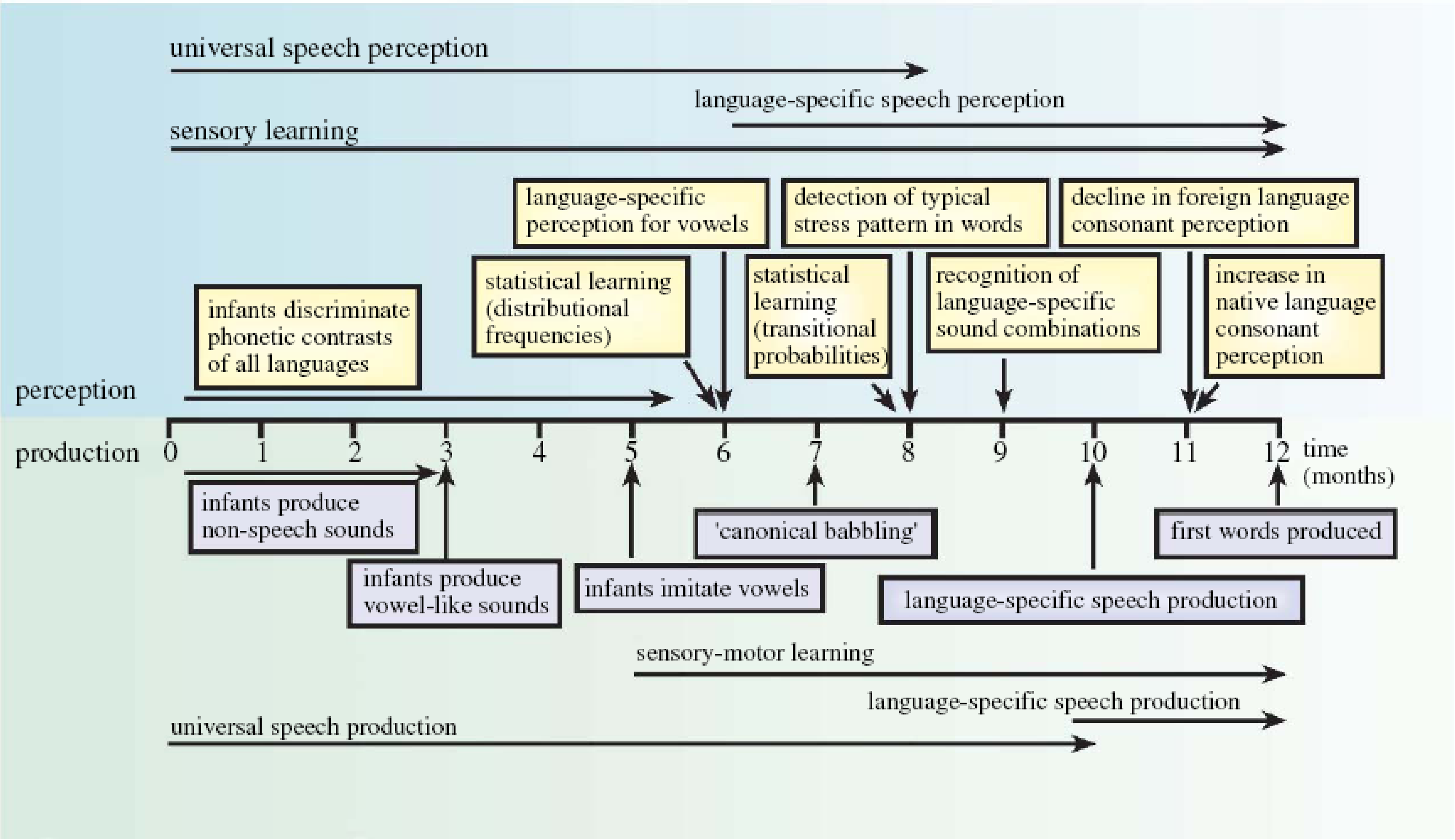


Figure 1. Universal timeline of infants' perception and production of speech in the first year of life. Modified from Kuhl (2004).

Kuhl, P. & M. Rivera-Gaxiola.

Neural Substrates of Language Acquisition.

Annual Review Neuroscience 31.511-34. 2008.

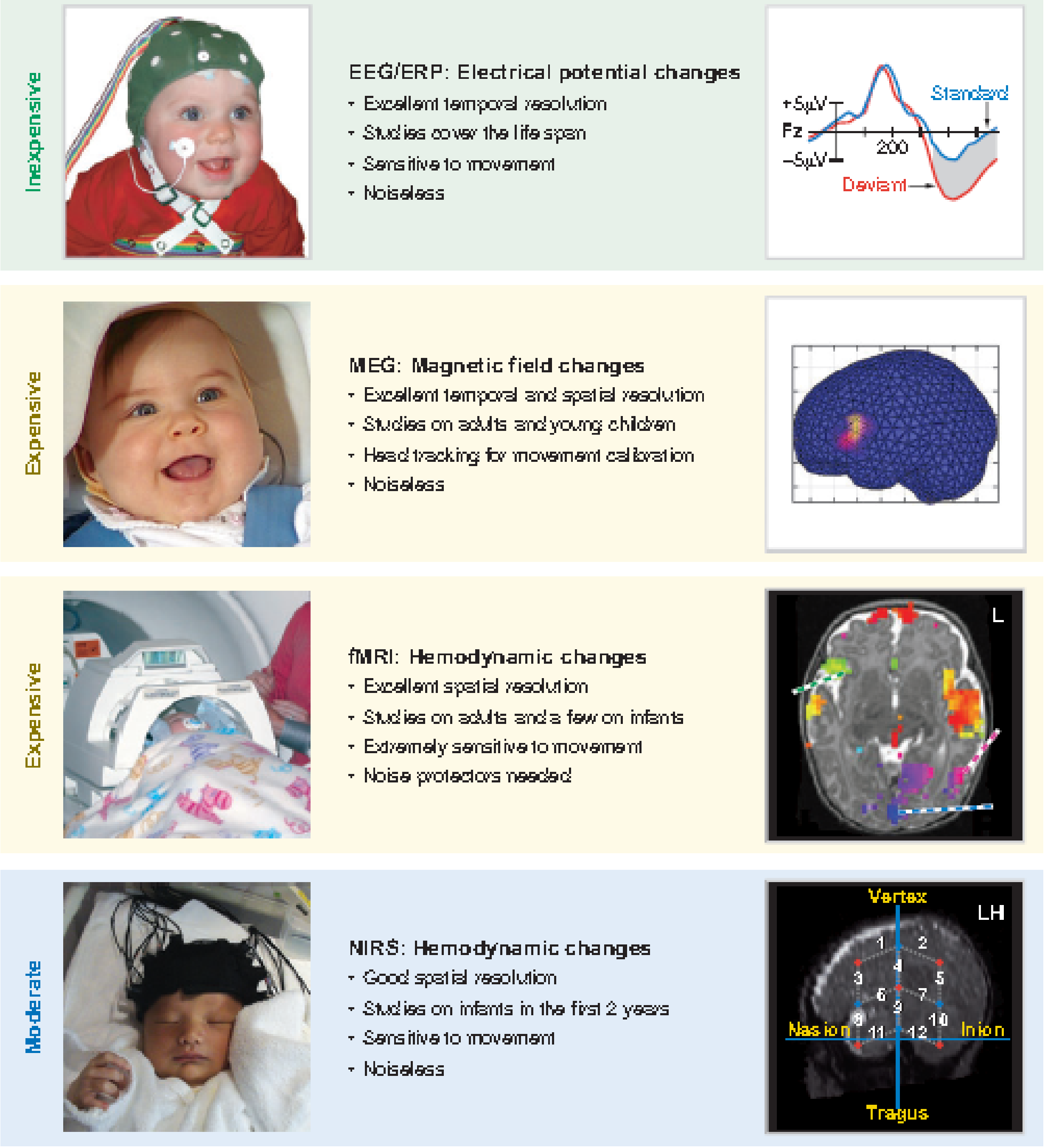
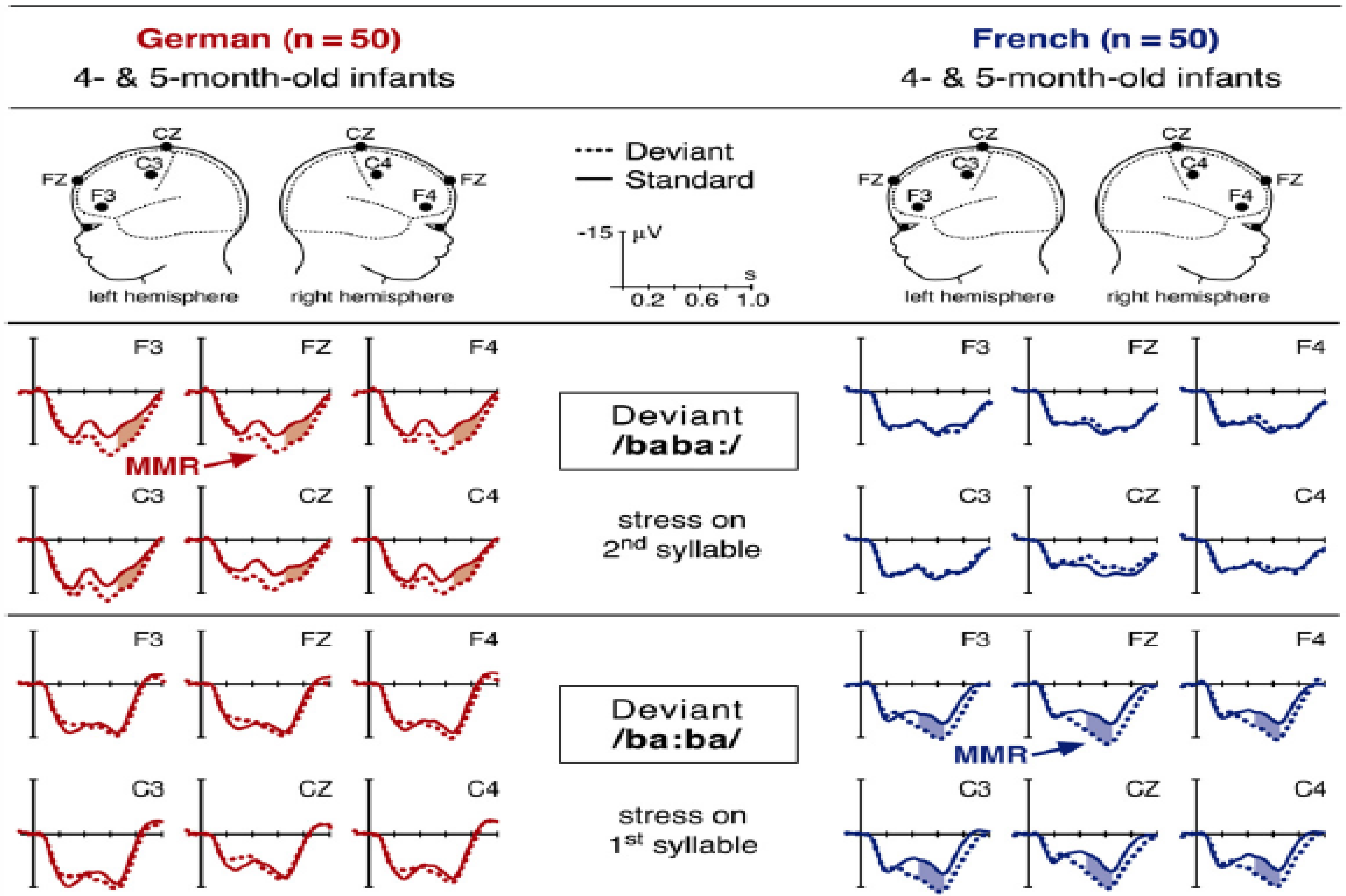


Figure 1

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

Friederici, Angela D., et al. 2007.
Current Biology 17.1208-11.
Brain responses in 4-month-old infants are already language specific.



Saffran, J.R., et al. 1996. Statistical Learning by 8-Month-Old Infants. *Science* 274.1926-28.

tupirogolabubidakupadoti

padotibidakutupirotupiro

golabubidakupadotigolabu

bidakutupirogolabupadoti

Saffran, J.R., et al. 1996. Statistical Learning by 8-Month-Old Infants. *Science* 274.1926-28.

tupirogolabubidakupadoti

padotibidakutupirotupiro

golabubidakupadotigolabu

bidakutupirogolabupadoti

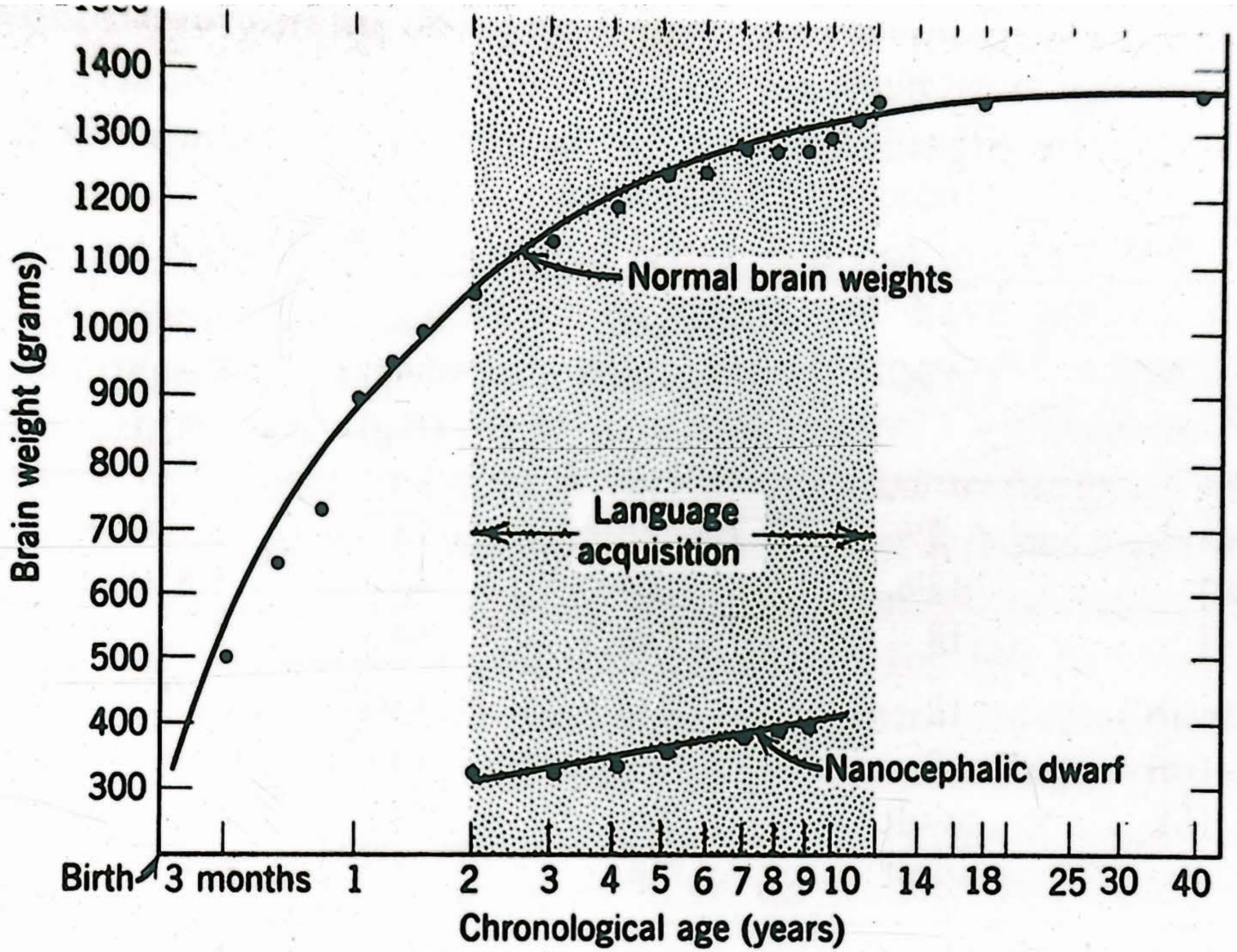


FIG. 2.25. Brain weights determined at autopsy plotted as function of patients' chronological age; data from Coppoletta and Wolbach (1933). *Bottom plot:* various measurements of head-circumference of patient described by Seckel (1960), converted to estimates of brain weight.

TABLE 1.1 AN OVERVIEW OF PERIODS OF THE LIFE SPAN

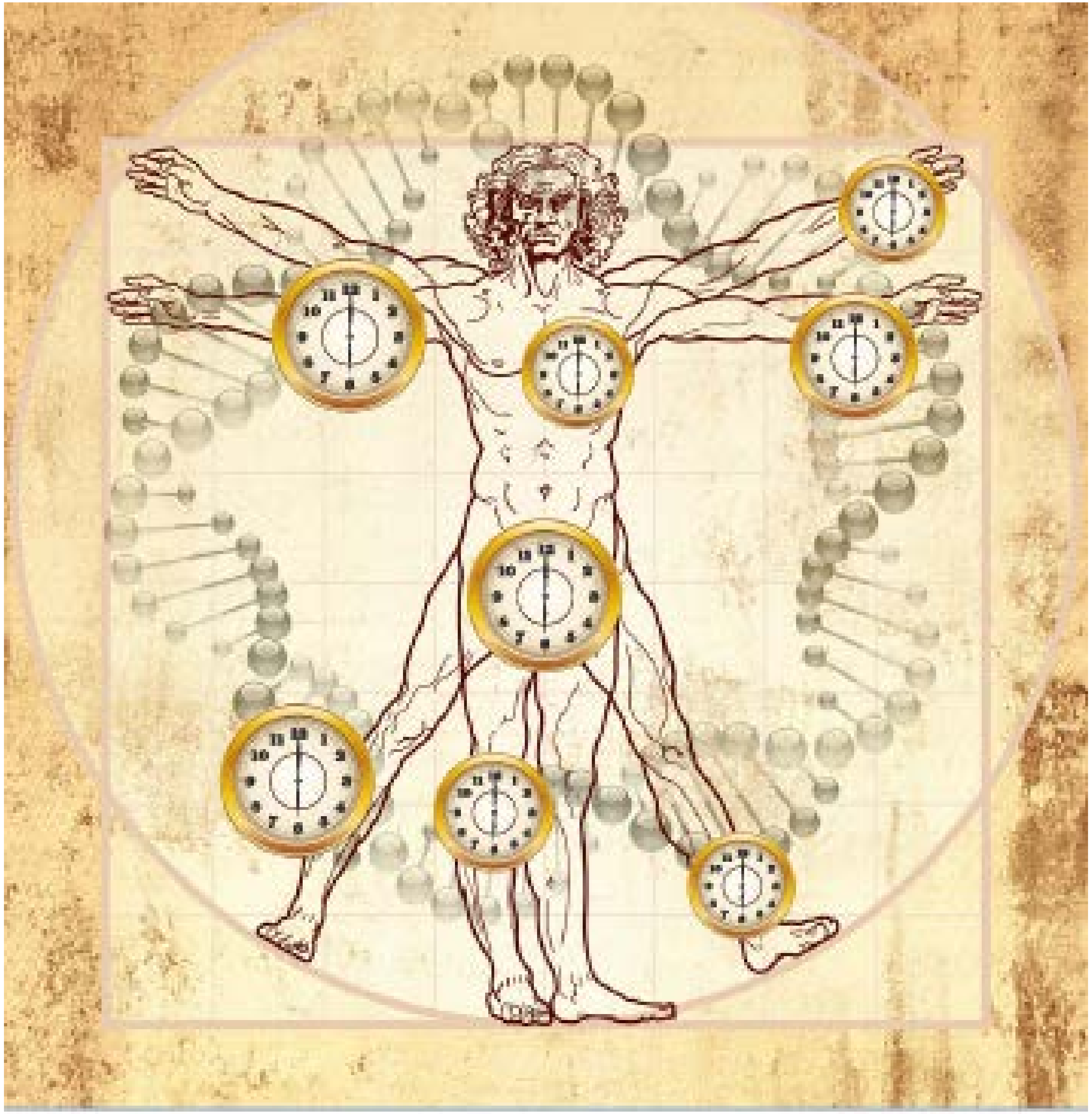
Period of Life	Age Range
Prenatal period	Conception to birth
Infancy	First 2 years of life (the first month is the neonatal or newborn period)
Preschool period	2 to 5 or 6 years (some prefer to describe as *toddlers* children who have begun to walk and are age 1 to 3)
Middle childhood	6 to about 12 (or until the onset of puberty)
Adolescence	Approximately 12 to 20 (or when the individual becomes relatively independent of parents and begins to assume adult roles)
Early adulthood	20 to 40 years (some distinguish an emerging adulthood period from 18 to 29—see Exploration 1.1)
Middle adulthood	40 to 65 years
Late adulthood	65 years and older (some break out subcategories such as the young-old, old-old, and very old based on differences in functioning)

Sigelman, C.K. & E.A. Rider. 2012.

Human Development across the Life Span.

Wadsworth Cengage Learning.

Chronological clock measured in years does not take into account tremendous amount of variation across individuals, due to genetic & environmental factors.



Horvath, Steve. (2013). DNA methylation age of human tissues and cell types. *Genome Biology, 14:R115,*

Horvath, Steve, et al. (2016). An **epigenetic clock** analysis of race/ethnicity, sex, and coronary heart disease. *Genome Biology, 17:171*.

Hedden, T. & J.D.E.Gabrieli. 2004. Insights into the ageing mind: a view from cognitive neuroscience. *Nature Reviews Neuroscience* 5.87-96.

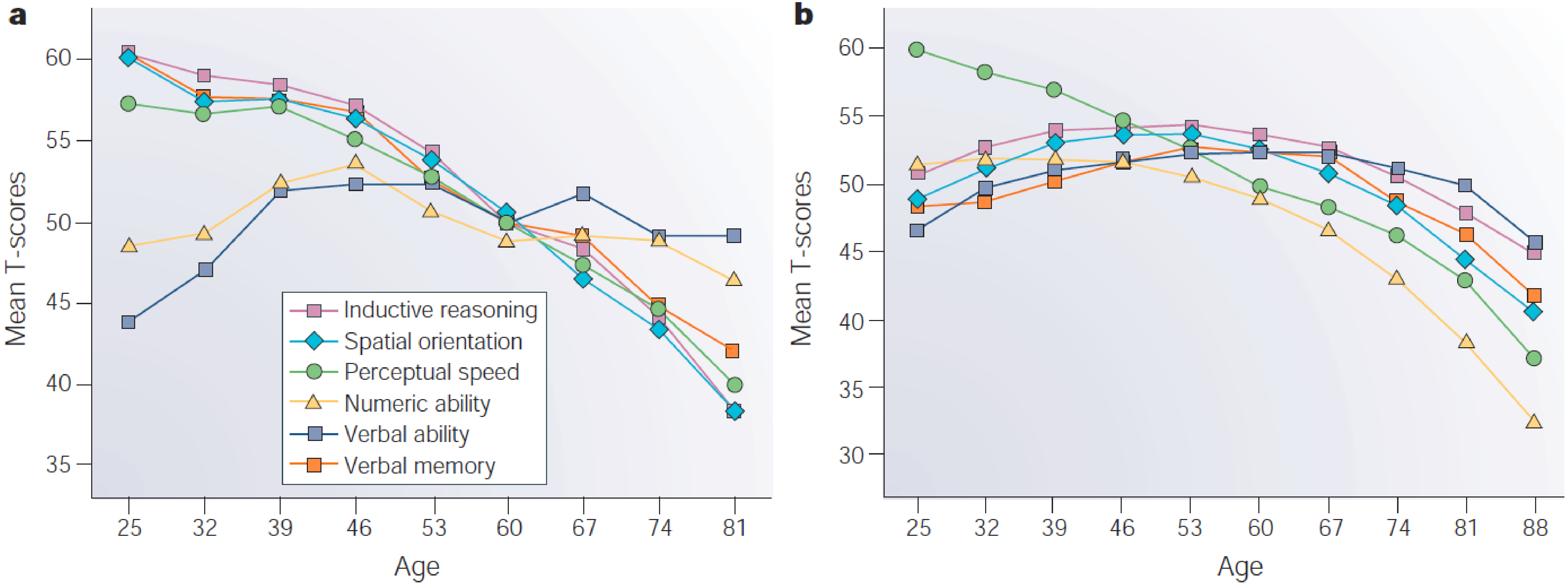
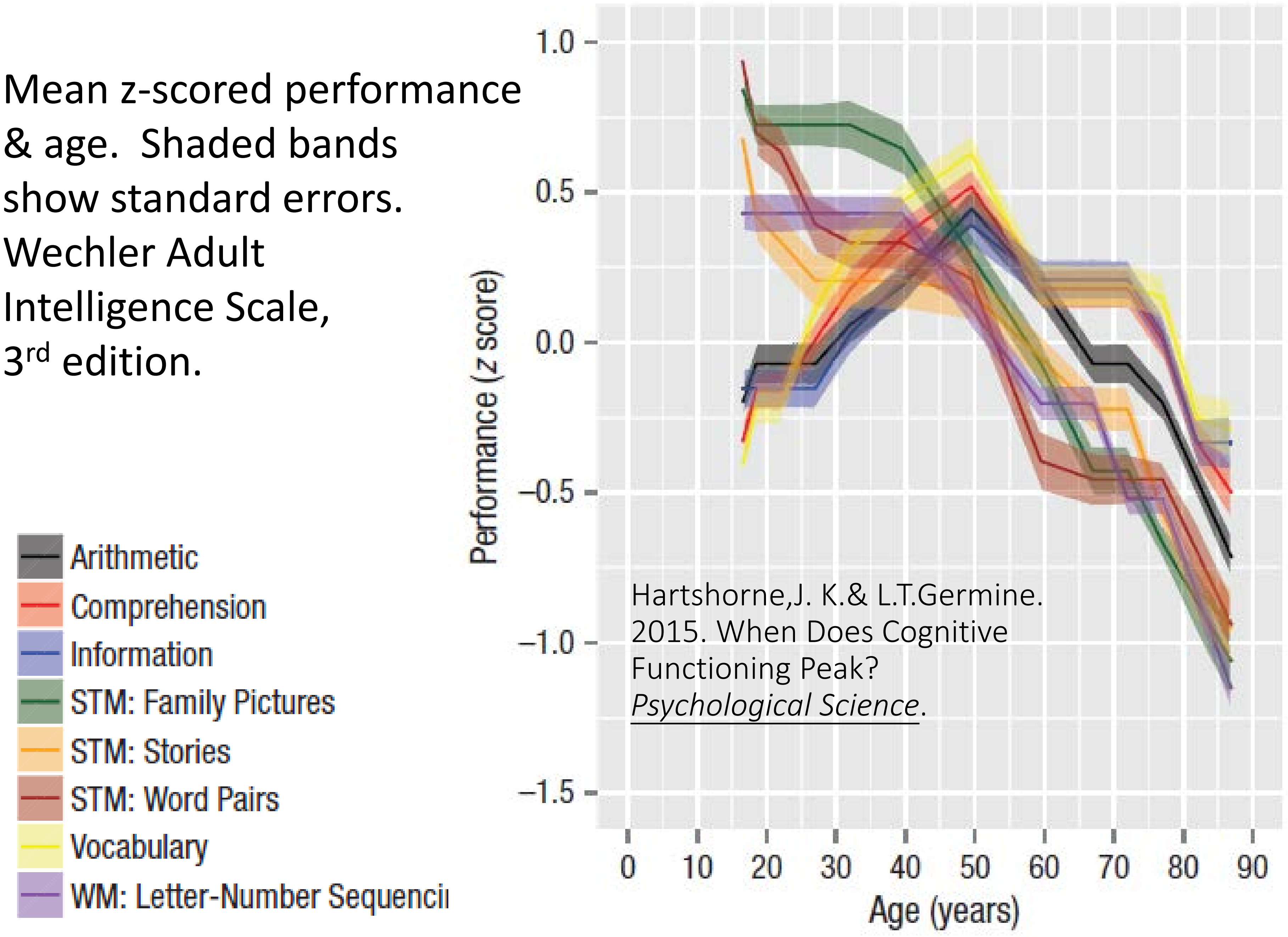


Figure 1 | **Cross-sectional and longitudinal estimates of age-related change in cognition. a** | Cross-sectional data from the Seattle Longitudinal Study. Declines are evident in all domains, with the exception of preserved verbal and numeric ability. **b** | Seven-year longitudinal data from the same study. Declines are evident in all domains after age 55, with only processing speed displaying declines before 55. Reproduced, with permission, from REF. 5 © (1996) Cambridge University Press.

Schaie, K.W. 1996. *Intellectual Development in Adulthood: The Seattle Longitudinal Study*. Cambridge University Press.

Mean z-scored performance & age. Shaded bands show standard errors. Wechler Adult Intelligence Scale, 3rd edition.



Hartshorne,J. K.& L.T.Germine. 2015. When Does Cognitive Functioning Peak? *Psychological Science*.

"There is now a **one in three** chance that children will live to 100."
Greenfield, Susan. (2015). Mind Change. Penguin. p.2.

"In Hong Kong, it is projected that by 2036 there will be 2.3 million people at 65 or older. It is estimated that the prevalence of dementia **doubles every 5 years after the age of 65**."

"It has been estimated that about **20 percent of China's 1.3 billion people** suffer from some kind of neurodegenerative or neuropsychiatric disorder. Just as an estimate, there are currently about **eight to nine million who are afflicted by dementia** in China. This number will increase by at least **three-fold by 2050** if we don't take immediate action. There is an urgent need for us to come up with better diagnoses and treatments, not just in China, but globally." *Nancy Ip, HKUST, interview.*

The Ageing Brain

- **Neurotransmitter** concentration changes with **age**:
  - reduced dopaminergic neuromodulation in healthy older adults
  - dopamine critical for healthy cognitive functionality

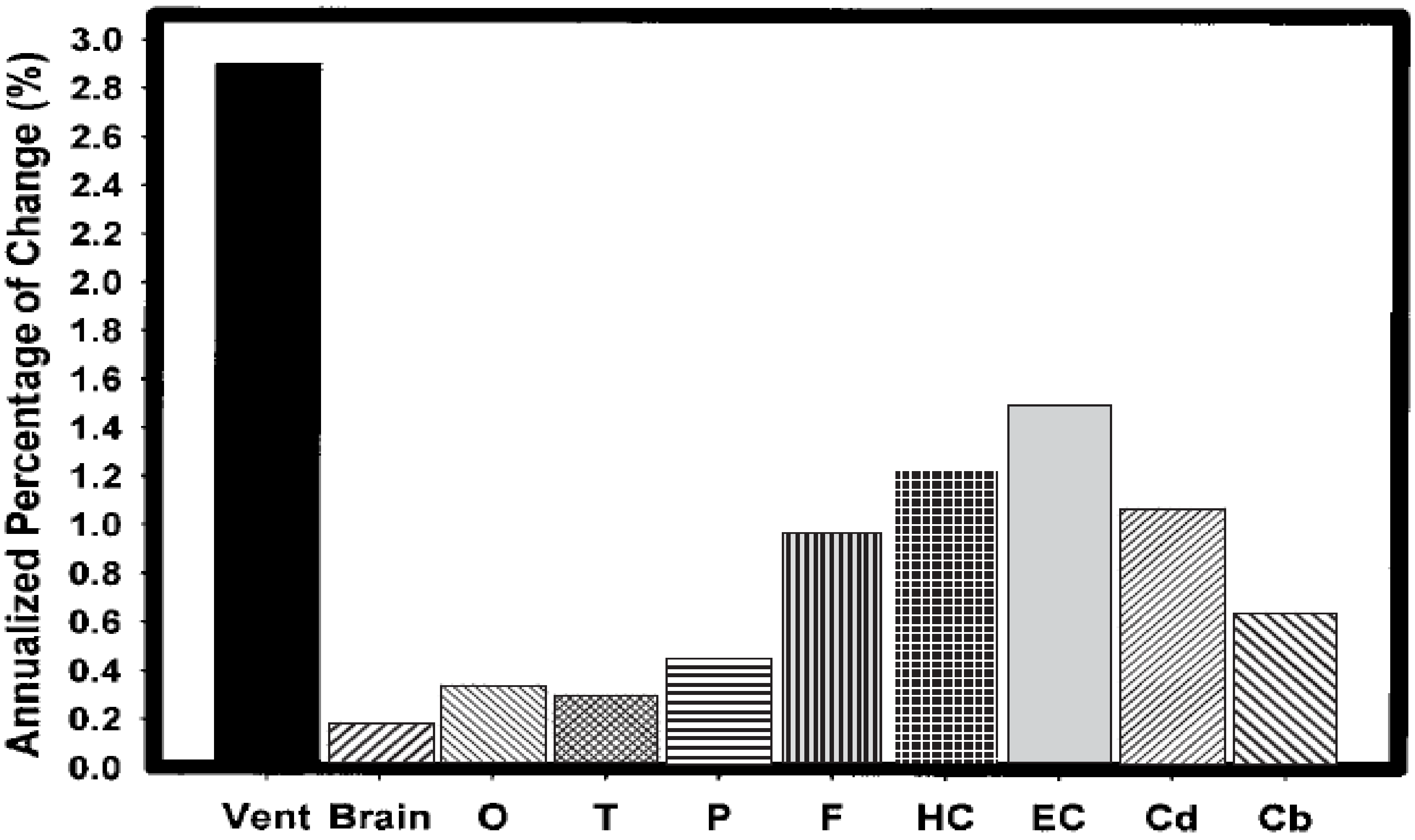
    e.g., Arnsten, AF, Wang, MJ, Paspalas, CD, *Neuron* 76, 223–239, 2012.

- **Brain volume** and weight changes with **age**:
  - expansion of cerebral ventricles
  - loss of myelin
  - reduced numbers of dendrites and synaptic density

    e.g., Raz, N, Rodrigue, KM, *Neurosci. Biobehav. Rev.* 30, 730–48, 2006.

- **Individual difference**:
  - particularly in pre-frontal cortex, hippocampus, etc.

    e.g., Raz, N, et al., *Cereb. Cortex* 15, 1676–89, 2005.



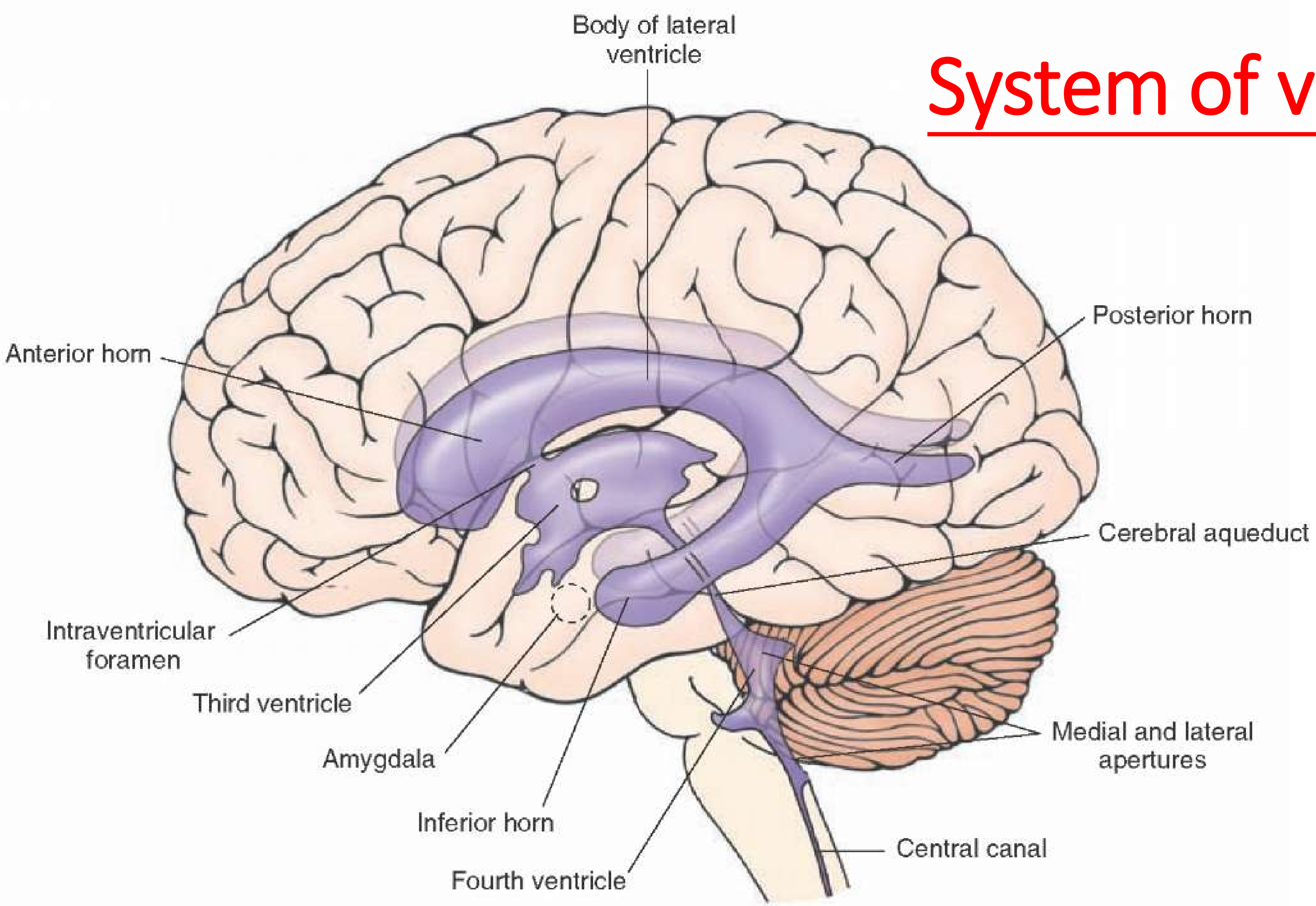
Naftali Raz. *2005:41.*
The Aging Brain Observed in Vivo: Differential Changes & Their Modifiers.

in

COGNITIVE NEUROSCIENCE OF AGING
Linking Cognitive and Cerebral Aging
Edited by
Roberto Cabeza, Lars Nyberg, Denise Park
Oxford University Press

The annualized percentage of change in different regions of the brain due to ageing. The most dramatic increase is in the size of the ventricles, nearly 3%, while the brain as a whole decreases by 0.2%. The decreases in the various regions of interest, ordered by magnitude, are: EC [entorhinal cortex], HC [hippocampus], Cd [caudate nucleus], F [frontal lobe], Cb [cerebellum], P [parietal lobe], O [occipital lobe], and T [temporal lobe]. The EC is strongly diagnostic of memory loss. It is particularly critical for our spatial memory, a fact highlighted by three researchers who won the Nobel Prize in 2014.

System of ventricles



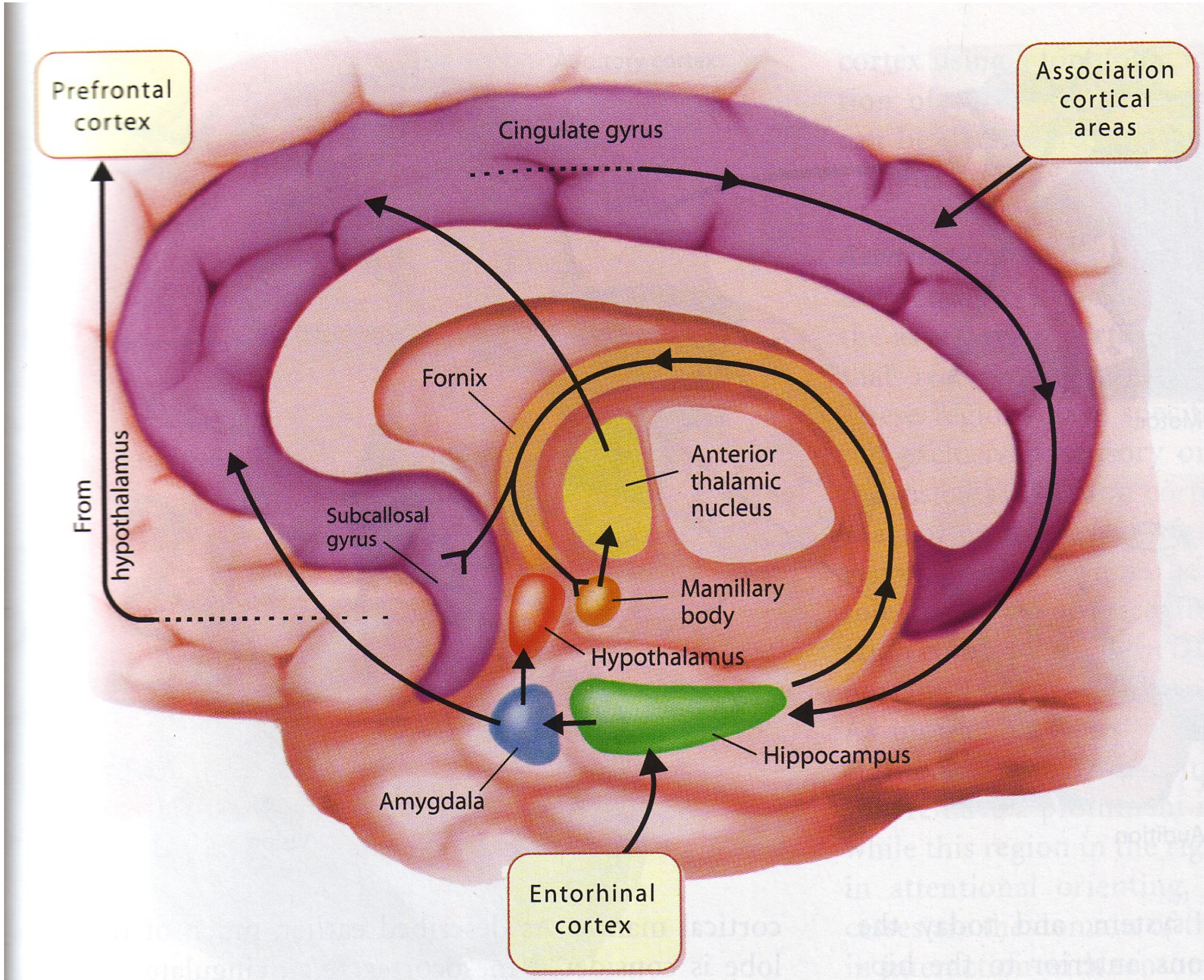
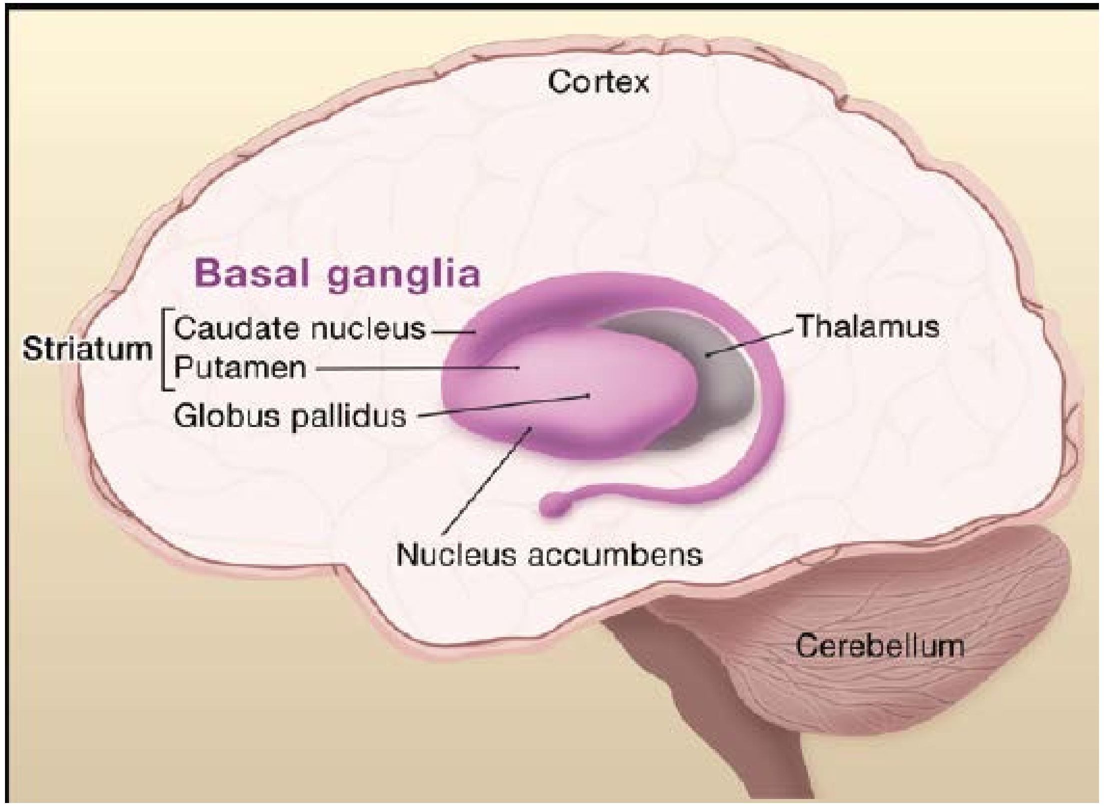


Figure 3.20 Major connections of the limbic system shown diagrammatically in a medial view of the right hemisphere. The figure zooms in on the region in purple in Figure 3.19. The basal ganglia are not represented in this figure, nor is the medial dorsal nucleus of the thalamus. There is more detail in this figure than needs to be committed to memory, but this figure provides a reference that will come in handy in later chapters. Adapted from Kandel et al. (1991).

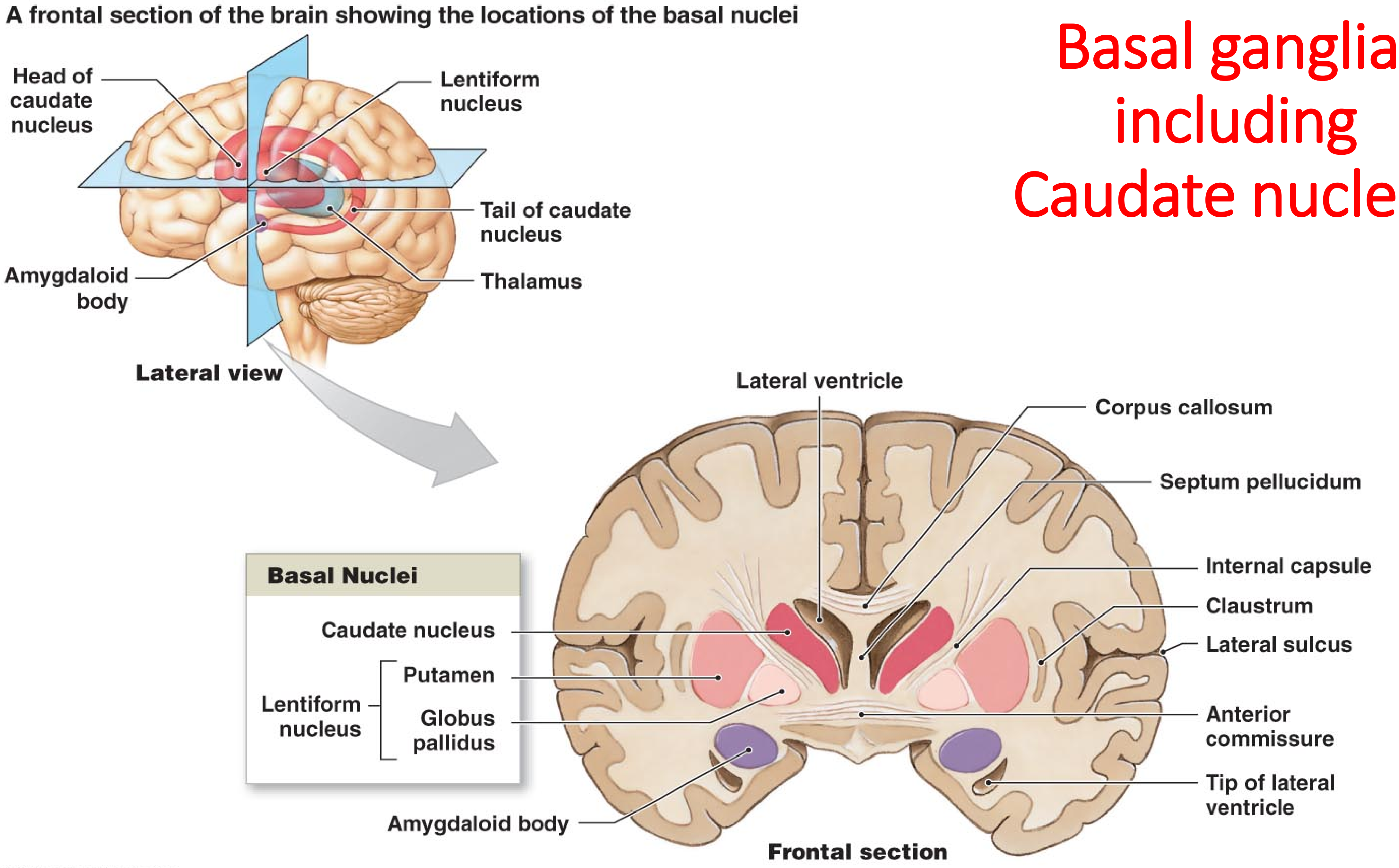
Lieberman, P. 2009.

FOXP2 and Human Cognition.
Cell 137.800-2.



"The **basal ganglia** (composed of the caudate nucleus, putamen, and globus pallidus) are subcortical structures deep within the neocortex of the brain. Cortico-basal ganglia circuits link local operations performed in anatomically isolated groups of basal ganglia neurons performed by neurons in dfferent regions of the cortex … Cortico-basal ganglia circuits involving the **motor cortex** sequence the complex motor gestures involved in talking, walking, running, and fine motor control. Those involving the **prefrontal cortex** are active in cognitive acts such as pulling a word out of our mental dictionary or comprehending the meaning of a sentence."

Basal ganglia, including Caudate nucleus

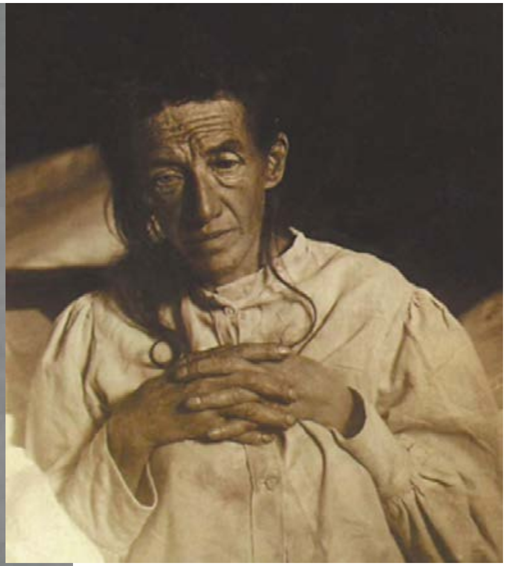


The Great Brain Drain

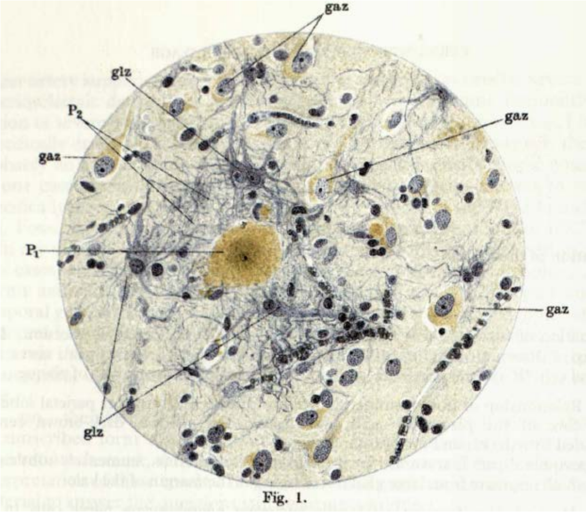
Is a chain reaction of toxic proteins behind all neurodegenerative diseases?

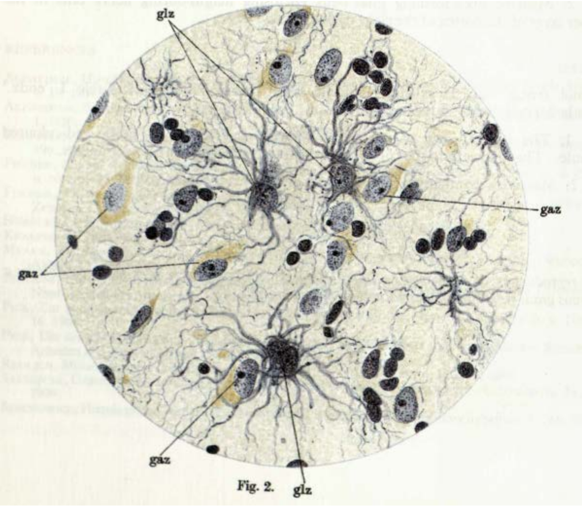
Kwon, Diana. 2015. Scientific American Nov. pp.17-18.

Alois Alzheimer



Auguste Deter





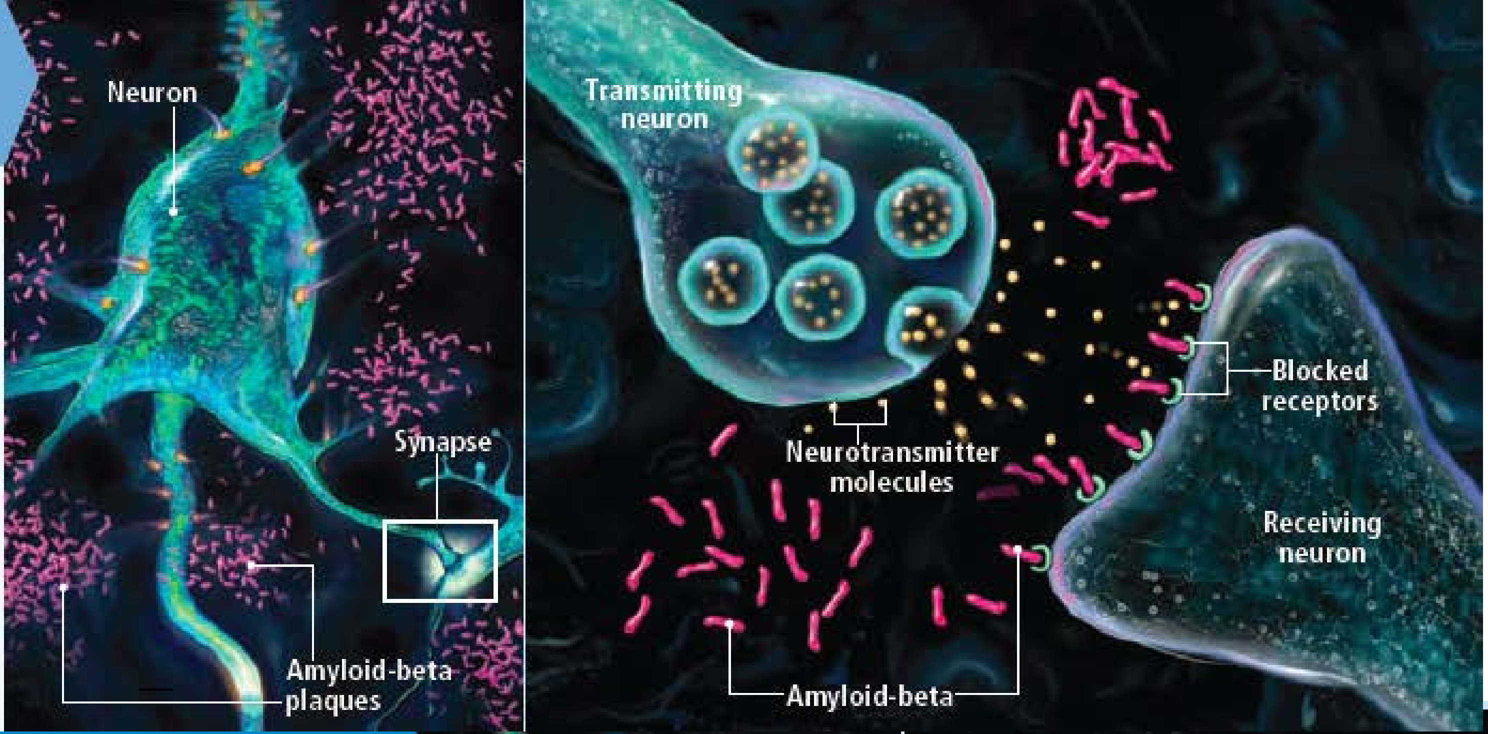
1911.

Uber eigenartige Krankheitsfalle des spateren Alters (On certain peculiar diseases of old age).

***<u>Hist Psychiatry</u>* 74-99.**

AMYLOID ACCRETION
5–20 years before diagnosis of Alzheimer's dementia

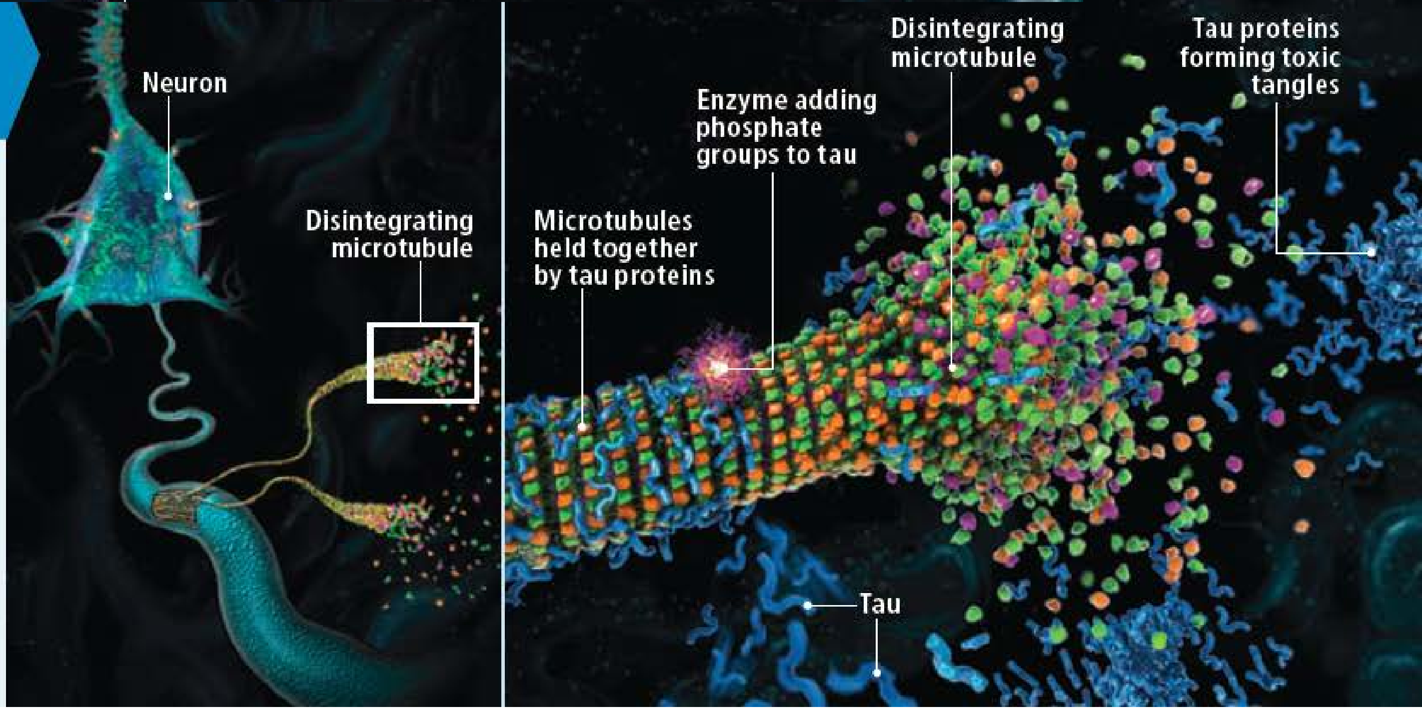
Early on, a protein fragment called amyloid-beta aggregates in the brain centers that form new memories. The amyloid buildup, a biomarker detected by the presence of plaques, results in damage to synapses, the interface between neurons (*detail*). Amyloid blocks chemical signals (neurotransmitters) from reaching receptors on receiving neurons. This buildup can be captured by various forms of neuroimaging, including positron-emission tomography (PET), that detect a radioactive compound, Pittsburgh imaging compound-B (PIB), able to bind specifically to amyloid. A spinal tap can also be used to gauge the amyloid biomarker.



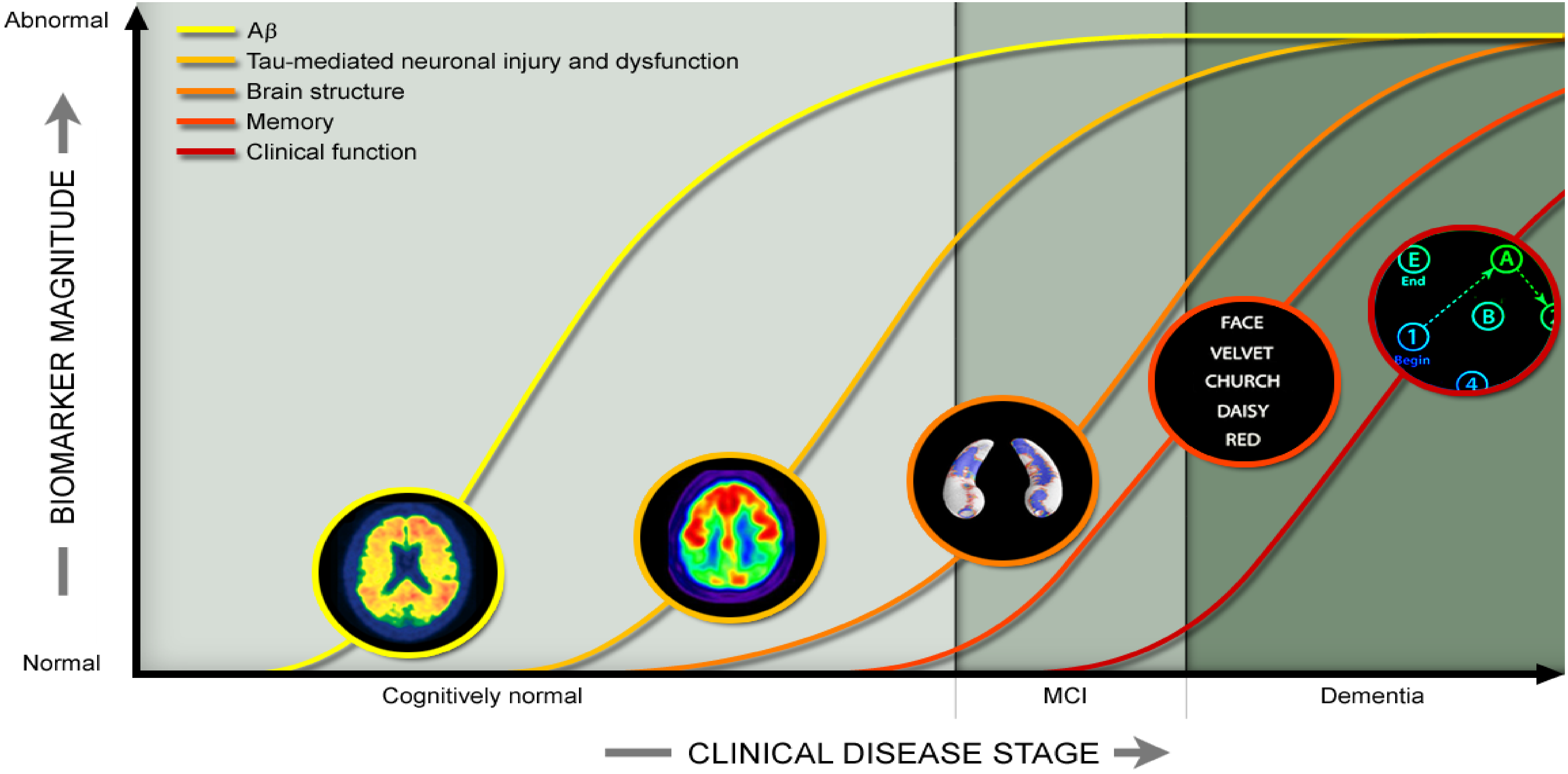
Amyloid

TAU BUILDUP
1–5 years before diagnosis

Before symptoms would justify an Alzheimer's diagnosis, a protein called tau inside neurons begins misbehaving. Normally tau helps to maintain the structure of tiny tubes (microtubules) critical to the proper functioning of neurons. But now phosphate groups begin to accumulate on tau proteins (*detail*), which detach from the microtubules. The tubules go on to disintegrate, and tau then aggregates, forming tangles that interfere with cellular functions. A sample of spinal fluid can detect this process.



Tau



http://adni.loni.usc.edu/studydesign/background-rationale/

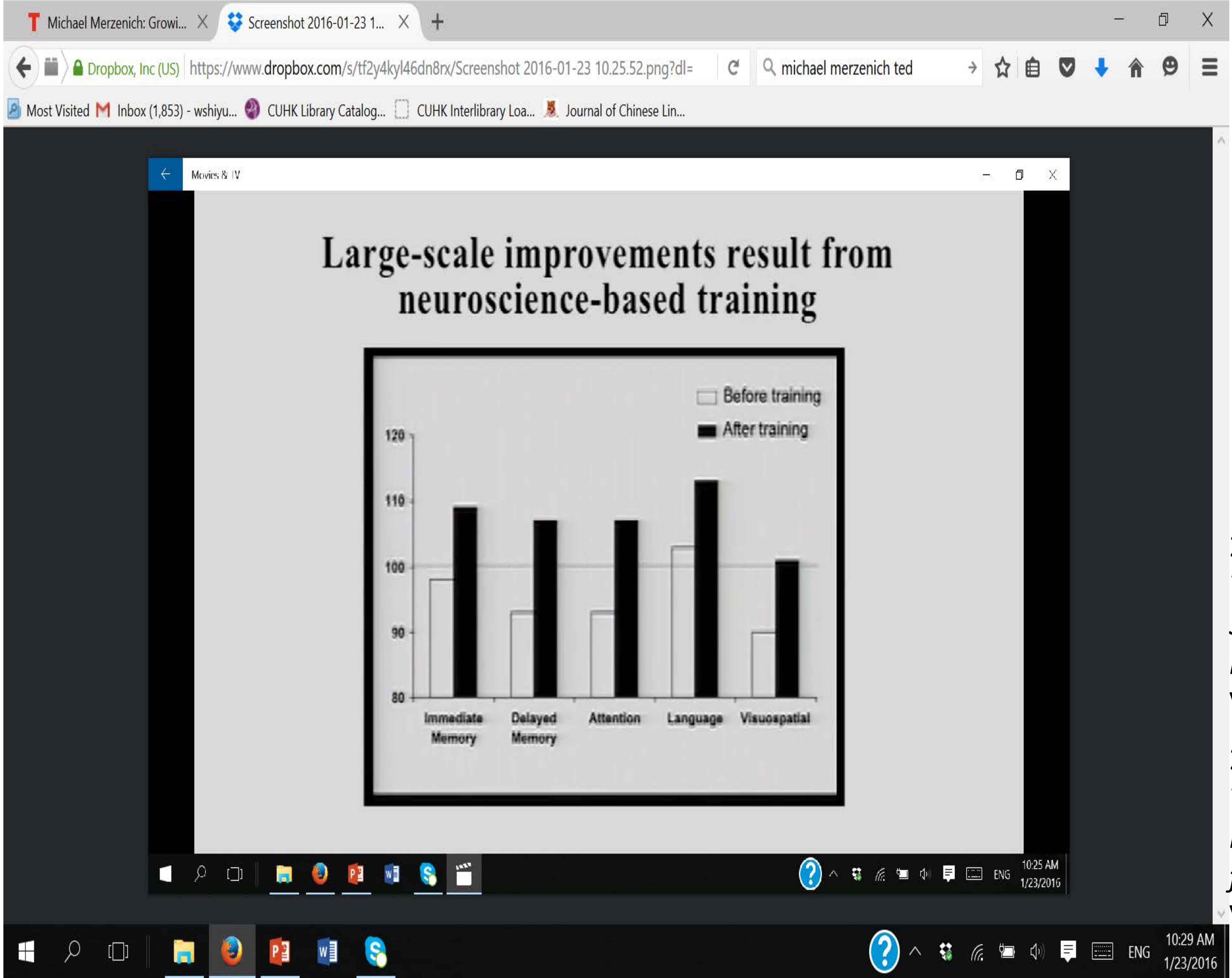
"*Does use and exertion of mental power gradually change the material structure of the brain,*

just as we see, for example, that much used muscles become stronger? It is not improbable, although the scalpel cannot easily demonstrate this.”

Samuel Thomas Soemmering, 1791.

Quoted in Restak, R. (2003). The New Brain: How the Modern Age is Rewiring your Brain. London, Rodale`

Cf. Chinese saying: “用进废退”，
& English: “Use it or lose it”.



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UCSF & NAS

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Temporal Processing Deficits of Language-Learning Impaired Children Ameliorated by Training.
Science 271: 77-81.

TedTalk Feb. 2004. Improvements in elders aged 80s and 90s.

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2007
The Brain That Changes Itself: : Stories of Personal Triumph From the Frontiers of Brain Science. Viking.

2015.
The Brain's Way of Healing: Remarkable Discoveries & Recoveries from the Frontiers of Neuroplasticity. Viking.

Anguera, J. A., et al. 2013. Video game training enhances cognitive control in older adults. *Nature* 501.97-101.

Underwood, E. *Science,* Oct.22, 2014.
Neuroscientists speak out against brain game hype.
"Aging baby boomers and seniors would be **better off going for a hike** than sitting down in front of one of the many video games designed to aid the brain …"

Unsworth, N., et al. 2015. *Psychological Science*
Is Playing Video Games Related to Cognitive Abilities?
"These results **cast doubt on recent claims that playing video games** leads to enhanced cognitive abilities."

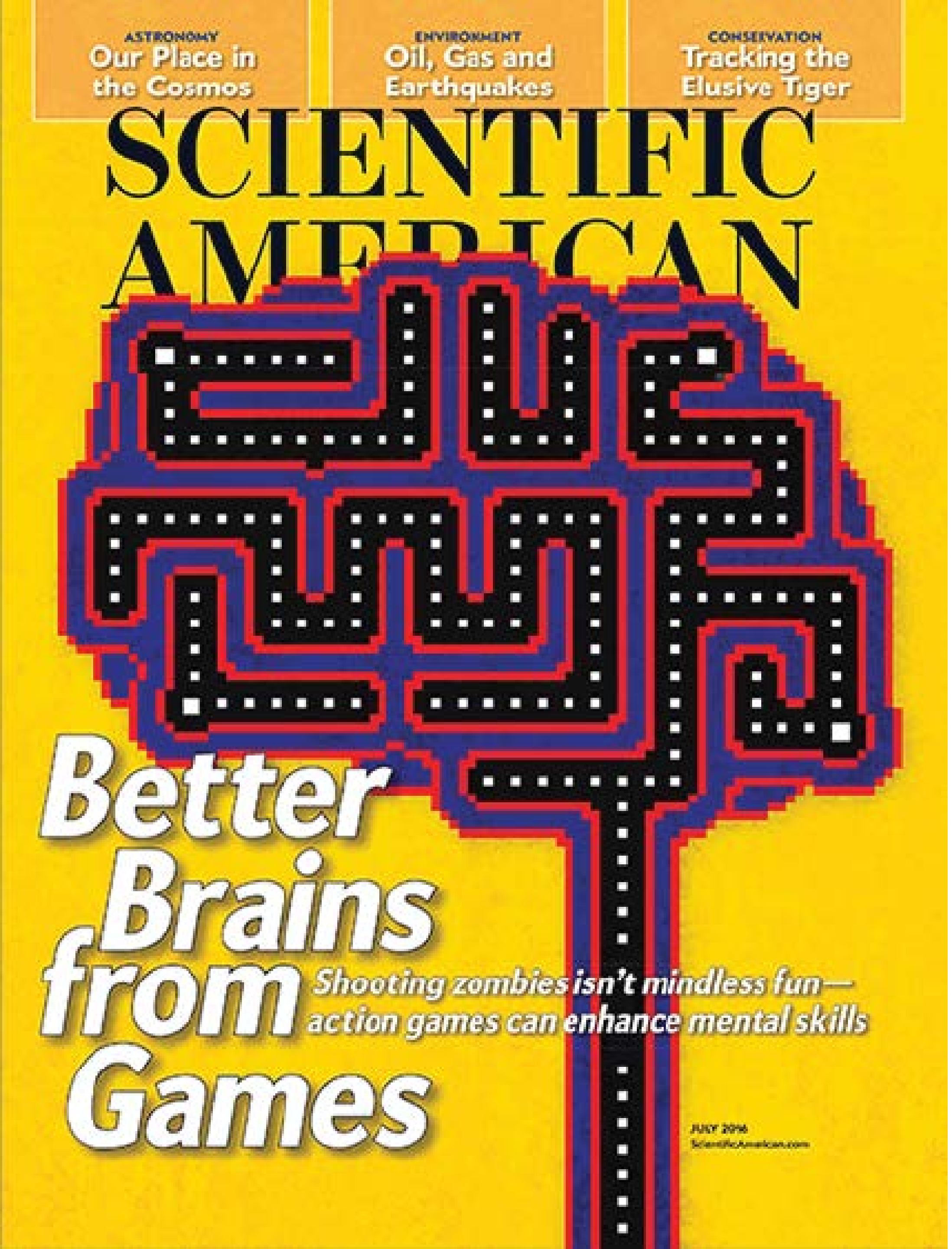
Federal Trade Commission

released January 5, 2016.

Lumosity to Pay $2 Million to Settle FTC Deceptive Advertising Charges for Its "Brain Training" Program.

Company Claimed Program Would Sharpen Performance in Everyday Life and Protect Against Cognitive Decline.

"The creators and marketers of the Lumosity "brain training" program have agreed to settle Federal Trade Commission charges alleging that they deceived consumers with unfounded claims that Lumosity games can help users perform better at work and in school, and reduce or delay cognitive impairment associated with age and other serious health conditions."



" … I know I've sometimes chided my daughters about what they are missing "IRL" when they play games on their mobile phones while, for instance, simultaneously trying to attend to a conversation or follow the plotline of a movie.

Not so fast, say scientists, who have been studying what actually happens to our brain when we play action games. In this issue's cover story, "The Brain-Boosting Power of Video Games," psychologists Daphne Bavelier and C. Shawn Green explain how fast-paced "shooter" games enhance certain cognitive functions, including bettering attention, reaction times and switching from one task to another. **The work could lead to designs for games that could provide similar benefits without some of the disturbingly violent content of the action genre. Surprisingly, popular marketed "brain-training" games don't seem to evince the same kinds of benefits**."

Mariette DiChristina on July 1, 2016

Editor in Chief of *Scientific American*.

Daphne Bavelier & C. Shawn Green

The Brain-Boosting Power of Video Games.

Scientific American July 2016: 26-31.

“ “. 打打電玩, 強健大腦.

科學人 174:42-47.

李如蕙, 張智宏. 2016.
打電動的大腦, 不會變老.
科學人 174:48-51.

The basic scientific issues concerning ageing are:

(1) To understand the bases of neuro-degeneration, at genetic, neural, and behavioral levels;

(2) To discover the earliest possible detection of these diseases, by means of diagnostic tests, and brain imaging, such as EEG, MRI, MEG, NIRS, etc.;

(3) To develop methods of intervention, including not only drugs, but also cognitive and physical training to reduce if not cure the effects of the disease.

Research on all these issues, especially in a Chinese context, is urgently needed. It would contribute fundamentally toward the human sciences, and help meet the demographic crisis the world now faces.

Paivio, Allan. (1971). Imagery and verbal processes. Holt, Rinehart & Winston.

“ “ (1986). Mental representations: A dual-coding approach. Oxford University Press.

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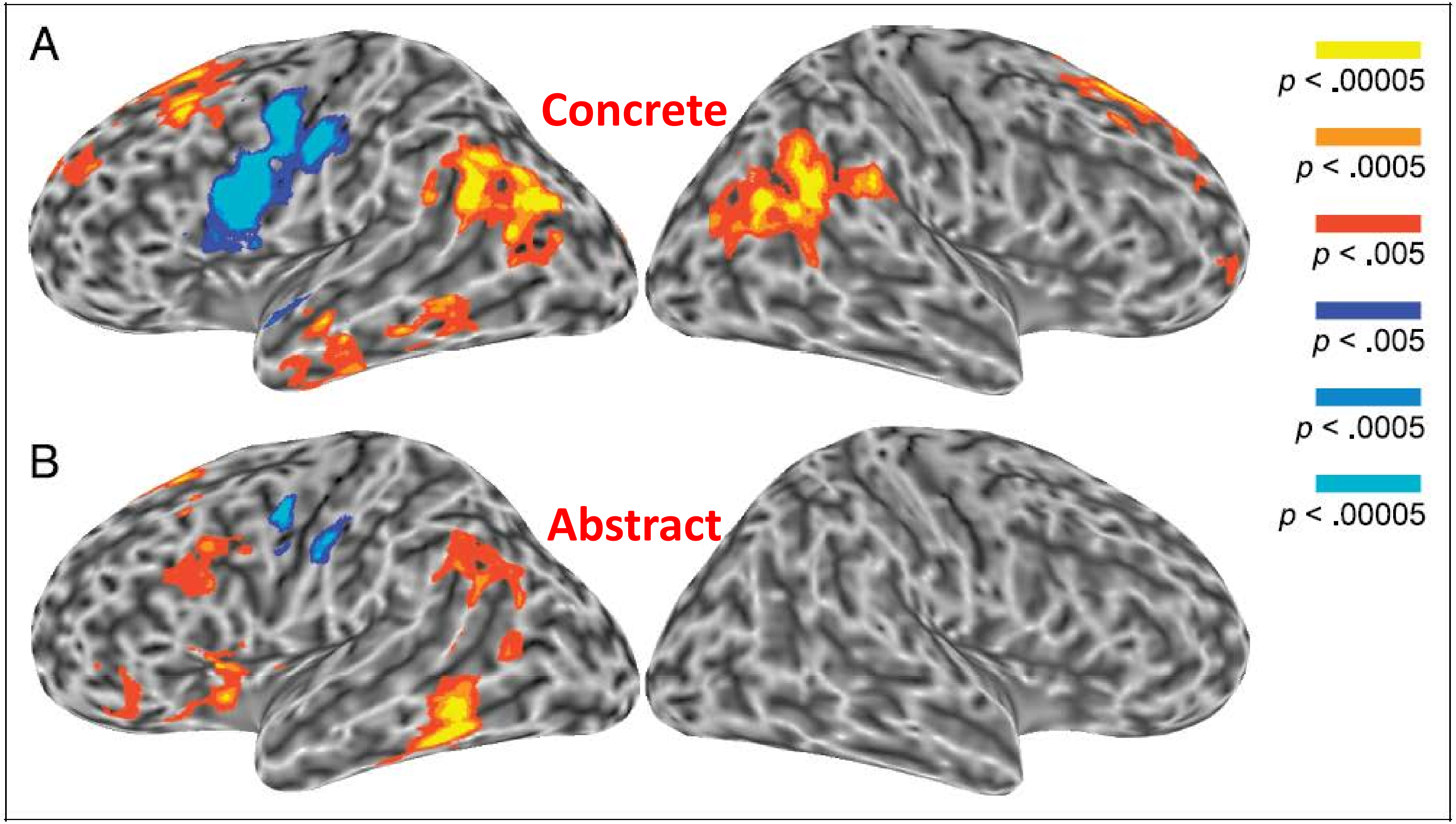
“ “. (2014). Intelligence, dual coding theory, and the brain. *Intelligence, 47*, 141-158.

Figure 1. fMRI results for the contrasts of (A) concrete–nonword, and (B) abstract–nonword. Red–yellow colors indicate positive t values, blue colors indicate negative t values. Activation is shown on inflated representations of the cortical surface. Images on the left represent the left hemisphere, images on the right represent the right hemisphere. All maps are thresholded at a corrected mapwise $p < .05$. (See Appendices 2 and 3 for a complete listing of stereotaxic peaks of activation.)



Binder, J. R. , Westbury, C. F., McKiernan, K. A., Possing, E. T., & Medler, D. A. (2005).

Distinct Brain Systems for Processing Concrete and Abstract Concepts.

Journal of Cognitive Neuroscience, 17(6), 905-917.

Cacciari, C., et al.. (2006). *Neuropsychologia 44*(8).

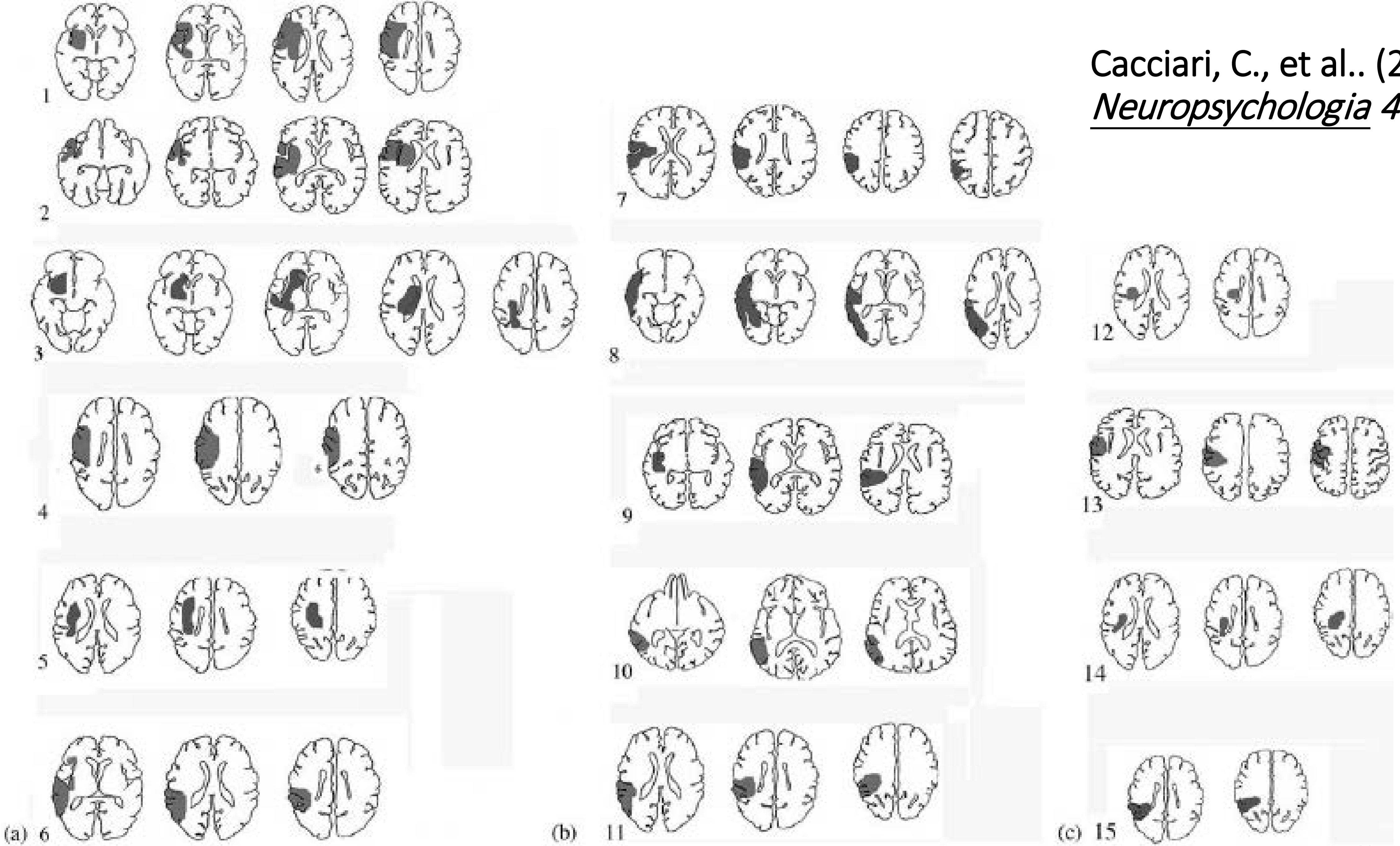


Fig. 1. Lesion site of the 15 aphasic patients.

Cacciari, C., et al. (2006). The comprehension of ambiguous idioms in aphasic patients. Neuropsychologia, 44(8), 1305-1314.

- **Alzare il gomito** (to lift the elbow, to drink too much) wine
- **Vuotare il sacco** (to empty the sack, to confess something) secret
- **Sputare il rospo** (to spit the toad, to reveal a secret) confession
- **Vedere le stele** (to see the stars, to experience a pain) pain
- **Essere al verde** (to be at the green, to be broke) money
- **Prendere la porta** (to take the door, to go away) separation

While the 15 patients knew all the individual words, and claimed to be familiar with all 23 idioms, they made numerous errors in matching the idioms with target words. Matched controls had a mean score of 22.13, whereas the patients scored 15.33.

Cabeza, R. 2002. Hemispheric asymmetry reduction in older adults: the HAROLD model. *Psychology & Aging* 17:85-100.

Mehta, J. & Jerger, J. (2014). Variation in semantic priming across age groups: An AERP study. *International Journal of Audiology 53*:235-242.

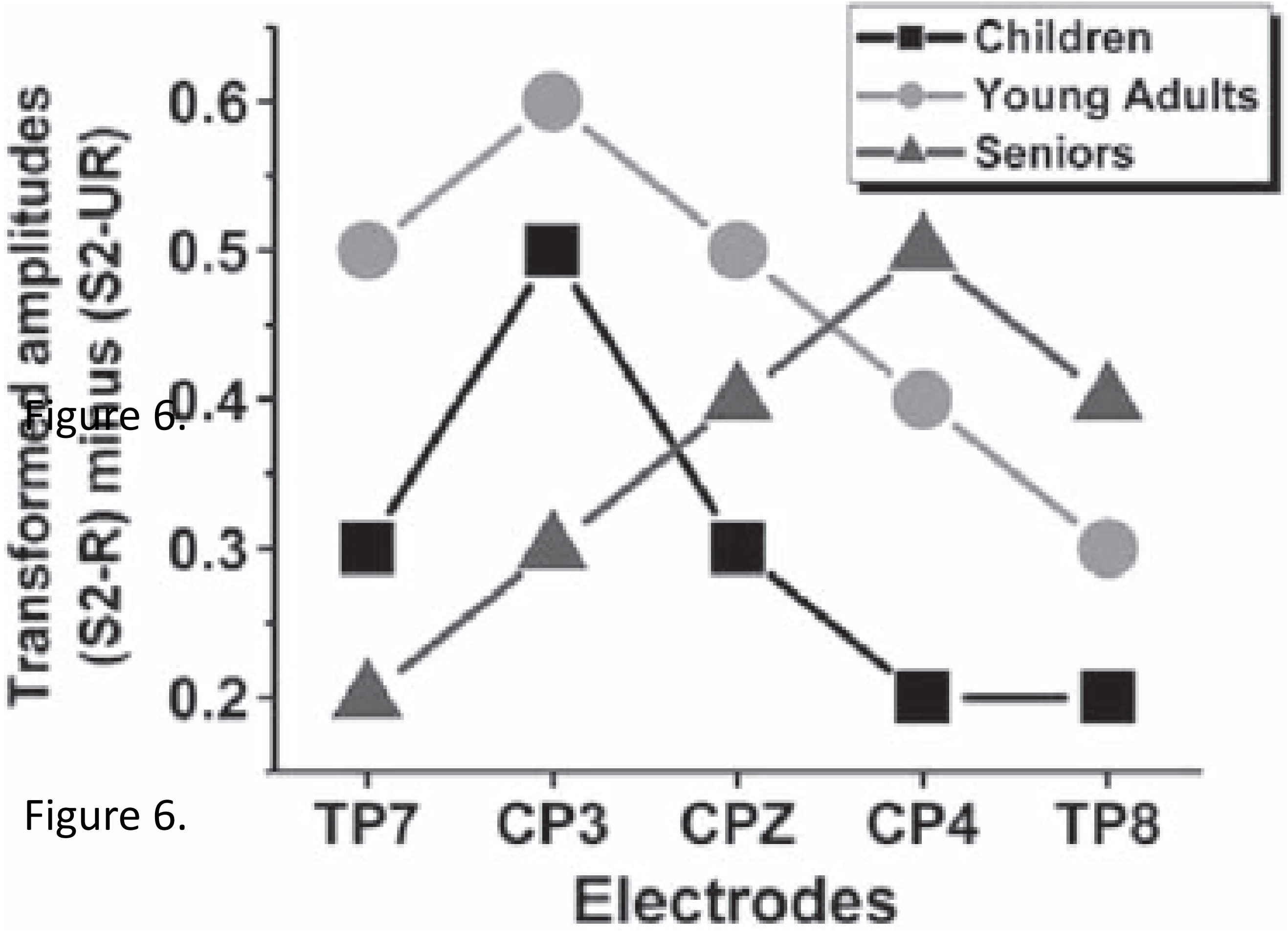


Figure 6.

Figure 6.

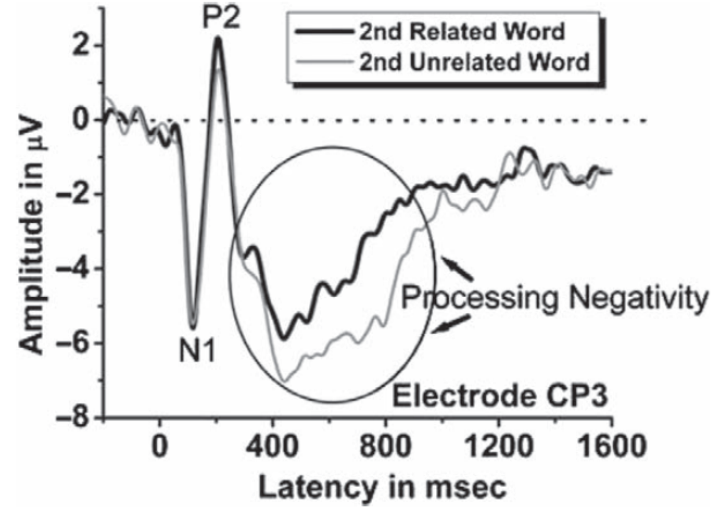


Figure 2.

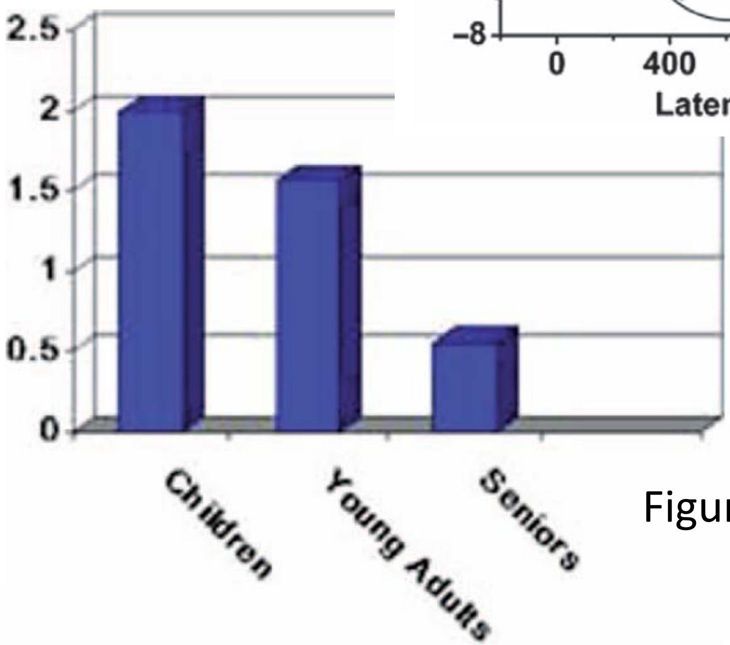


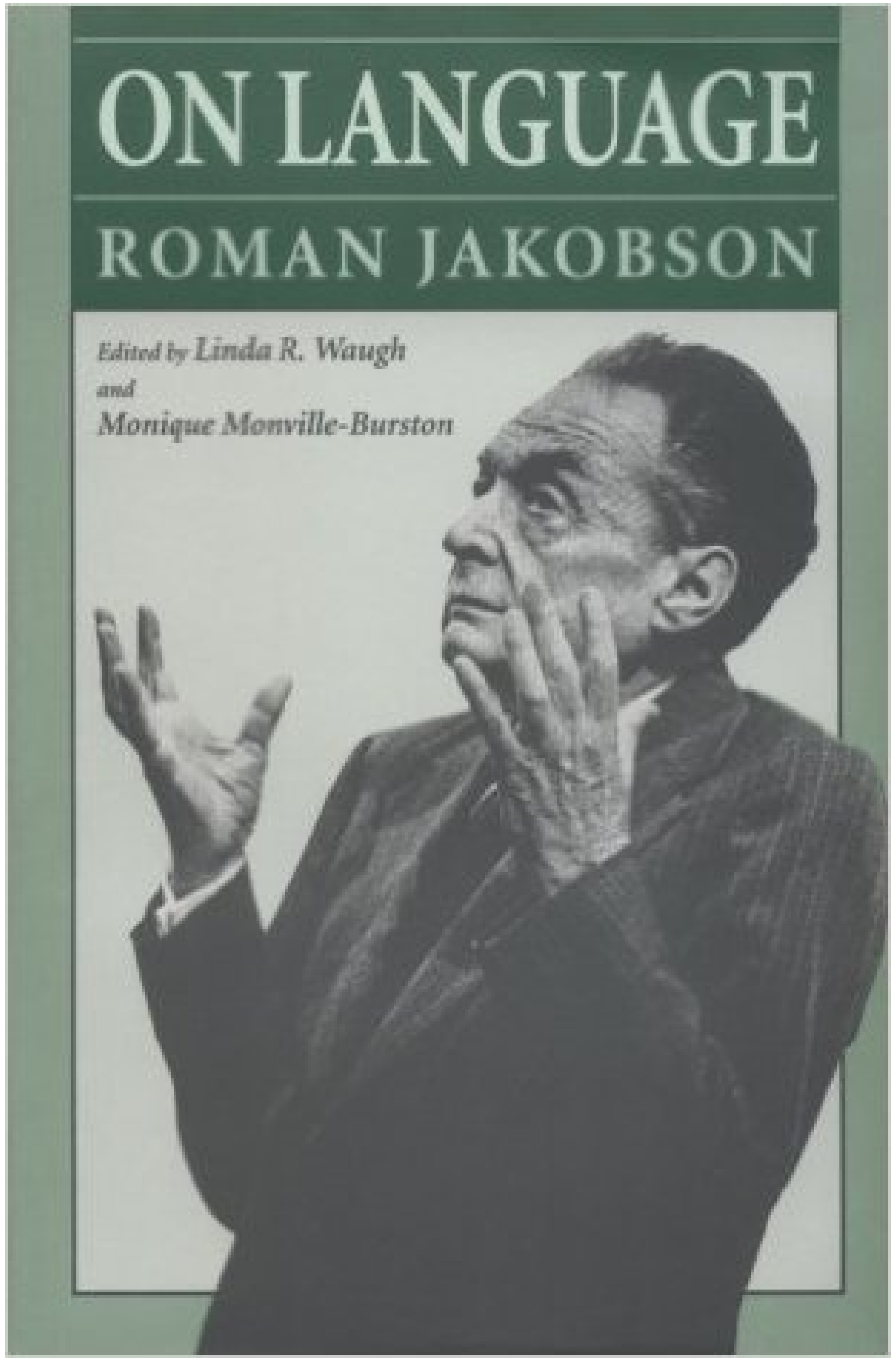
Figure 7.

Jakobson, Roman, 1896-1982

“ “ (1941).

Kindersprache, Aphasie und allgemeine Lautgesetze.

English translation by
Allan R. Keiler (1968):
Child Language, Aphasia, and Phonological Universals. Mouton.



Language is built upon a **complex infrastructure** of sensorimotor, cognitive, & emotional abilities, including breathing, chewing, memory, reasoning, etc., all supported by our remarkable brain.

This infrastructure starts to form late in gestation, as the fetus hears its mother's voice & her language, and readies itself to breathe & to swallow, vital necessities immediately at birth. Language develops especially rapidly during infancy & childhood, accumulating **tens of thousands of words** & **numerous grammatical constructions**.

In recent decades, with the emergence of Cognitive Neuroscience as an integrated discipline, together with major advances in imaging technology, we have learned a great deal about how language is acquired, organized & used during the **first several decades** of the lifespan.

After the various abilities peak, mostly in the second & third decades of life, they decline according to different biological schedules as the brain ages. Although some decline is **normal** & unavoidable, the situation is much more severe in cases of **pathology**, resulting in aphasias, dementias, Alzheimer's, Parkinson's, Schizophrenia, etc.

Modern science has abruptly brought the world greater longevity. The downside of this gift is a '**neurological epidemic**.' Ageing & the neuro-degenerative diseases bring various forms of dysfunction, including language, memory, etc., about which we know very little. This epidemic has created a demographic shift in which more & more elders depend on a dwindling working force. Unfortunately, most of what we have learned in recent decades about these challenges comes from Western research.

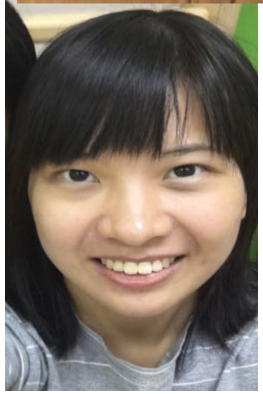
To meet these challenges effectively, each population must learn all it can about the mechanisms & consequences of ageing & neurodegeneration, in the context of its **own language** & its **own culture**. This will not only contribute to the science of life & the human condition in general, but also help meet the economic & emotional challenges society urgently faces. Together with many other disciplines, linguistics, as a window to mental life, has a great deal to contribute to the world.

*Henrich, J. 2010. Most people are not **WEIRD**. Nature 466: 29.*

*Jones, D. 2010. A **WEIRD** View of Human Nature Skews Psychologists' Studies. Science 328: 1627.*

***WEIRD** = **W**estern **E**ducated **I**ndustrialized **R**ich **D**emocratic.*

Manson Fong
方卓敏



Edith Fung
馮思允

Roza Hui
許雅欣

Patrick Chu
朱震球

THANK YOU !!

謝謝!!!

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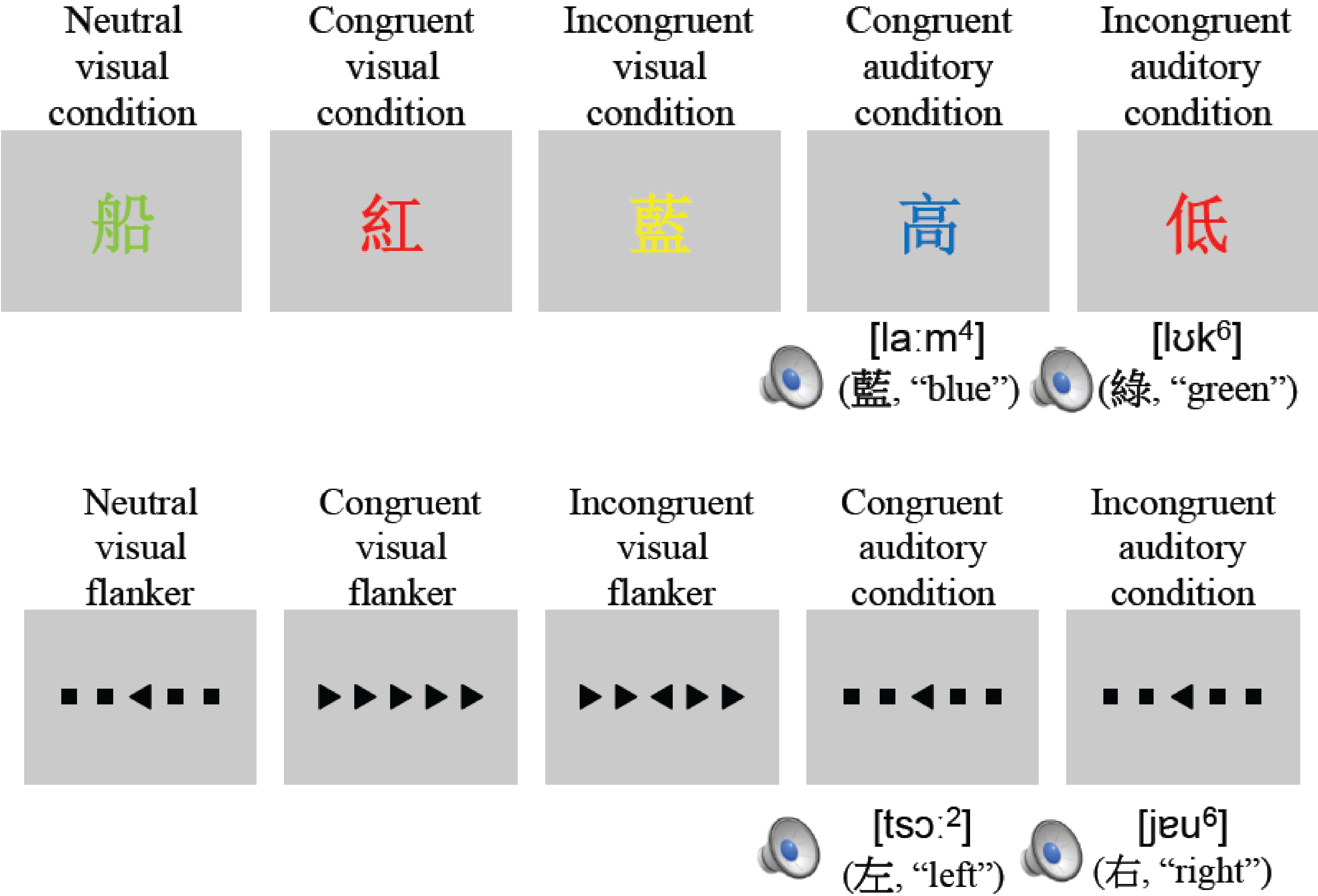

Some cognitive experiments to measure abilities in focusing attention & multi-modal *(visual & auditory)* integration.

Variants of Stroop Test & Flankers Test.

The New York Times | http://nyti.ms/1mSFopz

The Opinion Pages | OP-ED CONTRIBUTOR

The Benefits of Failing at French

By WILLIAM ALEXANDER JULY 15, 2014

"… just before tackling French I took a cognitive assessment called CNS vital signs. … I scored below average for my age group in nearly all the categories, notably landing in the bottom 10th percentile on the composite memory test and in the lowest 5 percent on the visual memory test. …

After a year of struggling with the language, I retook the cognitive assessment, and the results shocked me. My scores had skyrocketed, placing me above average in seven of 10 categories, and average in the other three. My verbal memory score leapt from the bottom half to the 88th — the **88th!** — percentile and my visual memory test shot from the bottom **5th percentile to the 50th**. Studying a language had been like **drinking from a mental fountain of youth**."

written at age 57.