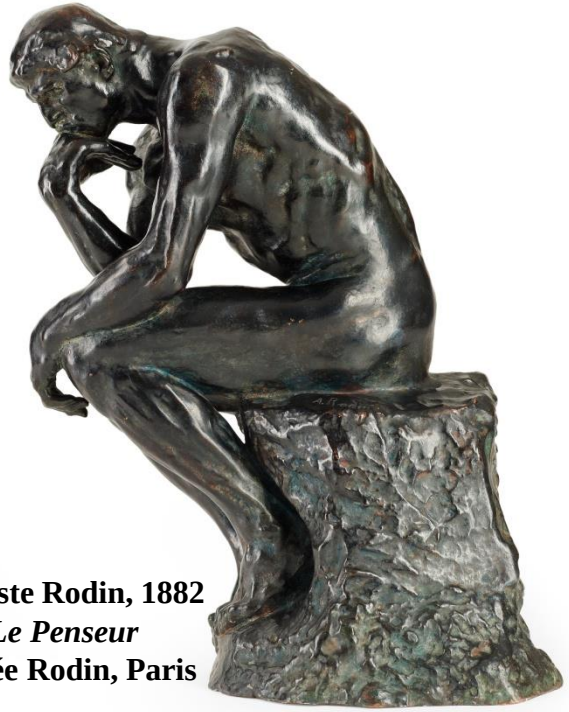
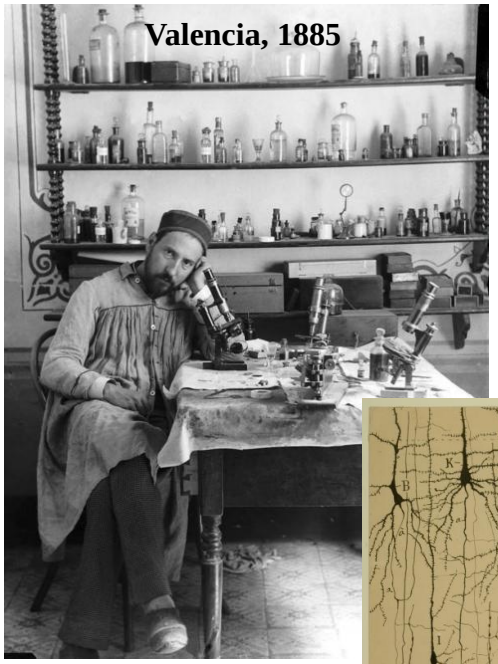
Rembrandt, 1656.
***De anatomische les van Dr. Jan Deijman* (1619-1666)**
Amsterdam Museum

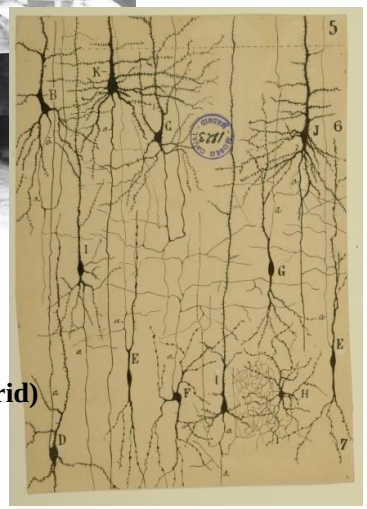
Pedro R. García Barreno
Madrid, 24 de marzo de 2015

N E U R O C I E N C I A S



Auguste Rodin, 1882
Le Penseur
Musée Rodin, Paris





Santiago Ramón y Cajal
(1852-1934)
PNFoM 1906
(Univ. Valencia, Barcelona y Madrid)
(1888)

Rafael Lorente de No
(1902-1990)
Inst. Rockefeller, NY.

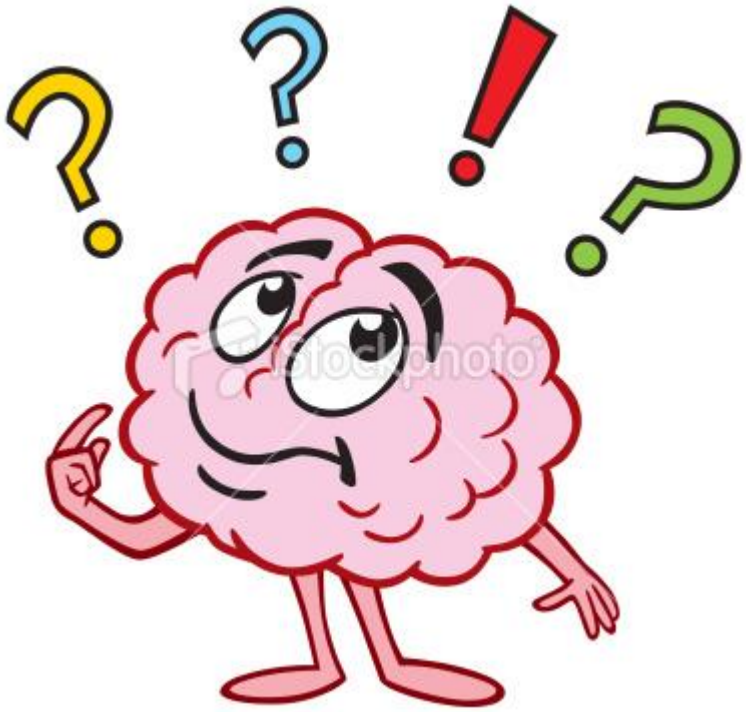
Carlos Belmonte Mtz.
(Albacete, 1943)

CSIC
INSTITUTO DE NEUROCIENCIAS

Presidente IBRO
International Brain
Resarch Organization

Rafael Yuste
(Madrid, 1963)
(Univ. Columbia., N.Y.)

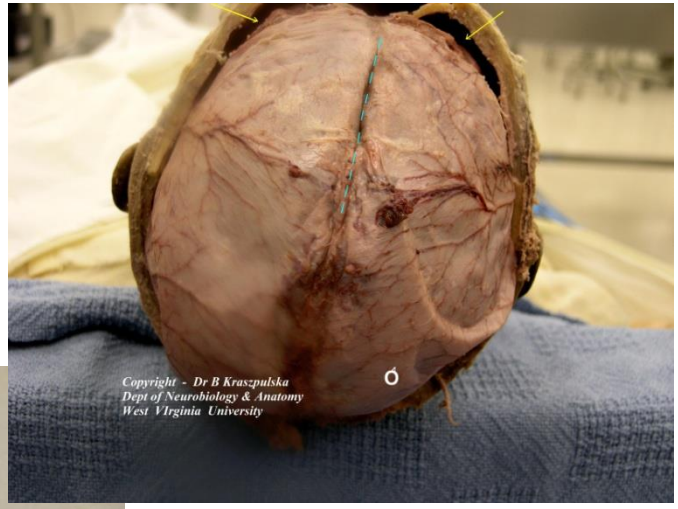
PROGRAMA TRANSCIENTÍFICO DE AUTOCOMPRENSIÓN DEL CEREBRO

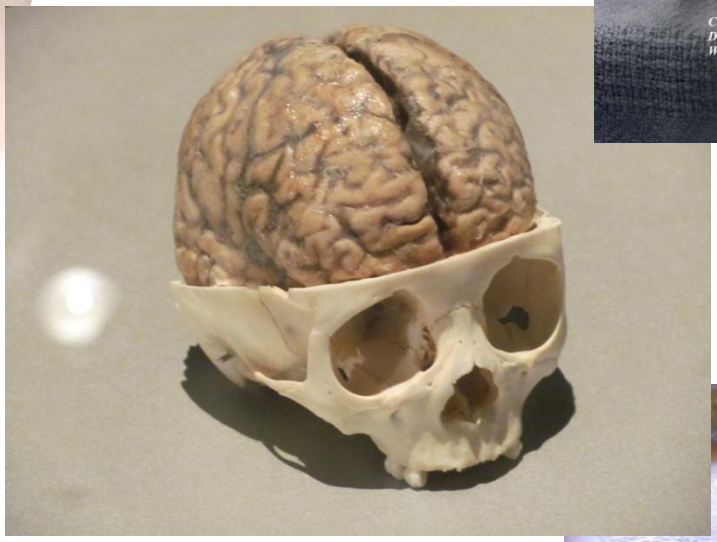


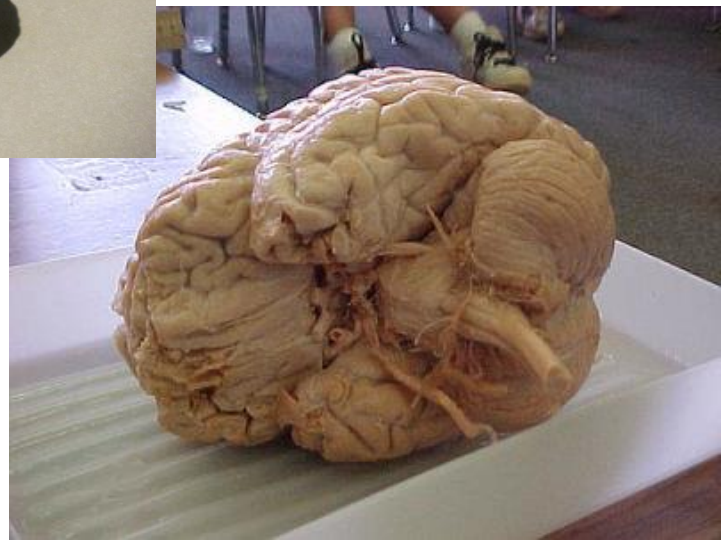
UTILIZA HERRAMIENTAS POR EL CREADAS

- Anatomía
  - desarrollo
  - evolución
- Histología
  - citoarquitectura
- Fisiología
- Técnicas de estudio
  - electrofisiología
  - electromagnetoencefalografía
  - imagen
    - estructural
    - funcional
- Patología
- Terapia
  - farmacología
  - interfaz cerebro-máquina (robótica)

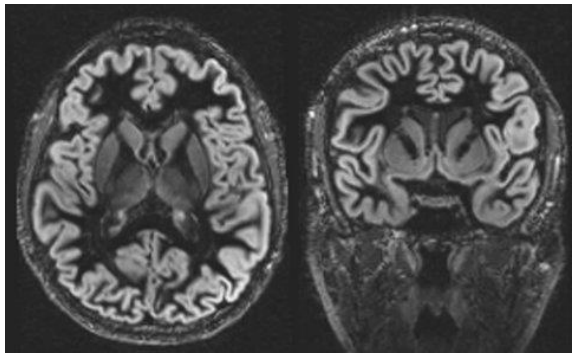
UN UNIVERSO DE 1400 g

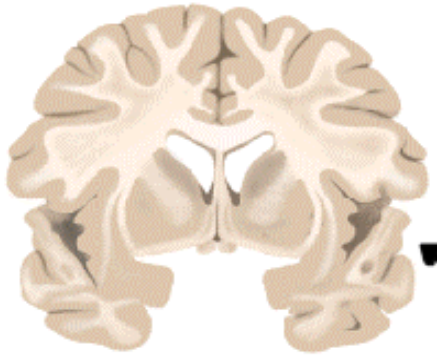






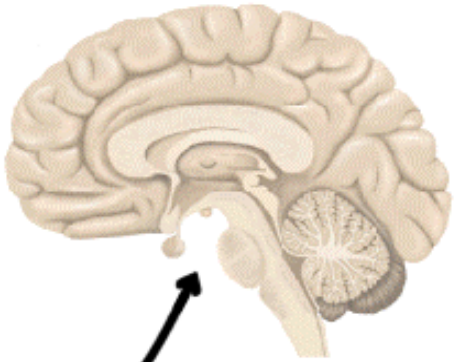
2% masa corporal
20-25% consumo energético total
Sustratos energéticos: glucosa, oxígeno



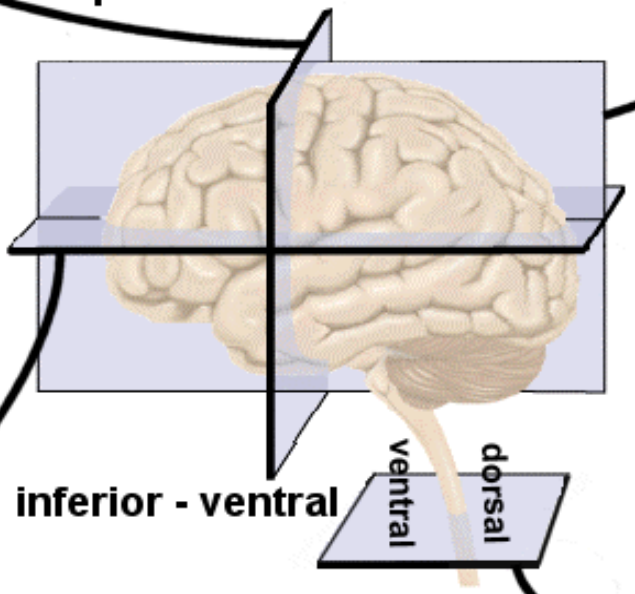


coronal (frontal) section

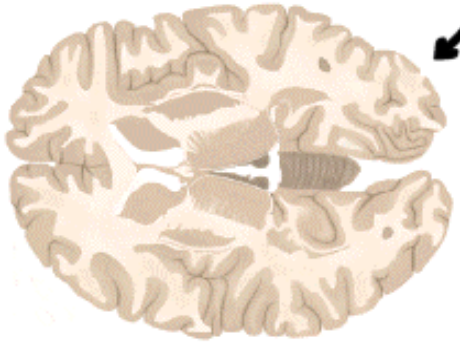
superior - dorsal

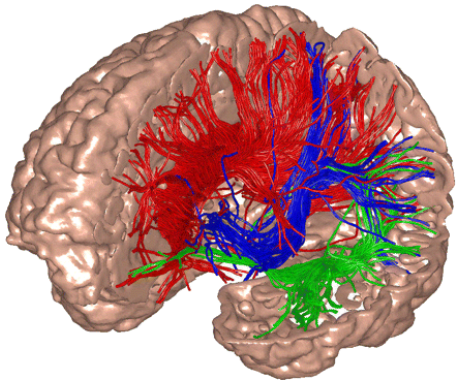


mid-sagittal (medial) section

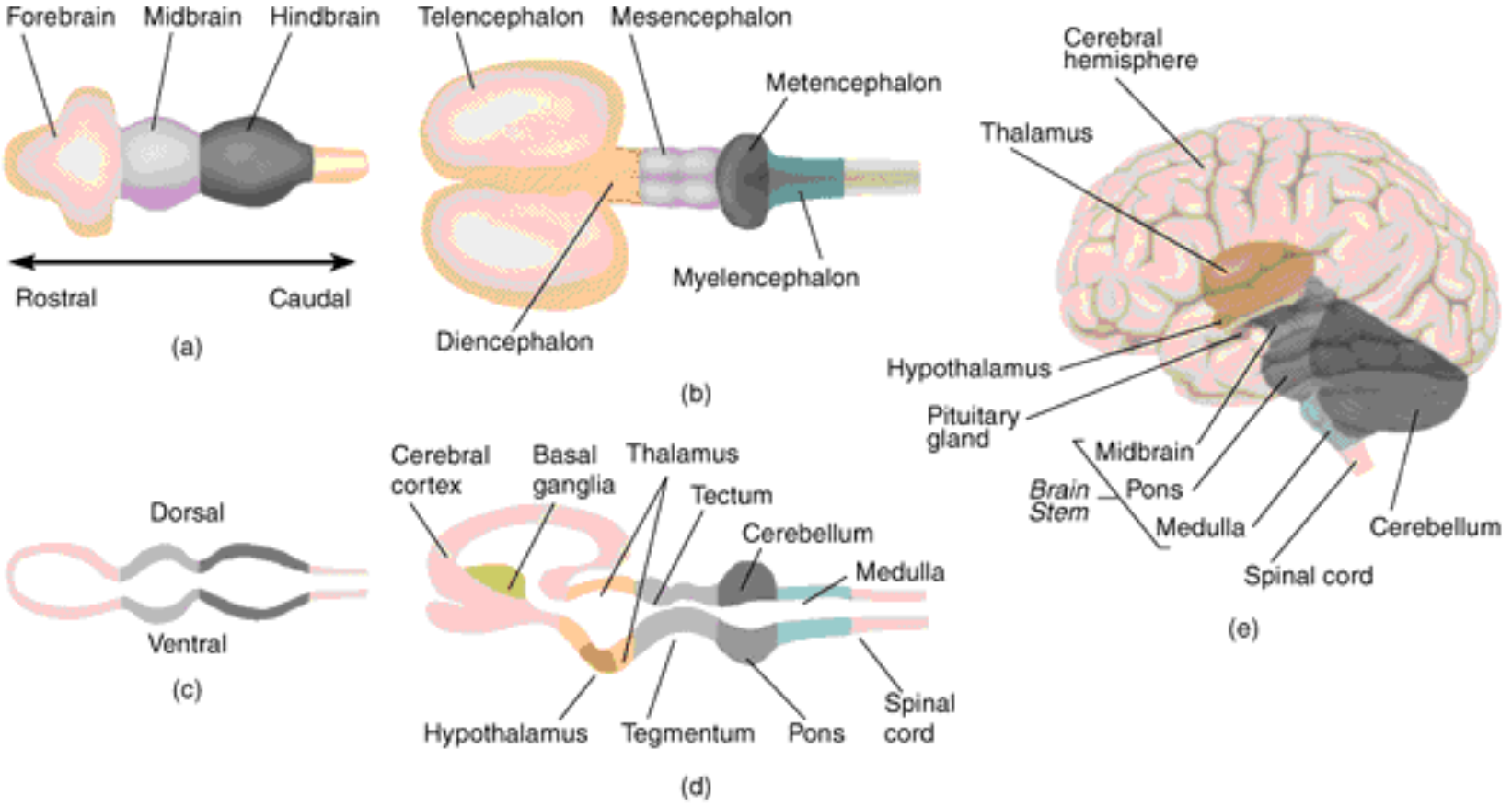


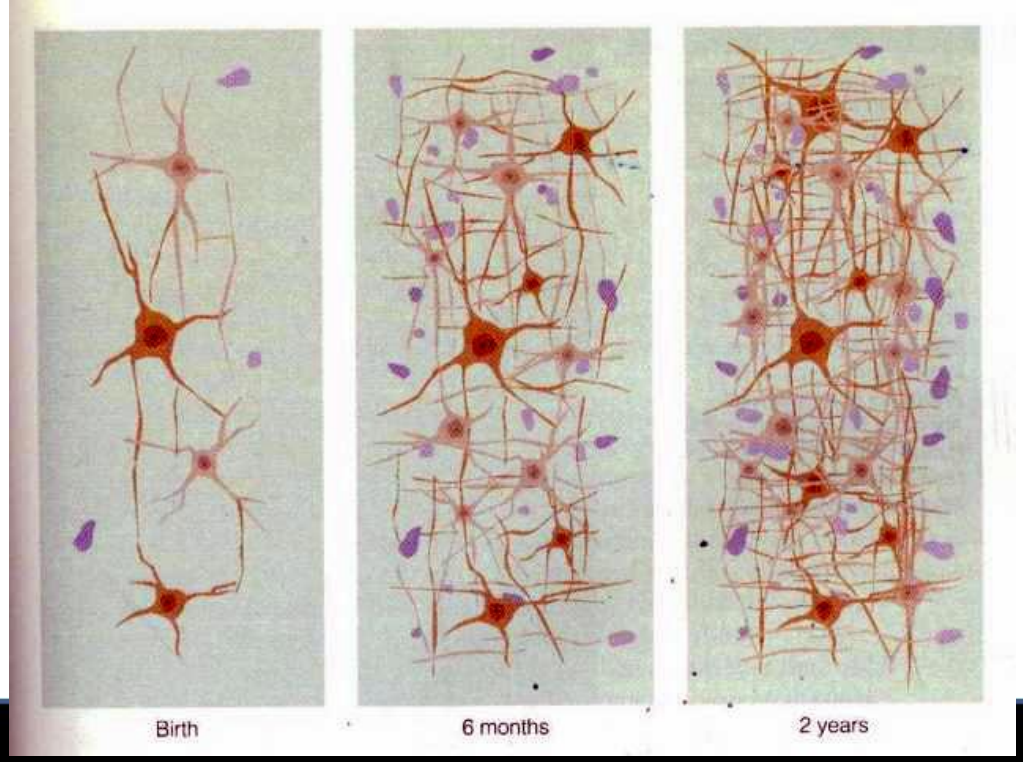
horizontal section

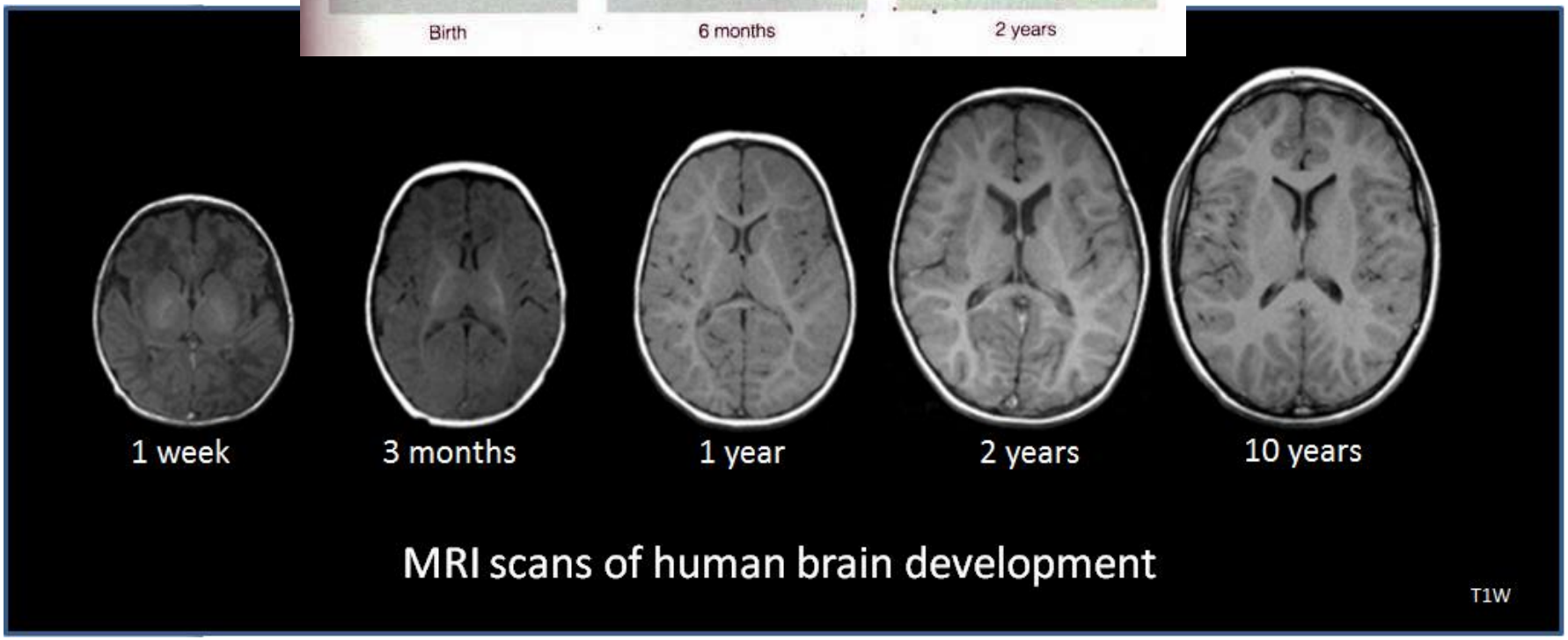




► **A Schematic Outline of Brain Development, Showing Its Relation to the Ventricles. (a) and (c) Early Development. (b) and (d) Later Development. (e) A Lateral View of the Left Side of a Semitransparent Human Brain**



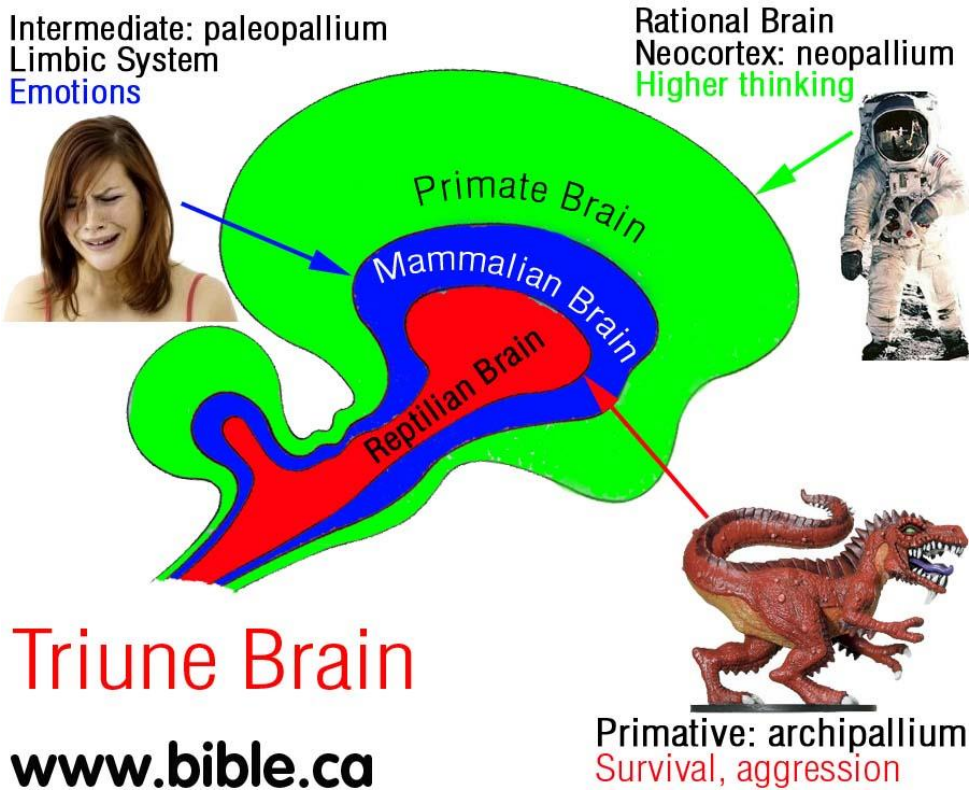

Birth
6 months
2 years


1 week
3 months
1 year
2 years
10 years
MRI scans of human brain development
T1W

Cerebro triuno

complejo-R (cerebro reptiliano):	**tronco cerebral y cerebelo** **comportamiento instintivo y supervivencia.**
paleocerbero (sistema límbico):	**amígdala, hipotálamo e hipocampo** **motivación e instintos: alimentación, reproducción, altruismo.** **circuitos de recompensa o de gratificación mesolímbico**
neocerebro (córtex cerebral):	**consciencia, razonamiento, abstracción, habla**

Paul D. MacLean
(1913-2007)



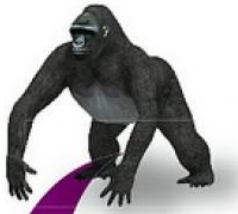
What is the difference?

Humans vs. animals

Humans have long considered themselves truly unique. But it turns out that the better word from "unique" is "most advanced". Every year scientists prove that some purely human traits are found in animals.

Ravens use stones to crack eggs, sometimes immobilizing an egg with a bigger stone and hitting it with a smaller one.

Tool use and construction



Sense of humor

Apes in the wild have been recorded to taunt tiger cubs by pulling their ears, tails and patting them – and escaping later, only to return and do it again.

Complex communication

Although chimpanzees can't really communicate verbally, they can do it through sign language.

Clark's nutcrackers remember for at least half year where they put seeds – and they use 5 thousand caches in a 15-mile area.

Long term memory

Emotions

Elephants feed and wait for crippled herd member, showing empathy.

Chimpanzees have similar basic arithmetic mental, non-verbal skills (adding up) as humans.

Counting

Culture

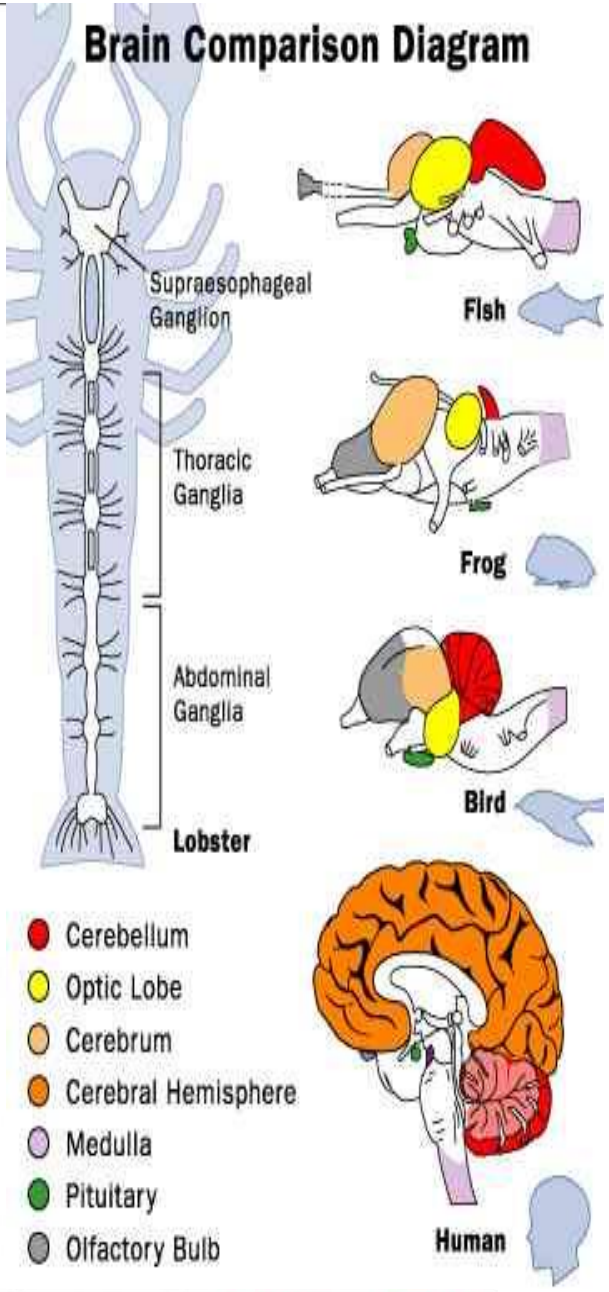
Wild dolphins, which were recovering from an illness in Adelaide dolphinarium, learned to tail-walk only from dolphins living in captivity, without human trainers.

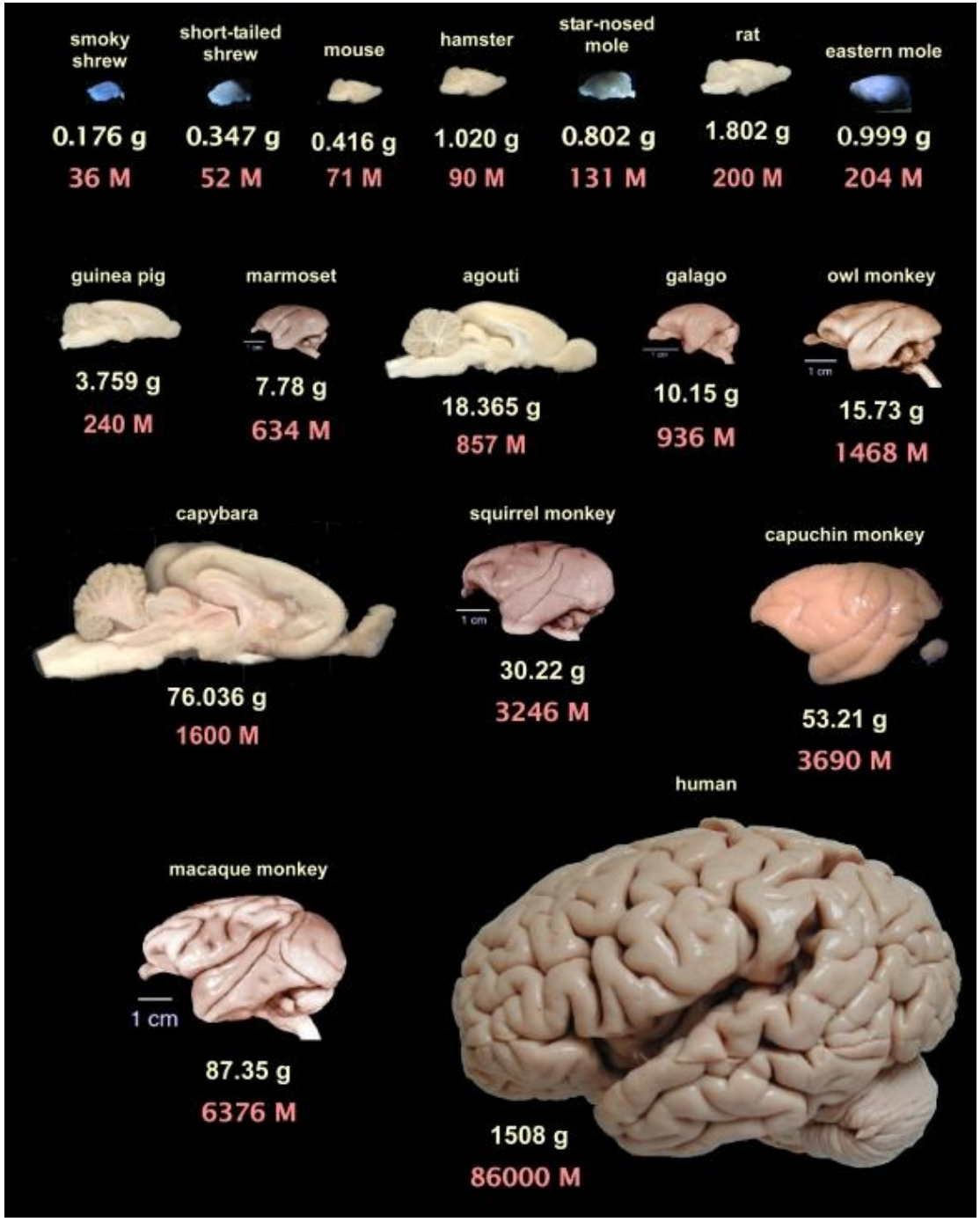
Self-awareness

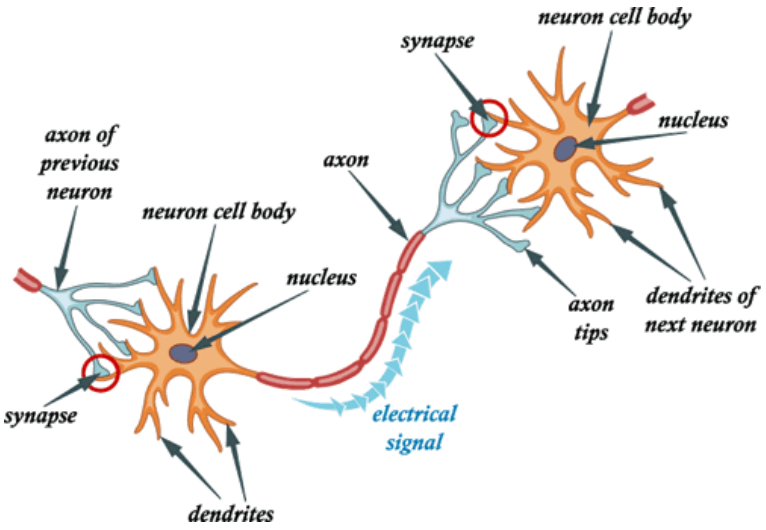
All great apes, dolphins, elephants and magpies recognize their reflection in the mirror, if they see anything unusual they try to rub it/remove it.

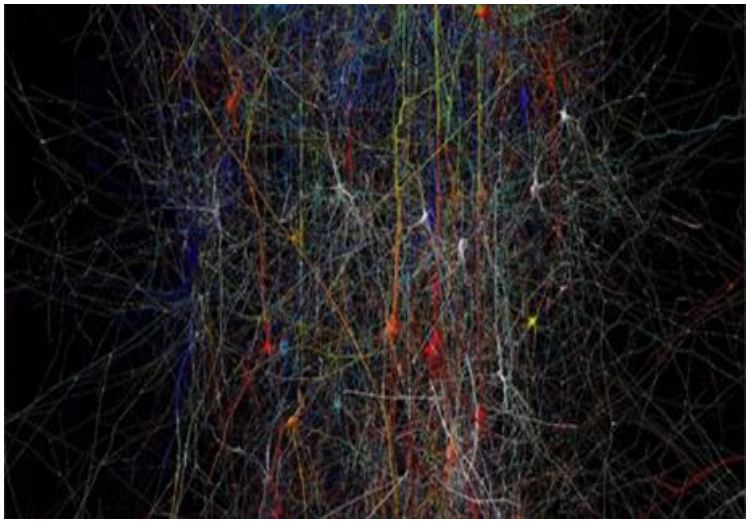
Graphic by www.SWgraphics.com

Brain Comparison Diagram

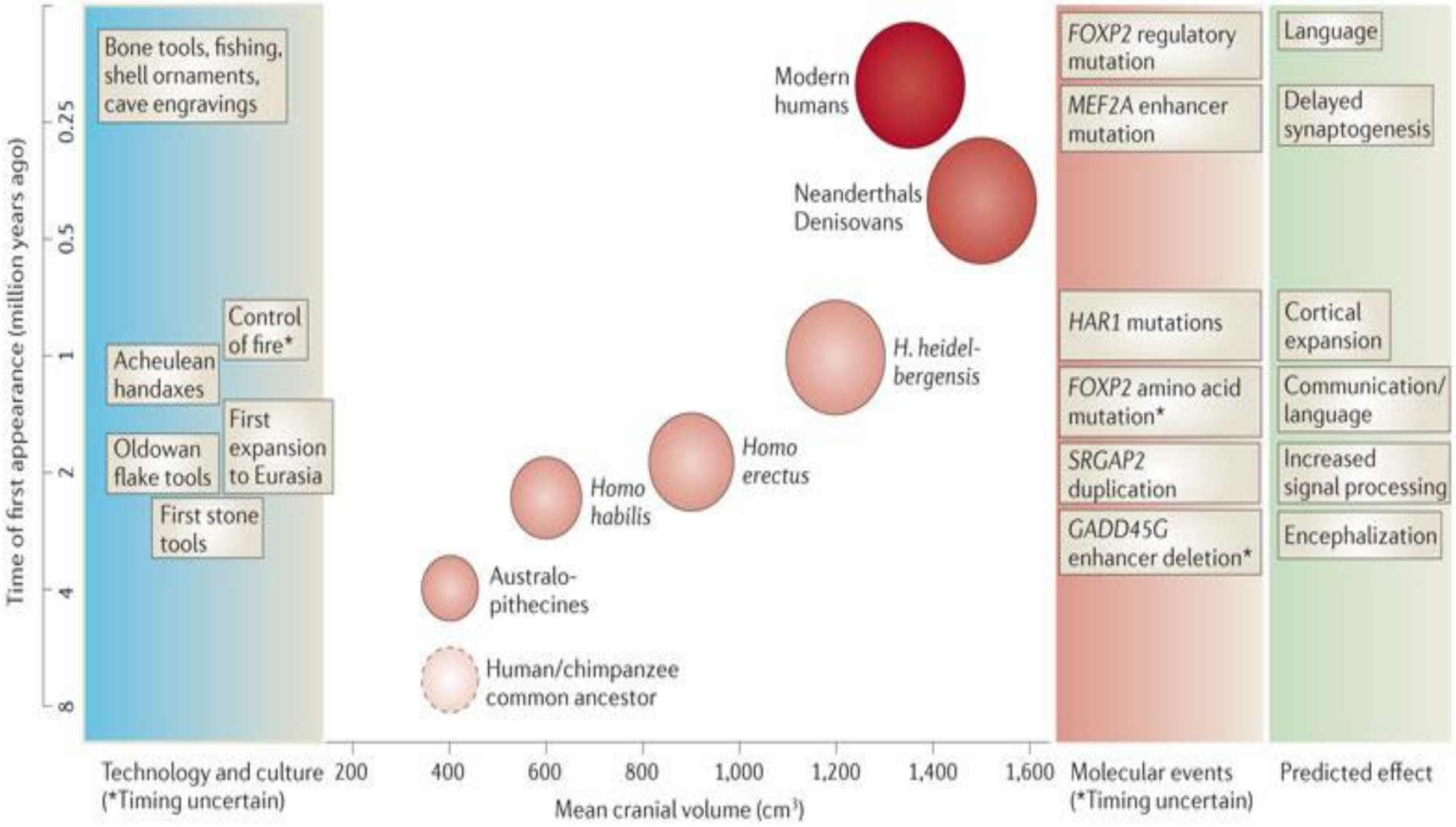




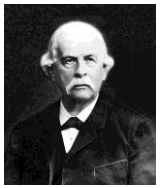




SNC:	**1.0 x 10 ^{11} neuronas**
Cortex:	**1.6 x 10 ^{10} neuronas**
Conexiones:	**1.0 x 10 ^{14} sinapsis**
Capacidad:	**10 ^{12} (TB) – 10 ^{15} (PB)**

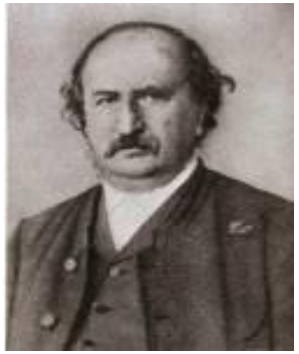

Time of first appearance (million years ago)
0.25
0.5
1
2
4
8
Bone tools, fishing, shell ornaments, cave engravings
Control of fire*
Acheulean handaxes
First expansion to Eurasia
Oldowan flake tools
First stone tools
Modern humans
Neanderthals Denisovans
H. heidel-bergensis
Homo erectus
Homo habilis
Australo-pithecines
Human/chimpanzee common ancestor
200
400
600
800
1,000
1,200
1,400
1,600
Mean cranial volume (cm³)
Technology and culture (*Timing uncertain)
FOXP2 regulatory mutation
MEF2A enhancer mutation
HAR1 mutations
FOXP2 amino acid mutation*
SRGAP2 duplication
GADD45G enhancer deletion*
Molecular events (*Timing uncertain)
Language
Delayed synaptogenesis
Cortical expansion
Communication/ language
Increased signal processing
Encephalization
Predicted effect

Teoría sincitial del sist. nervioso



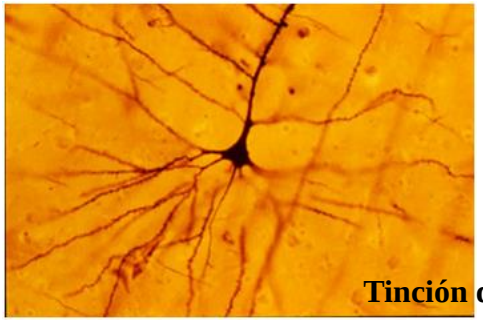
Rudolph A. von Kölliker
(1817-1905)

Santiago Ramón y Cajal
(1852-1934)

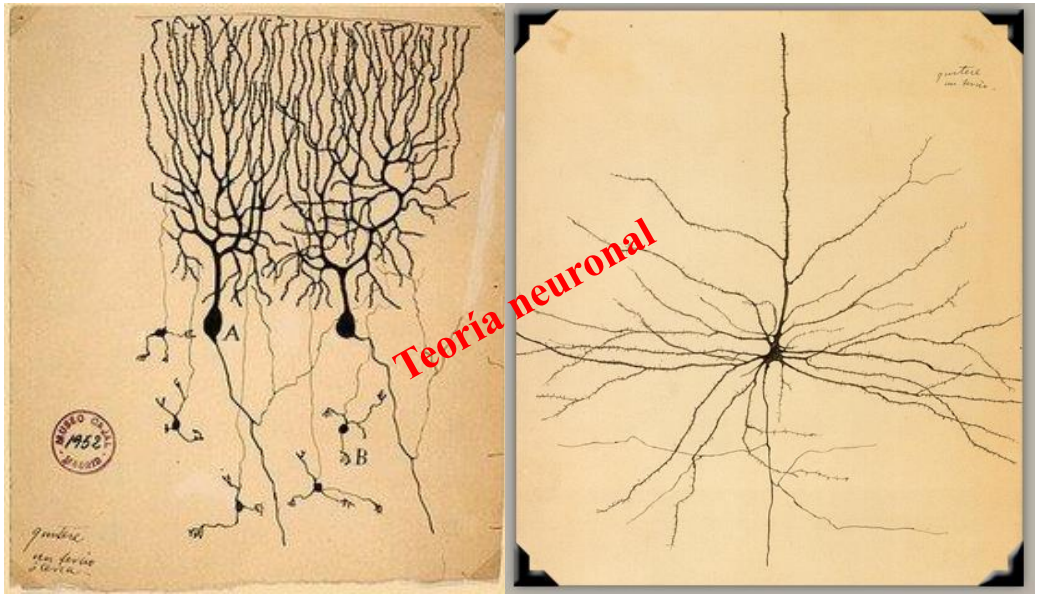


Joseph von Gerlach
(1820-1896)

B. Camilo E. Golgi
(1843-1926)

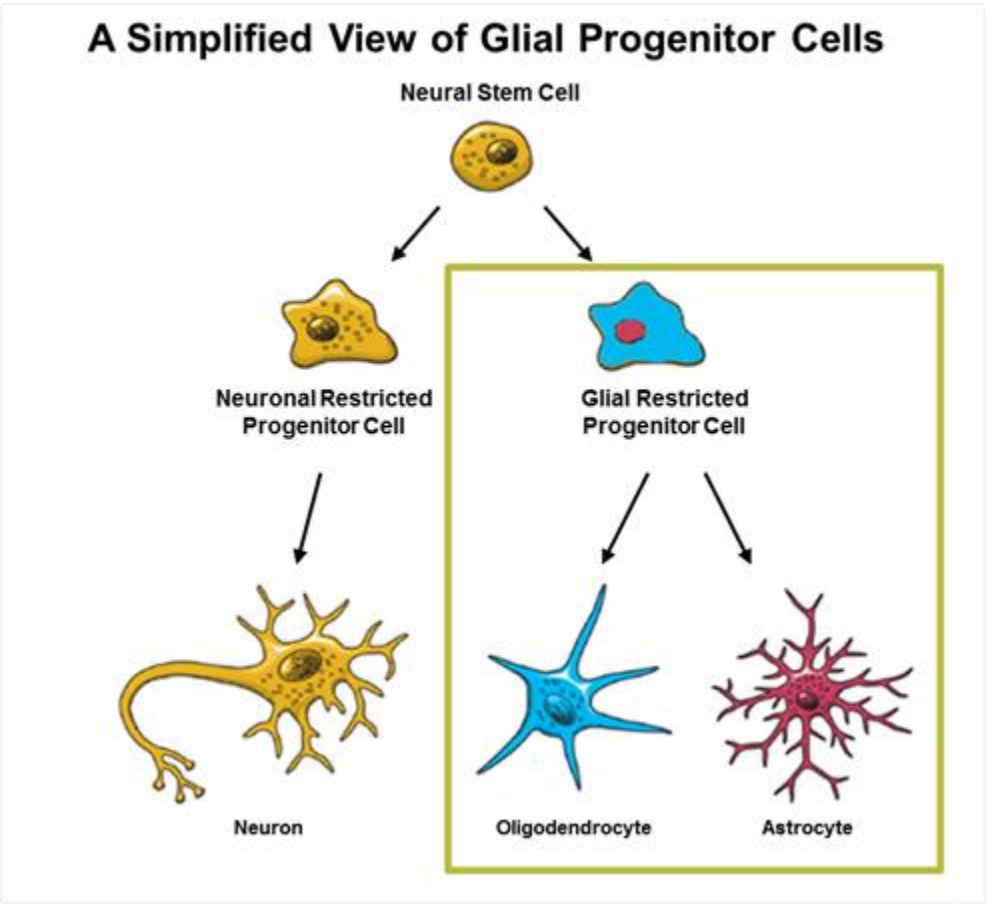


Tinción de Golgi



Teoría neuronal

«Le he descubierto a usted, y deseo divulgar en Alemania mi descubrimiento»
Congreso de la Sociedad Anatómica Alemana, octubre 1889.



85-100 x 10^9 **85-100 x 10^{10}**

- **SN**
  - **Neuronas** — **NSC**
  - **Glia**
    - **oligodendrocitos** — **NSC**
    - **astrocitos** — **NSC**
    - **microglia** — **HSC**

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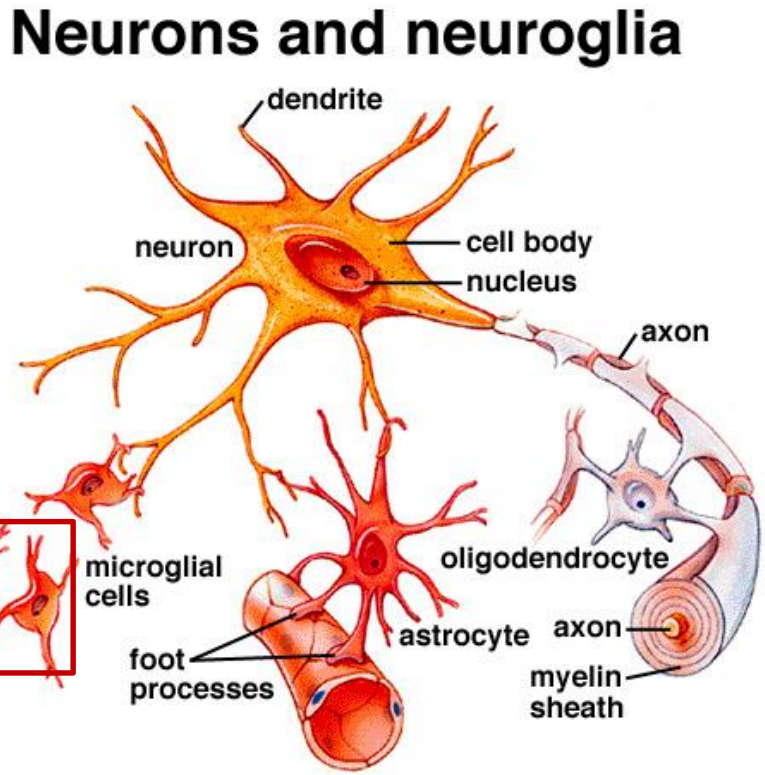
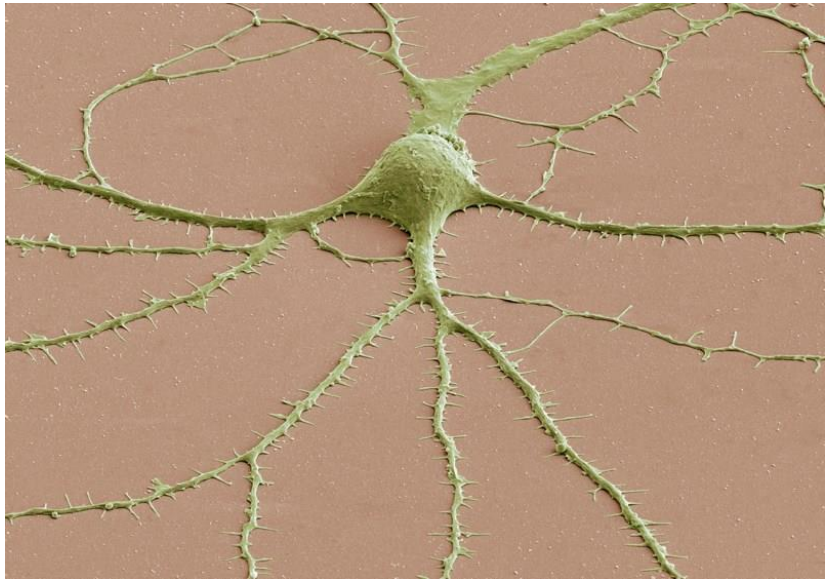
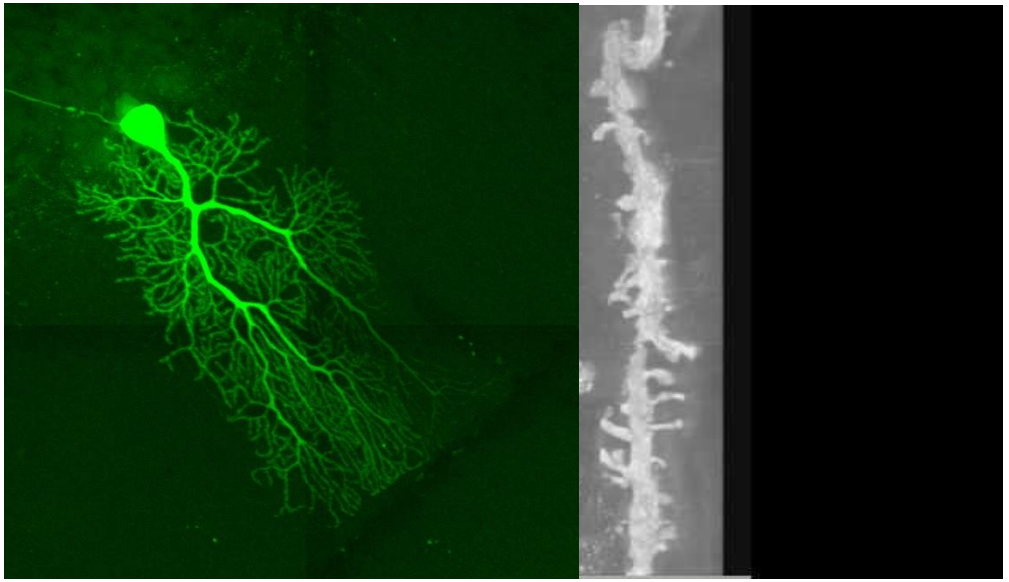
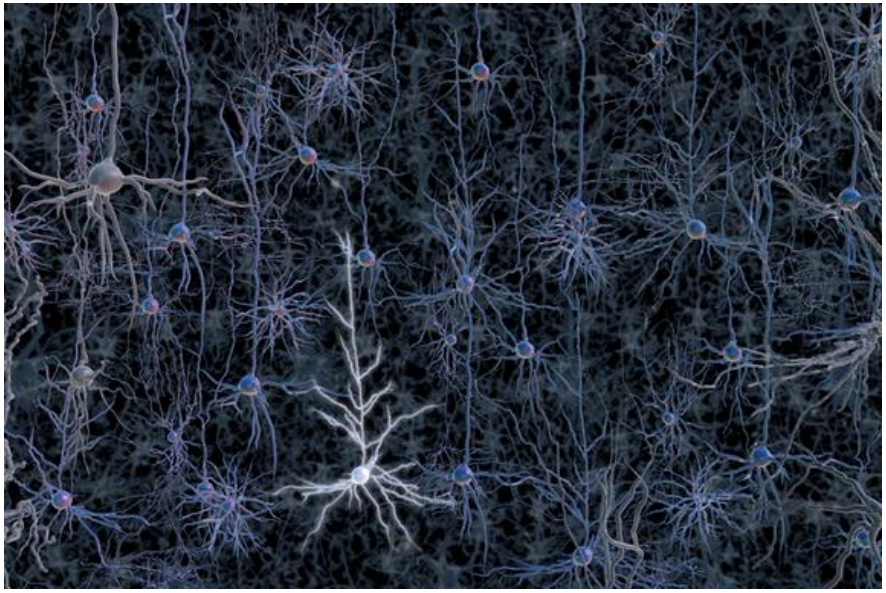
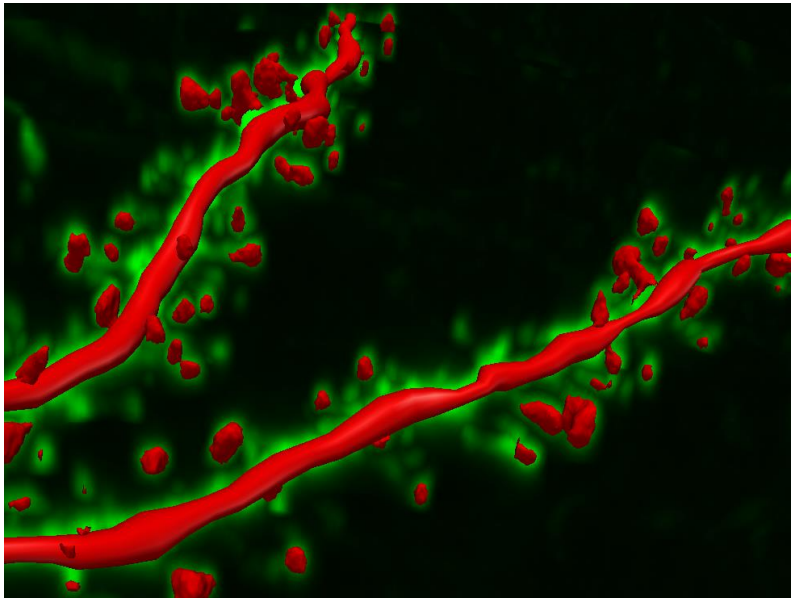


Hematopoietic Stem Cells →

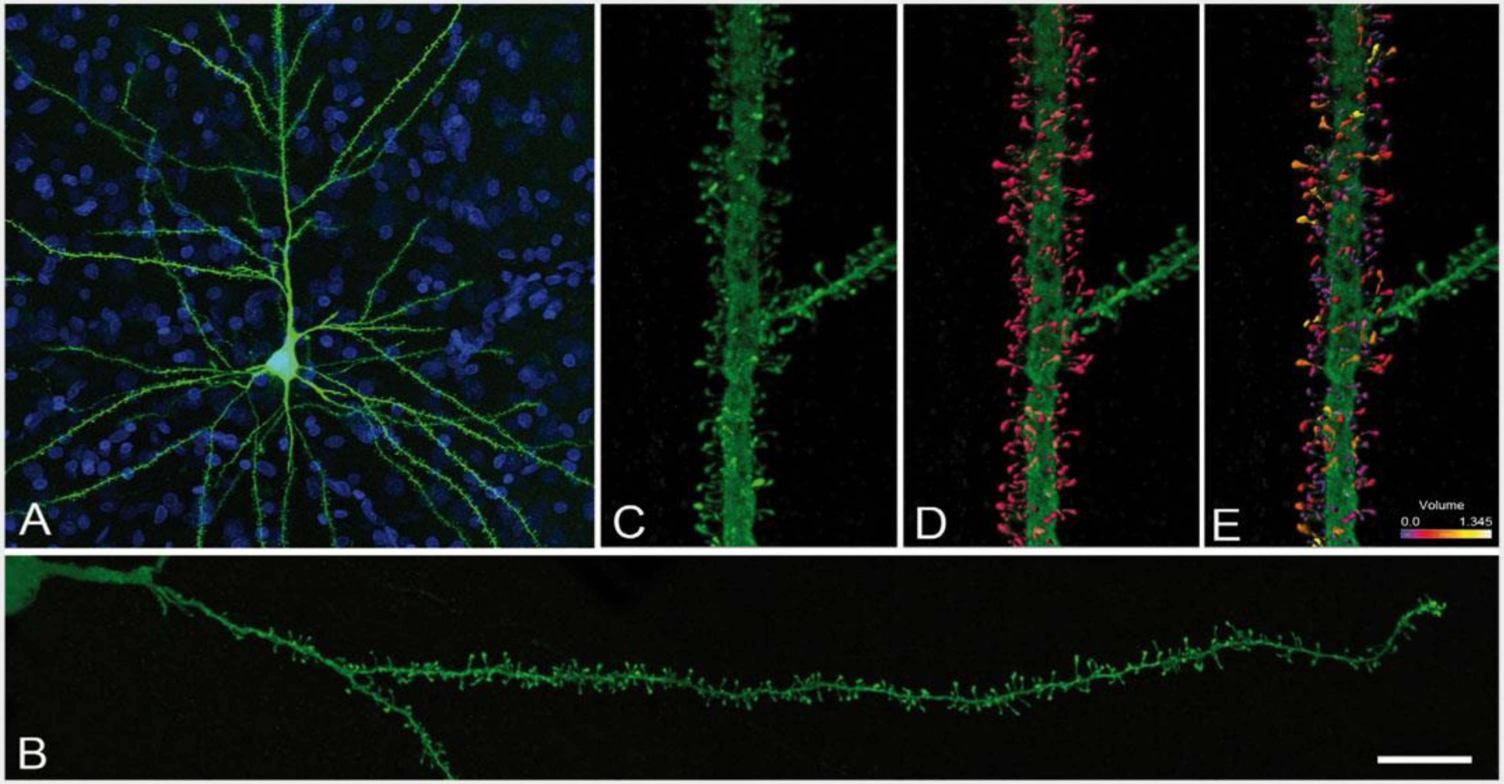








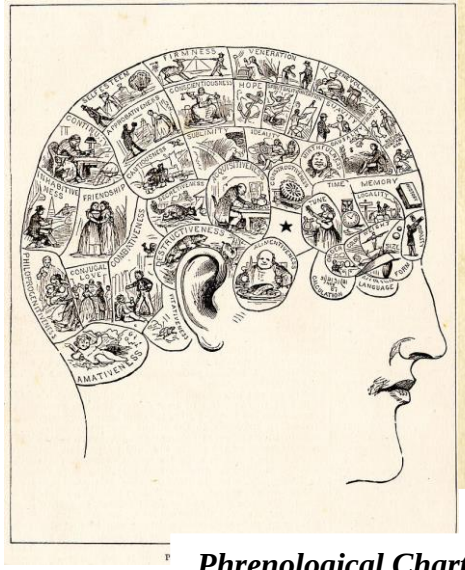
/// Figura 2. Análisis de la microantomía de la células piramidales inyectadas intracelularmente con Lucifer Yellow //



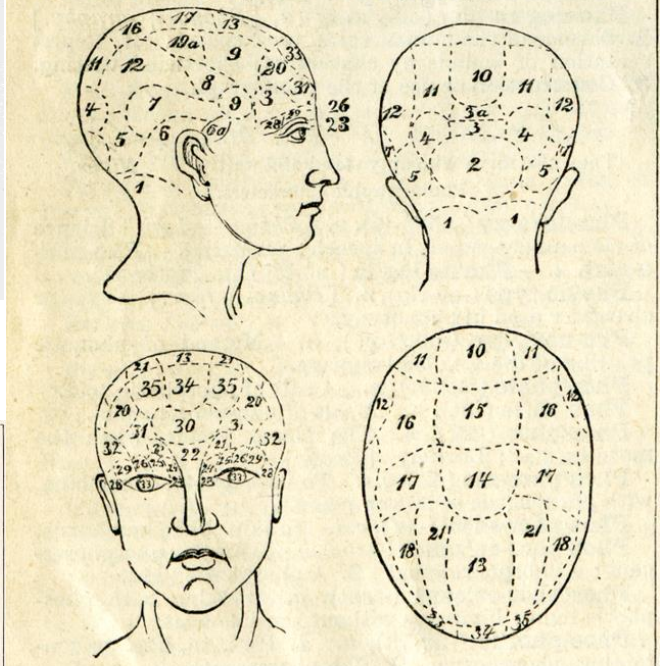
Imágenes tomadas con el microscopio confocal para analizar la microantomía de la células piramidales inyectadas intracelularmente con Lucifer Yellow (un marcador fluorescente).
El Lucifer Yellow difunde por el interior de la neurona mediante el paso de una corriente negativa continua, permitiendo visualizar la morfología completa de la célula, incluyendo las espinas dendríticas. A: Imagen de una célula piramidal en la capa III de las corteza temporal humana. A, B: Detalles de una dendrita basal (B) y de la dendrita apical (C). D: Reconstrucción tridimensional de la morfología completa de las espinas dendríticas mostradas en C. E: Estimación de los volúmenes de las espinas dendríticas mostradas en D. Los códigos de color indican distintos volúmenes (azul-blanco: 0.0-1.345 μm^3). Barra de calibración: 40 µm en A; 13 µm en B; 7 µm en C-E.

Fuente: Benavides-Piccione et al., 2012 Cereb Cortex. *2012 Jun 17. [Epub ahead of print].*

Franz Joseph Gall
(1758-1828)



Phre-nol'o-gy (-nŏl'ŏ-jy), *n.* [Gr. φρήν, φρενός + *-logy.*] **1.** Science of the special functions of the several parts of the brain, or of the supposed connection between the faculties of the mind and organs in the brain. **2.** Physiological hypothesis that mental faculties, and traits of character, are shown on the surface of the head or skull; craniology. — **Phre-nol'o-gist**, *n.* — **Phren'o-log'ic** (frĕn'ŏ-lŏj'ĭk), **Phren'o-log'ic-al**, *a.*



A Chart of Phrenology.

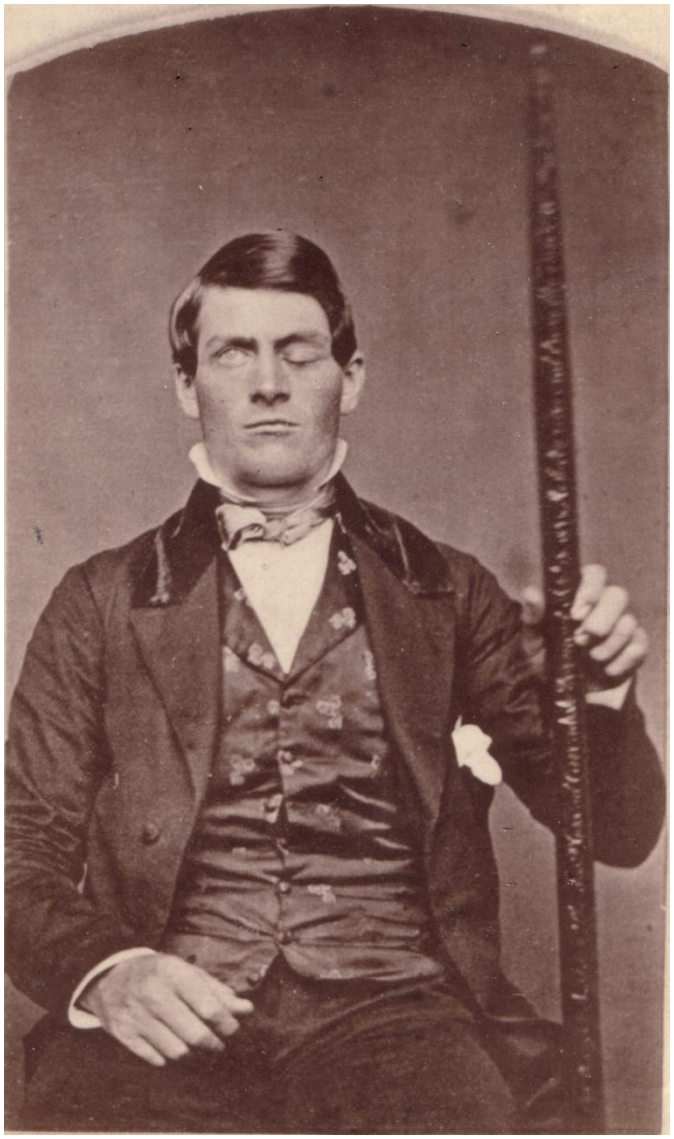
1 Amativeness · 2 Philoprogenitiveness; 3 Concentrativeness; 3 *a* Inhabitiveness; 4 Adhesiveness; 5 Combativeness; 6 Destructiveness; 6 *a* Alimentiveness; 7 Secretiveness; 8 Acquisitiveness; 9 Constructiveness; 10 Self-esteem; 11 Love of Approbation; 12 Cautiousness; 13 Benevolence; 14 Veneration; 15 Firmness; 16 Conscientiousness; 17 Hope; 18 Wonder; 19 Ideality; 19 *a* (Not determined); 20 Wit; 21 Imitation; 22 Individuality; 23 Form; 24 Size; 25 Weight; 26 Coloring; 27 Locality; 28 Number; 29 Order; 30 Eventuality; 31 Time; 32 Tune; 33 Language; 34 Comparison; 35 Causality. [Some raise the number of organs to forty-three.]

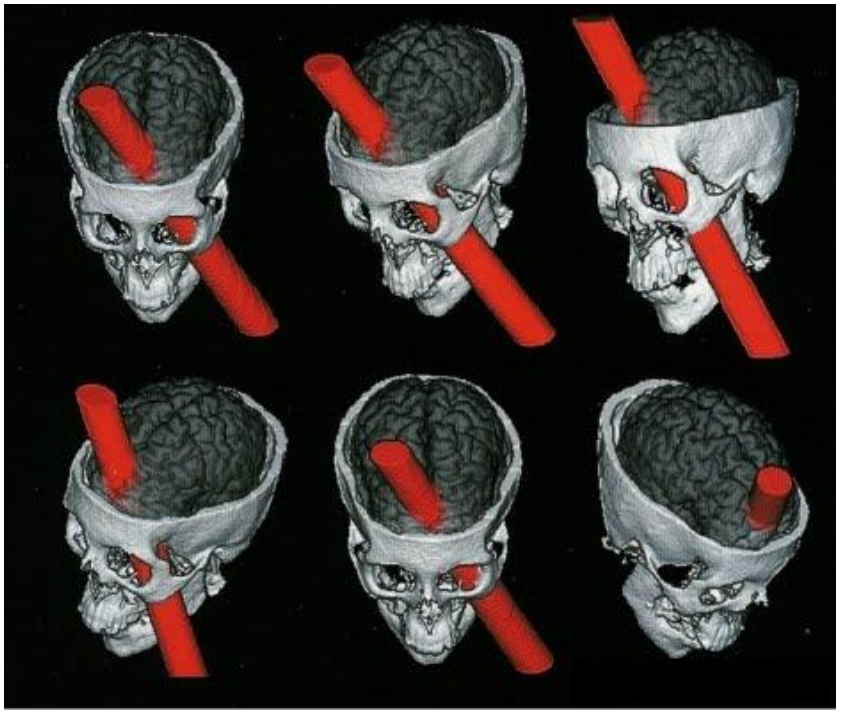
Phrenological Charts of the Faculties,
1883 y 1895.

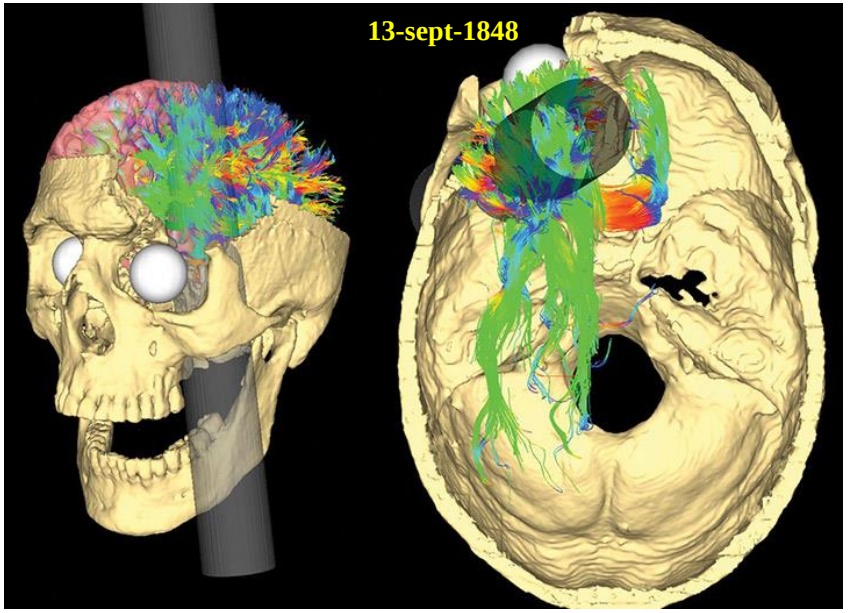
Principios doctrinales.

- **El cerebro es el órgano de la mente.**
- **El cerebro no es una unidad homogénea sino un agregado de órganos mentales con funciones específicas.**
- **Los órganos cerebrales están localizados topográficamente.**
- **Como en otras situaciones, el tamaño relativo de un órgano cerebral en particular indica su importancia.**
- **Dado que el cráneo se osifica sobre el cerebro durante el desarrollo infantil, la expresión craneológica externa puede utilizarse para diagnosticar los estados internos de los caracteres mentales.**

Phineas P. Gage
1823-1861







Carl Wernicke (1848-1905)

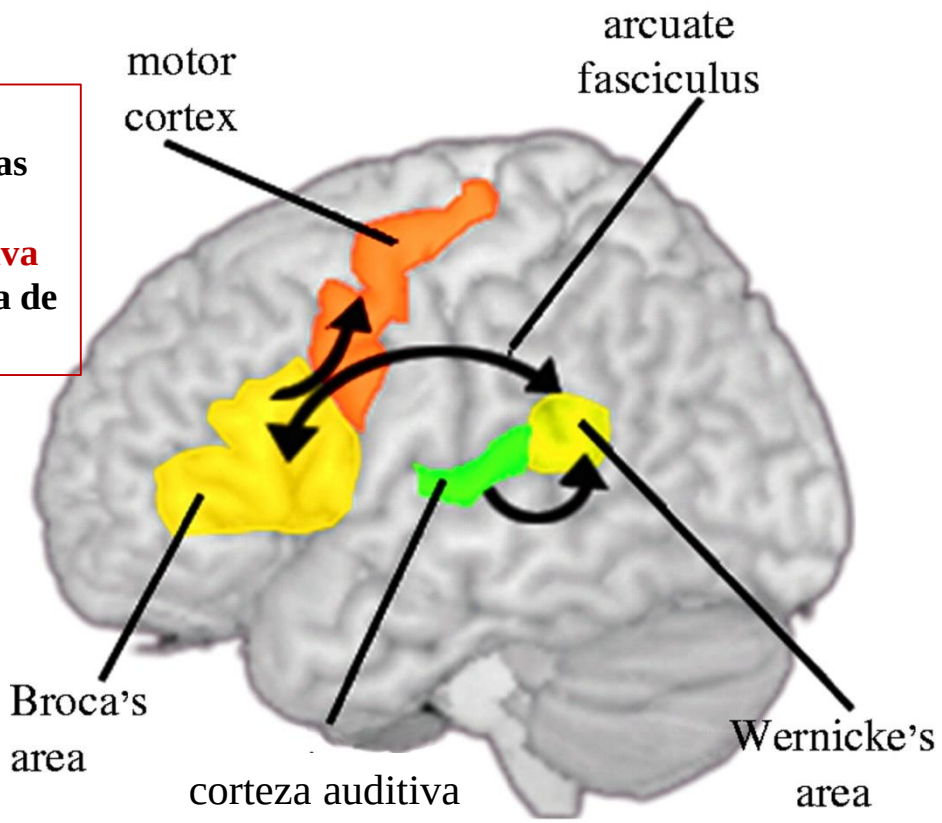
Paul Broca (1824-1880)

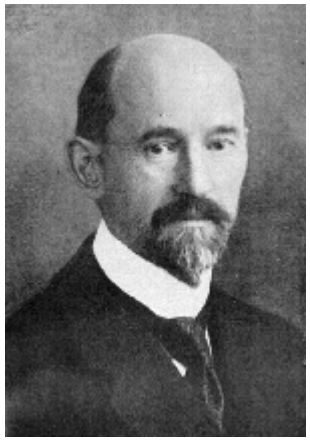
Richard L. Heschl (1824-1881

Área de Wernicke: zona –área 22 de Brodman- de la corteza responsable de la recepción del habla, donde el conocimiento del lenguaje se usa en la interpretación o memorización de la información lingüística, de conceptos escuchados o leídos (decodificación auditiva) .

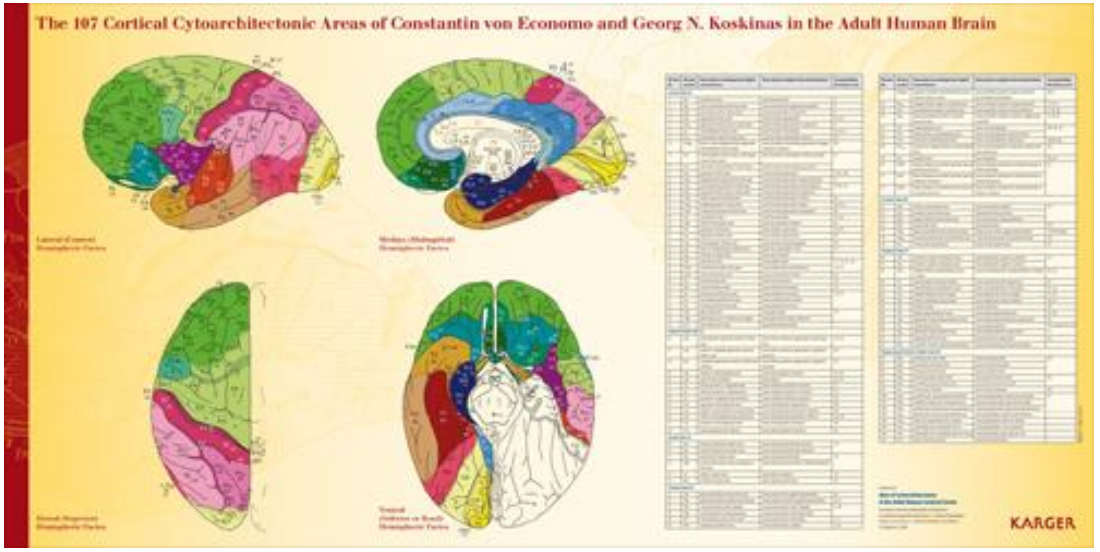
Afasia: déficit de la capacidad del lenguaje debido a lesiones en las áreas corticales de lenguaje o en las rutas de asociación. La afasia expresiva afecta al lenguaje hablado (área de Broca) mientras que la afasia receptiva afecta a la interpretación y memoria del lenguaje (área de Wernicke).

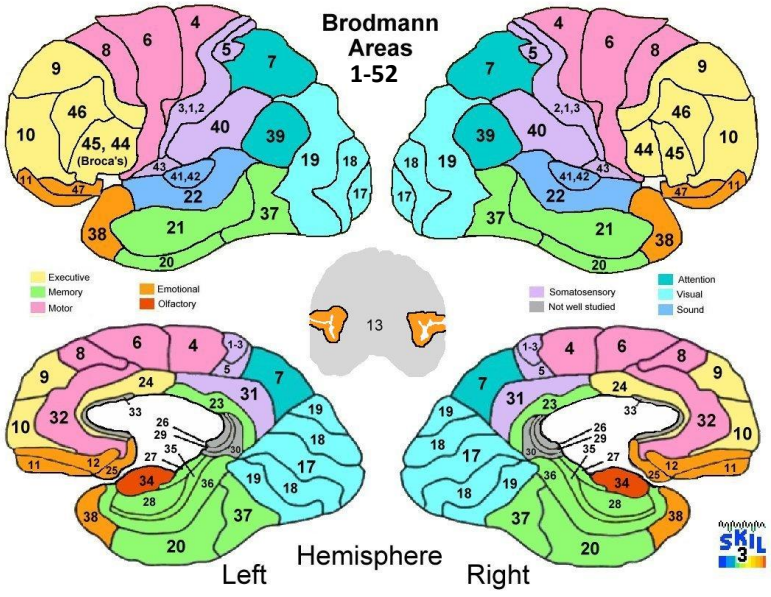
Área de Broca: zona –áreas 44 y 45 de Brodman- de la corteza responsable del habla expresiva. Allí se traduce el conocimiento de un lenguaje en palabras y oraciones comprensibles. Al ser dañada, el afectado entiende todo lo que le dicen pero no tiene habilidad en expresarse con claridad ni en forma entendible.





Korbinian Brodmann
(1868-1918)





Constantin F. v Economo
(1876-1931)

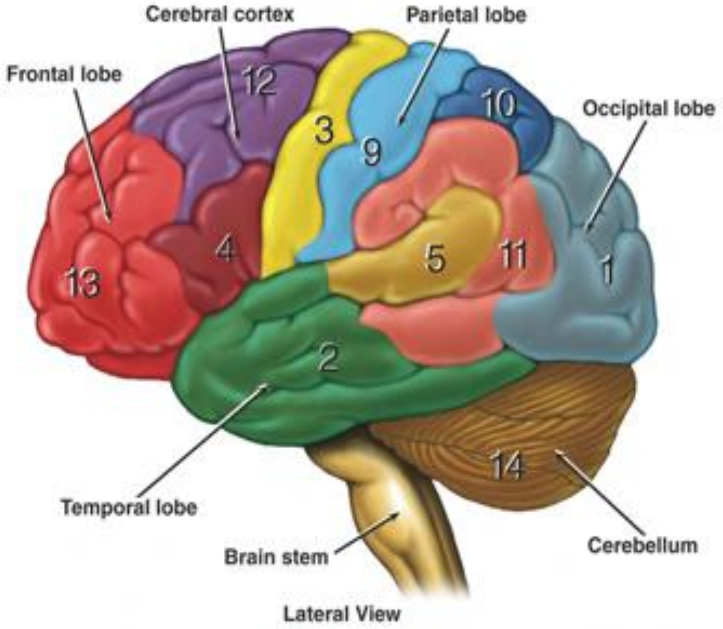
Georg N. Koskinas
(1885-1975)

Functional Areas of the Cerebral Cortex

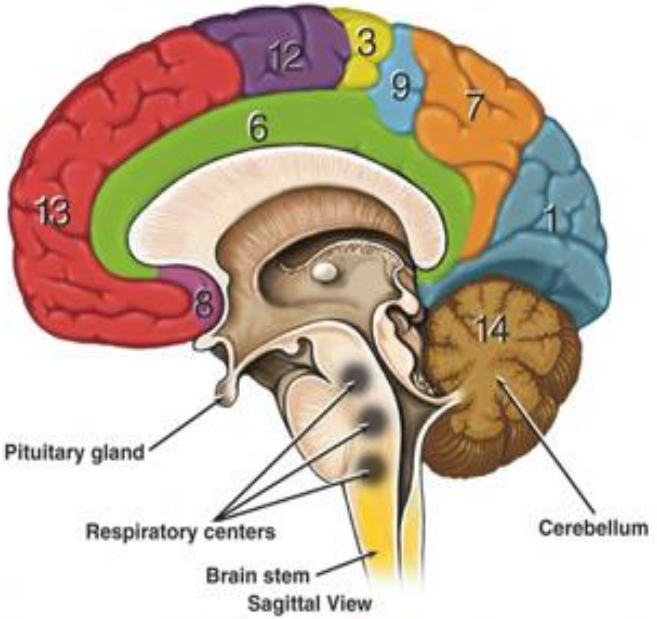
1. **Visual Area:**
   - Sight
   - Image recognition
   - Image perception
2. **Association Area**
   - Short-term memory
   - Equilibrium
   - Emotion
3. **Motor Function Area**
   - Initiation of voluntary muscles
4. **Broca's Area**
   - Muscles of speech
5. **Auditory Area**
   - Hearing
6. **Emotional Area**
   - Pain
   - Hunger
   - "Fight or flight" response
7. **Sensory Association Area**
8. **Olfactory Area**
   - Smelling
9. **Sensory Area**
   - Sensation from muscles and skin
10. **Somatosensory Association Area**
    - Evaluation of weight, texture, temperature, etc. for object recognition
11. **Wernicke's Area**
    - Written and spoken language comprehension
12. **Motor Function Area**
    - Eye movement and orientation
13. **Higher Mental Functions**
    - Concentration
    - Planning
    - Judgment
    - Emotional expression
    - Creativity
    - Inhibition

Functional Areas of the Cerebellum

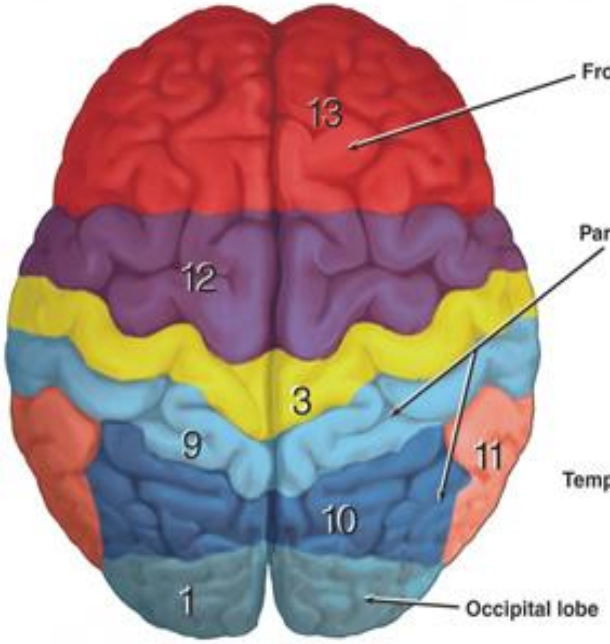
14. **Motor Functions**
    - Coordination of movement
    - Balance and equilibrium
    - Posture



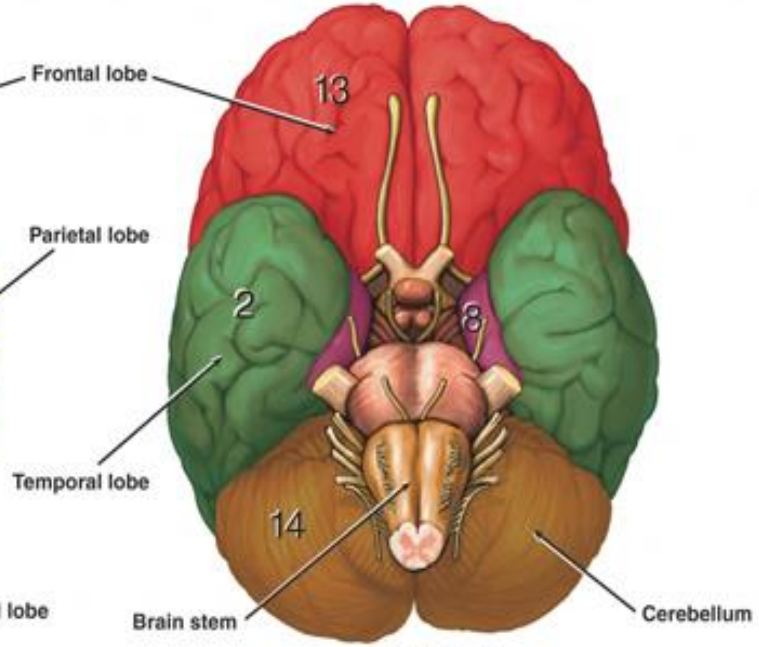
Lateral View



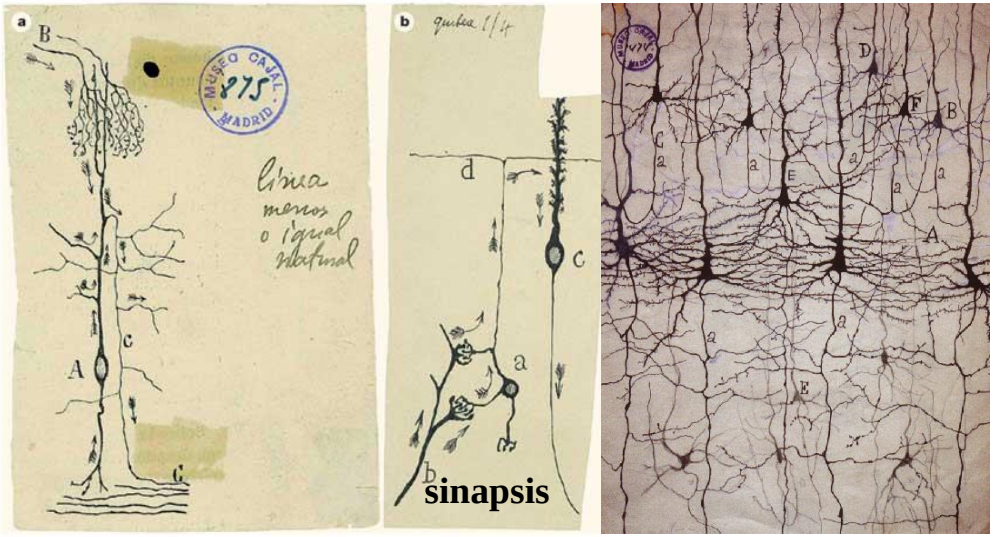
Sagittal View



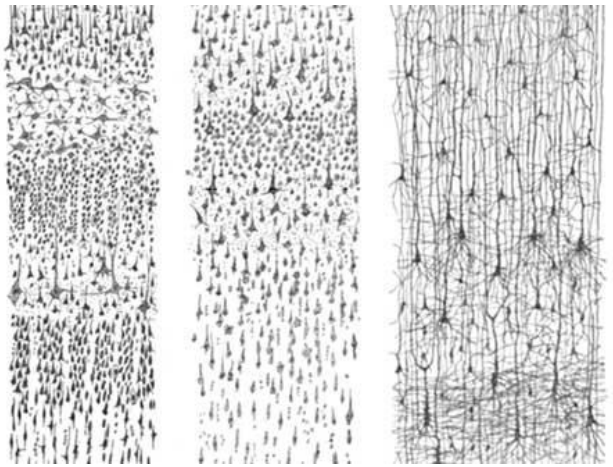
Superior View



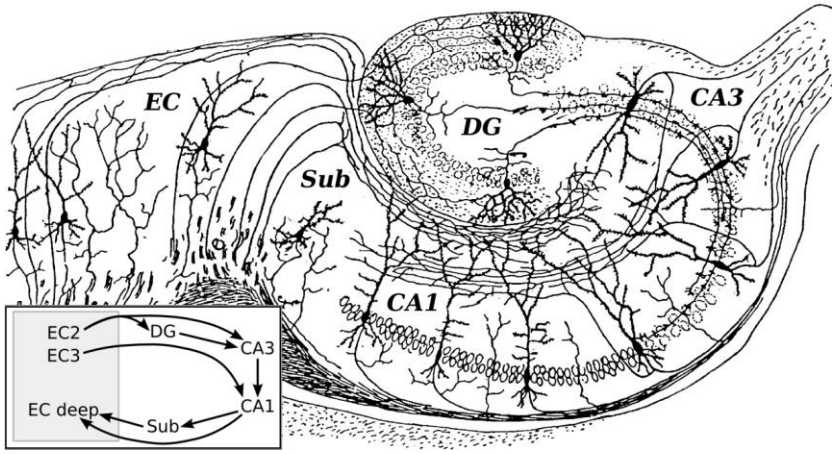
Inferior View



sinapsis

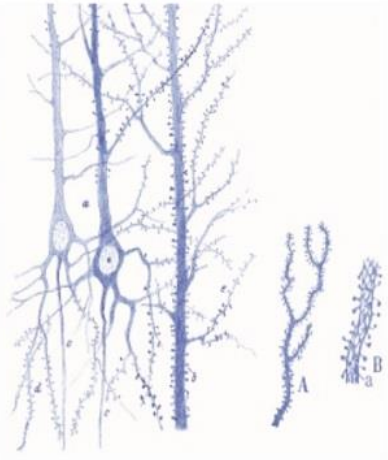


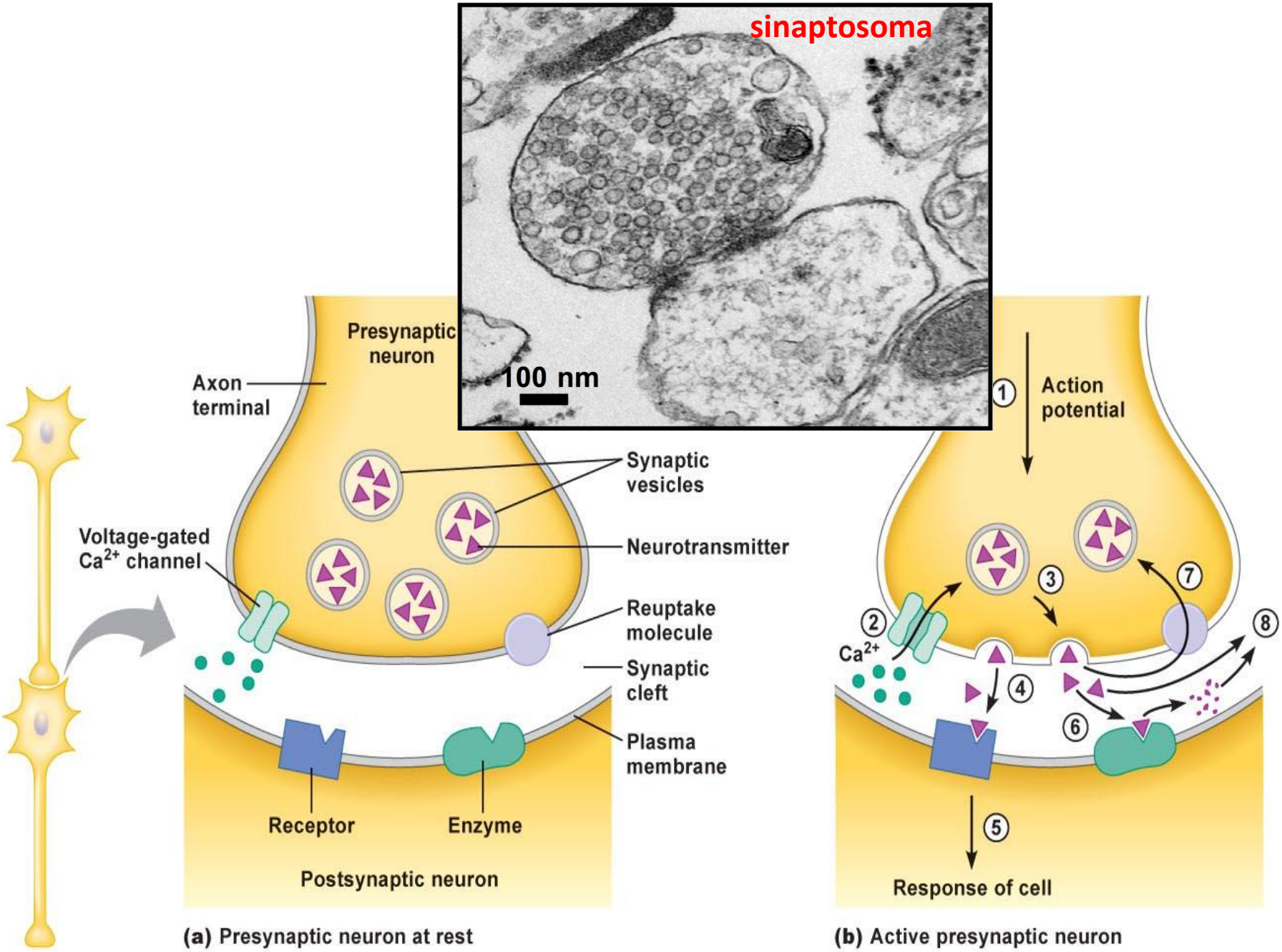
citoarquitectura específica zonal



circuitería [conectoma] hipocampal

plasticidad





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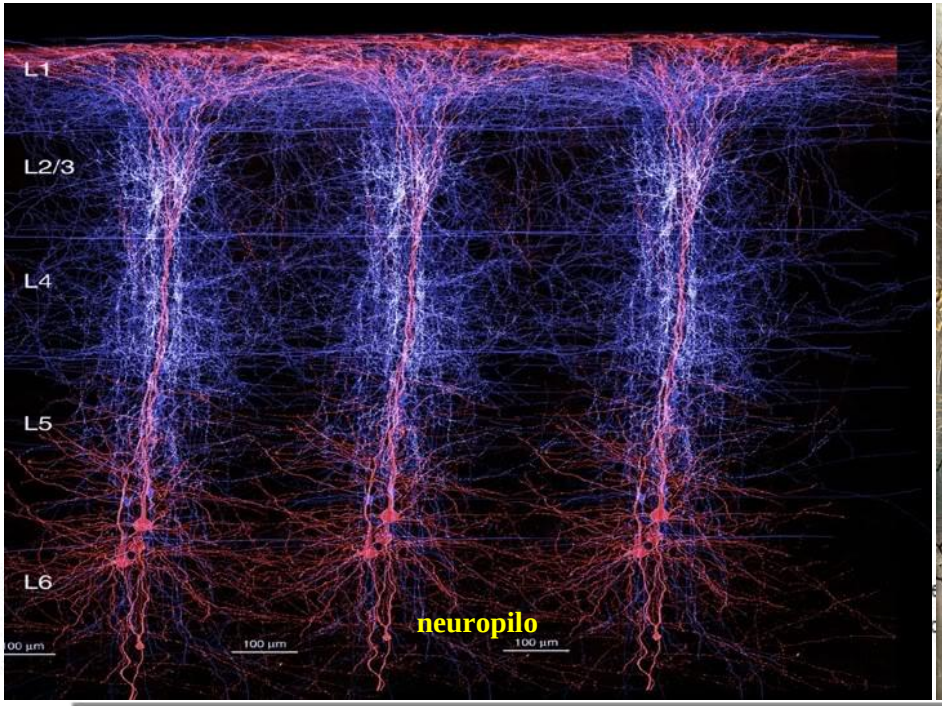
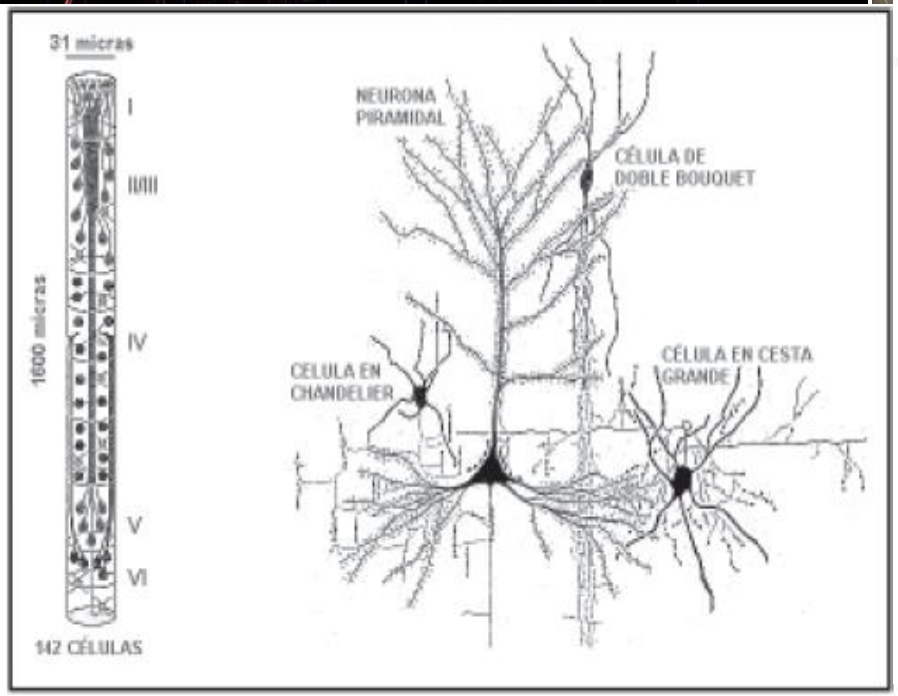
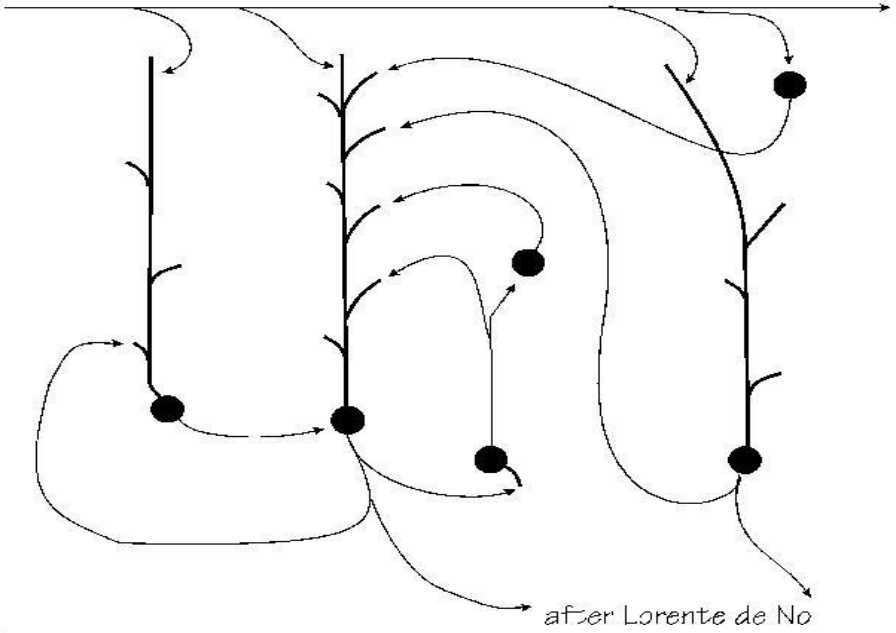
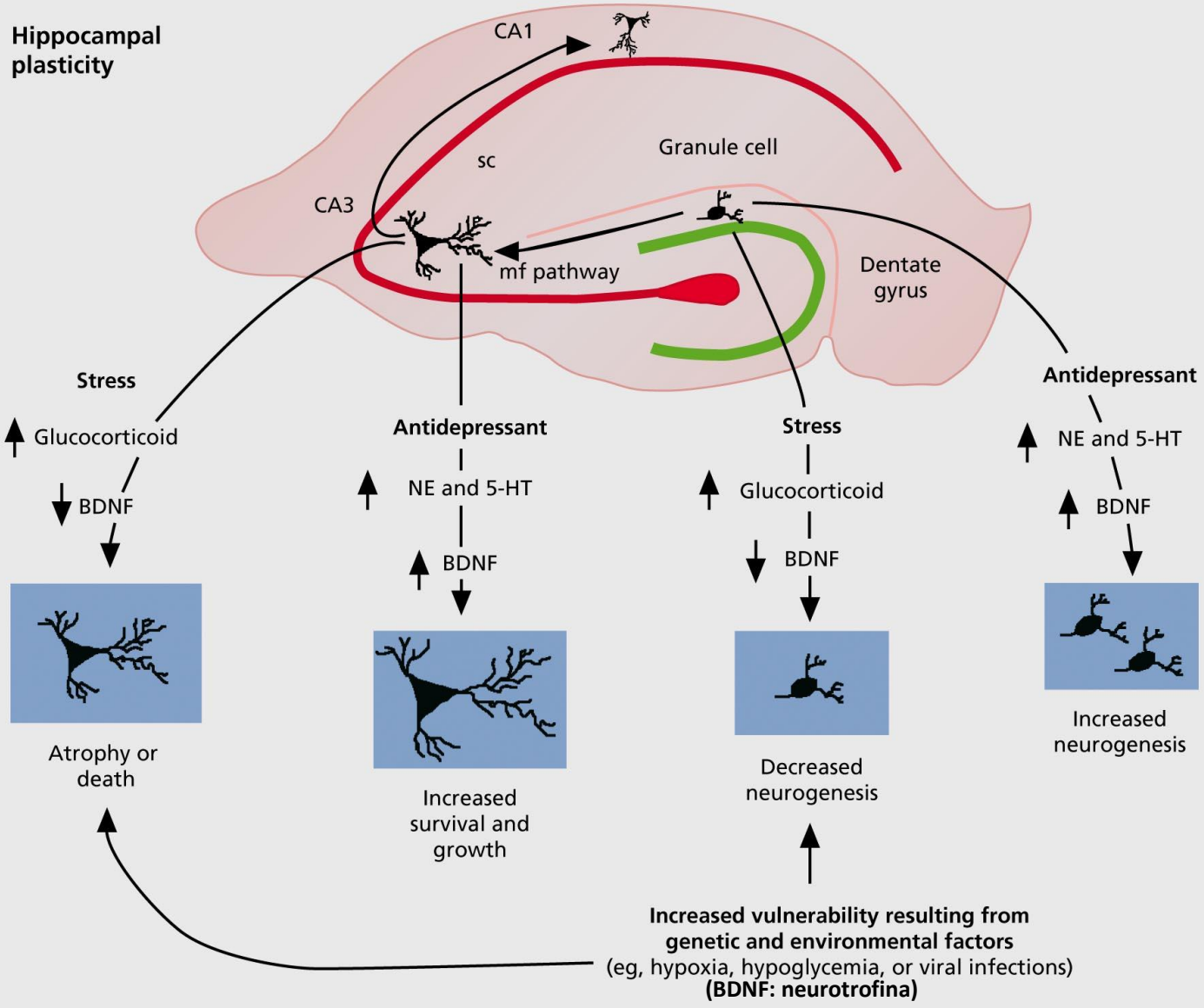


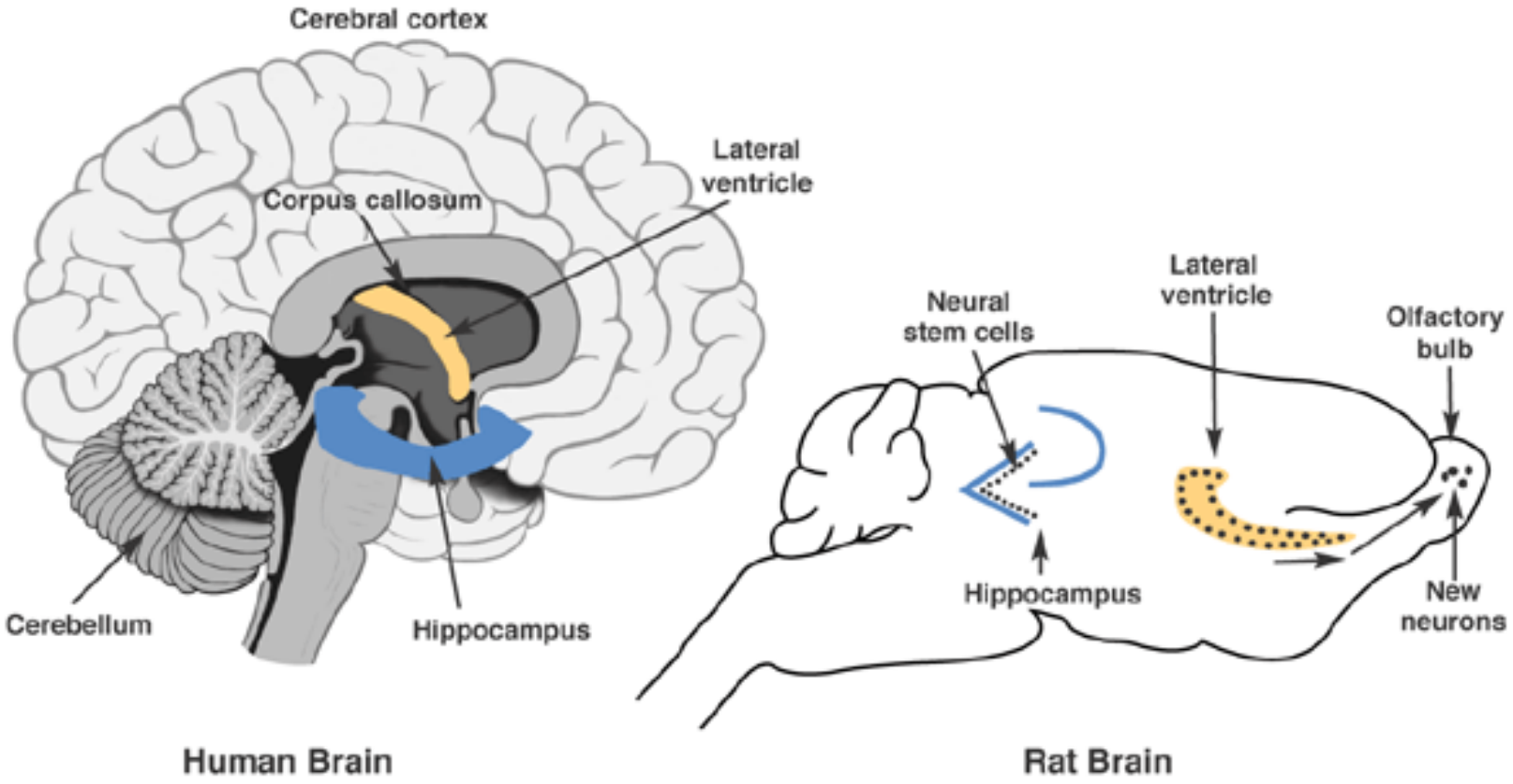


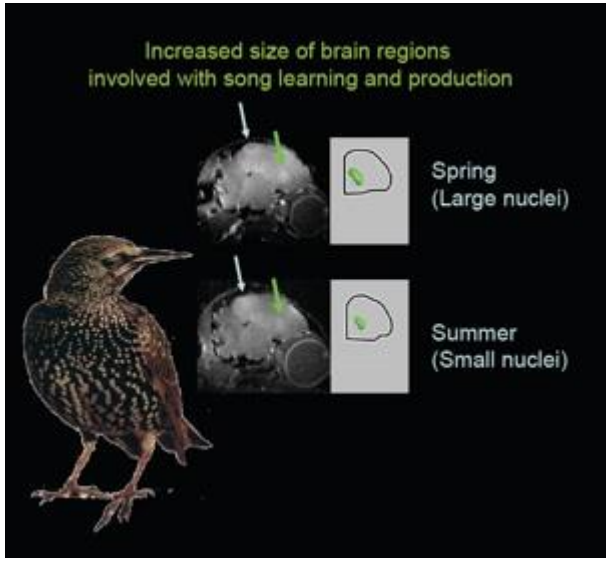
Conexiones recurrentes que mantienen actividad intrínseca.

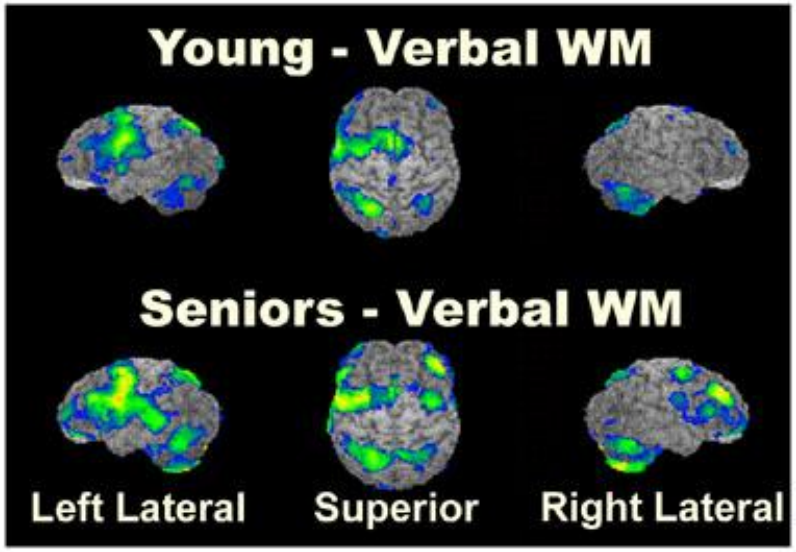


Dialogues Clin Neurosci. 2004; **6**:157-169.




Cerebral cortex
Lateral ventricle
Corpus callosum
Cerebellum
Hippocampus
Human Brain
Neural stem cells
Lateral ventricle
Olfactory bulb
Hippocampus
New neurons
Rat Brain





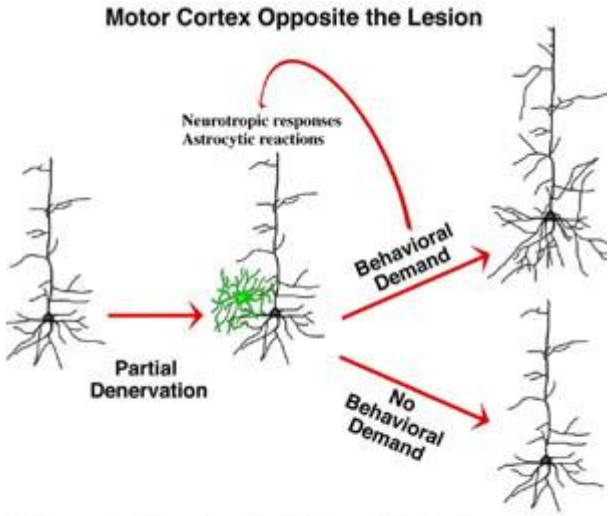
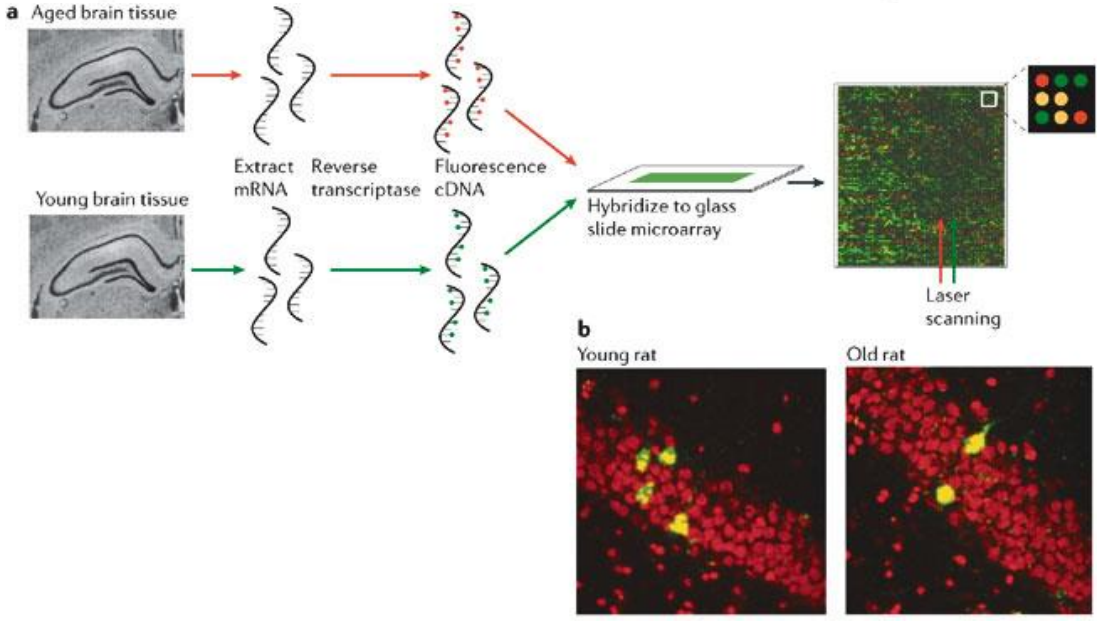


Figure 3. Hypothesized interaction between denervation and experience in the motor cortex.



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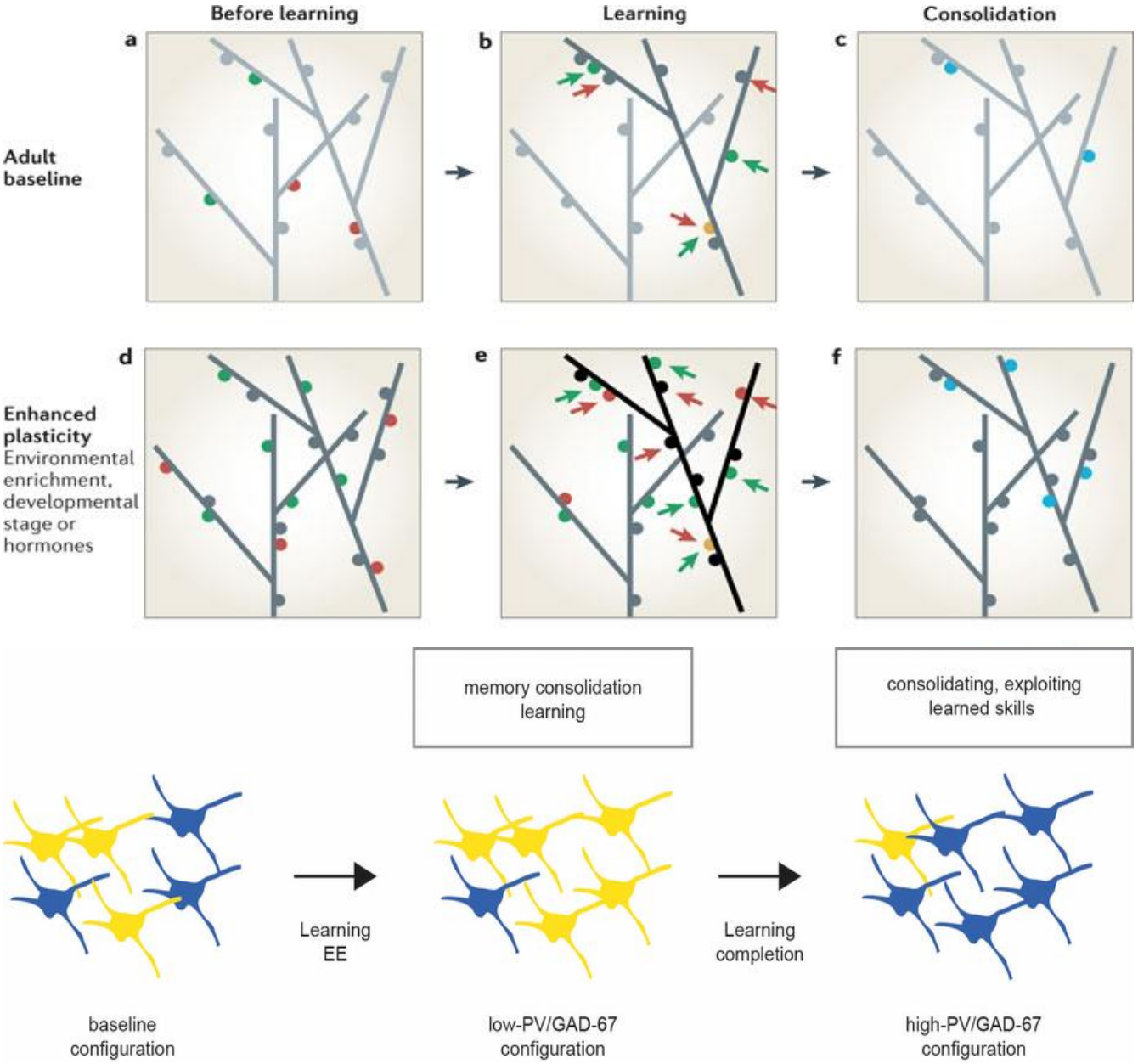
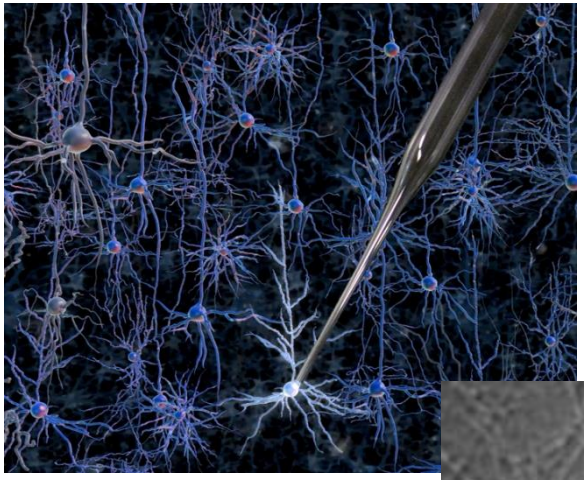
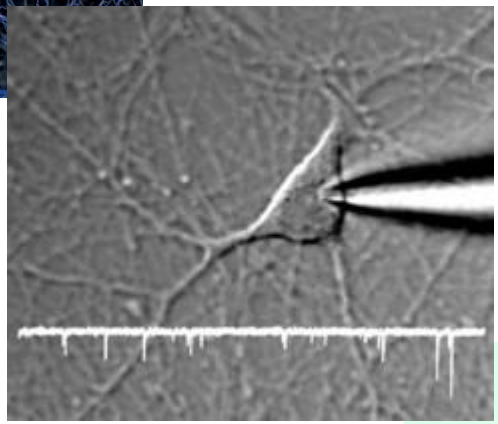
Nature Reviews | Neuroscience

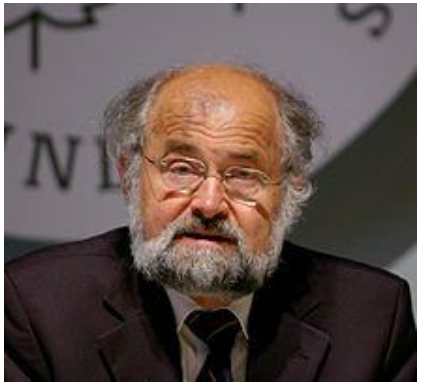
Nature Reviews Neuroscience 2012; **13, 478-490.**



Nature **2013; 504,: 272–276 .**





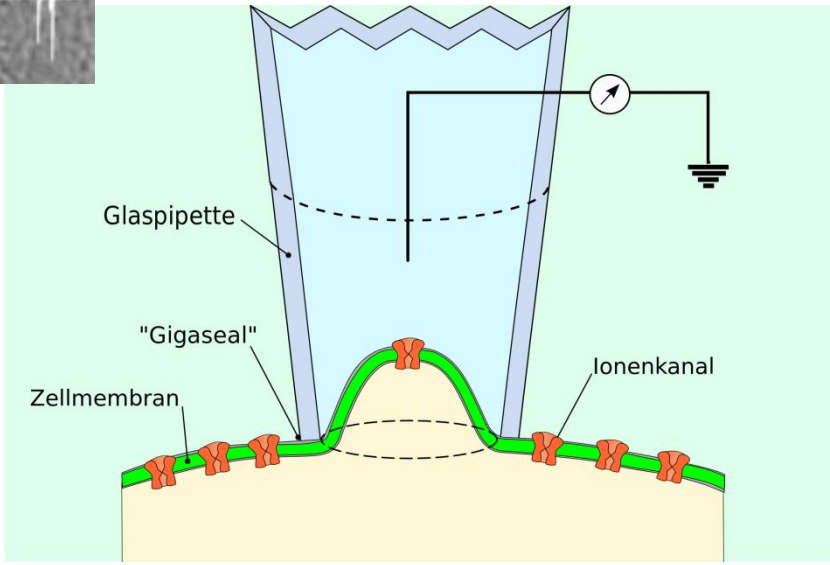


PNFoM 1991

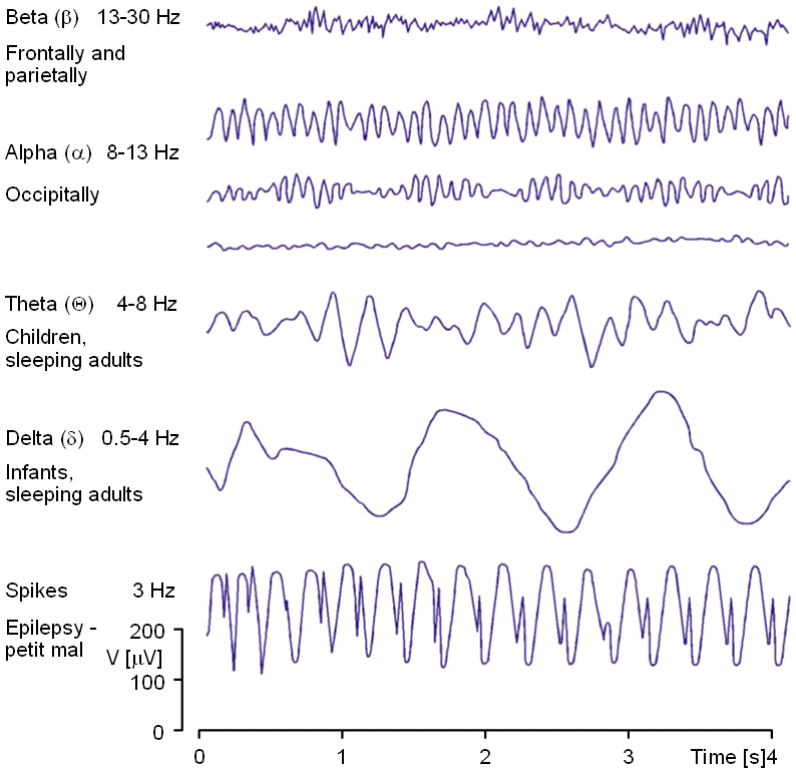
Erwin Neher
(n 1944)

Bert Sakmann
(n 1942)

«*Patch clamp*»
(pinzamiento zonal)

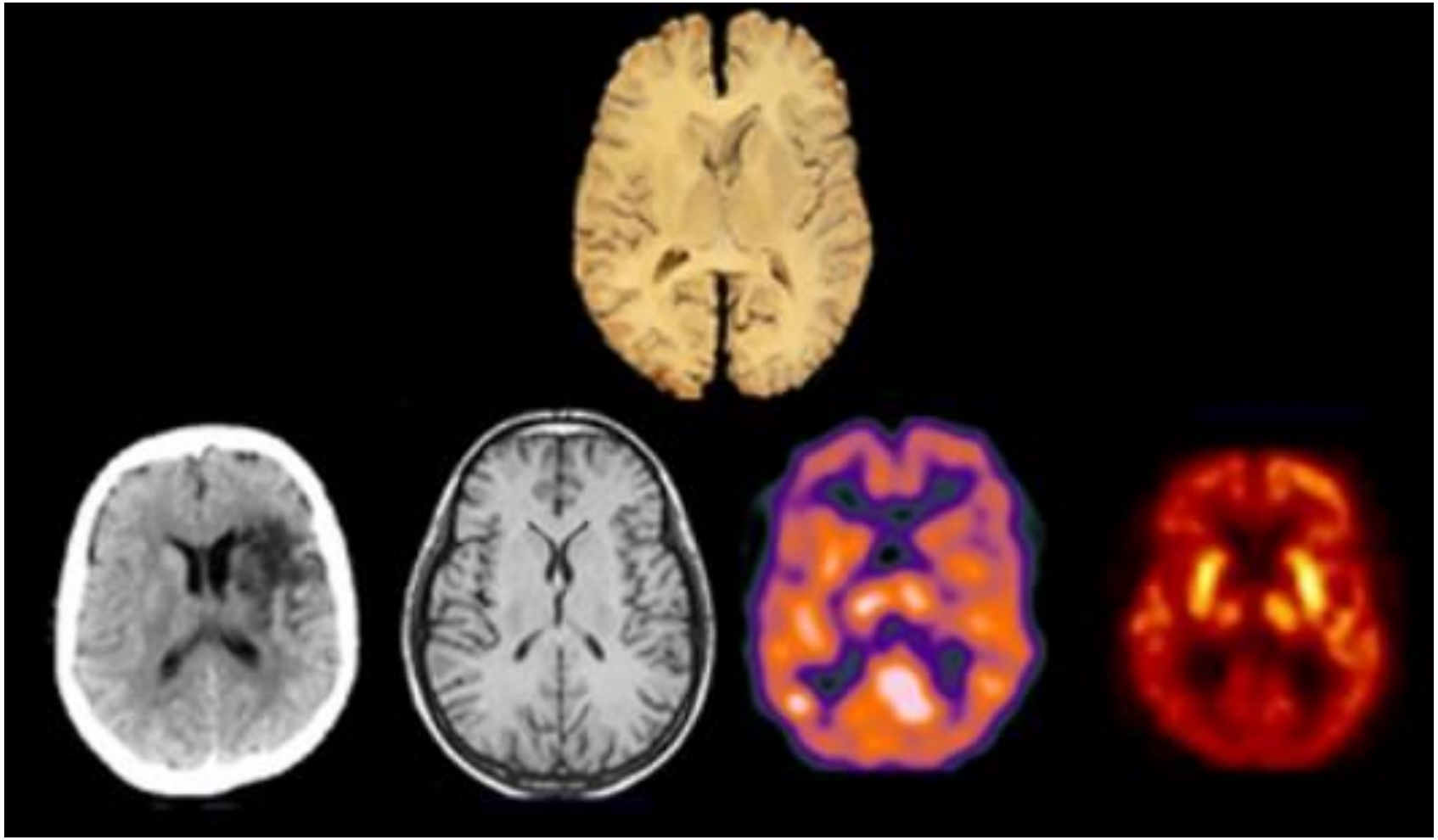


electroencefalografía

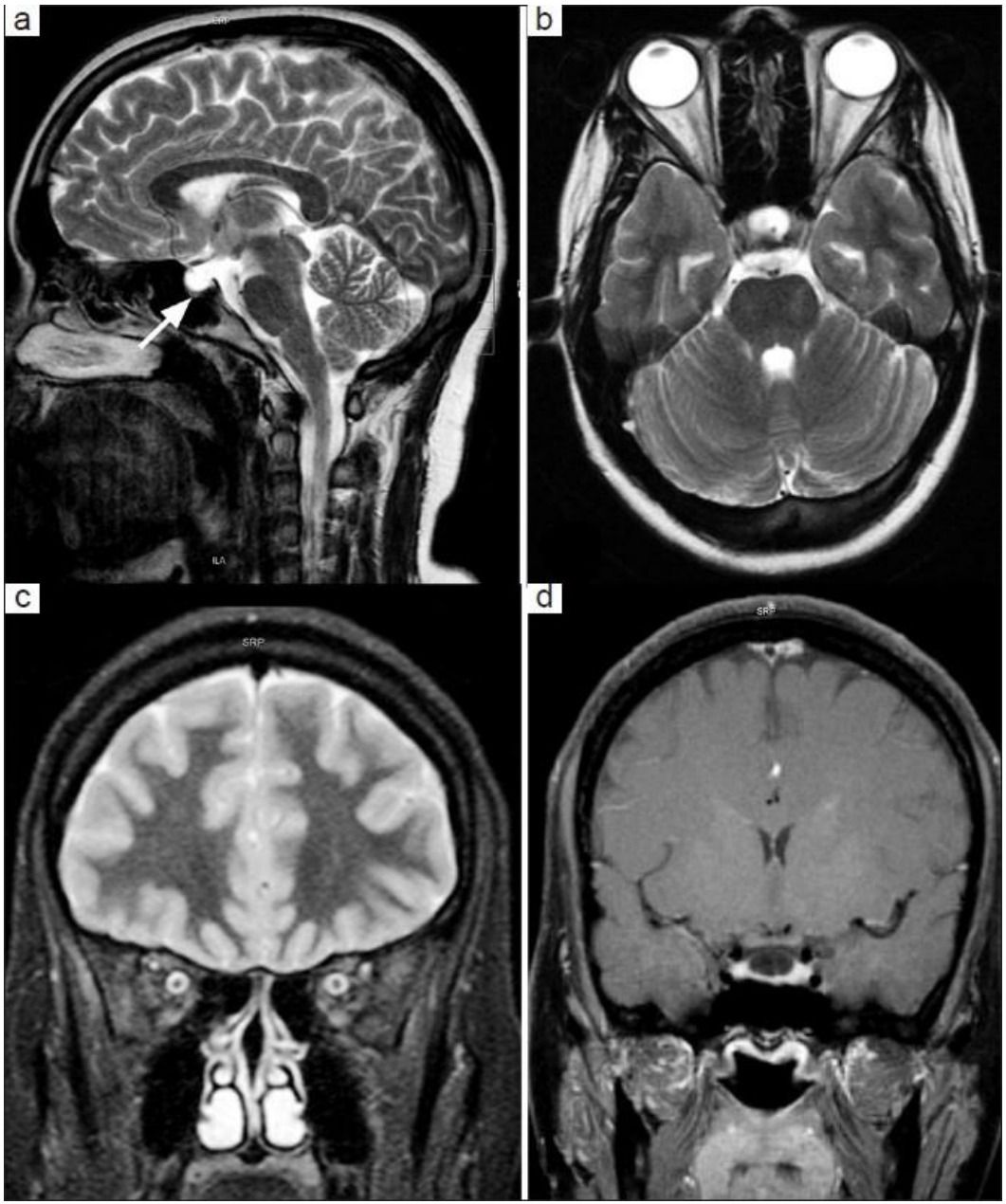


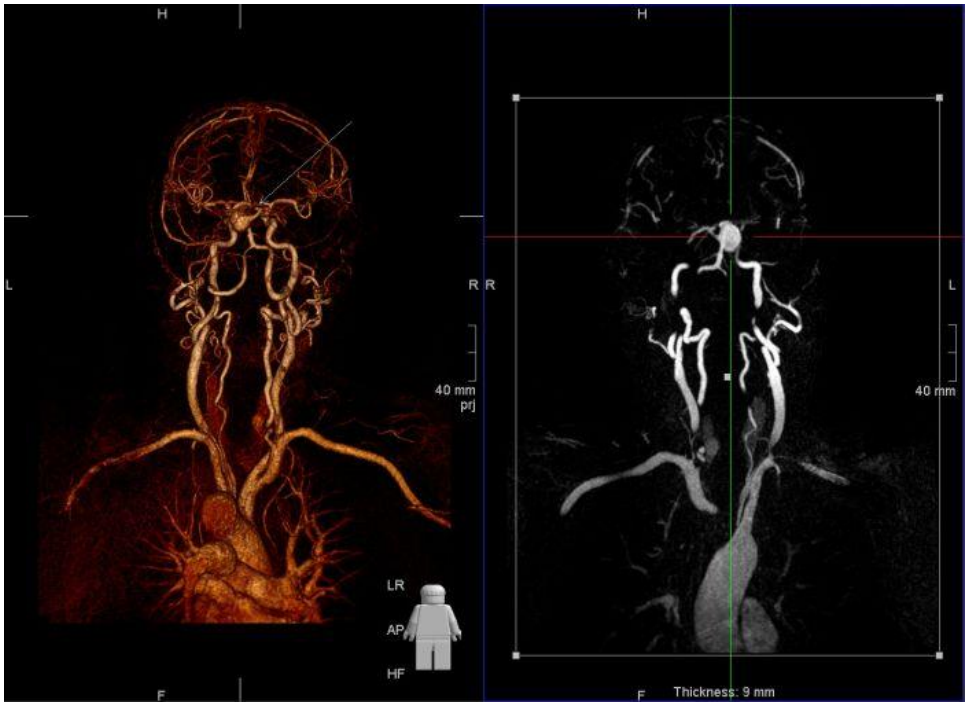
magnetoencefalografía

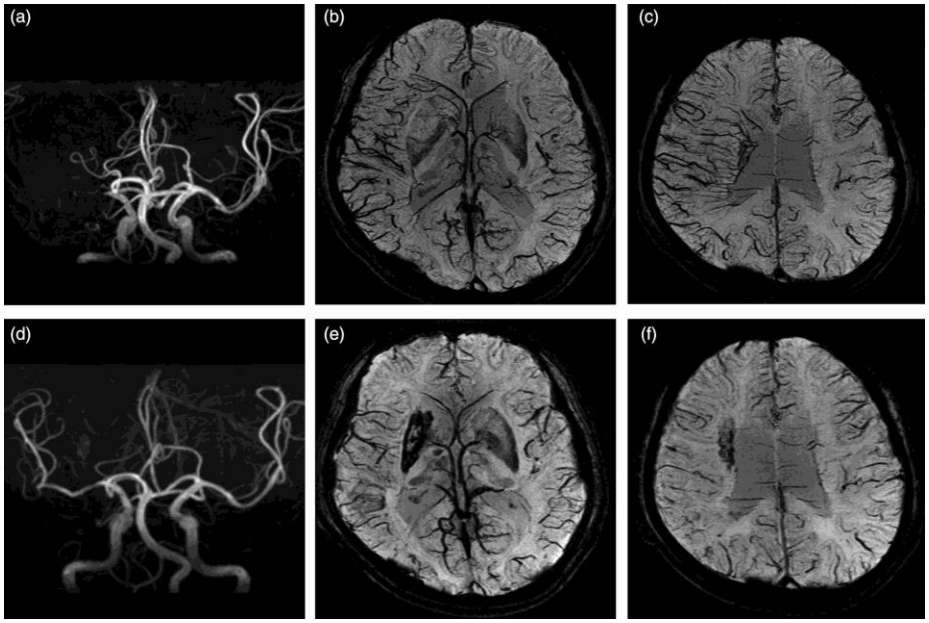
Oscilación neuronal espontánea (10 Hz) en el hemisferio izq.
Oscilación neuronal evocada (40 Hz) en el área auditiva (hemisferio izq.)

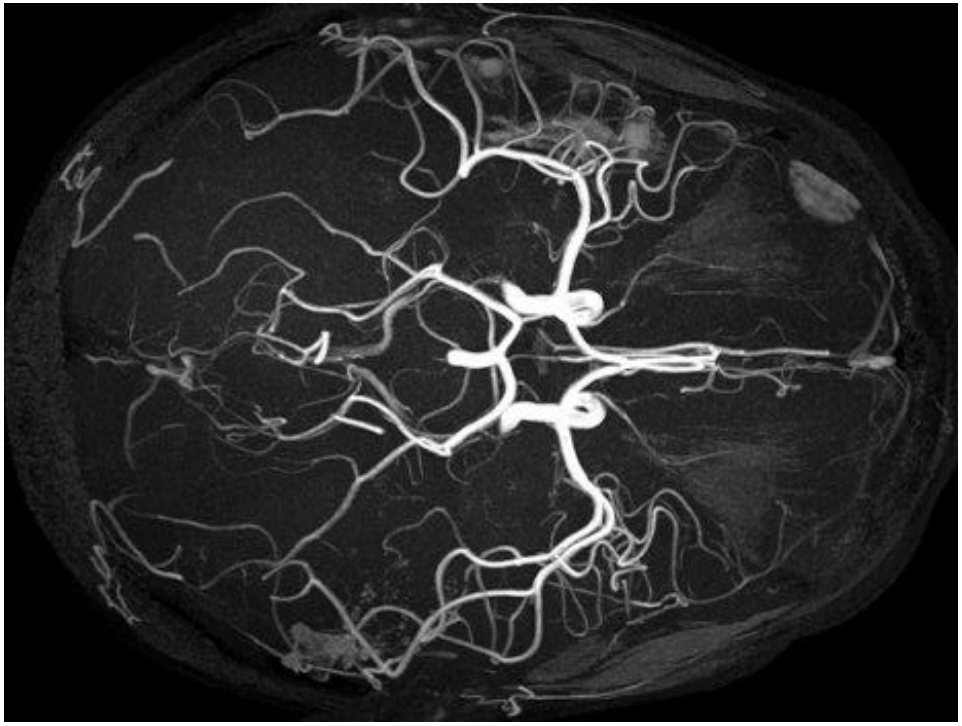


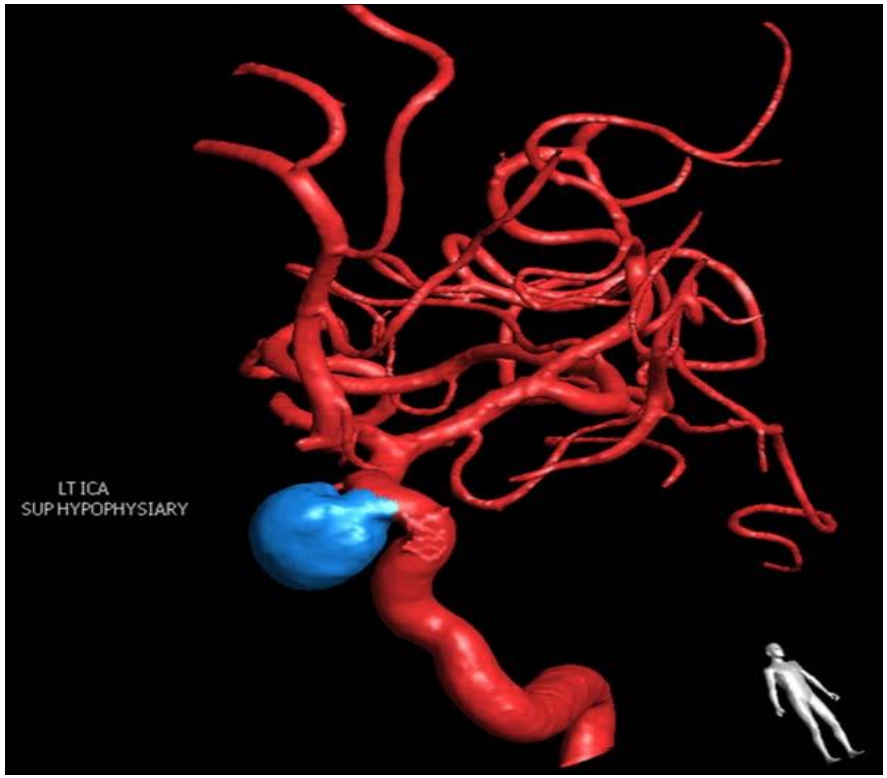
TAC NMR SPECT PET

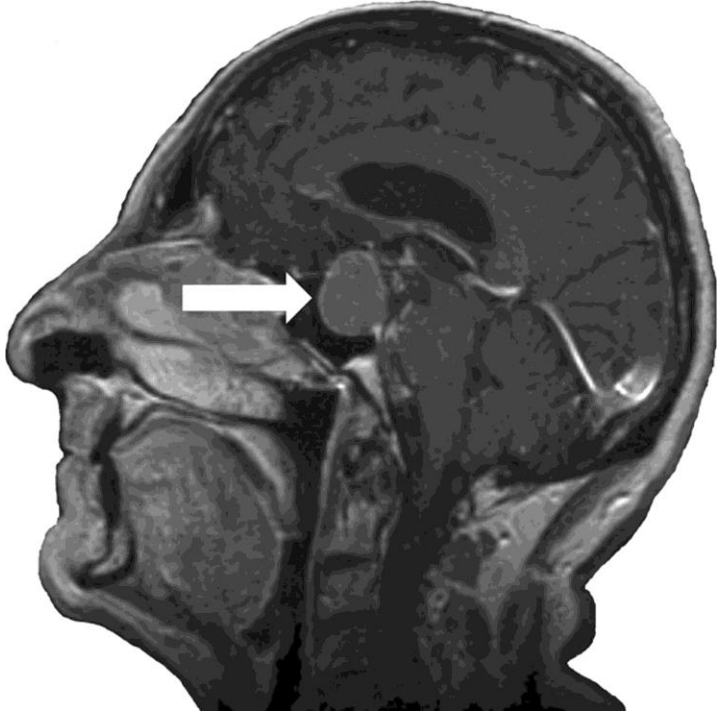

a
b
c
d

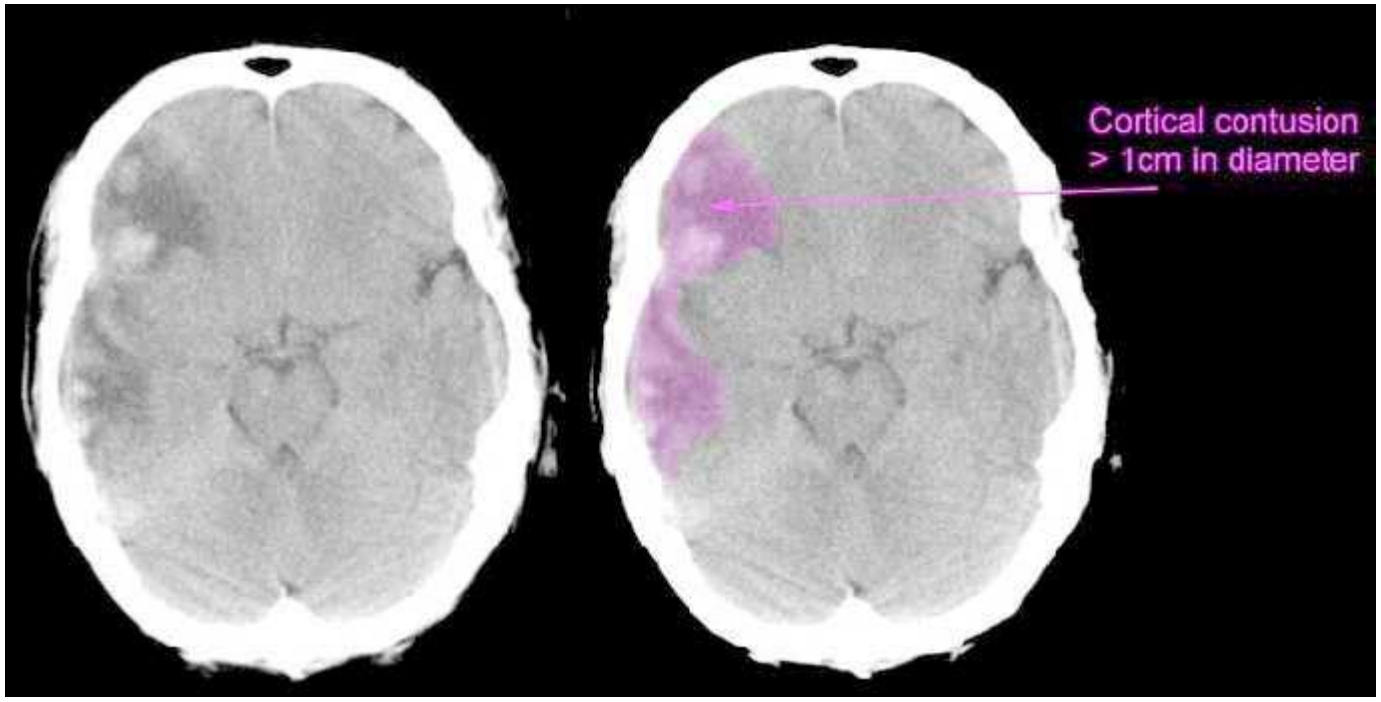

H
L
R R
L
40 mm
prj
40 mm
LR
AP
HF
F
H
F
Thickness: 9 mm


(a)
(b)
(c)
(d)
(e)
(f)



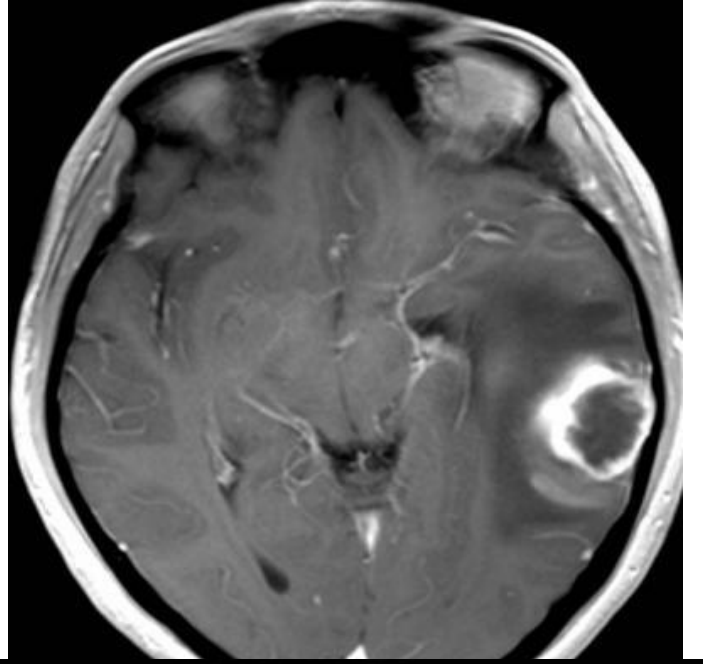

LT ICA
SUP HYPOPHYSIARY



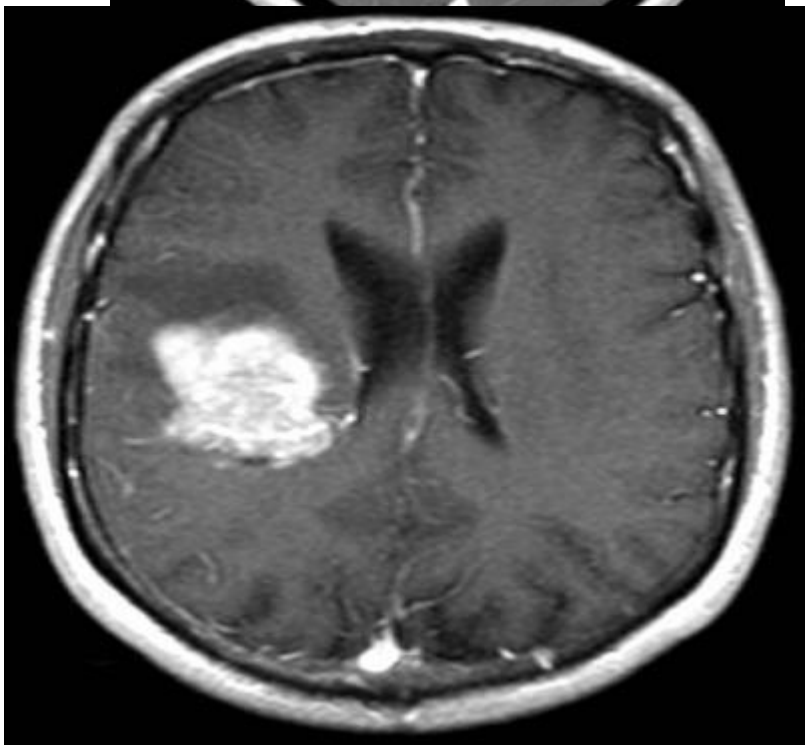

Cortical contusion
> 1cm in diameter

CT

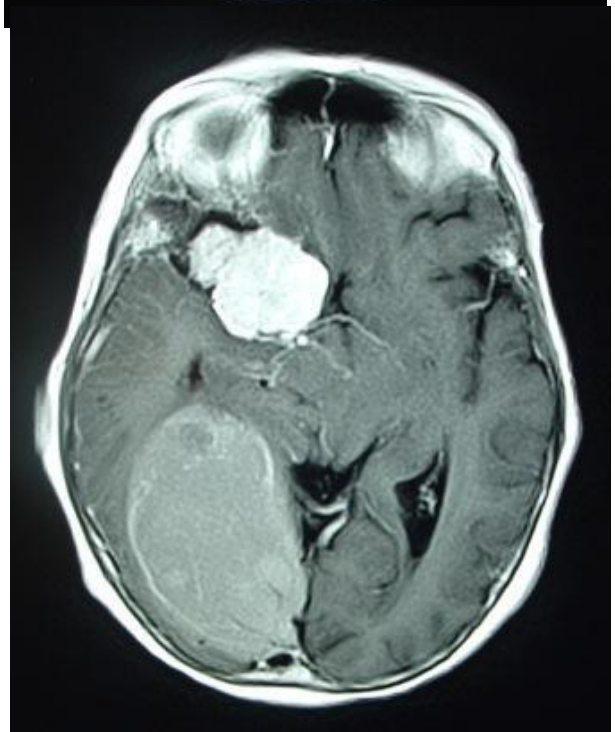
Oncoterapia sensible

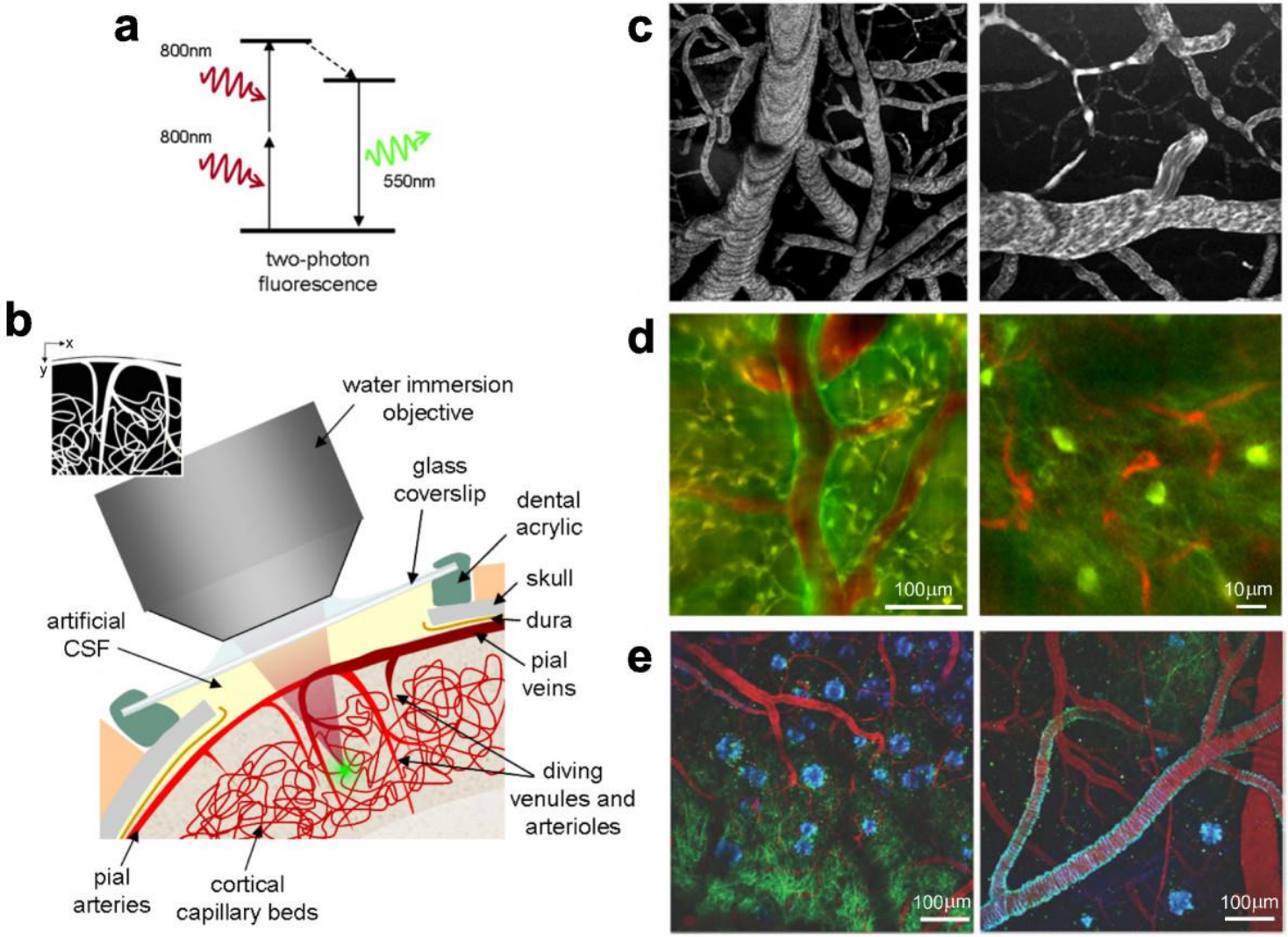


Oncoterapia resistente



MRI





Two-photon microscopy of in vivo brain function. (a) Basic mechanism of two-photon fluorescence. (b) Schematic of surgical preparation of exposed cortex, with sealed glass window and microscope objective positioning. (c) Examples of two-photon maps of the vasculature following intravenous injection of dextran-conjugated fluorescein. (d) Dual-channel imaging of neuronal (green) and vascular (red) signals. (e) Three channel imaging of Alzheimer's disease mouse model with amyloid-targeting dye (blue), GFP expressing neurons and dendrites (green) and vasculature (red).

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    Judgment
    Emotional expression
    Creativity
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Functional Areas of the Cerebellum

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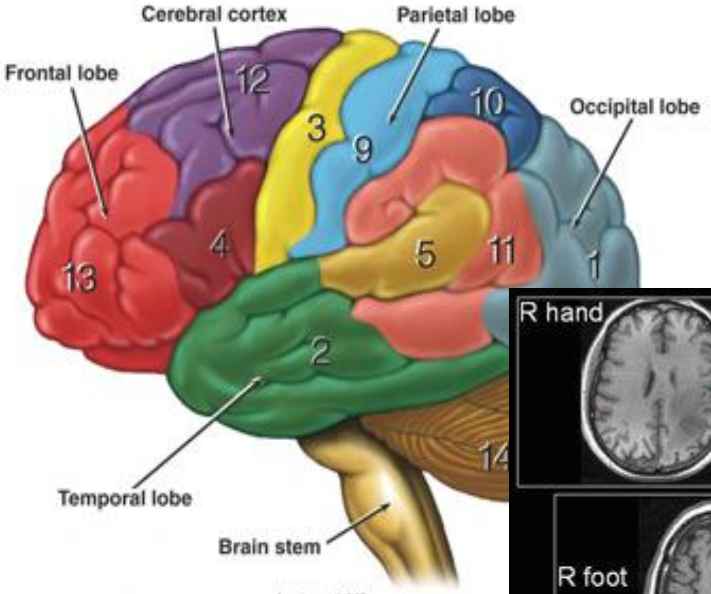
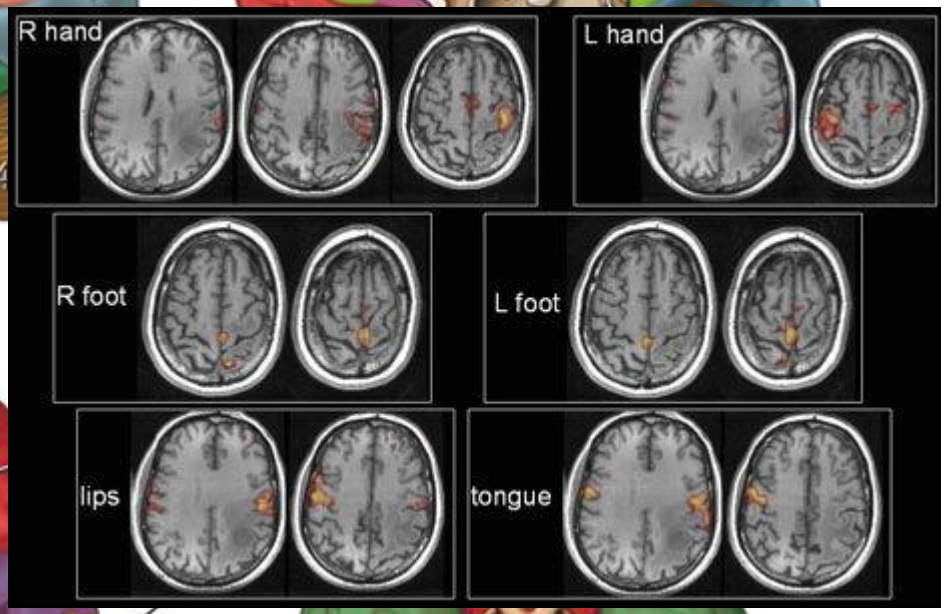
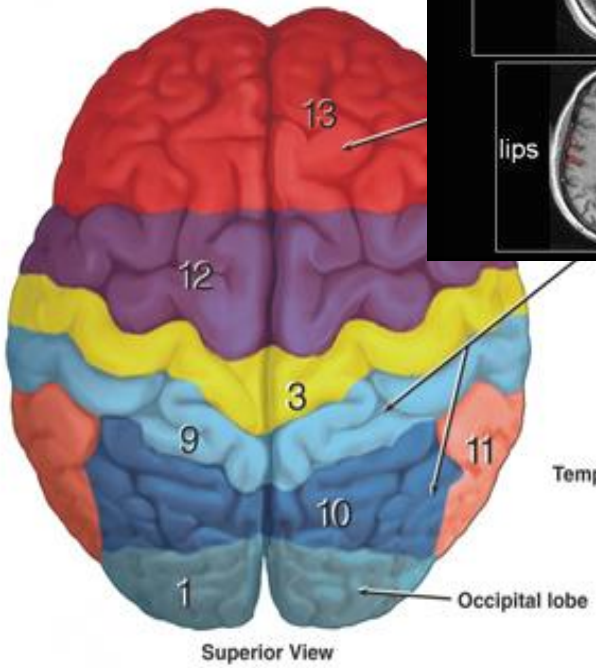
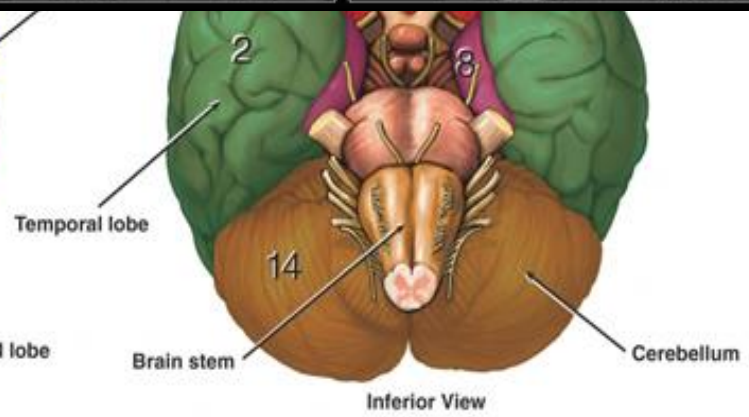
    Balance and equilibrium
    Posture

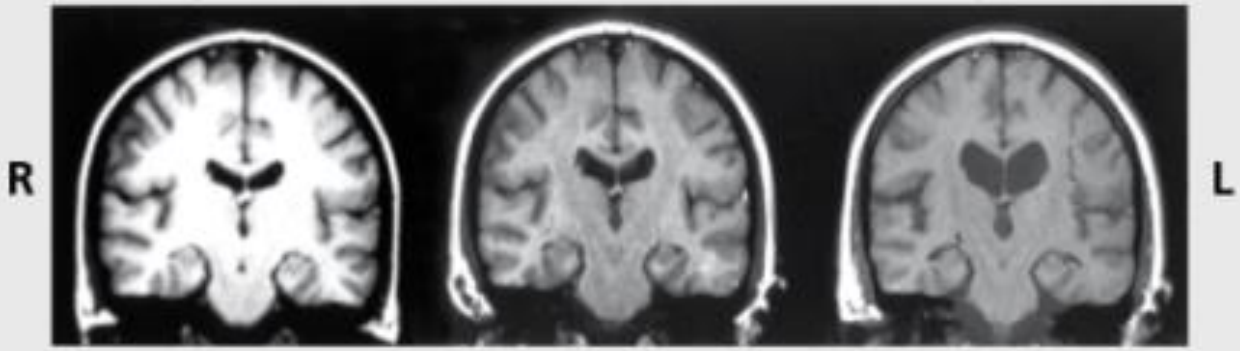








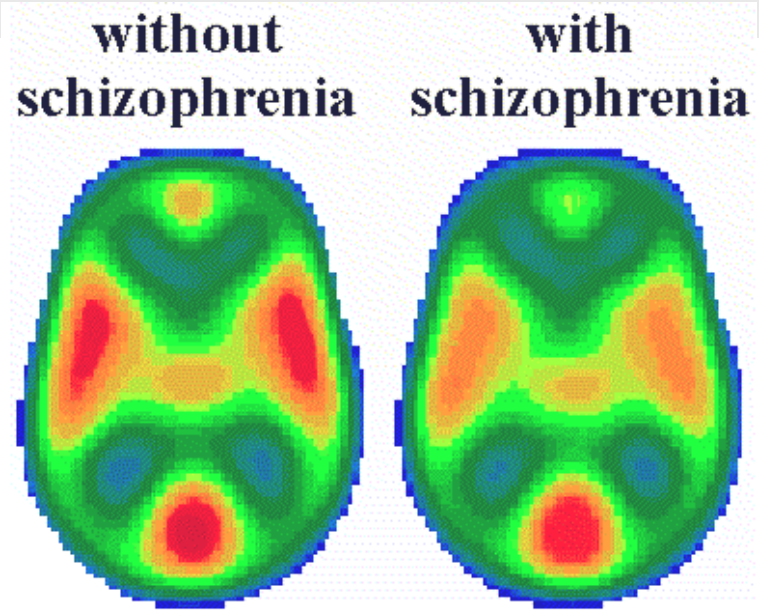
10-year MRI follow-up
34-year-old female with chronic schizophrenia

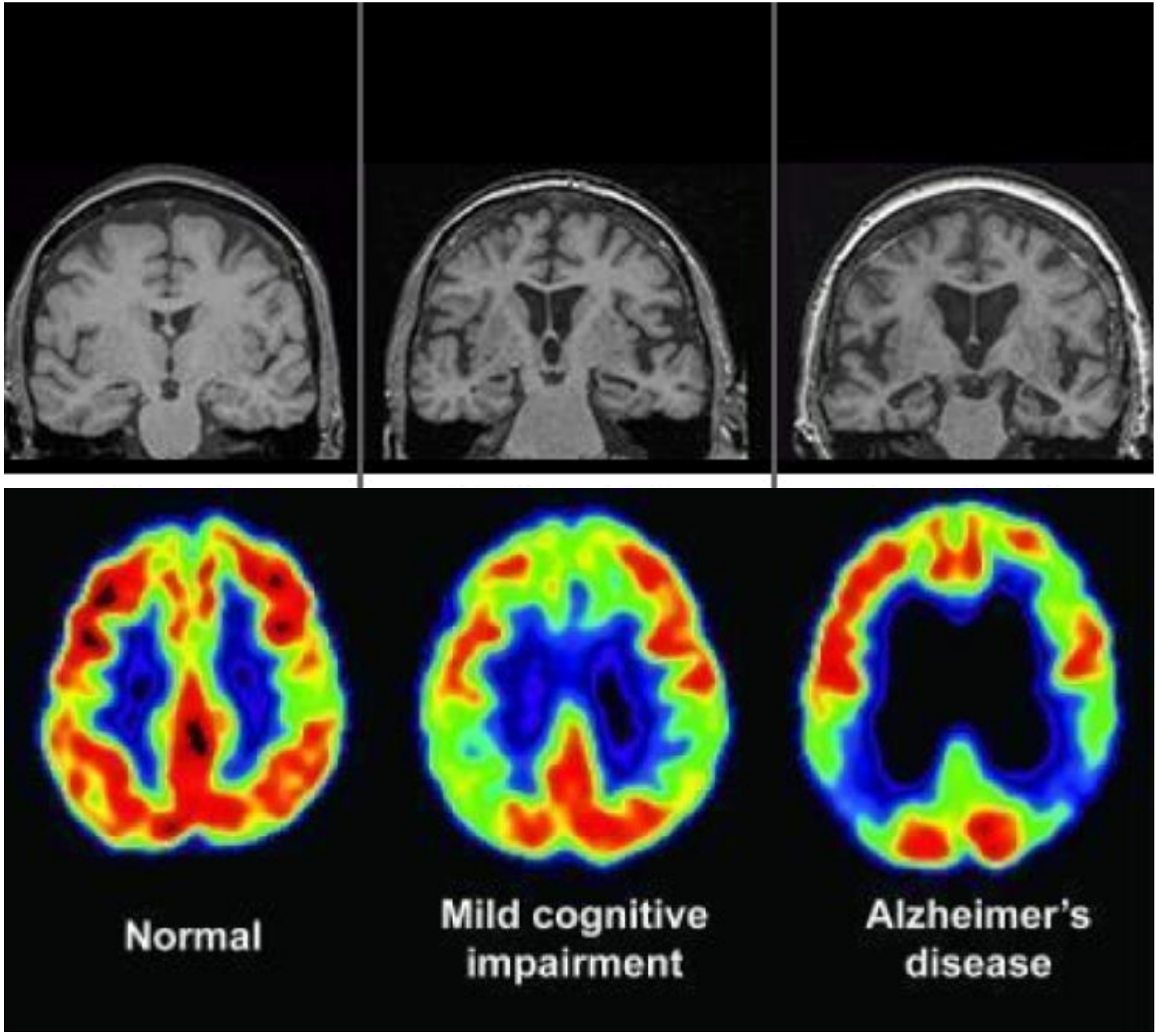


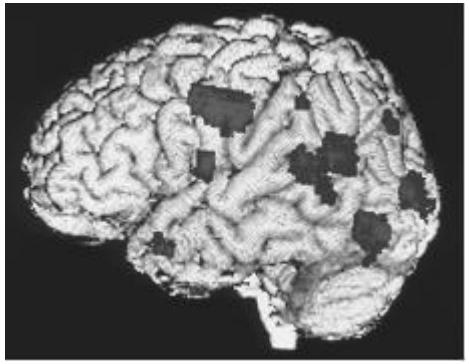
Feb. 1990
1st episode

Feb. 1995
5 years later

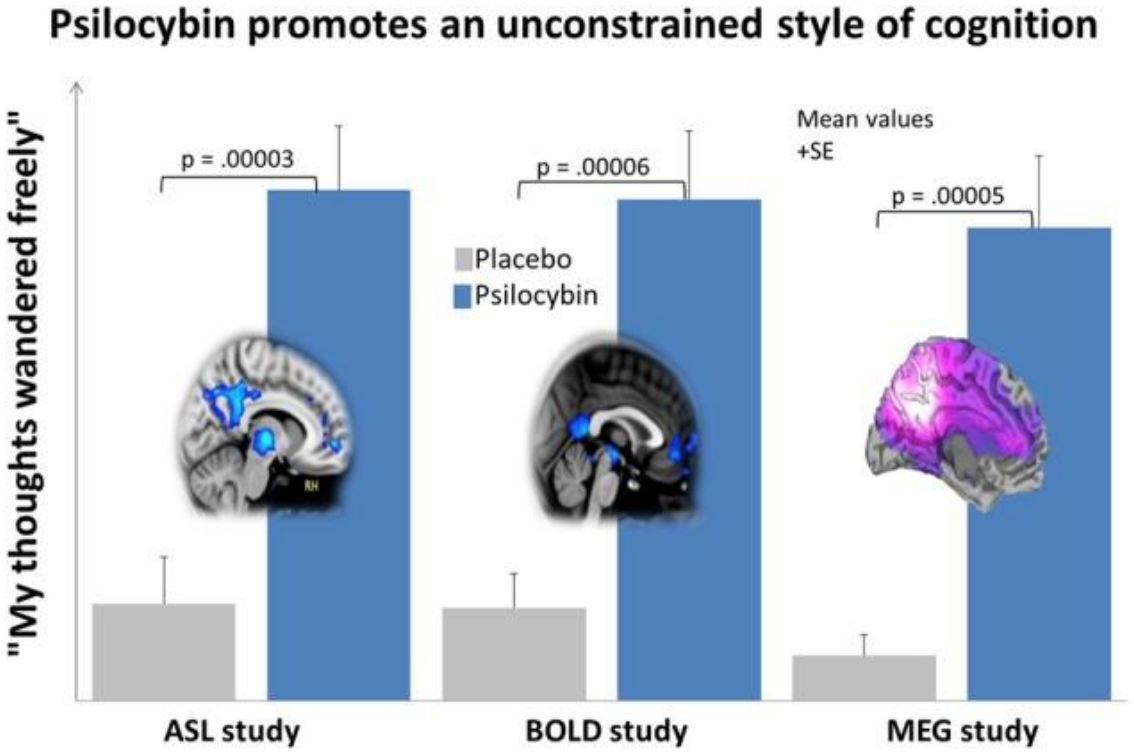
Jan. 2000
10 years later

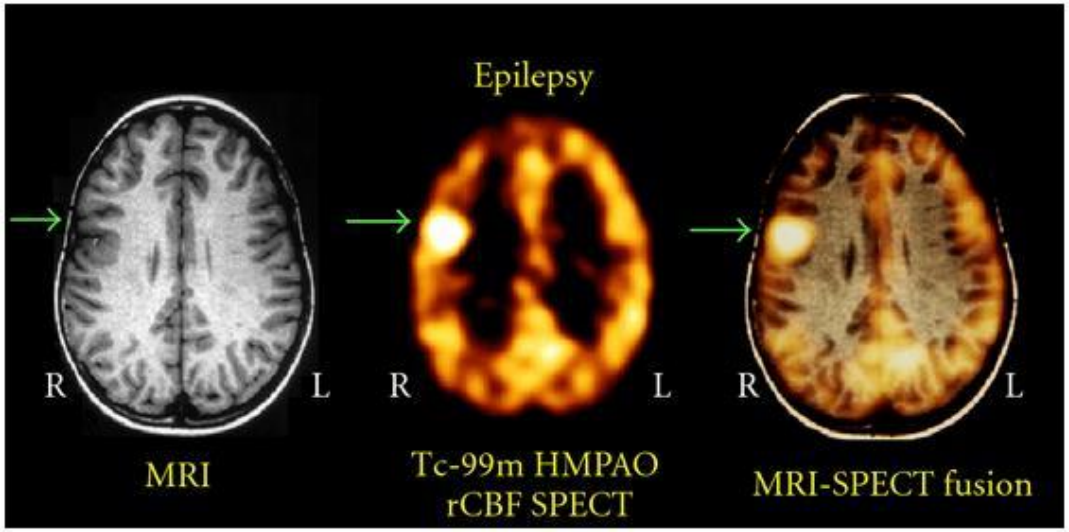


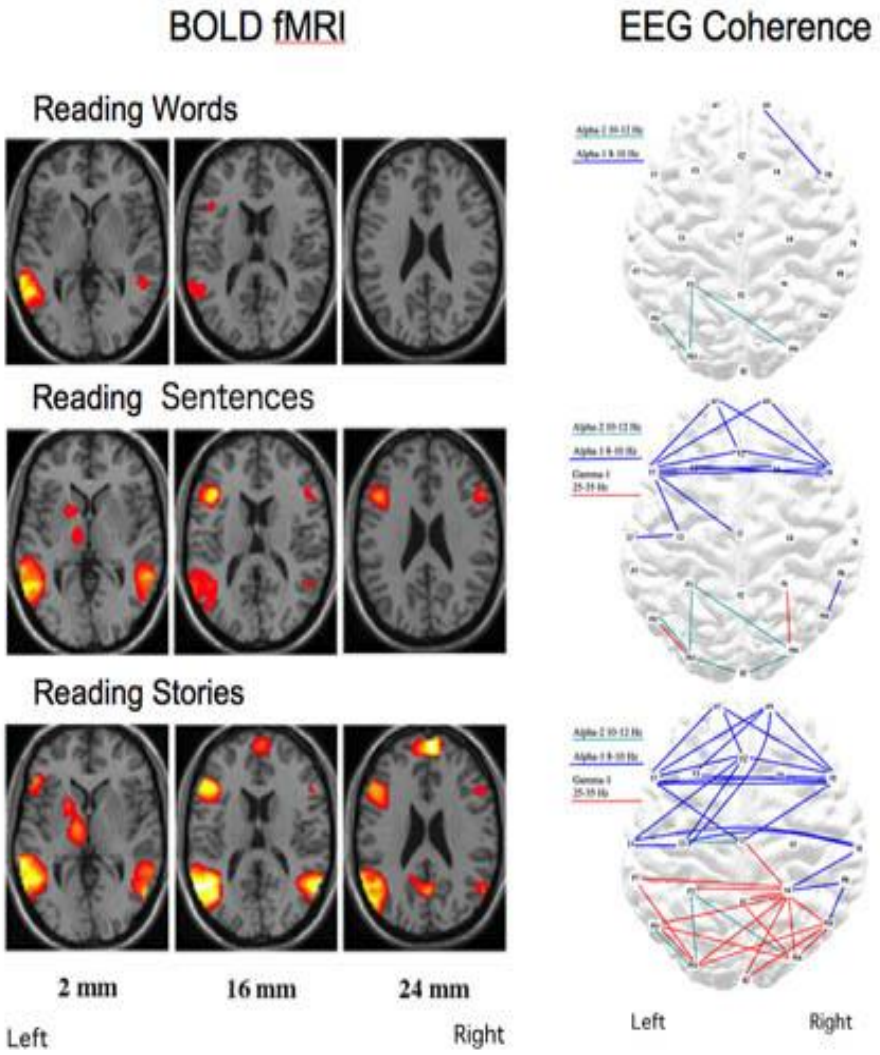

MRI
PET
Normal
Mild cognitive impairment
Alzheimer's disease



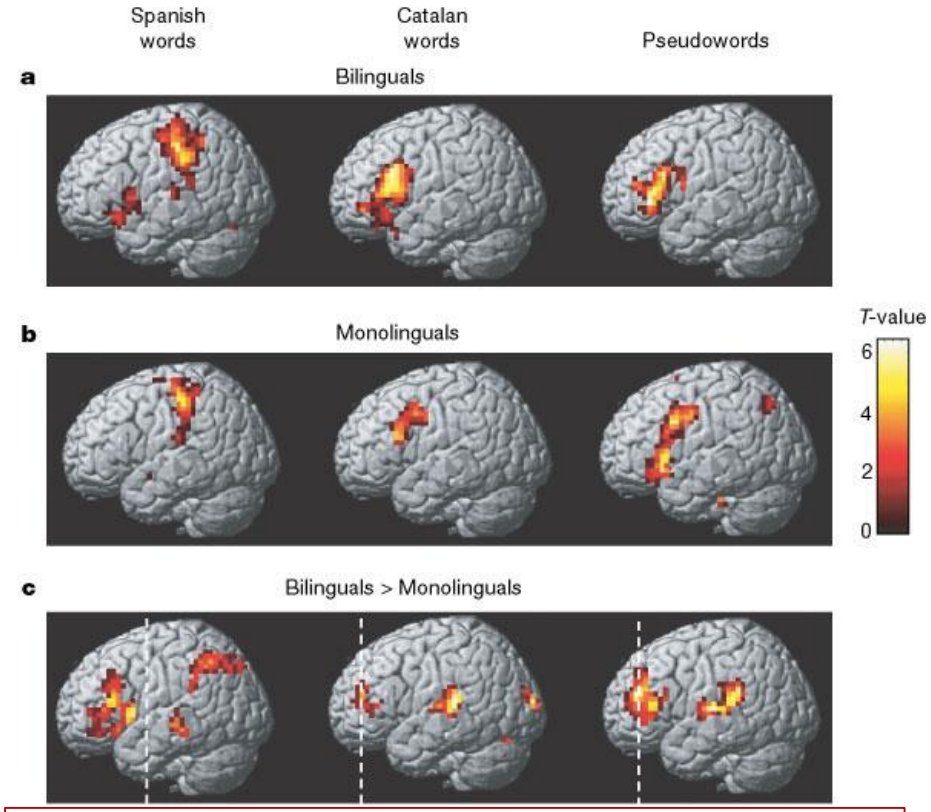
PET: Paciente esquizofrénico con halucinaciones audiovisuales



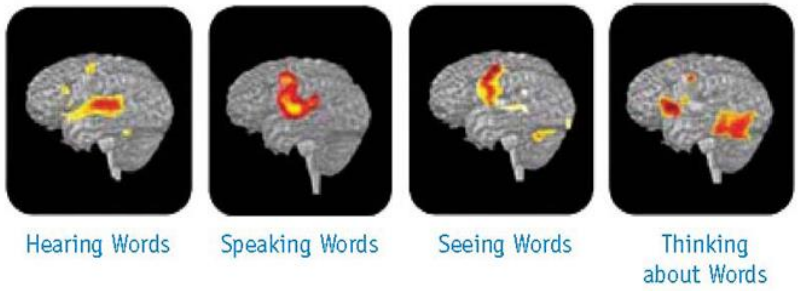


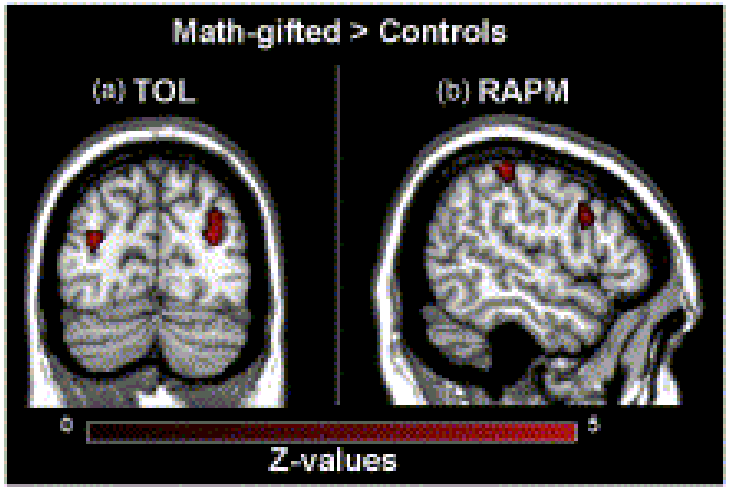


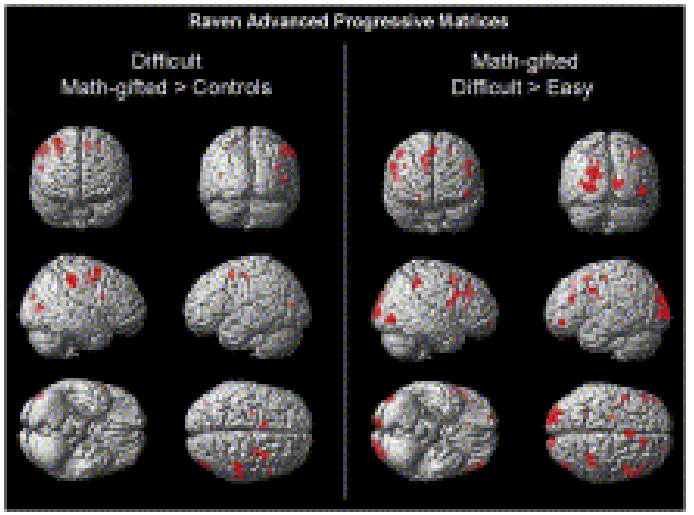
Brain maps illustrating increasing activity and functional connectivity of perisylvian and extrasylvian areas in both hemispheres as subjects read words, sentences and narratives. These emergent, context-dependent effects are demonstrated using both fMRI and EEG coherence methods.

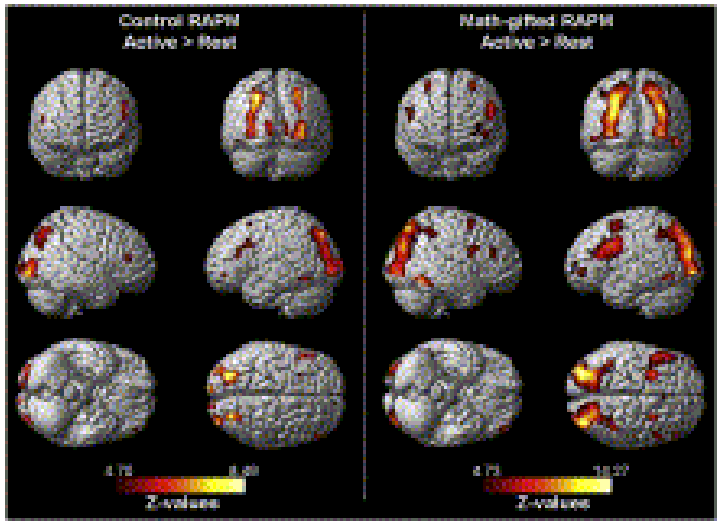


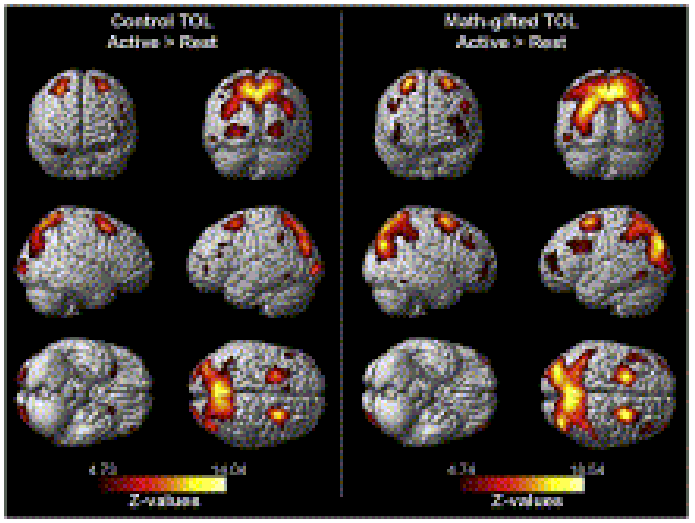
Each condition was contrasted against the baseline condition (consonant strings). a, The bilingual group ; b, the monolingual group . c, Group differences were identified using a *t*-test between groups for each of the conditions . Shown are regions with greater activations in the bilinguals.. In the pseudoword condition the peak activity was located more anteriorly, near to the medial frontal gyrus .

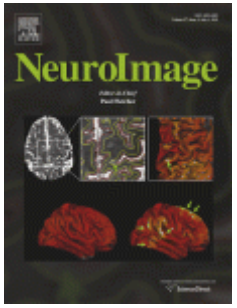








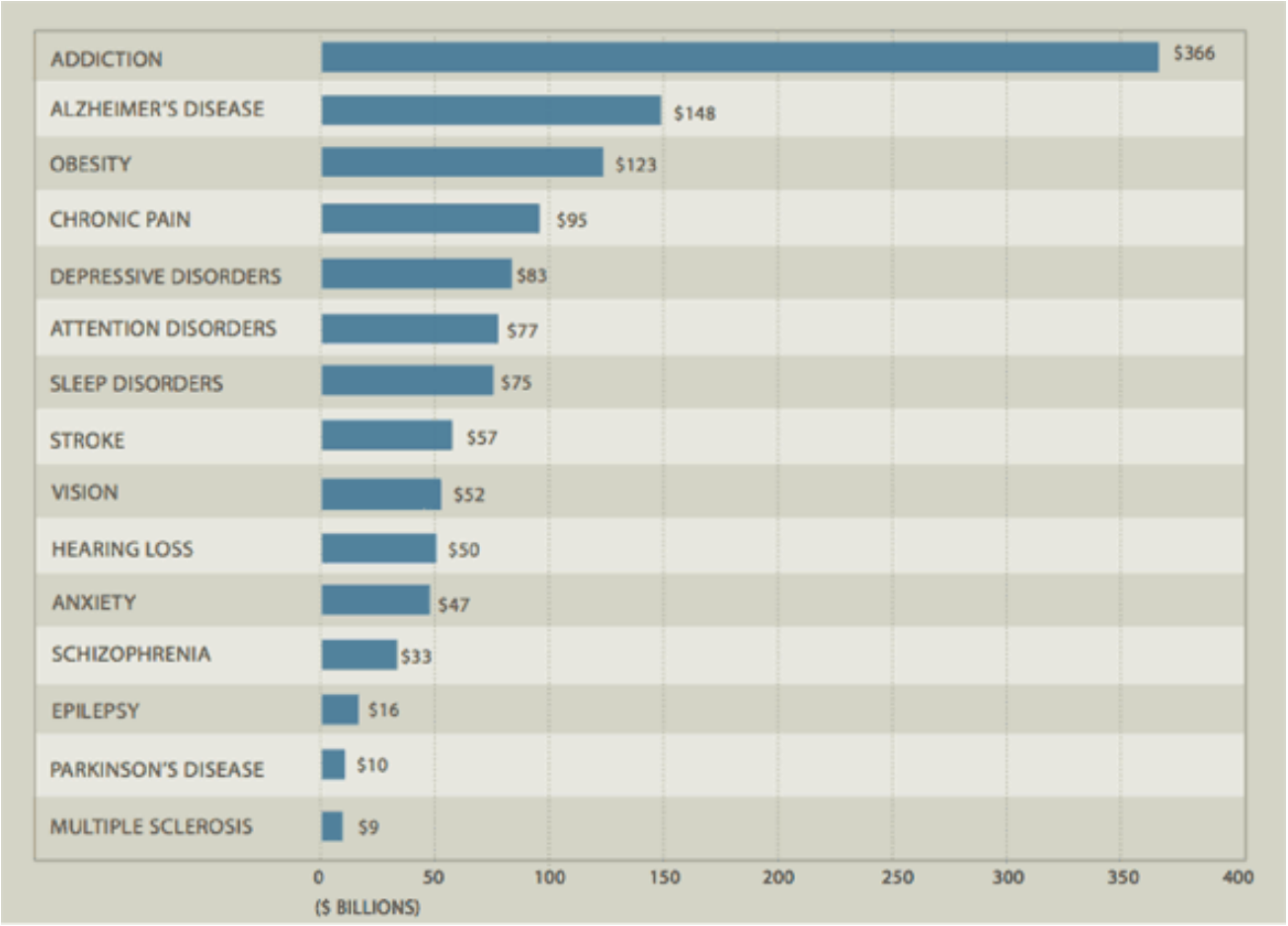




«Mathematically gifted adolescents use more extensive and more bilateral areas of the fronto-parietal network than controls during executive functioning and fluid reasoning tasks».

Volume 57, Issue 1, 1 July 2011, Pages 281–29.
P. García-Barreno, M. Desco, C. Arango et al.

The annual national economic burden of brain-related disorders has reached over $1 trillion (see chart) and is growing alarmingly due to an aging population. While research into the brain and brain-related illnesses is moving forward more rapidly than any other science today, our understanding of how the brain works still has many gaps and our ability to repair damage remains limited. Critical unmet medical needs exist in almost every area of brain and nervous system disorders, including Alzheimer's disease, addiction, anxiety, autism, depression, epilepsy, multiple sclerosis, obesity, Parkinson's disease, pain, sensory disorders, spinal cord injury, stroke, schizophrenia, sleep disorders, and traumatic brain injury.



SOURCE: Neuroinsights, Office of Nat'l Drug Policy, Nat'l Institute of Diabetes, Alz Assoc., Duke University, American Psych. Association, Harvard, Nat'l Sleep Found., American Stroke Assoc., Prevent Blindness America, CDC, Journal of Clinical Psych, Epilepsy Foundation, Cost of Brain Disorders Europe

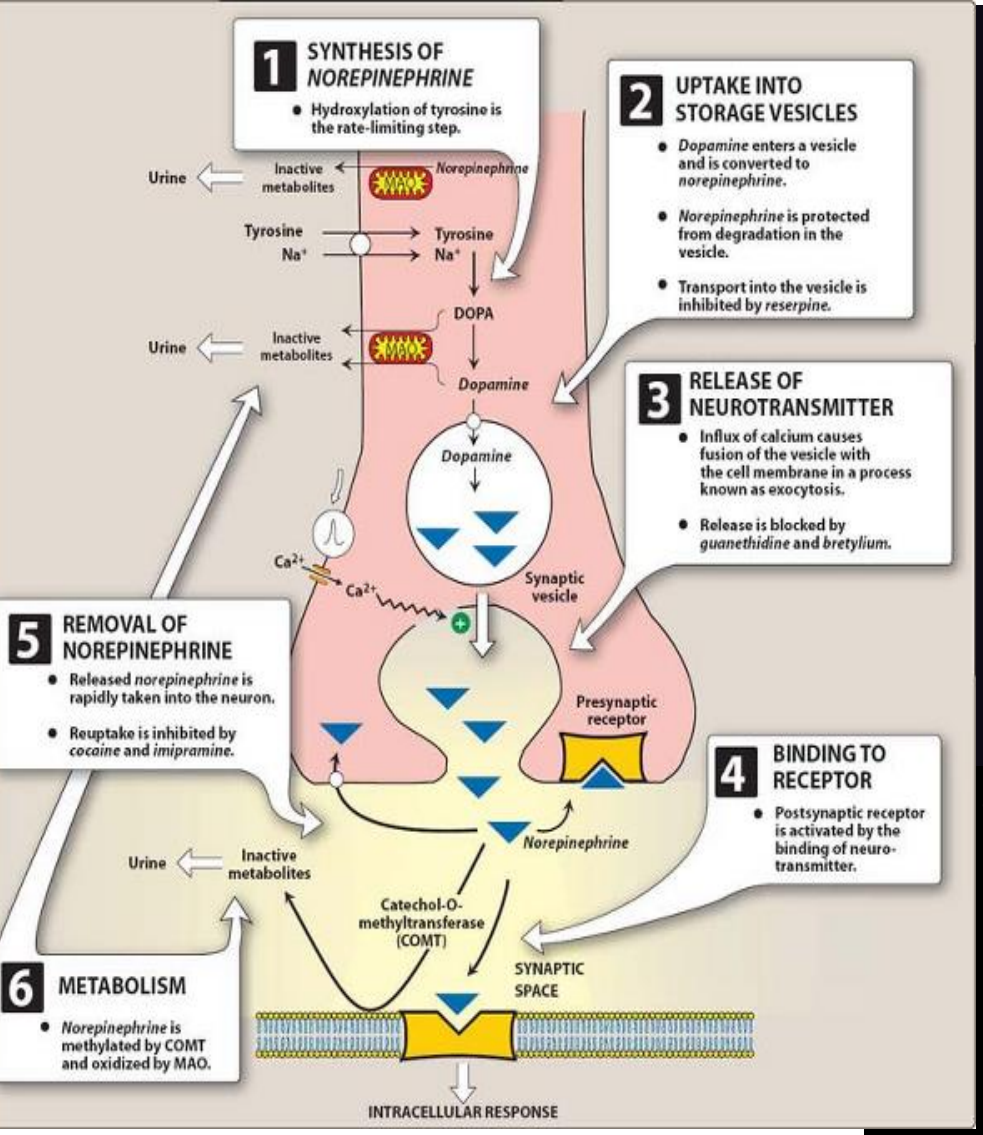
Creation Date: **6 Nov 2013** | Review Date: **6 Nov 2013**

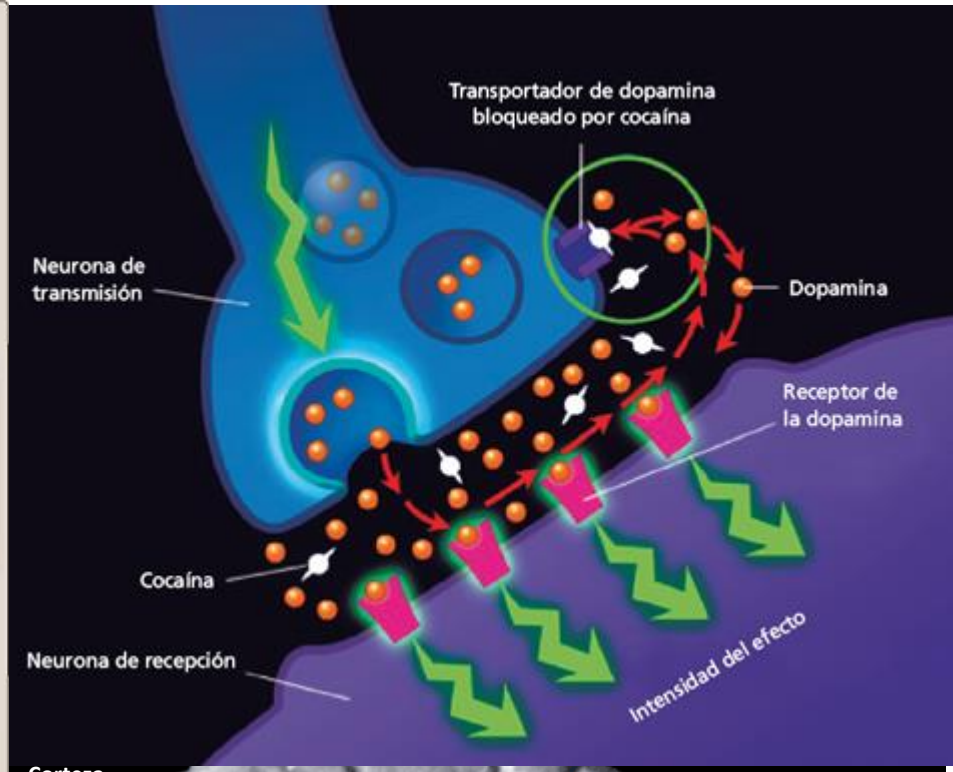
Brain Disease in Europe

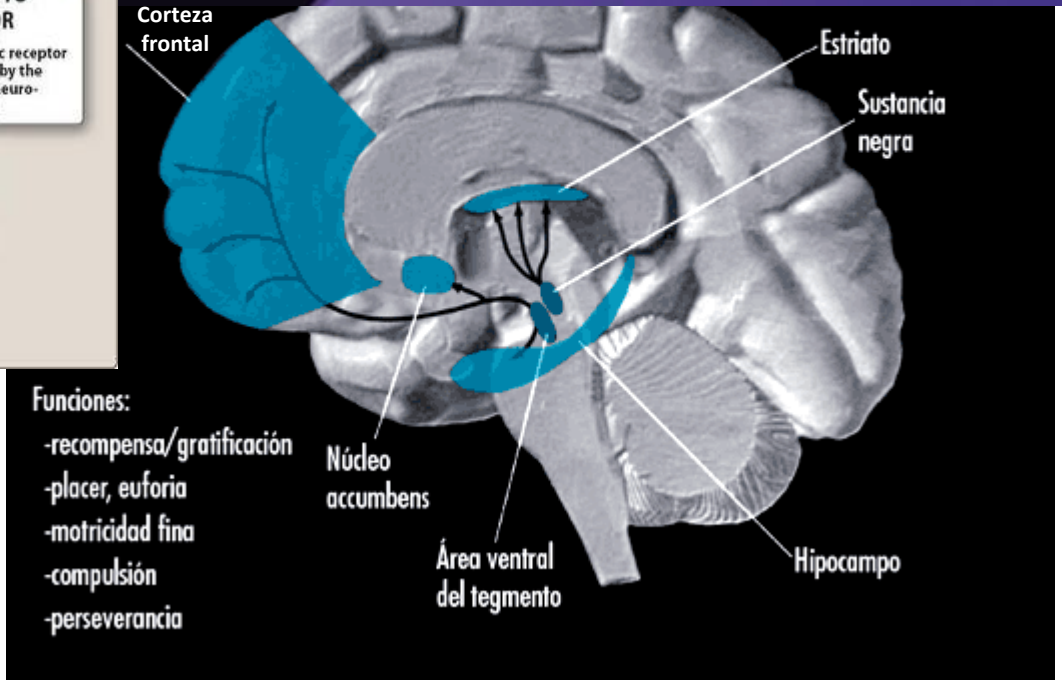
Source: **Federation of European Neurosciences**

Recent studies on the prevalence of brain diseases and disorders provide a stunning picture of mental health in Europe. As of 2011, an estimated 164.7 million people are affected by brain disorders in the 30 countries studied. Almost 38 percent of the European Union population suffer from some form of mental disorder. Furthermore, these disorders cost Europeans just under 800 billion euros each year.

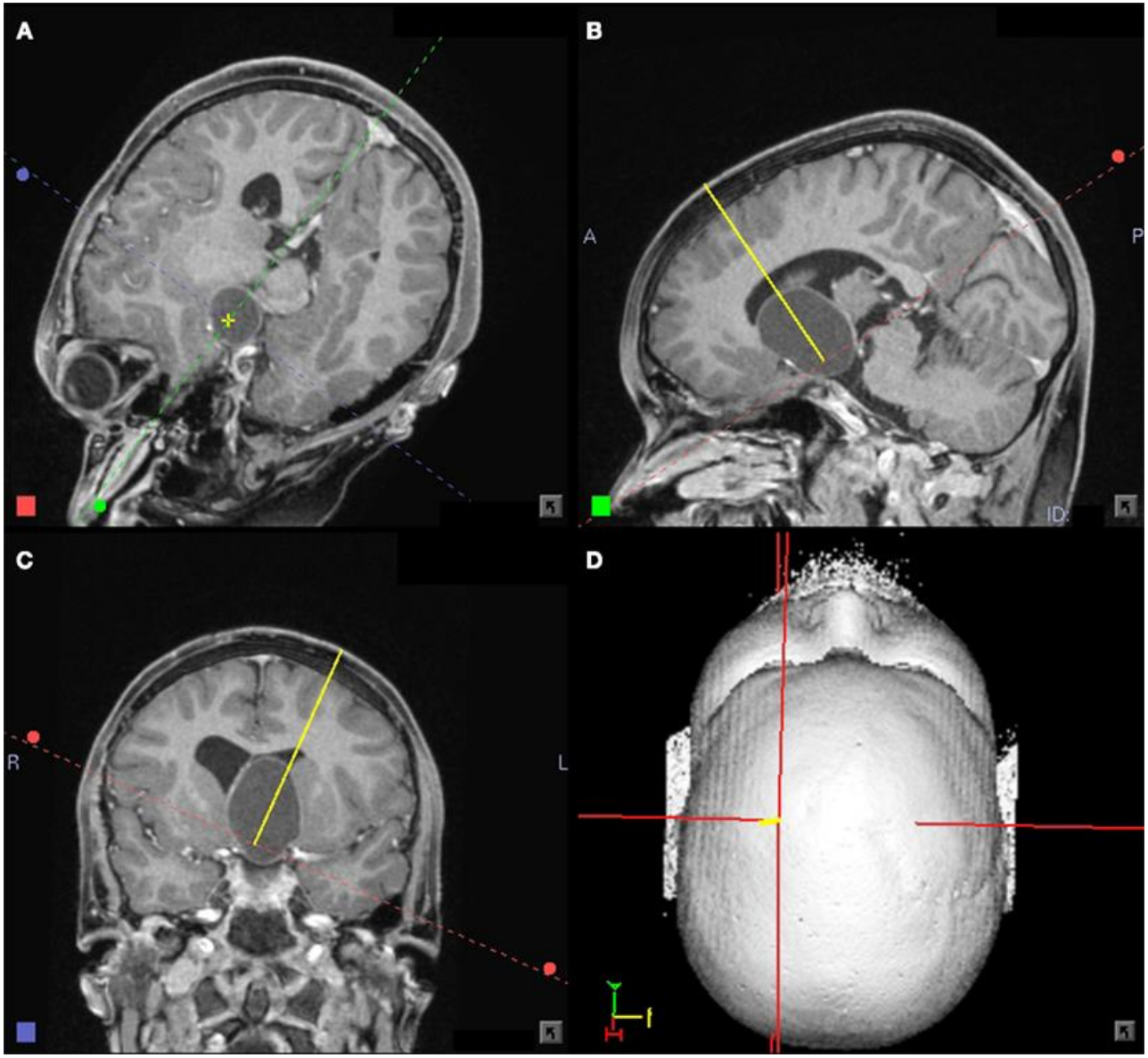
Disorders	Estimated number of subjects affected (millions)	Total costs (million €PPP 2010)			Total
		Direct health care costs	Direct non-medical costs	Indirect costs	
Addiction	15.5	27 685	13 569	24 430	65 684
Anxiety disorders	69.1	46 267	144	27 969	74 380
Brain Tumor	0.2	3208	0	1966	5174
Child/Adolescent disorders	5.9	2601	18 724	0	21 326
Dementia	6.3	16 949	88 214	0	105 163
Eating Disorders	1.5	593	70	164	827
Epilepsy	2.6	6503	1653	5644	13 800
Headache	152.8	9039	0	34 475	43 514
Mental retardation	4.2	29 204	14 097	0	43 301
Mood disorders	33.3	26 016	15 437	71 952	113 405
Multiple sclerosis	0.5	5295	4554	4709	14 559
Neuromuscular disorders	0.3	1834	1450	4442	7726
Parkinson's disease	1.2	7029	5519	1386	13 933
Personality disorders	4.3	3342	2701	21 301	27 345
Psychotic disorders	5.0	29 007	0	64 920	93 927
Sleep disorders	44.9	19 796	0	15 630	35 425
Somatoform disorder	20.4	9547	0	11 622	21 169
Stroke	8.2	42 352	16 769	4932	64 053
Traumatic brain injury	3.7	10 106	3348	19 560	33 013
TOTAL	**Number of diagnosis 380.1**	**296 374**	**186 250**	**315 101**	**797 725**

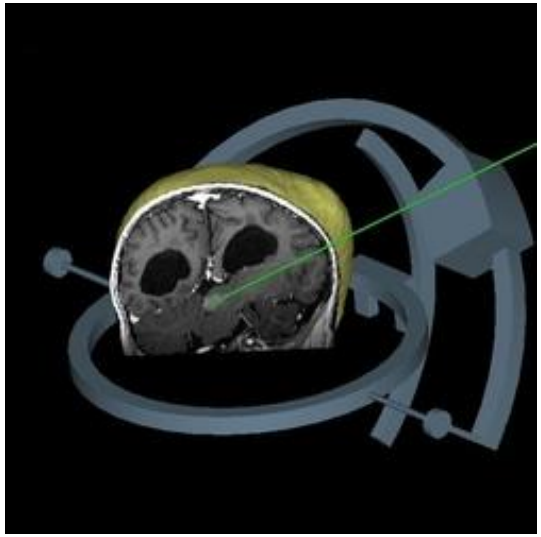


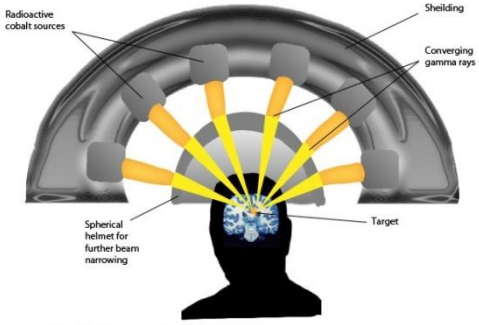




Neurofarmacología



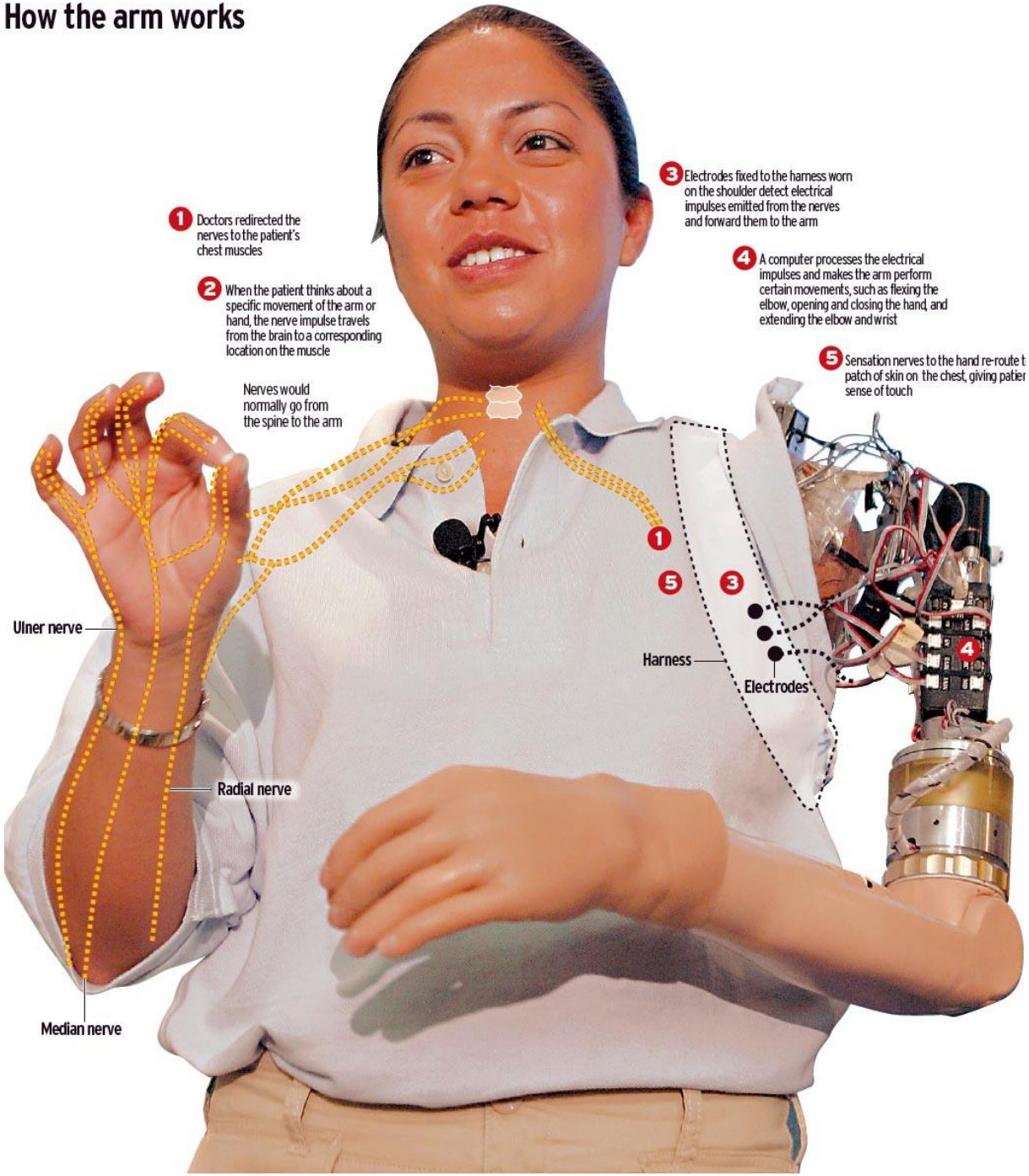




Stereotaxic Radiosurgery - Gamma Knife Concept

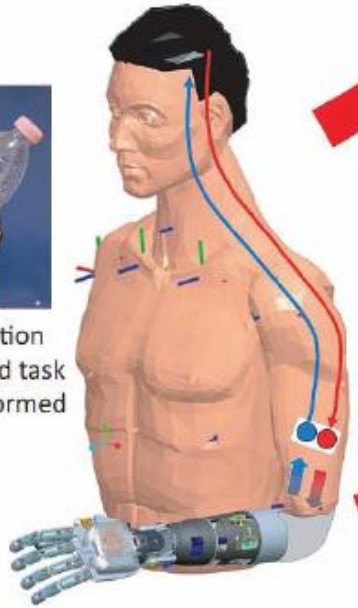
Multiple radiation beams converge on target tumor, delivering high-dose radiation to the tumor, but little to surrounding tissues. It is a single treatment and to ensure proper patient positioning and immobility, a positioning frame is secured to the patient's skull, then attached to the radiation source. Treatment lasts 45 to 60 minutes.

How the arm works



1

Visualization of the hand task to be performed



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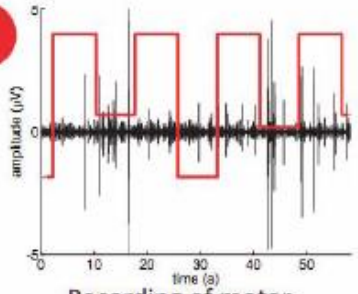
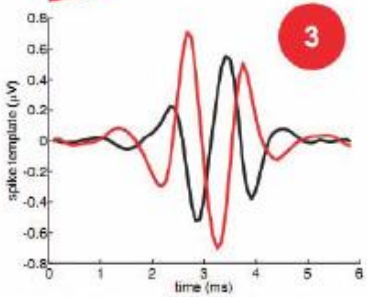


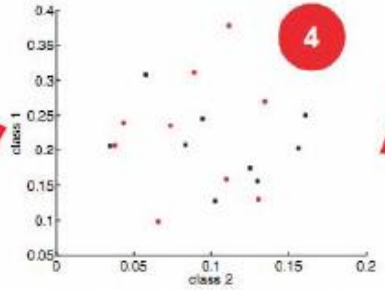
Recording of motor LIFE signals and wavelet denoising

3

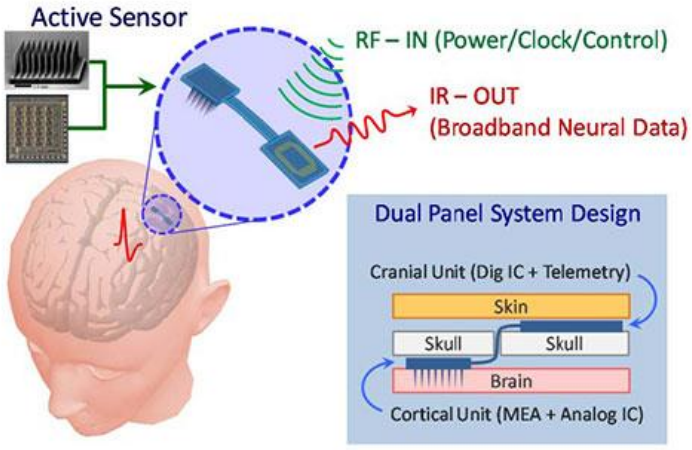


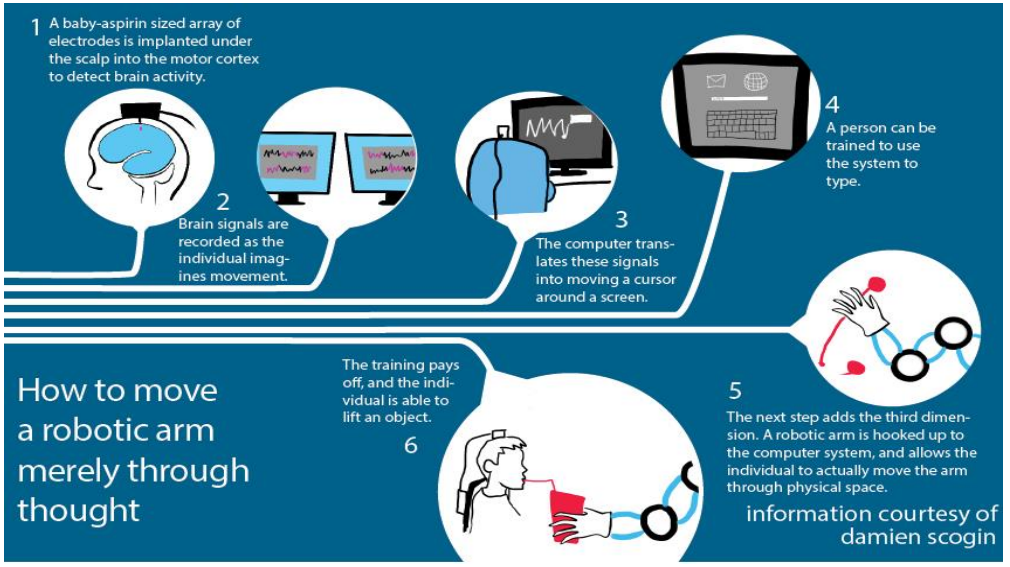
Spike detection and sorting

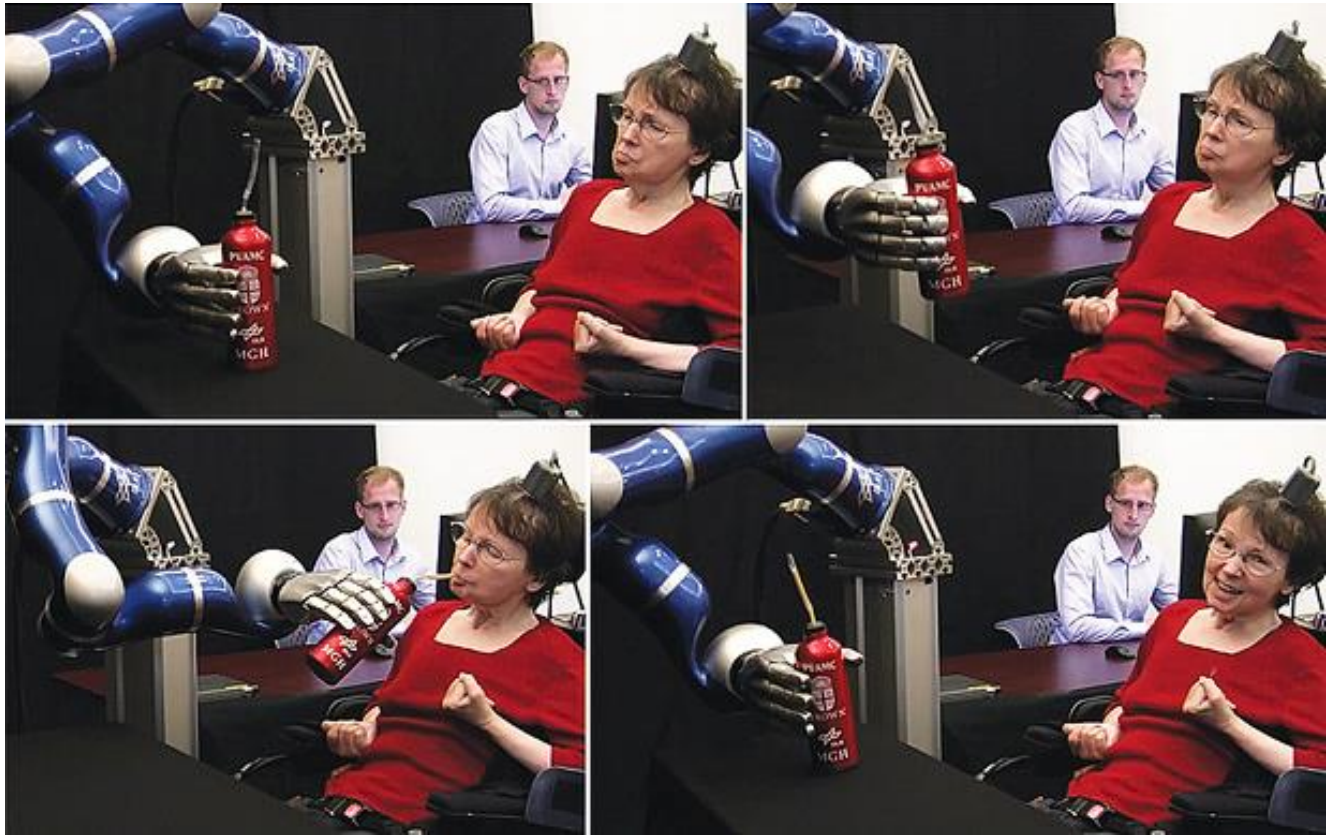
4

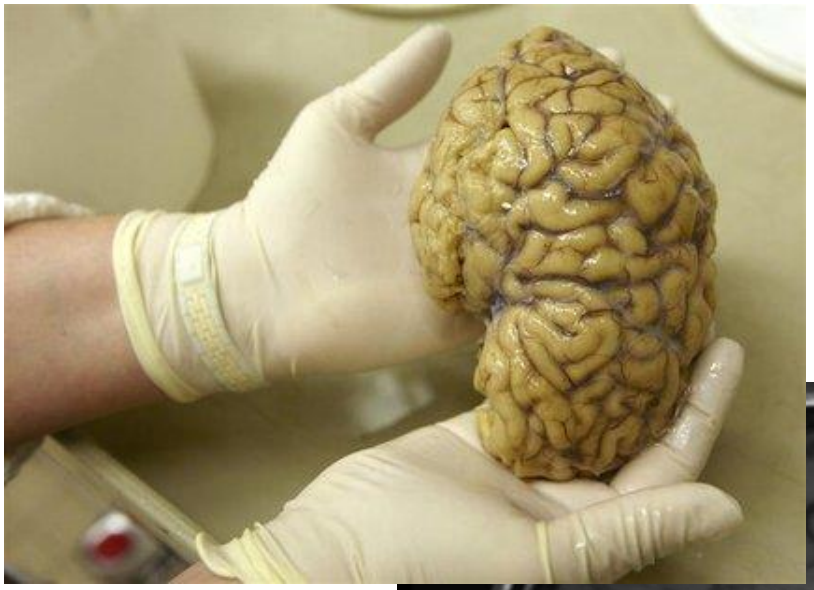


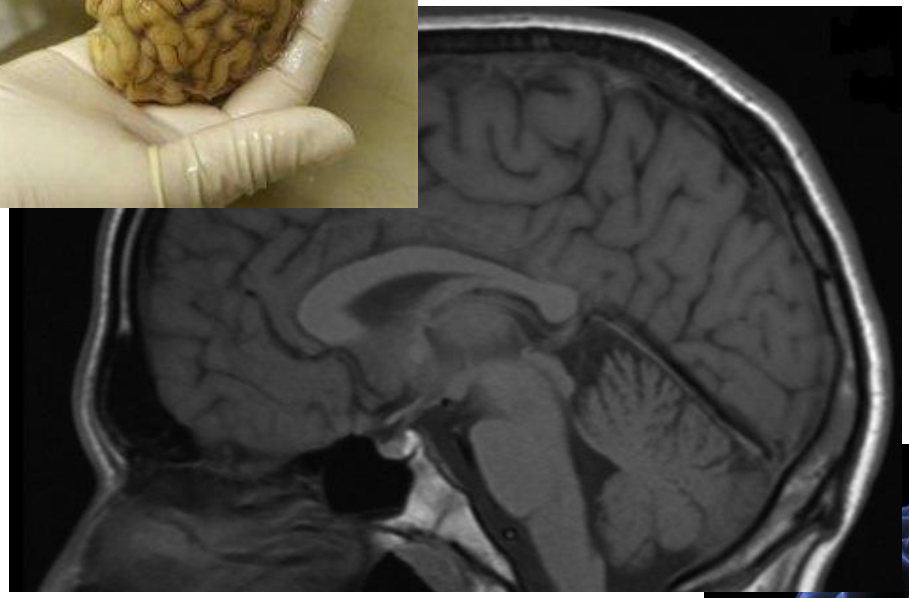
Detection of the desired intention and control of the prosthesis

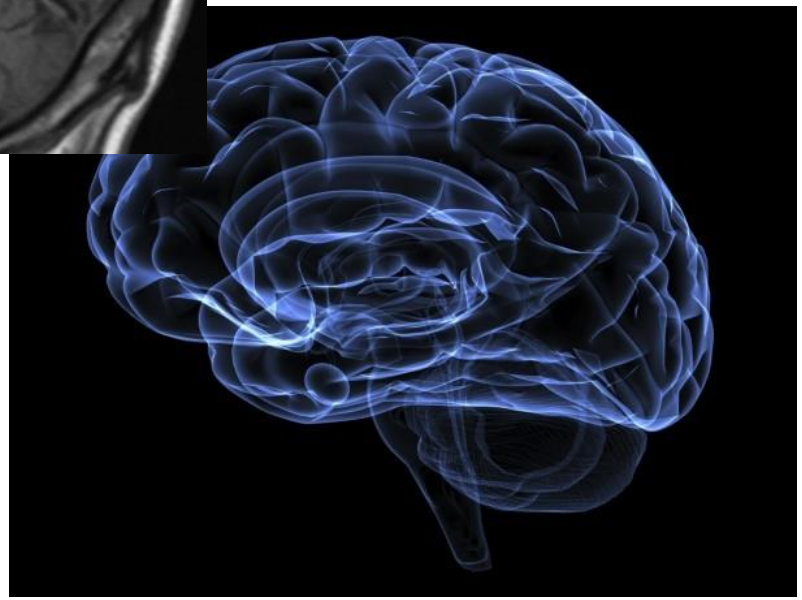

Active Sensor
RF – IN (Power/Clock/Control)
IR – OUT
(Broadband Neural Data)
Dual Panel System Design
Cranial Unit (Dig IC + Telemetry)
Skin
Skull
Skull
Brain
Cortical Unit (MEA + Analog IC)


1 A baby-aspirin sized array of electrodes is implanted under the scalp into the motor cortex to detect brain activity.
2 Brain signals are recorded as the individual imagines movement.
3 The computer translates these signals into moving a cursor around a screen.
4 A person can be trained to use the system to type.
5 The next step adds the third dimension. A robotic arm is hooked up to the computer system, and allows the individual to actually move the arm through physical space.
6 The training pays off, and the individual is able to lift an object.
How to move a robotic arm merely through thought
information courtesy of damien scogin



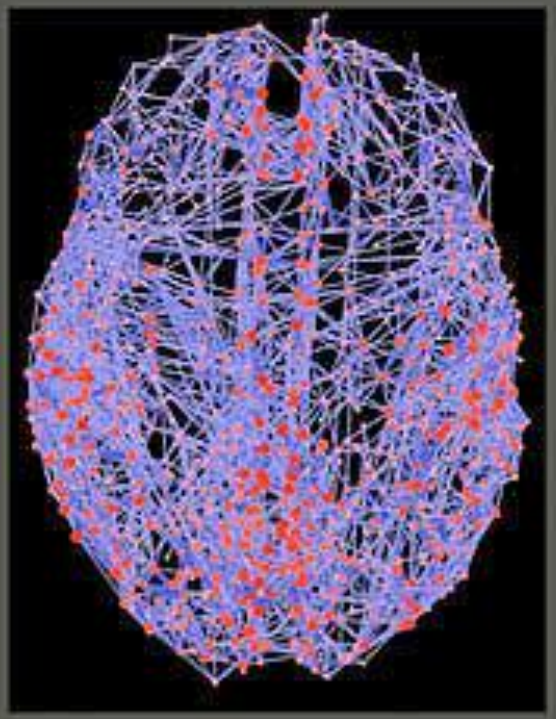






The Human Connectome

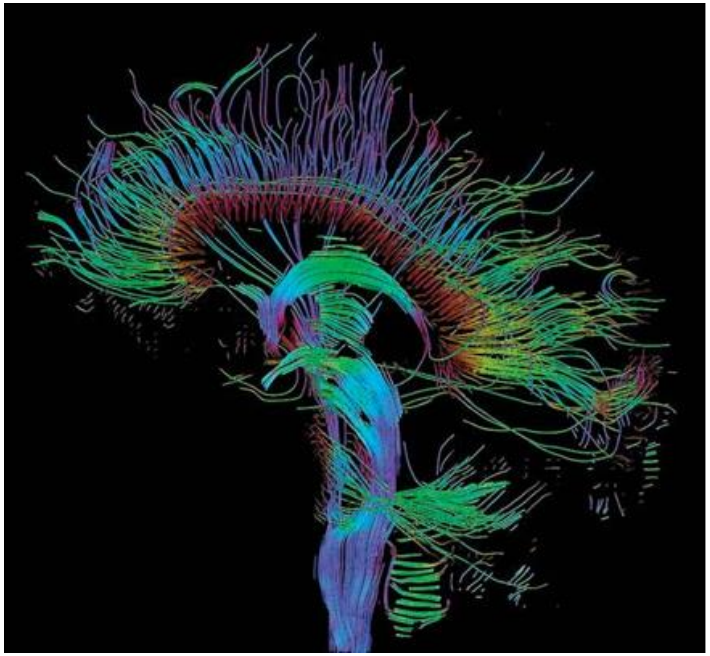
Anatomy
Klingler's method for fiber tract dissection uses freezing of brain matter to spread nerve fibers apart. Afterwards, tissue is carefully scratched away to reveal a relief-like surface in which the desired nerve tracts are naturally surrounded by their anatomical brain areas.



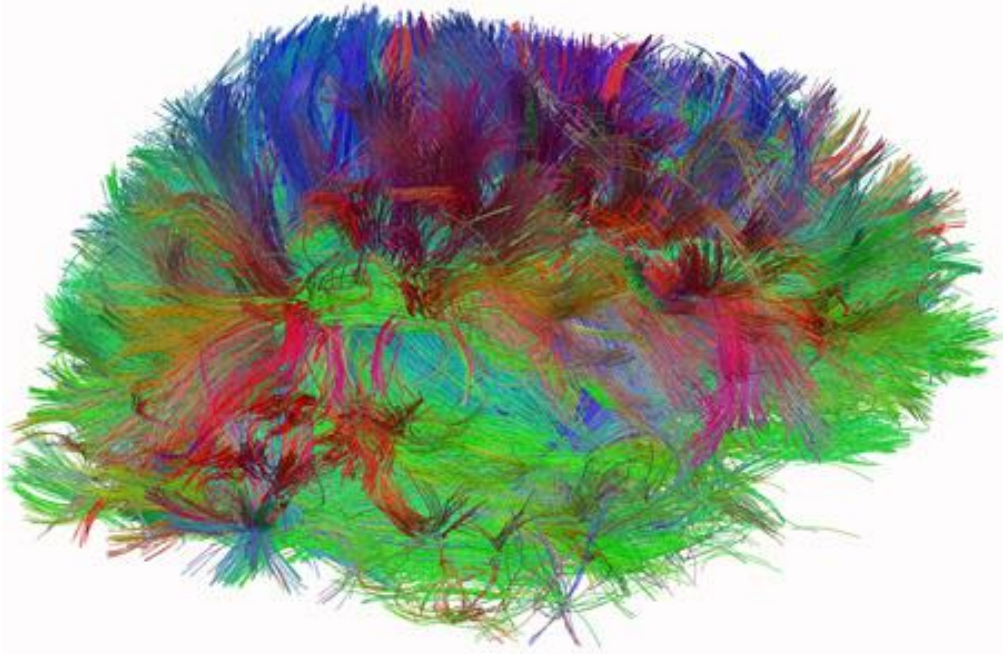
Connectome
Shown are the connections of brain regions together with "hubs" that connect signals among different brain areas and a central "core" or backbone of connections, which relays commands for our thoughts and behaviors.

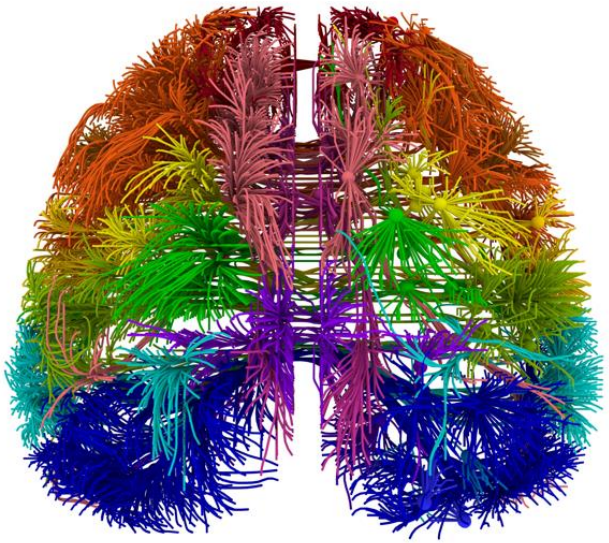
Neuronal Pathways
A new MRI technique called diffusion spectrum imaging (DSI) analyzes how water molecules move along nerve fibers. DSI can show a brain's major neuron pathways and will help neurolo-gists relate structure to function.

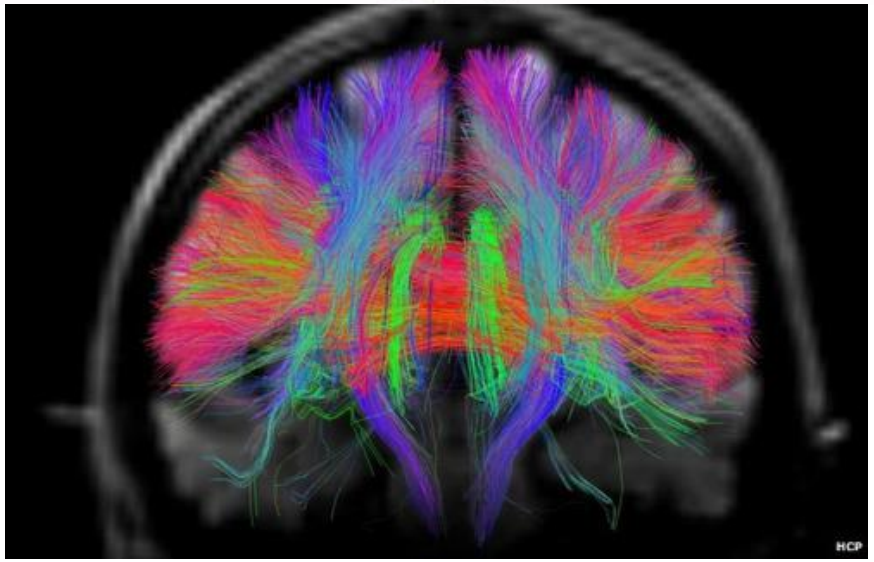
Reconstrucciones tractográficas del conectoma.
***Diffusion tensor imaging* (DTI)**

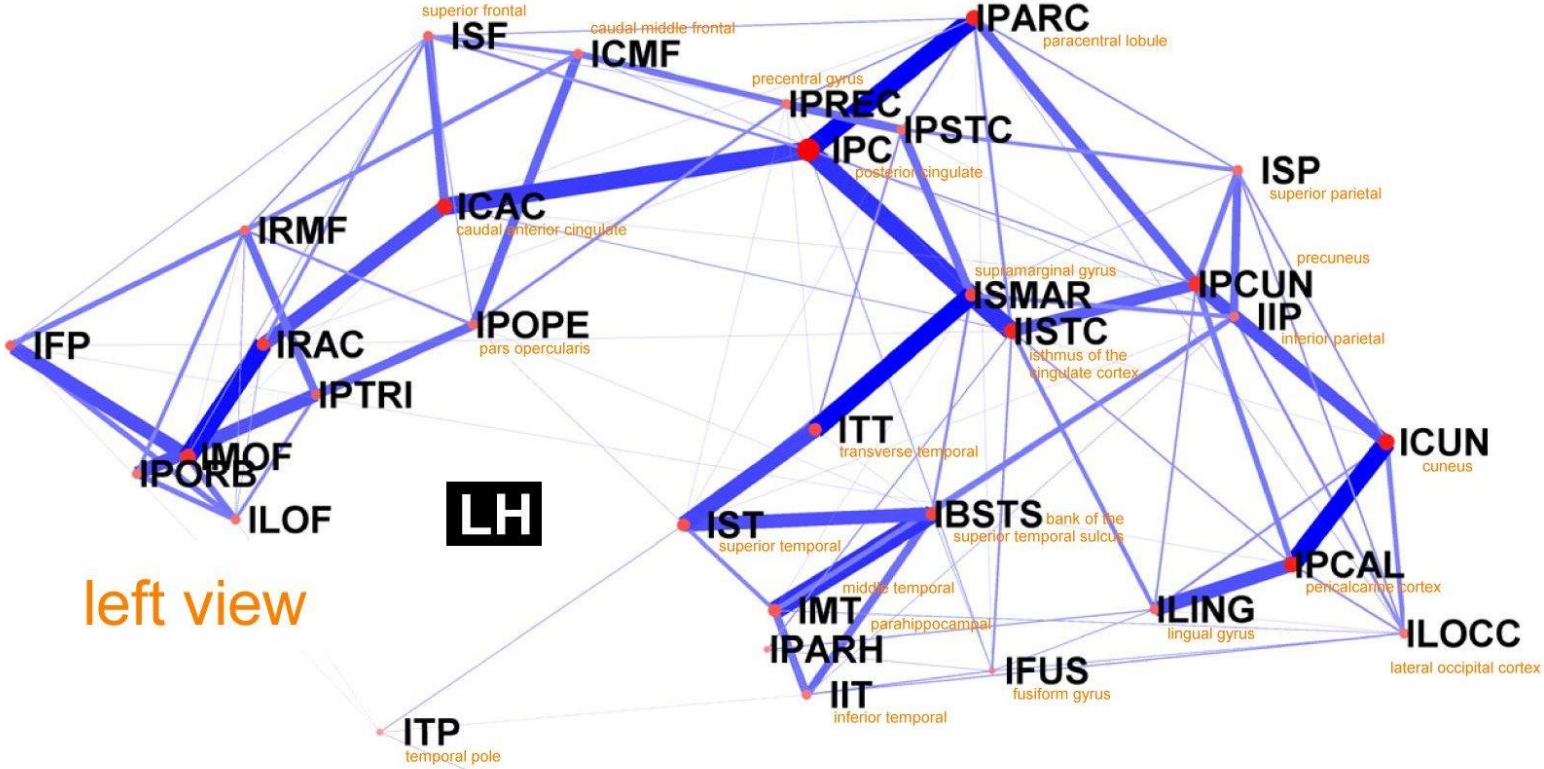


Diffusion spectrum image shows brain wiring in a healthy human adult. The thread-like structures are nerve bundles, each containing hundreds of thousands of nerve fibers.

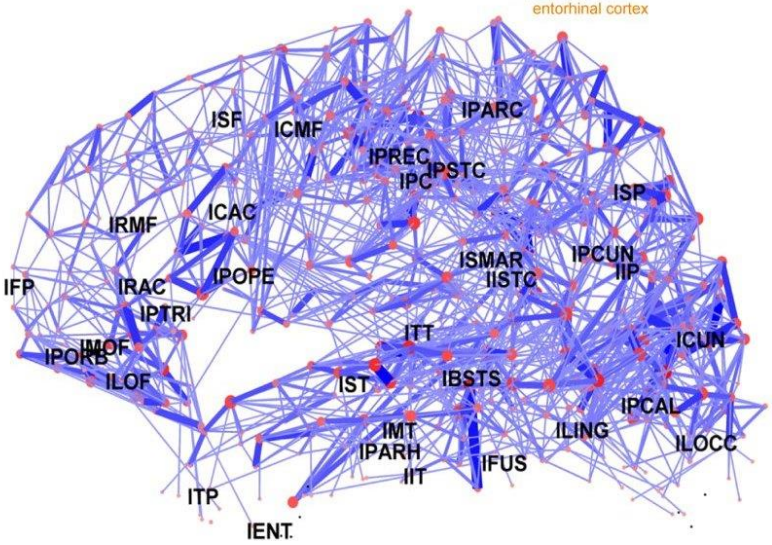


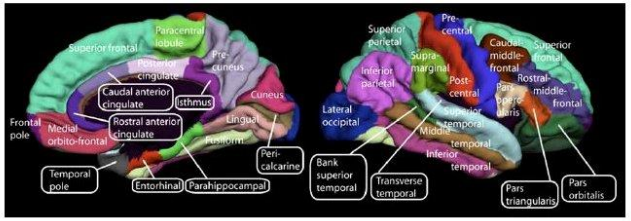






left view

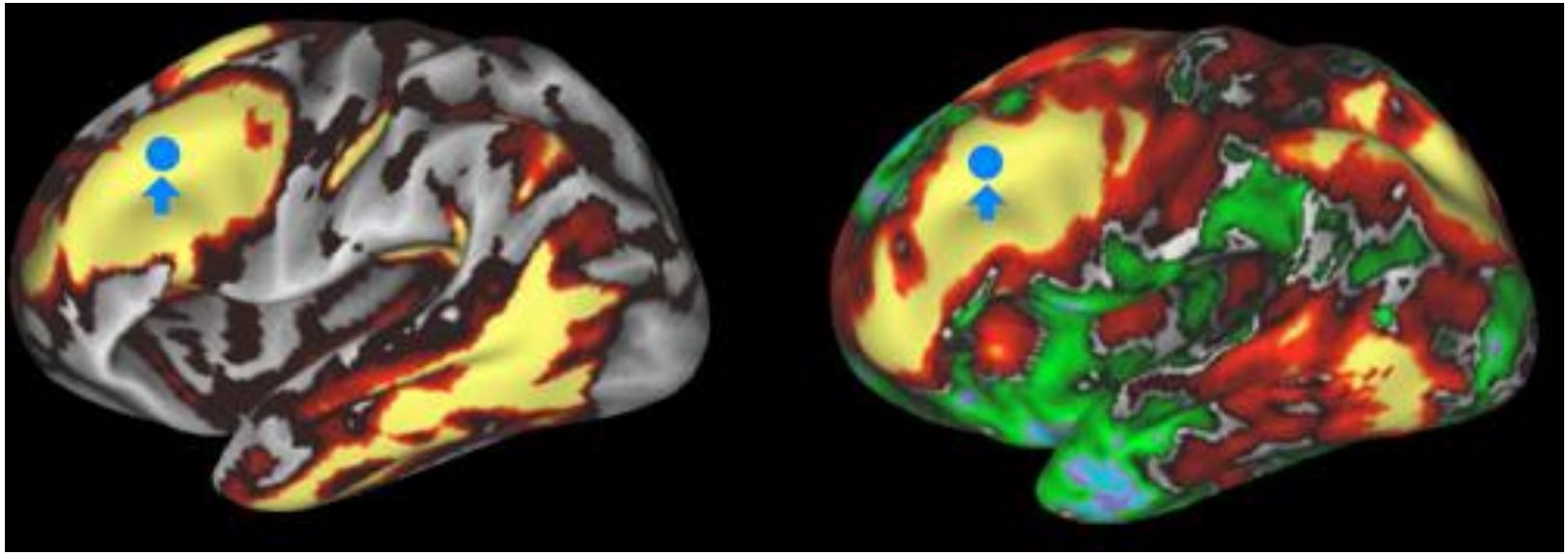




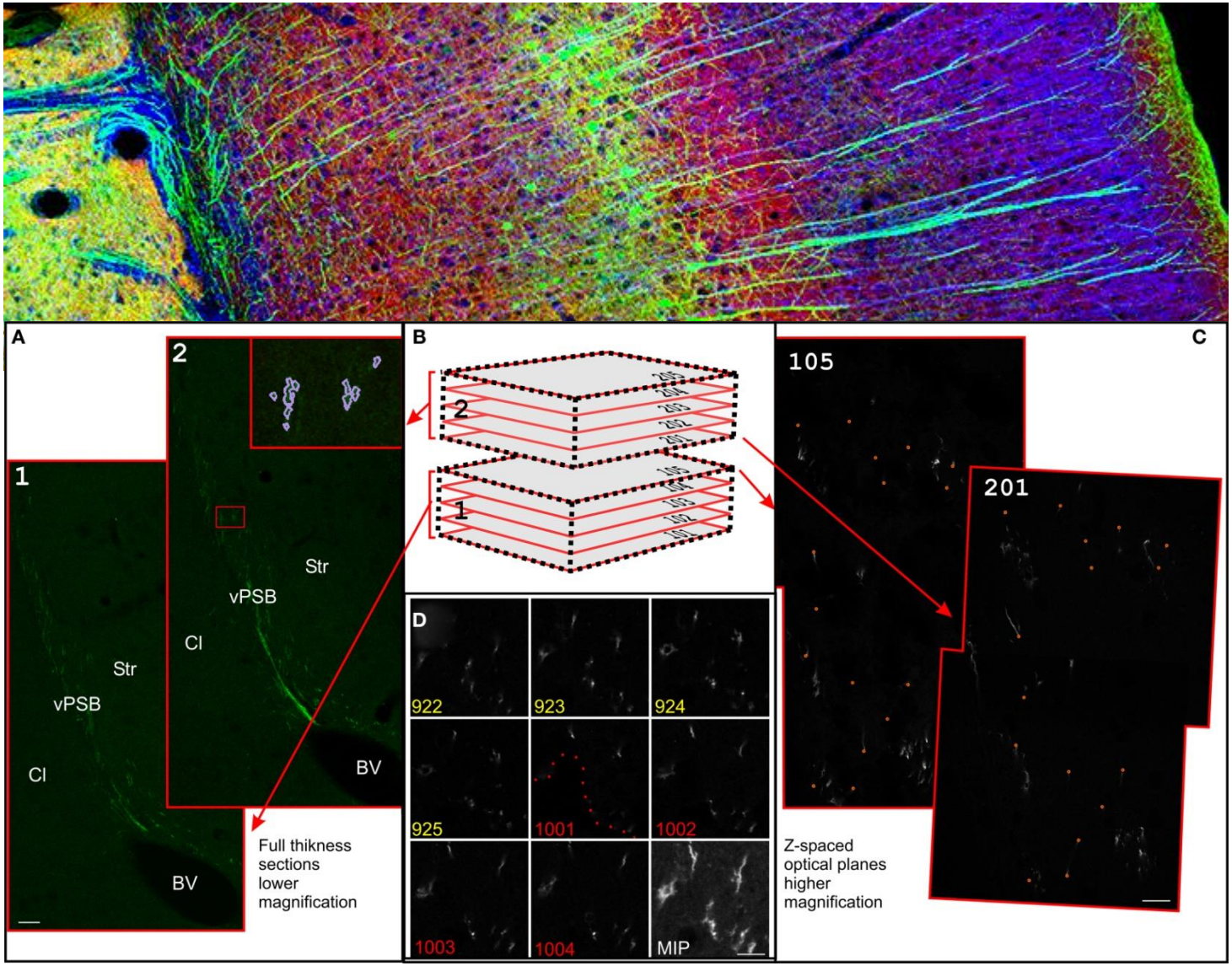
What does this mean for auditory-to-visual crossmodal connectivity? Primarily via IIP? Bandwidth? Latency?

Implications for The vOICe sensory substitution?

Ref: Mapping the Structural Core of Human Cerebral Cortex
Hagmann P, Cammoun L, Gigandet X, Meuli R, Honey CJ, et al.
PLoS Biology Vol. 6, No. 7, e159 doi:10.1371/journal.pbio.0060159



The Washington U. / U. Minnesota Connectome project will map the brain connections in each of 1200 participants. In the left image, yellow and red show a map of 'structural connectivity' in human cerebral cortex (regions that are connected to the blue spot as revealed by diffusion MRI). In the right image, yellow and red show a map of 'functional connectivity' (regions associated with the blue spot as revealed by functional MRI).



The synapses of the mammalian central nervous system are complex and deeply diverse structures that mediate complex, diverse and highly plastic signaling functions. To understand the structure, function and disorders of brain circuitry, it will be necessary to build bodies of knowledge that thoroughly and quantitatively fathom synapse molecular and functional diversity, i.e., synaptomes (genome, proteome,… conetome).

Irresponsabilidad (Insanity defense)

M'Naghten Rules (1843)

"*did the defendant know what he was doing, or, if so, that it was wrong*?"

Durham v. United States (*Durham*/New Hampshire test, 1954)

"*irresistible impulse test*"

Frendak v. United Sates (1979)

Nootropicos (1972)

Twinkle defense

Settled insanity

Non compos mentis

Neuroderecho (law)

J. Sherrod Taylor, J. Anderson Harp, Tyron Elliot «Neuropsychologists and Neurolawyers» *Neuropsychology* 1991; 5(4): 293-305.

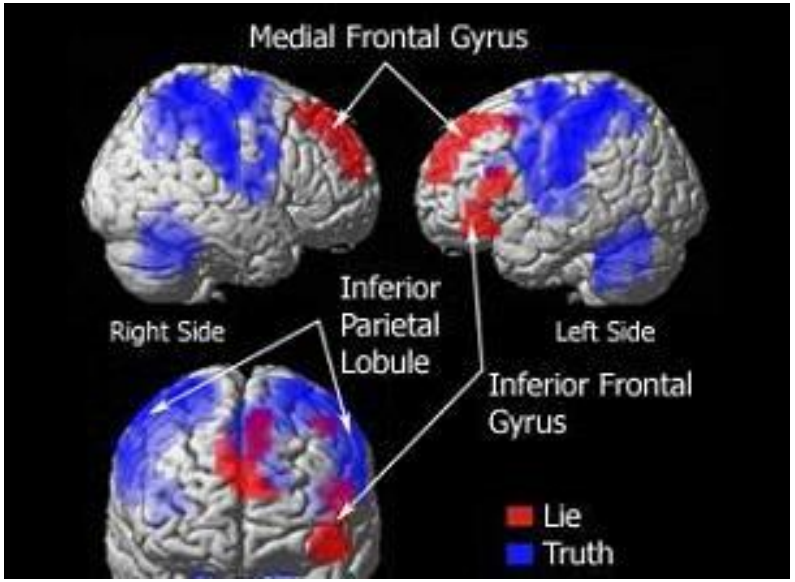
Dana Foundation – The Dana *Alliance for Brain Initiatives*, 1993
(The Gruter Institute for Law and Behavioural Research)

***Law and Neuroscience Project* / The MacArthur Foundation, 2007**

Baylor College of Medicine's *Initiative on Neuroscience and the Law* (NeuLaw), 2008

The University of Pennsylvania. *Center for Neuroscience & Society*, 2009.

Neuropsychology
Editor:
Gregory Brown, PhD
Special Issue: Head Injury
Guest Editor:
Neil Brooks



Neuropsychologists and neurolawyers.

By Taylor, J. Sherrod; Harp, J. Anderson; Elliott, Tyron
Neuropsychology, Vol 5(4), Oct 1991, 293-305.

Abstract

Describes the US civil justice system and analyzes the roles played by neuropsychologists (NPs) and neurolawyers (NLs) within this system. Traumatic brain injuries (TBIs) occur in a variety of accidents, which may become the subject of personal injury claims or litigation. Competent clinical NPs can provide convincing evidence of the reality of brain injury deficits. NPs are most likely to become involved in such aspects of personal injury cases as testing and treatment of the TBI claimant, conference with the claimant's lawyer, reporting the patient's status to the lawyer, giving a deposition during discovery, and presenting direct evidence and being cross-examined at the trial. The relationship between NPs and NLs is highlighted.
(PsycINFO Database Record (c) 2012 APA, all rights reserved)

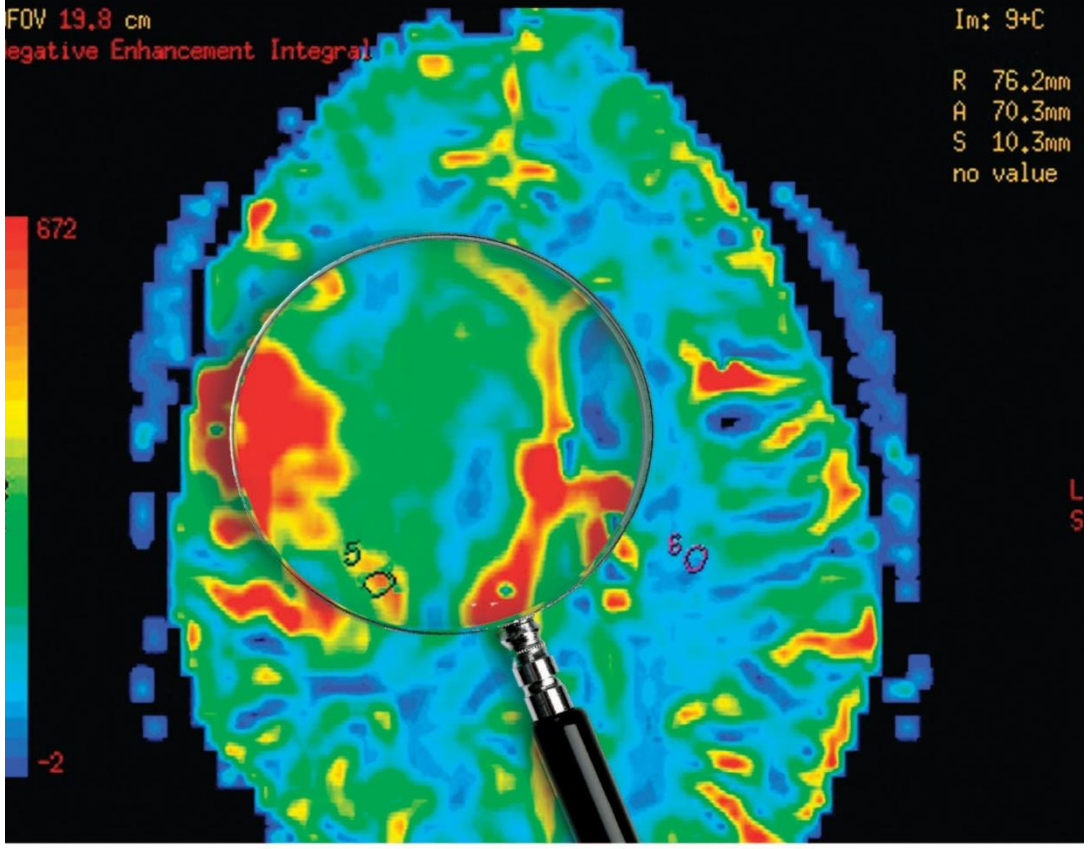
https://www.youtube.com/watch?v=qGLeAlffdk8

THE RESEARCH NETWORK ON LAW + NEUROSCIENCE lawneuro.org

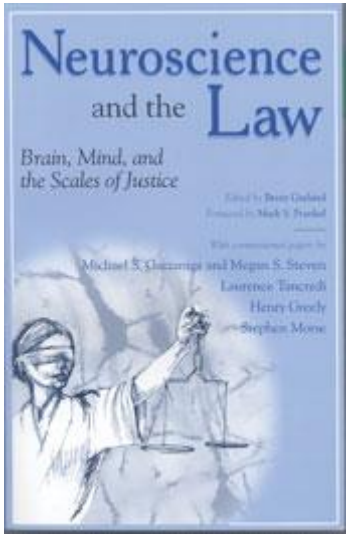
Law + Neuro

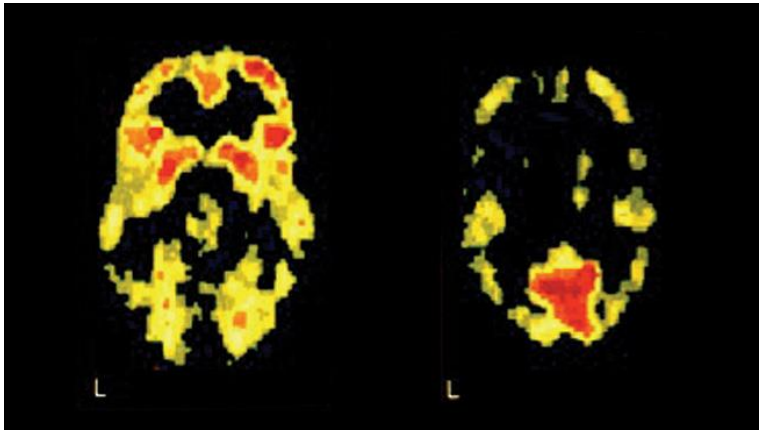
COLLOQUIUM FOR FEDERAL JUDGES ON LAW, NEUROSCIENCE, + CRIMINAL JUSTICE

VANDERBILT UNIVERSITY 02.06-07.2014



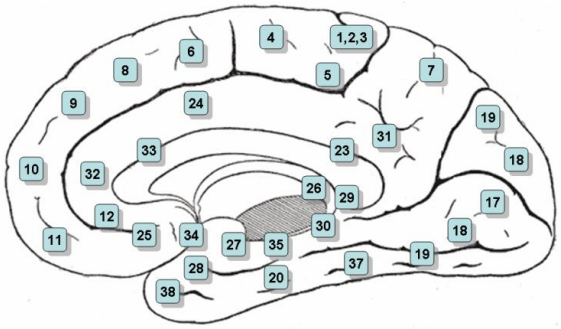
MacArthur Foundation · VANDERBILT Law School · Federal Judicial Center · AAAS · Gruter Institute for Law and Behavioral Research

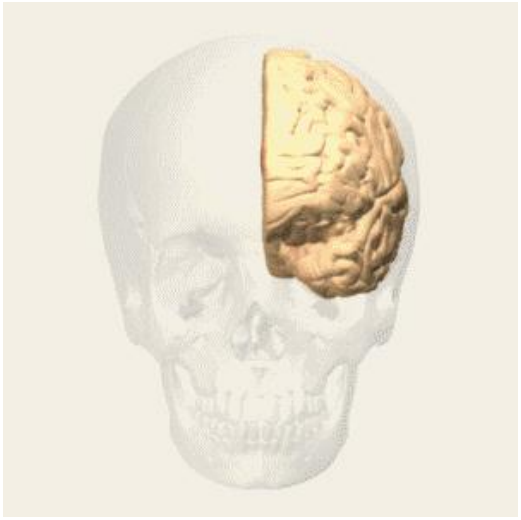


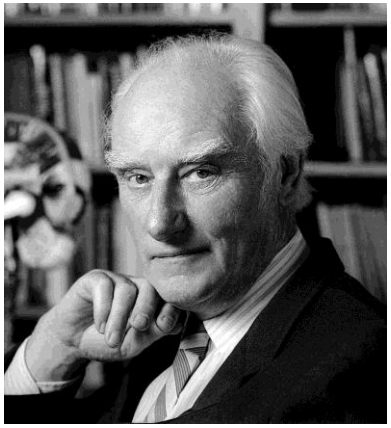


Brain scans of a normal subject (left) and a murderer (right), illustrating the lack of activation in the prefrontal cortex (top of figure), associated with self-control, in the murderer (recidivism). Warm colors (red, yellow) indicate areas of high brain activation; cold colors (blue, black) indicate low activation.

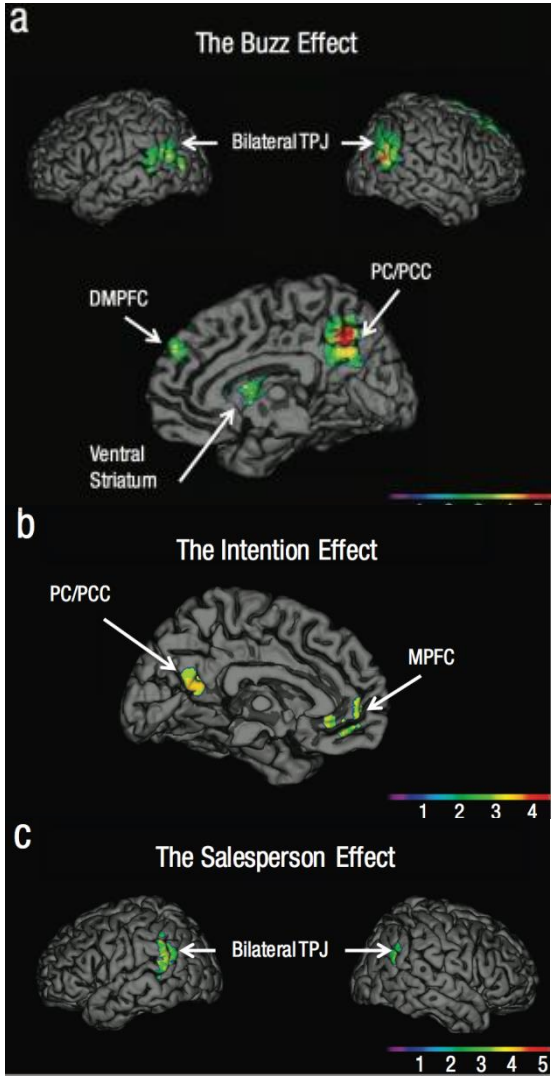
Área 24: Francis Crick (PNFoM 1962 – ADN) rescata de las notas de Antonio Damasio y col. el caso de una mujer con déficit en esa zona por un accidente, que la dejó casi inerte. Estaba en cama con expresión alerta. Seguía los movimientos de la gente con los ojos. No hablaba espontáneamente. Entendía las preguntas que se le formulaban pero como respuesta gesticulaba con los ojos sin emisión de voz. Repetía palabras que se le sugerían a un ritmo muy lento. Luego de un mes, casi recuperada, alegaba no haber hablado porque no tenía nada que decir. Su mente - señalaba - estaba vacía. No es un caso único: hay otras constancias similares. La interpretación de Crick reside en que había perdido la voluntad y el libre albedrío y luego los había recuperado. El correlato neural del libre albedrío residiría, entonces, en el área 24. Esta tiene muchos terminales relacionados con los niveles altos de percepción y muchas subrredes eferentes conectadas con los niveles altos motores.

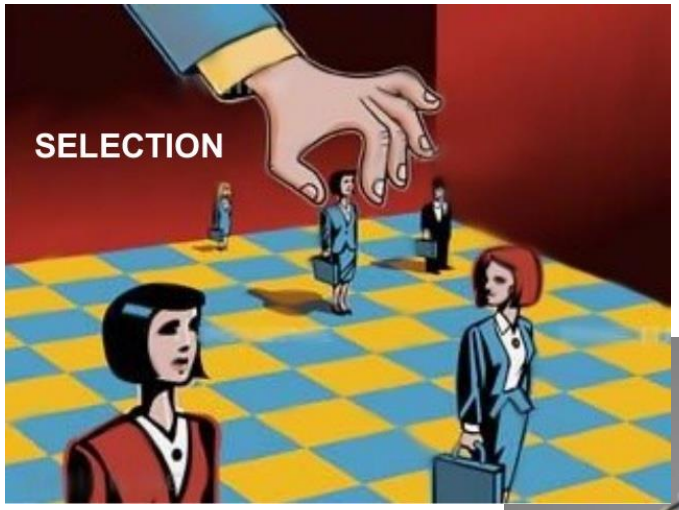


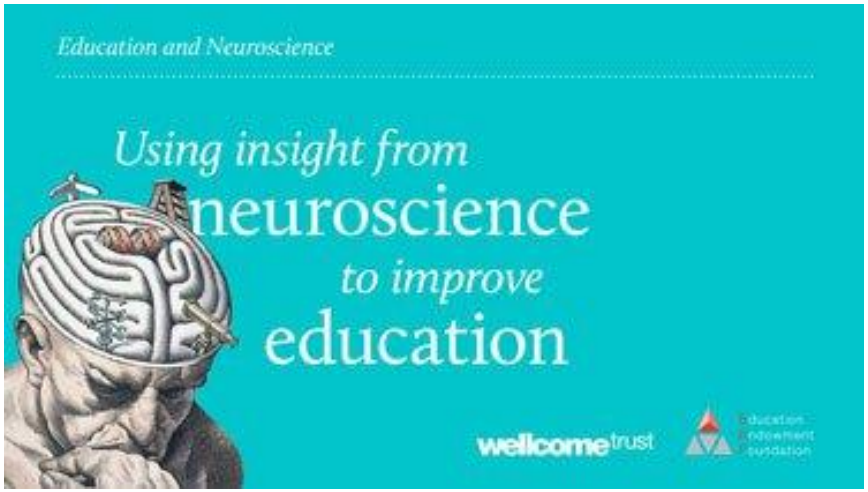




Francis H.C. Crick
1916-2004

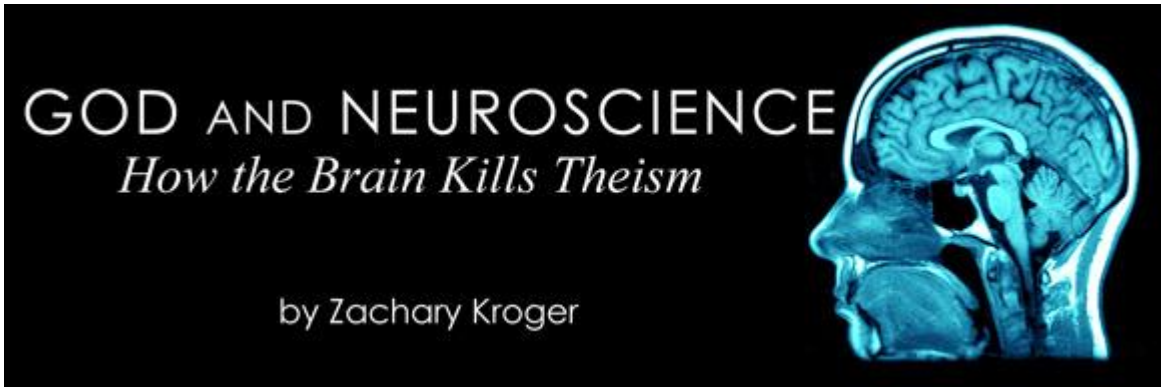


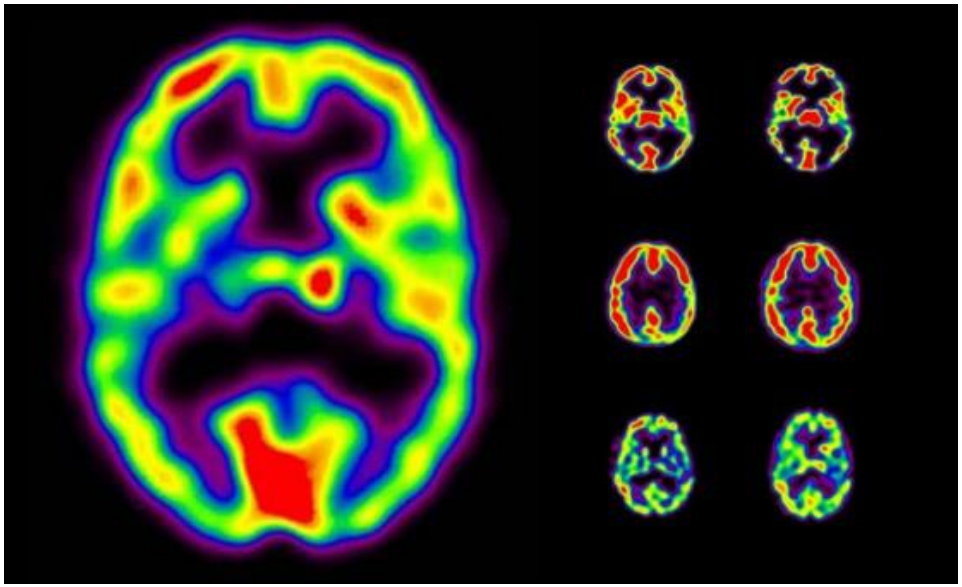


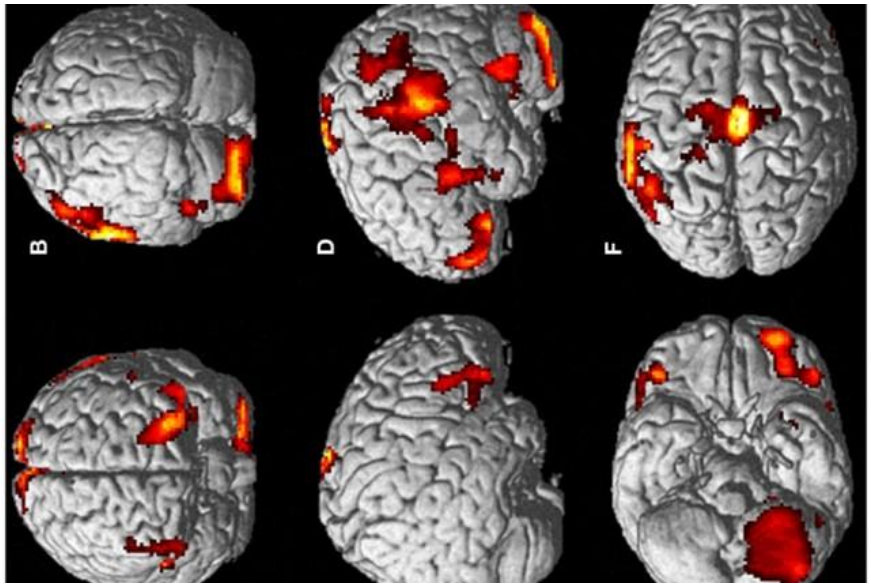


S.B. Kaufman
"The neuroscience of social influence"
***Scientific American* July 9, 2013.**

NEUROTEOLOGÍA







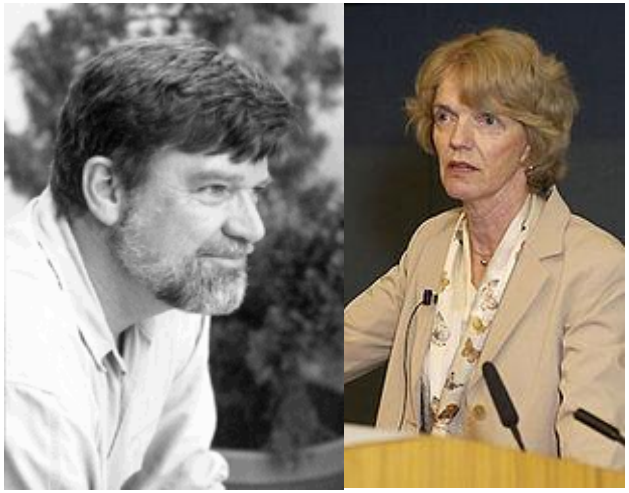
Activated regions of the brain while the participant claimed to have extra-corporeal experiences / A.M. Smith & C. Messier, Front. Hum. Neurosci. 2014

Investigators are exploring the analgesic benefits of virtual reality. The computer-simulated environments immerse people in a 3-dimensional world of sights, sounds, and, in some cases, smells. No longer science fiction, virtual reality programming is becoming increasingly common and clinically useful.

Presenting at the American Pain Society 29th Annual Scientific Meeting -2010-, investigators showed the immersive technology lessens the perception of pain by engaging the senses.

U.S. President Barack Obama
White House
April 2, 2013

(1596-1650)



Paul Churcland & Patricia Smith Churchland
(Canadá, 1942 y1943)

EU FET-Flagship Programme
Future & Emerging Technologies (FET) initiative
European Research Programme (ERP)

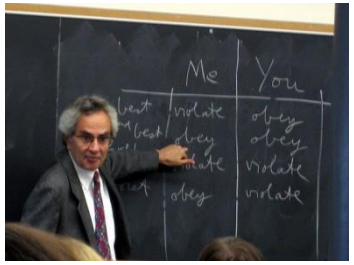
Human Brain Project

SP1: Strategic Mouse Brain Data
SP2: Strategic Human Brain Data
SP3: Cognitive Architectures
SP4: Theoretical Neuroscience
SP5: Neuroinformatics Platform
SP6: Brain Simulation Platform
SP7: High Performance Computing Platform
SP8: Medical Informatics Platform
SP9: Neuromorphic Computing Platform
SP10: Neurorobotics Platform
SP11: Applications
SP12: Ethics and Society

HBP Summit: October 2013

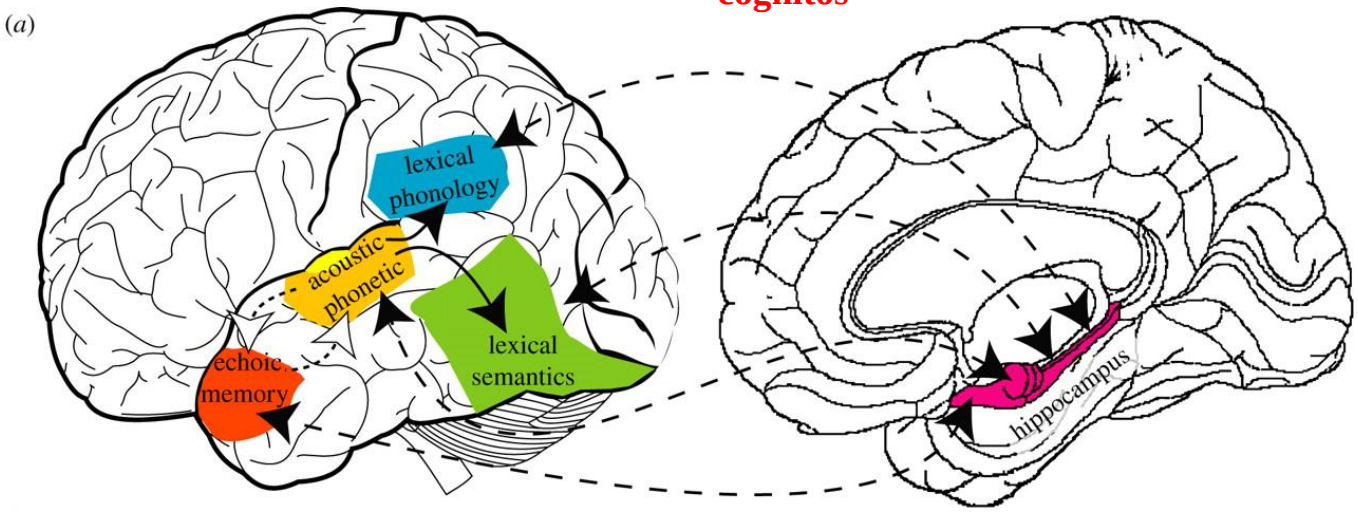
¿Tabula rasa?

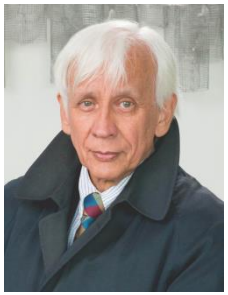
Daniel C. Dennett
(n 1942)



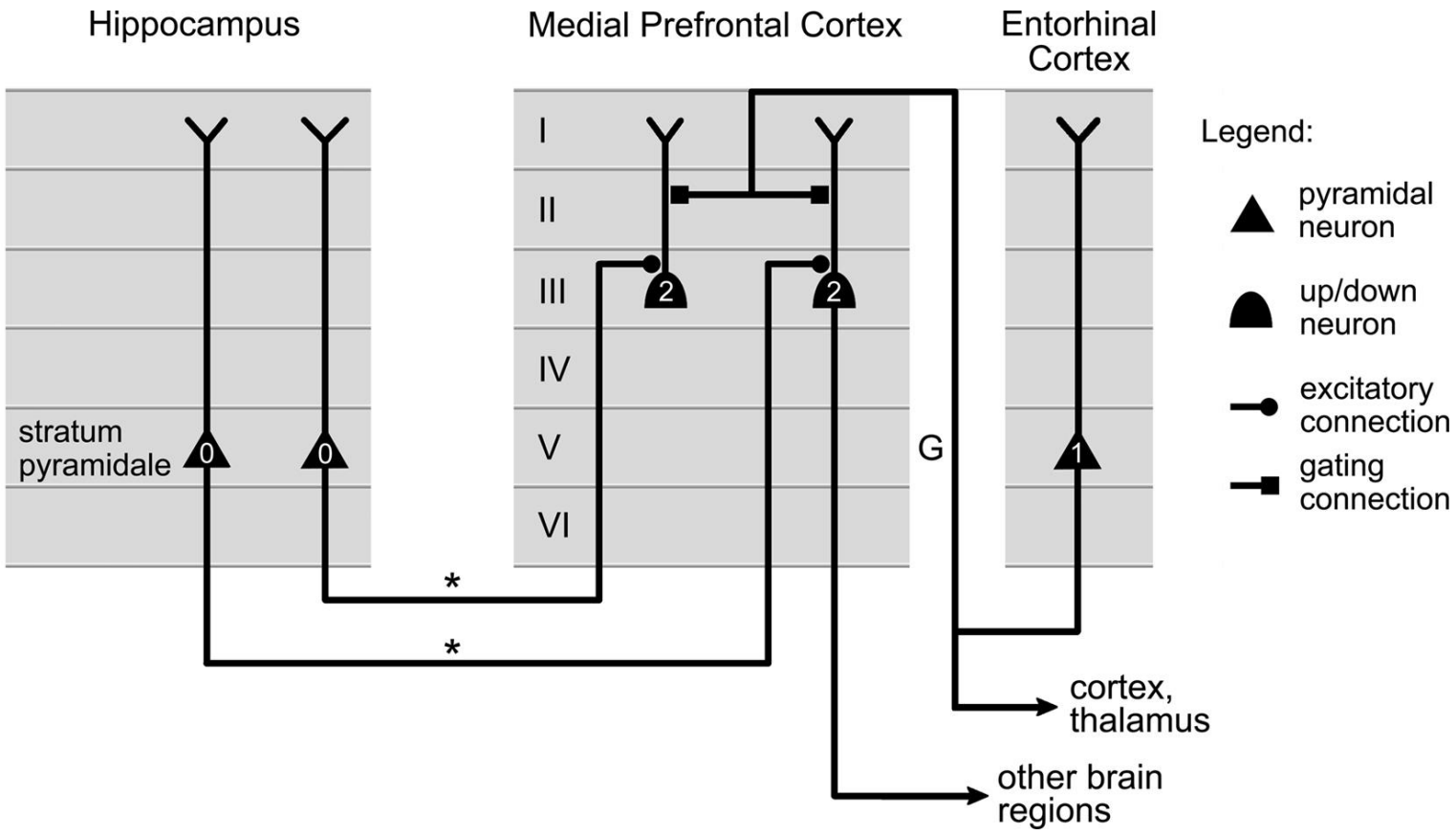
Thomas Nagel
(n 1937)

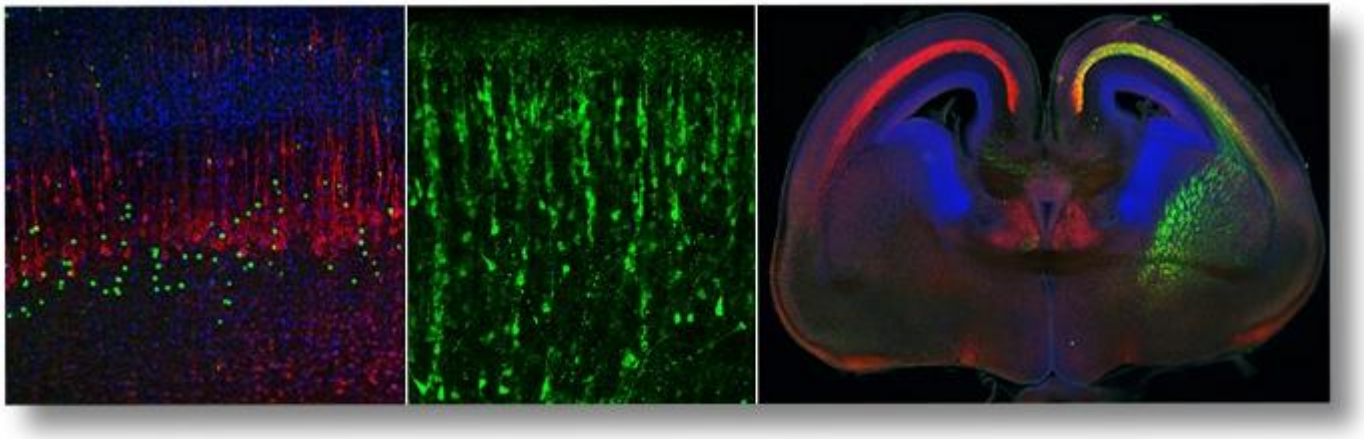
qualias
cógnitos



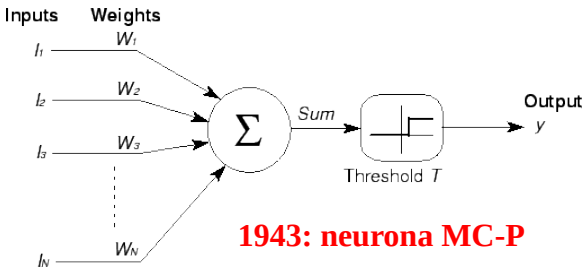


Rodolfo [Ga]Llinás
(n 1934)
Ley de Llinás
[de la no intercambiabilidad]


Hippocampus
Medial Prefrontal Cortex
Entorhinal Cortex
I
II
III
IV
V
VI
stratum pyramidale
0
0
2
2
1
G
*
*
cortex, thalamus
other brain regions
Legend:
pyramidal neuron
up/down neuron
excitatory connection
gating connection



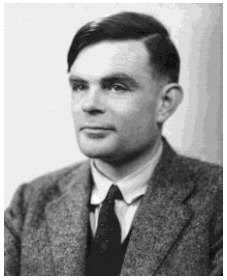
Walter S. McCulloch (1898-1969) **Walter H. Pitts (1923-1969)**



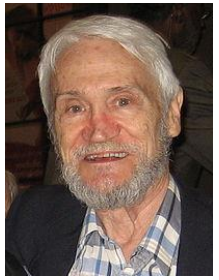
1943: neurona MC-P

Donald O. Hebb (1904-1986)

Aprendizaje: plasticidad neuronal → potenciación a largo plazo (LTP)
1945: aprendizaje hebbiano



Alan M. Turing (1912-1954)
máquinas de Turing tipo B
1948: máquinas desorganizadas

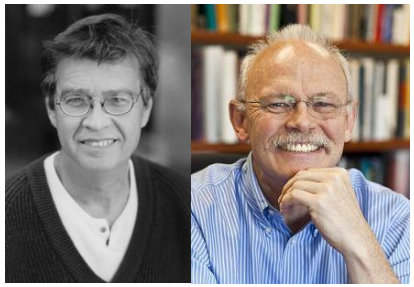


Wesley A. Clark (n 1927)
1954: simulación computacional de una red hebbiana

Frank Rosenblatt (1928-1971)
1958: perceptron

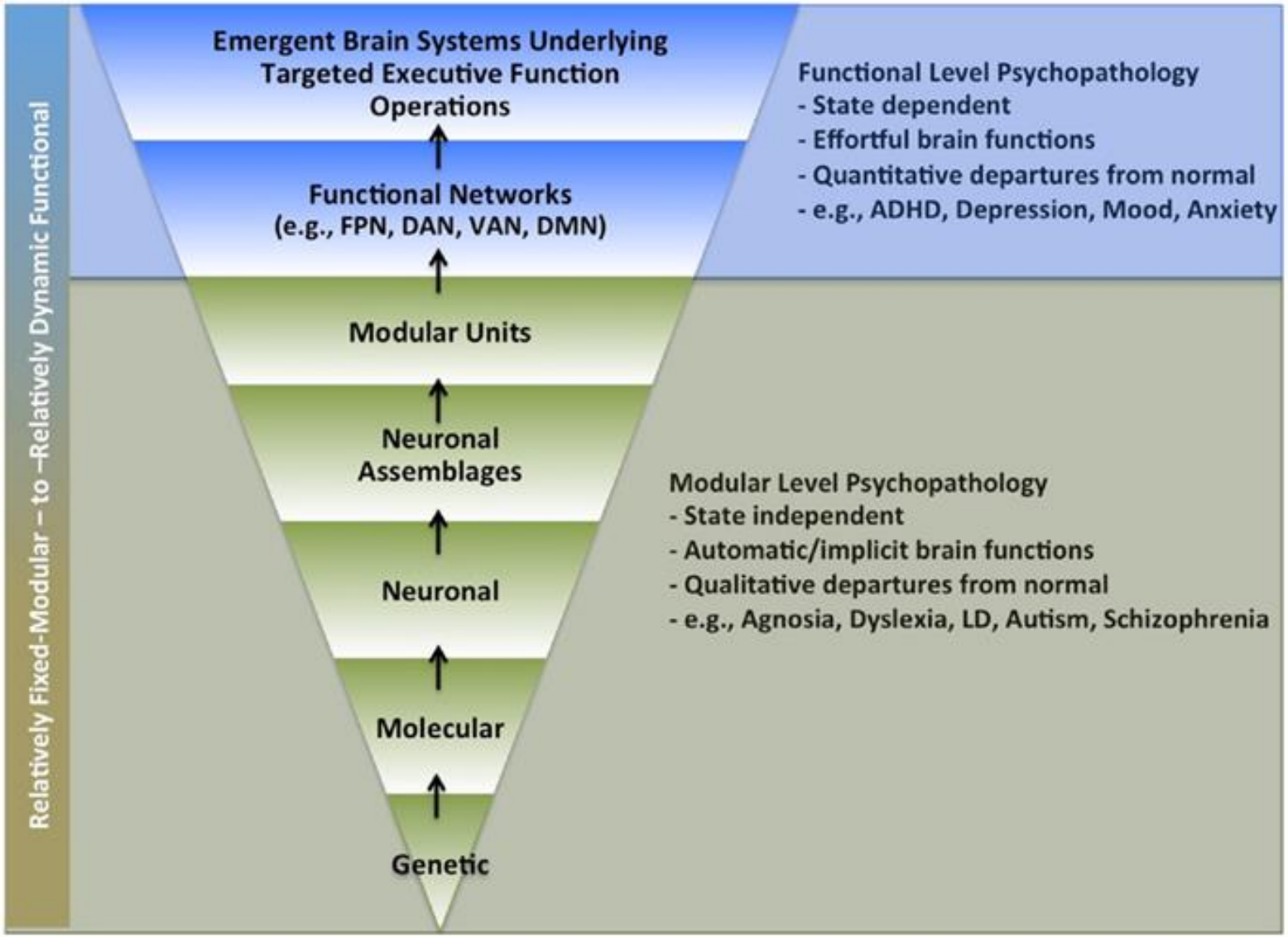
Marvin L. Minsky (n 1927)
Seimour A. Papert (n 1928)
1980: AI

John J Hopfield (n 1933)
1982: Redes neurales con capacidad computacional colectiva emergente



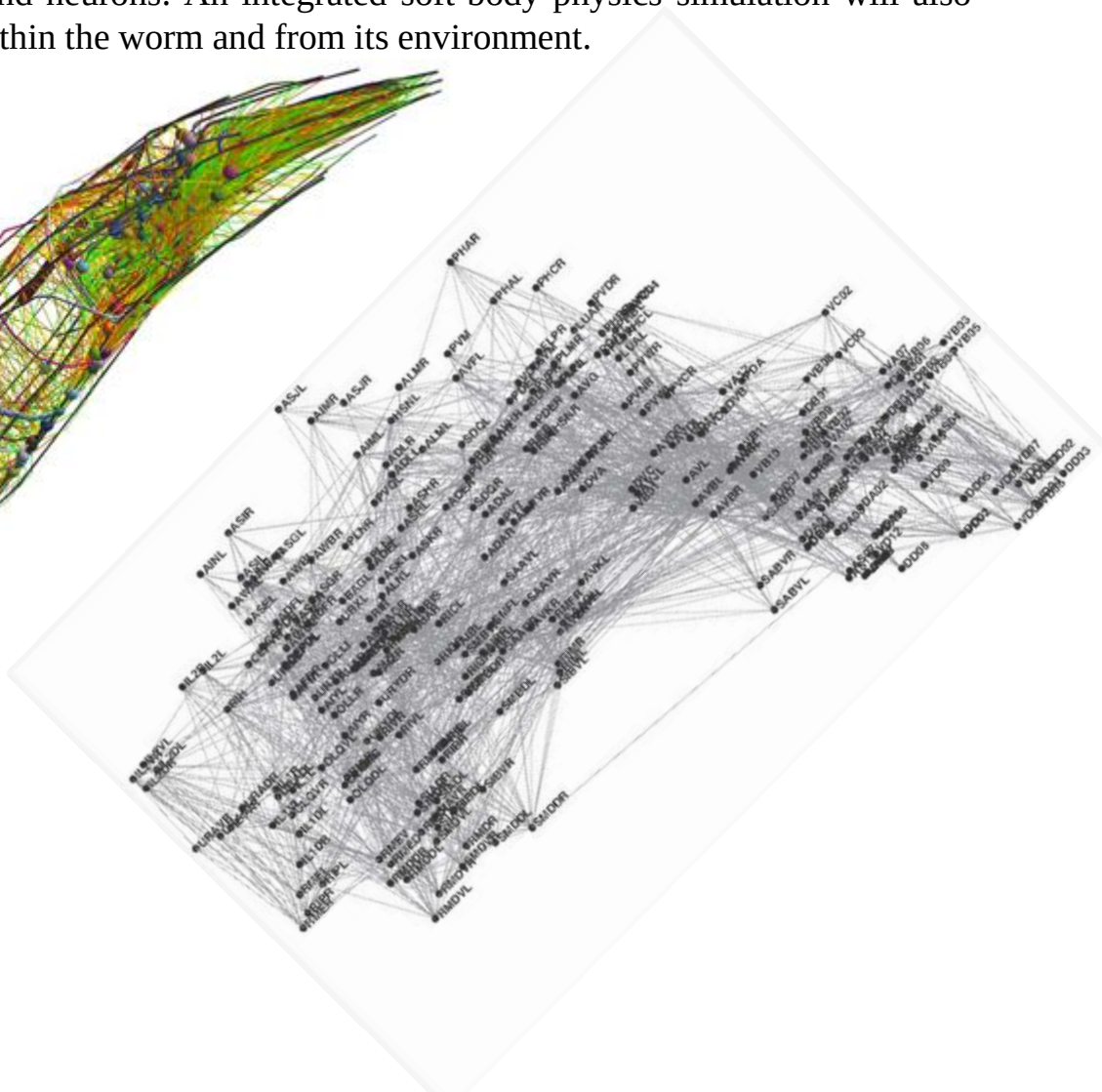
David E. Rumelhart (1942-2011)
James L McClelland (n 1948)
1985: conexionismo

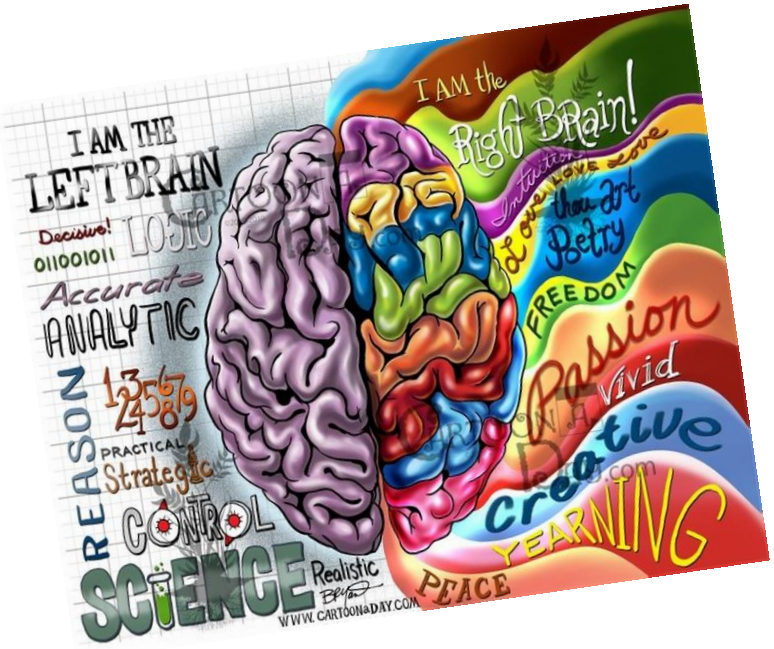
Blue Brain Project:
2008: Computación neuromórfica

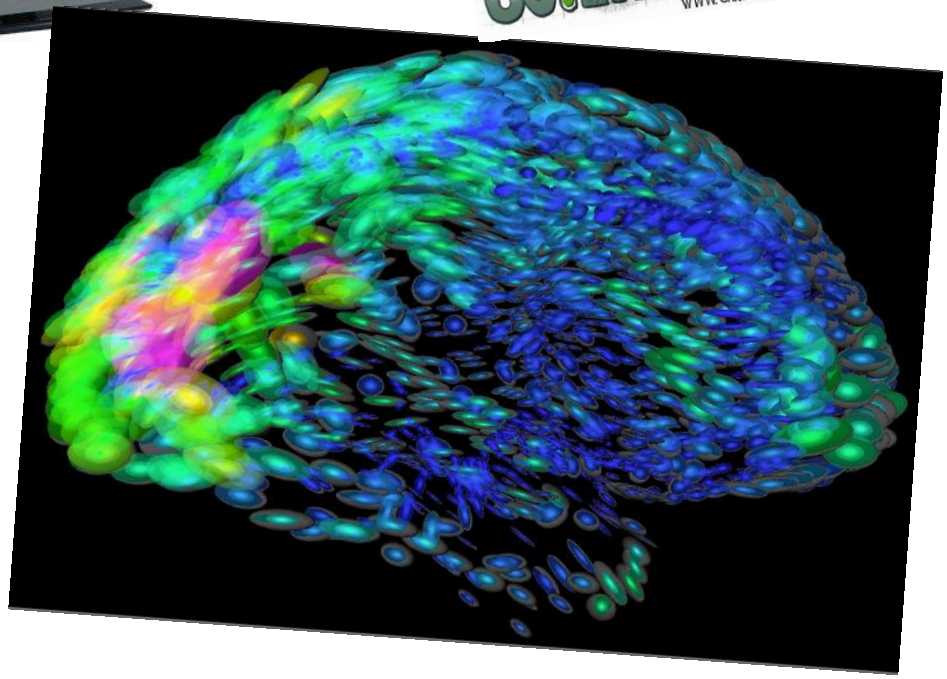


Possible levels of impairment underlying psychiatric disorders. *Legend*: multiple levels of brain function levels that might underlie brain function pathology in psychiatric disorders. Lower section (in green) highlights levels more likely to involve automatic processing (i.e., that do not require self-directed effort). Upper section (in blue) highlights levels more likely to require active volitional effort. FPN, fronto-parietal network; DAN, dorsal attention network; VAN, ventral attention network; DMN, default mode network; LD, learning disability

OpenWorm is an attempt to build a complete cellular-level simulation of the nematode worm *Caenorhabditis elegans*. Of the 959 cells in the hermaphrodite, 302 are neurons and 95 are muscle cells. The simulation will model electrical activity in all the muscles and neurons. An integrated soft-body physics simulation will also model body movement and physical forces within the worm and from its environment.







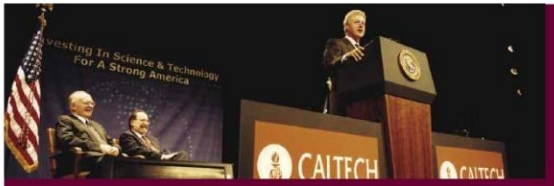
PROPIEDADES EMERGENTES

«The Decision to Go to the Moon»: President John F. Kennedy's May 25, 1961 Speech before a Joint Session of Congress.

Declaring War Against Cancer

- The signing of the National Cancer Act of 1971 by then U.S. President Richard *Nixon* is viewed as the beginning of the *war on cancer.*

President Richard Nixon signs the National Cancer Act, Dec. 23, 1971, launching a $1.6 billion federal crusade to conquer cancer. (AP)



In the January 2000 President Clinton's program speech on establishing National Nanotechnology Initiative (NNI) at Caltech.

President George W. Bush signed into law the "21st Century Nanotechnology Research and Development Act" - 3rd of December, 2003

President Obama speaks on the «BRAIN Initiative and American Innovation» (The White House, April 02, 2013).

Gracias por su atención

«Even if you're on the right track, you'll get run over if you just sit there»

William P.A. Rogers (1879-1935)

P A Z
Y
B I E N

Vetus sed non antiquus