

Histoire du lien entre cerveau et psychologie

Gilles Lafargue

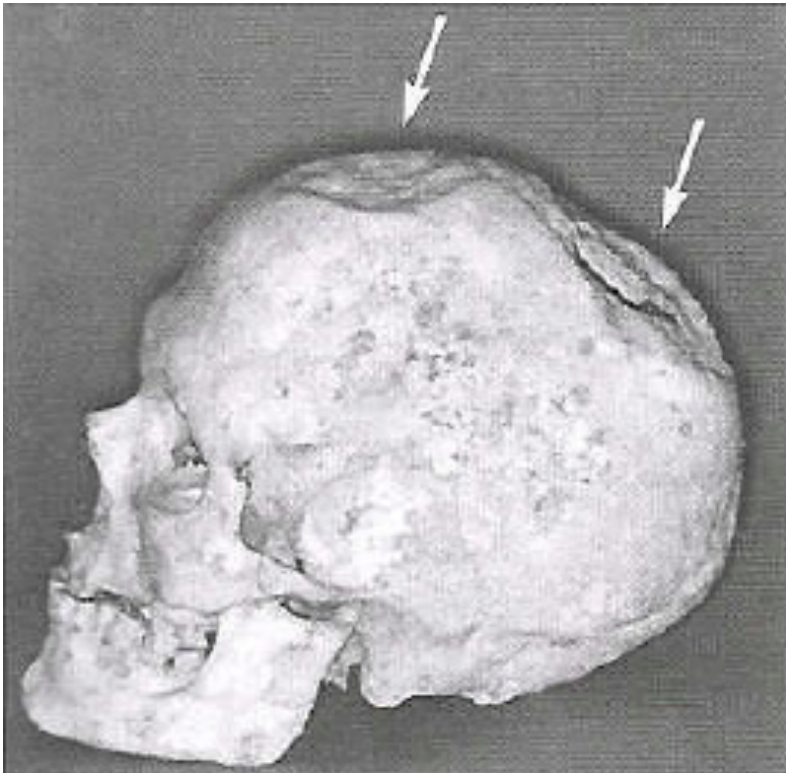
gilles.lafargue@gmail.com

La Préhistoire



- Mésolithique (env 12000 ans) : traces de trépanations + autopsies post-mortem

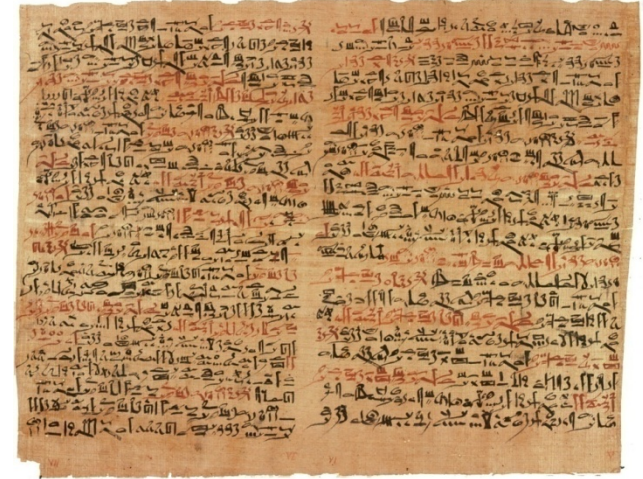
La Préhistoire



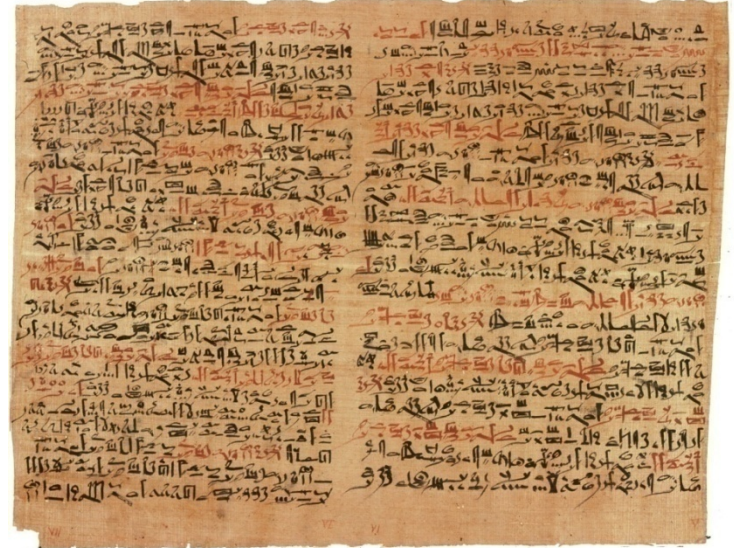
- Crâne humain datant de plus de 7000 ans.
- Intervention neurochirurgicale du vivant du sujet (trépanations cicatrisées)

Les Egyptiens

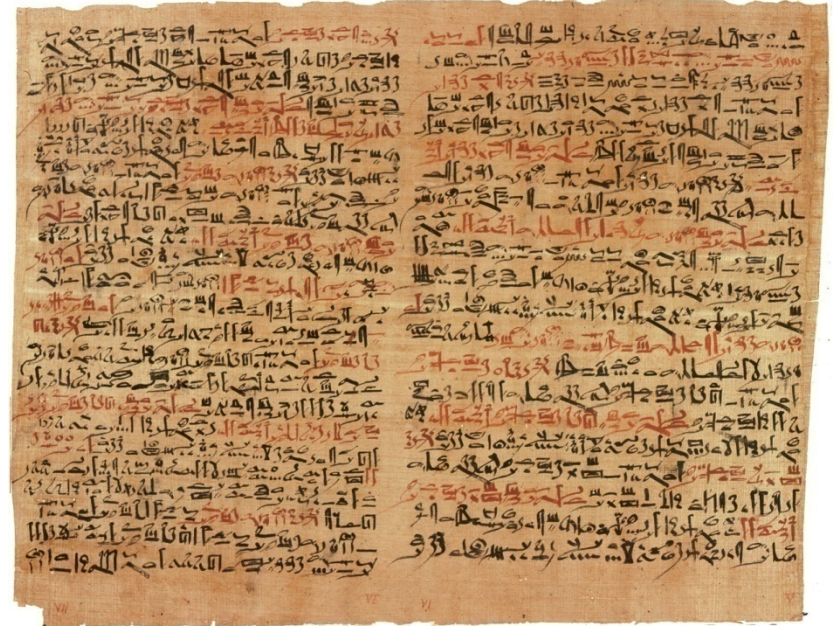
- 1882, Papyrus acheté par **Edwin Smith** à Louxor
- 1930, James Breasted, dir des Antiquités orientales à L'Univ de Chicago le déchiffre



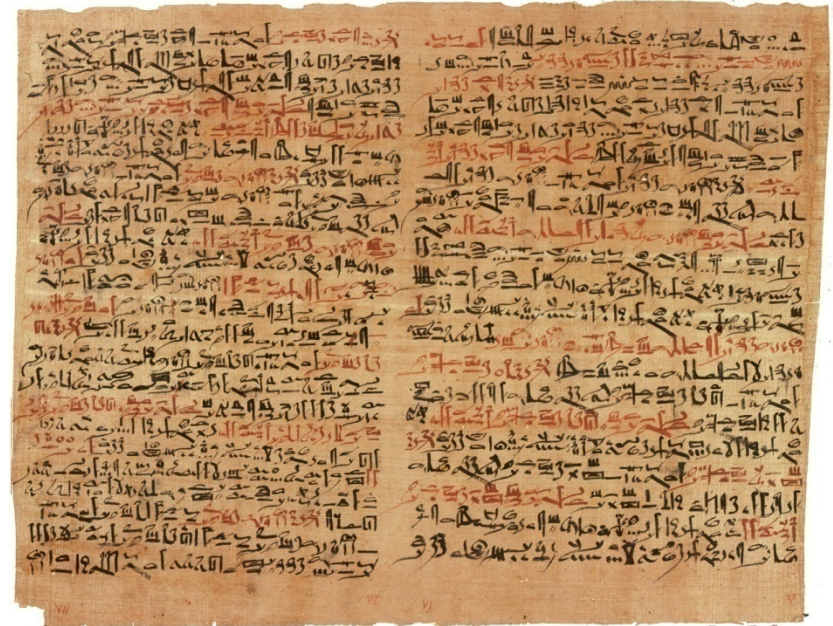
- Fragment d'un traité de chirurgie
- **Le cerveau apparaît avec un nom qui lui est propre pour la première fois**
- Ecriture hiéroglyphique, 17^{ème} av JC – mais probablement copie d'un texte rédigé vers - 3000



- Liste de 48 cas de blessures à la tête et au cou... avec titre, examen, diagnostic et traitement



Cas 22, on lit : « Si tu examines un homme ayant la tempe enfoncée... lorsque tu l'appelles, il ne répond pas, il a perdu l'usage de la parole »



3500 ans av Broca

XIX^{ème} siècle

**Contexte qui a précédé la naissance de la
Neuropsychologie**

Franz Joseph Gall

(1758-1828)

Médecin anatomiste Autrichien



DISCOURS

PRONONCÉ

PAR M. LE DOCTEUR GALL,

A LA PREMIERE SEANCE

DE SON COURS PUBLIC,

LE 15 JANVIER 1803.

INTRODUCTION

Au cours de physiologie du cerveau,

*Considérations générales sur la Science de
l'Homme.*

DANS tous les temps, l'Histoire Naturelle de l'espèce humaine a été la science la plus intéressante pour l'homme, et a fixé les méditations des meilleurs esprits. Mais, tant que cette branche importante n'est pas à peu près complète, il ne paroît point possible de donner une direction sûre à l'éducation, ni une impulsion convenable aux

A 2

Franz Joseph Gall

- Le cerveau est constitué de plusieurs organes indépendants

-Ils sous-tendent les
diverses facultés
mentales, morales,
intellectuelles

-Gall est
« antidualiste ».



- On peut considérer qu'il a apporté une pierre décisive à l'entreprise de **laïcisation du cerveau**

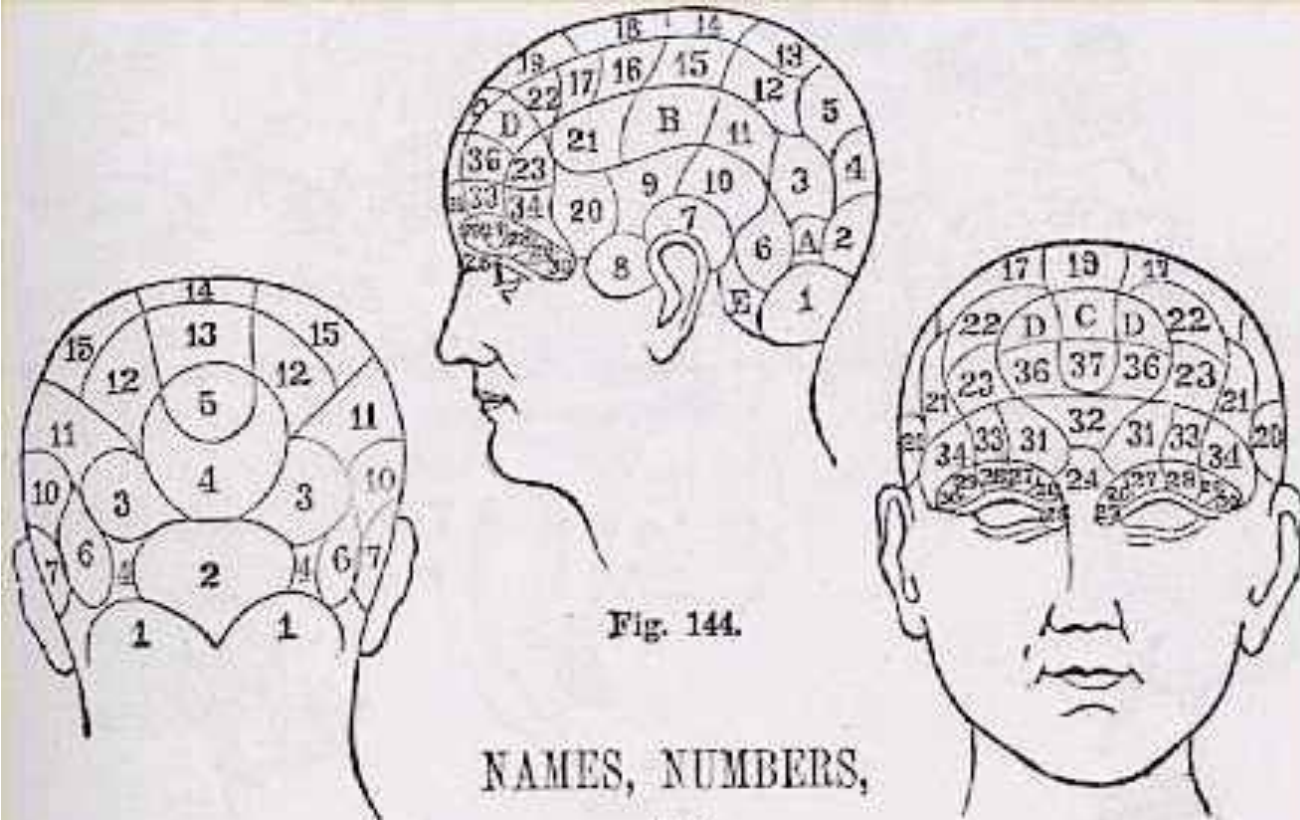


Fig. 144.

NAMES, NUMBERS,

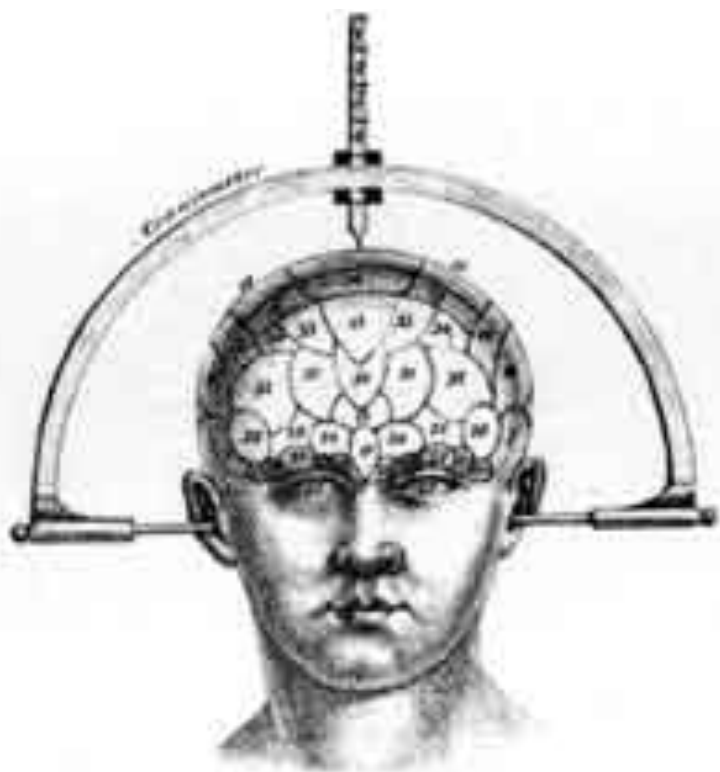
AND

LOCATION OF THE ORGANS.

1. AMATIVENESS.
- A. CONJUGAL LOVE.
2. PARENTAL LOVE.
3. FRIENDSHIP.
4. INHABITIVENESS.
5. CONTINUITY.
- E. VITATIVENESS.
6. COMBATIVENESS.
7. DESTRUCTIVENESS.
8. ALIMENTIVENESS.
9. ACQUISITIVENESS.
10. SECRETIVENESS.
11. CAUTIOUSNESS.
12. APPROBATIVENESS.

13. SELF-ESTHEM.
14. FIRMINESS.
15. CONSCIENTIOUSNESS.
16. HOPE.
17. SPIRITUALITY.
18. VENERATION.
19. BENEVOLENCE.
20. CONSTRUCTIVENESS.
21. IDEALITY.
- B. SUBLIMITY.
22. IMITATION.
23. MIRTH.
24. INDIVIDUALITY.
25. FORM.

26. SIZE.
27. WEIGHT.
28. COLOR.
29. ORDER.
30. CALCULATION.
31. LOCALITY.
32. EVENTUALITY.
33. TIME.
34. TUNE.
35. LANGUAGE.
36. CAUSALITY.
37. COMPARISON.
- C. HUMAN NATURE.
- D. SUAVITY.



Jean-Pierre Flourens

(1794-1867)

Tenant du ***holisme*** cérébral,
il s'oppose à la conception
localisationniste



Le fonctionnement cérébral
est « quantité-dépendant »

Jean-Baptiste Bouillaud (1796-1881)



« les mouvements des organes de la parole sont régis par un centre cérébral, spécial, distinct, indépendant... »

« ce centre cérébral occupe les lobules antérieurs »

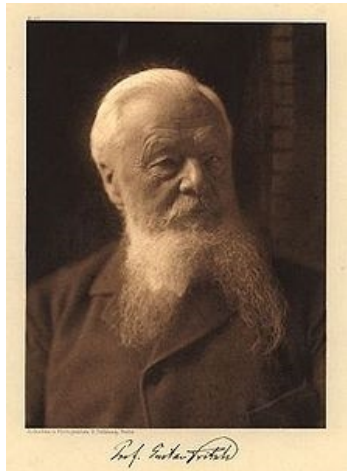
Marc Dax (1770-1837)

- a servi comme chirurgien dans les armées de Napoléon
- découvre la relation entre lésions de l'hémisphère gauche, parésie droite et aphasie

Dax, G. (1836/1863) Observations tendant à prouver la coïncidence constante des dérangements de la parole avec une lésion de l'hémisphère gauche du cerveau. *Comptes-rendus hebdomadaire des séances de l'Académie des Science*, Tome LXI (23 mars 1863): 534.

Fritsch, Gustav (1838-1929)

Hitzig, Eduard (1838-1907)



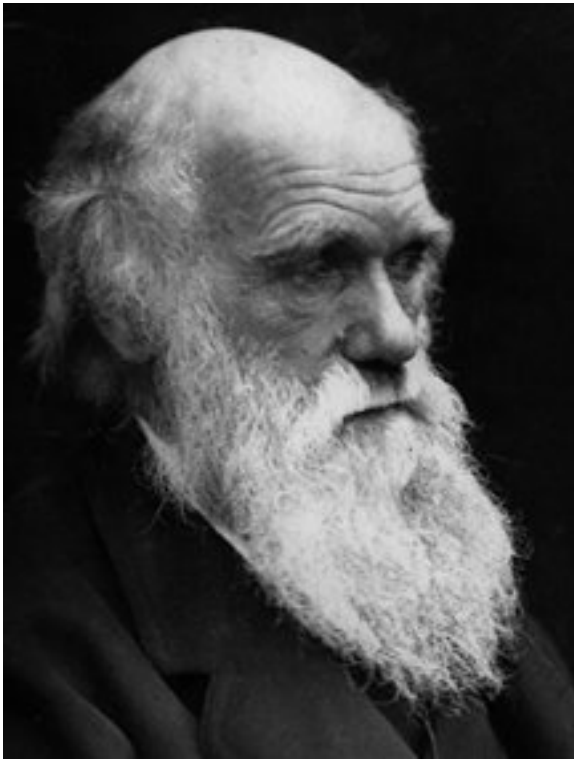
1870, La stimulation directe du cortex frontal cause des mouvements des extrémités contra-latérales à la région stimulée, **chez des lapins, chiens, singes chats... et humains**

Robert Bartholow (1831-1904)



1874 : Observation de
mouvements non
volontaires durant la
stimulation du cerveau
humain

Charles Darwin (1809-1882)



“In the distant future . . .
psychology will be based
on a new foundation, that
of the necessary
acquirement of each
mental power and capacity
by gradation.”

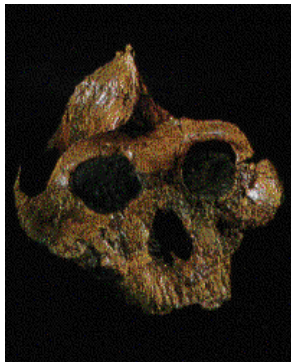
Charles Darwin, 1859

Augmentation du volume cérébral



ardipithecus

brain size:
300 ccs



Australopithe-
cus

brain size:
310-530 ccs



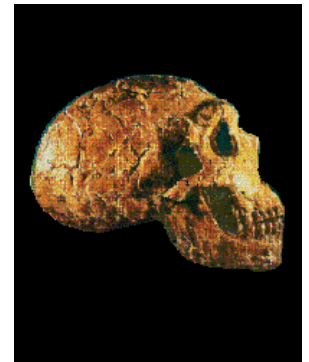
homo
habilis

brain size:
580-752
ccs



homo
erectus

brain
size:
775-1225
ccs



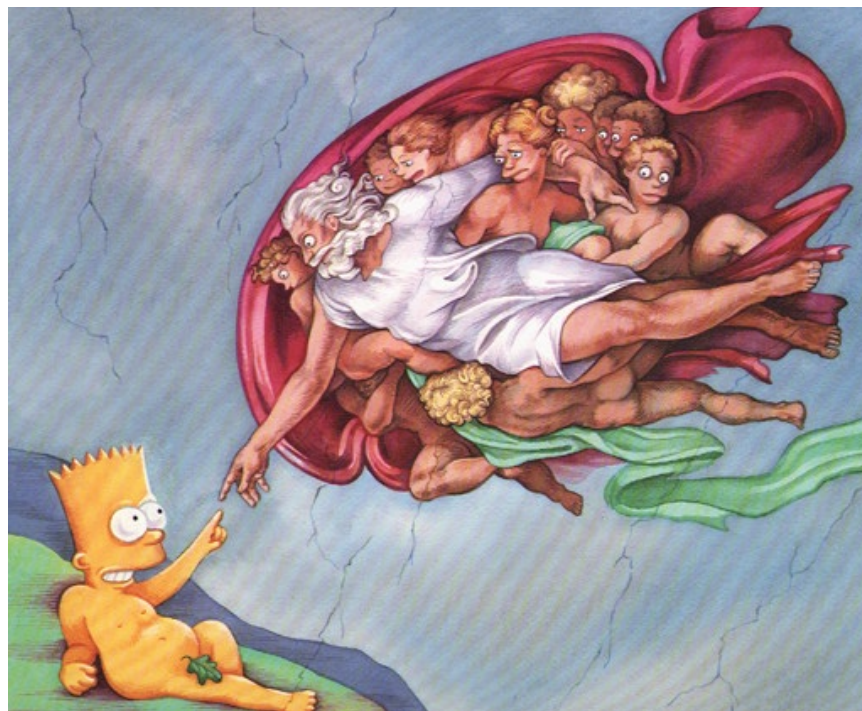
Neandertal

brain size:
1200-1450
ccs



modern
human

brain
size:
1350
ccs



La naissance et le développement de la Neuropsychologie

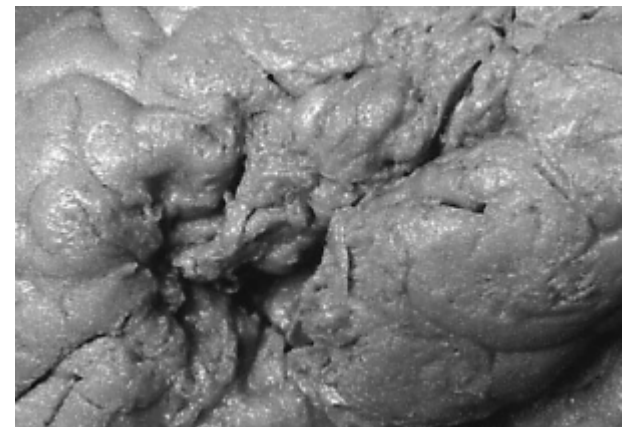
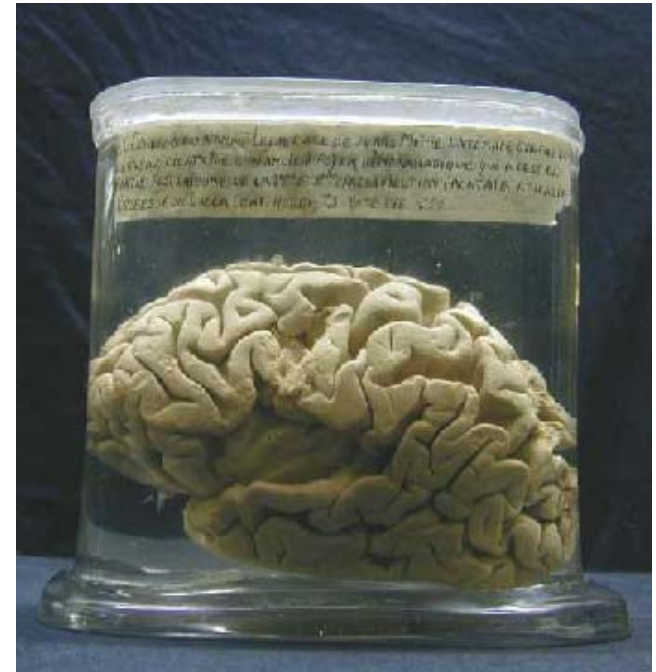
La découverte de la localisation des
facultés

Paul Broca
(1824-1880)



**Le 18 avril 1861
présentation du cas
Leborgne, dit « Tan »
ou « Tantan »**

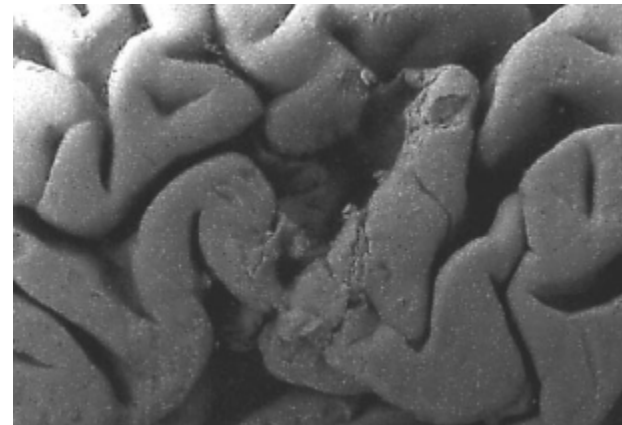
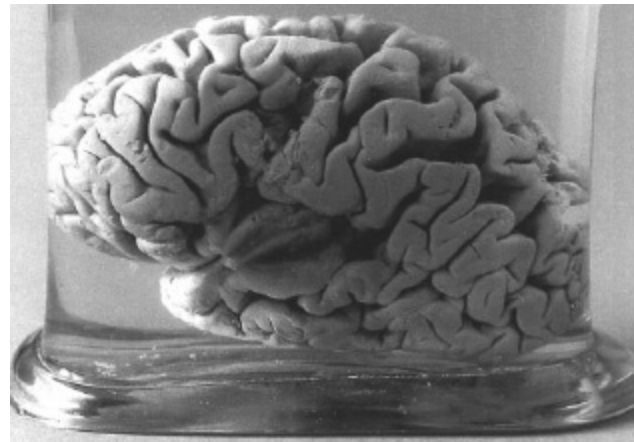
**Corrélation anatomo-
clinique**



Paul Broca
(1824-1880)



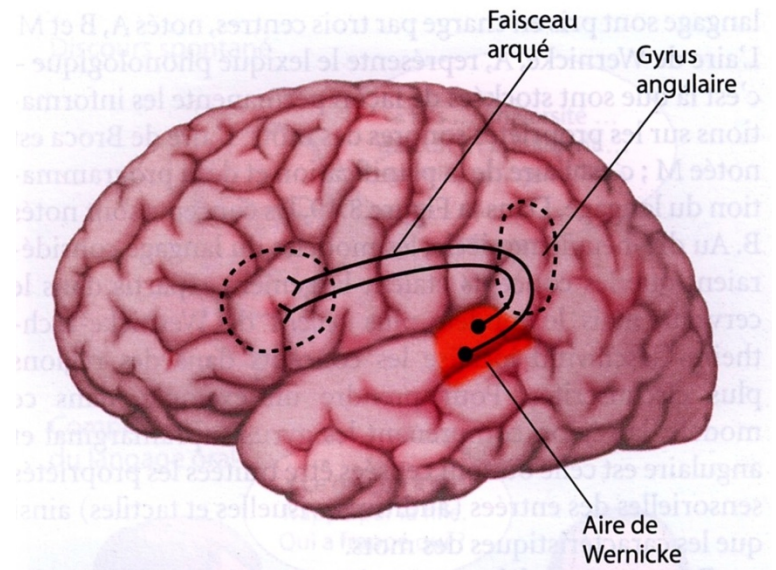
Cerveau de Lelong





La lésion d'une zone située sur le lobe temporal gauche s'accompagne d'un trouble du langage bien différent de celui décrit par Broca : aphasie fluente avec trouble de la compréhension et de la production (jargon) du langage

Karl Wernicke (1848-1905)

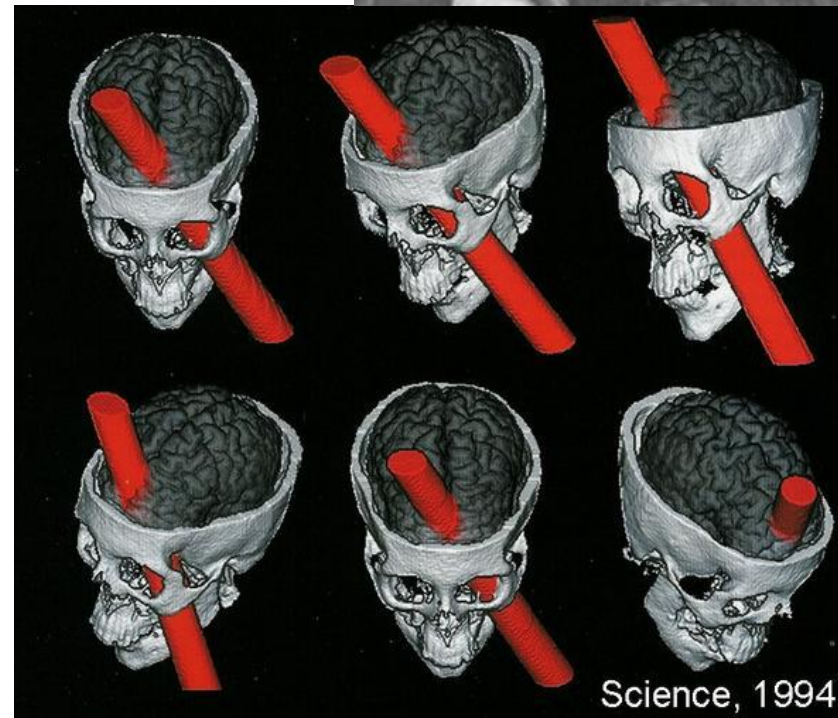


John Harlow

Le cas Phineas Gage, 1848



PHINEAS GAGE (1823-1860)



Sir William Osler (1849-1919)



**1913 – Apparition du mot
« neuropsychologie »**
pour désigner la science
étudiant les relations
entre les perturbations
cognitives et
émotionnelles, ou encore
les désordres de la
personnalité, et , les
lésions du cerveau

Karl Lashley

(1890-1957)



Karl S. Lashley (1890–1958)

1937 - 1^{er} professeur de
Neuropsychologie,
Nommé à Harvard

1951 : Les premières instances de la Neuropsychologie

- Symposium annuel (1951) consacré aux problèmes de la neuropsychopathologie (H. Hécaen)

1963 : Les premiers journaux (1963)

- Neuropsychologia, Cortex

Société de Neuropsychologie de Langue Française

<http://www.neuropsychology.ulg.ac.be/snlf/>

Un exemple de thématique en Neuropsychologie

La spécialisation hémisphérique
par l'étude de patients split brain
(cerveau divisé)

Roger Sperry

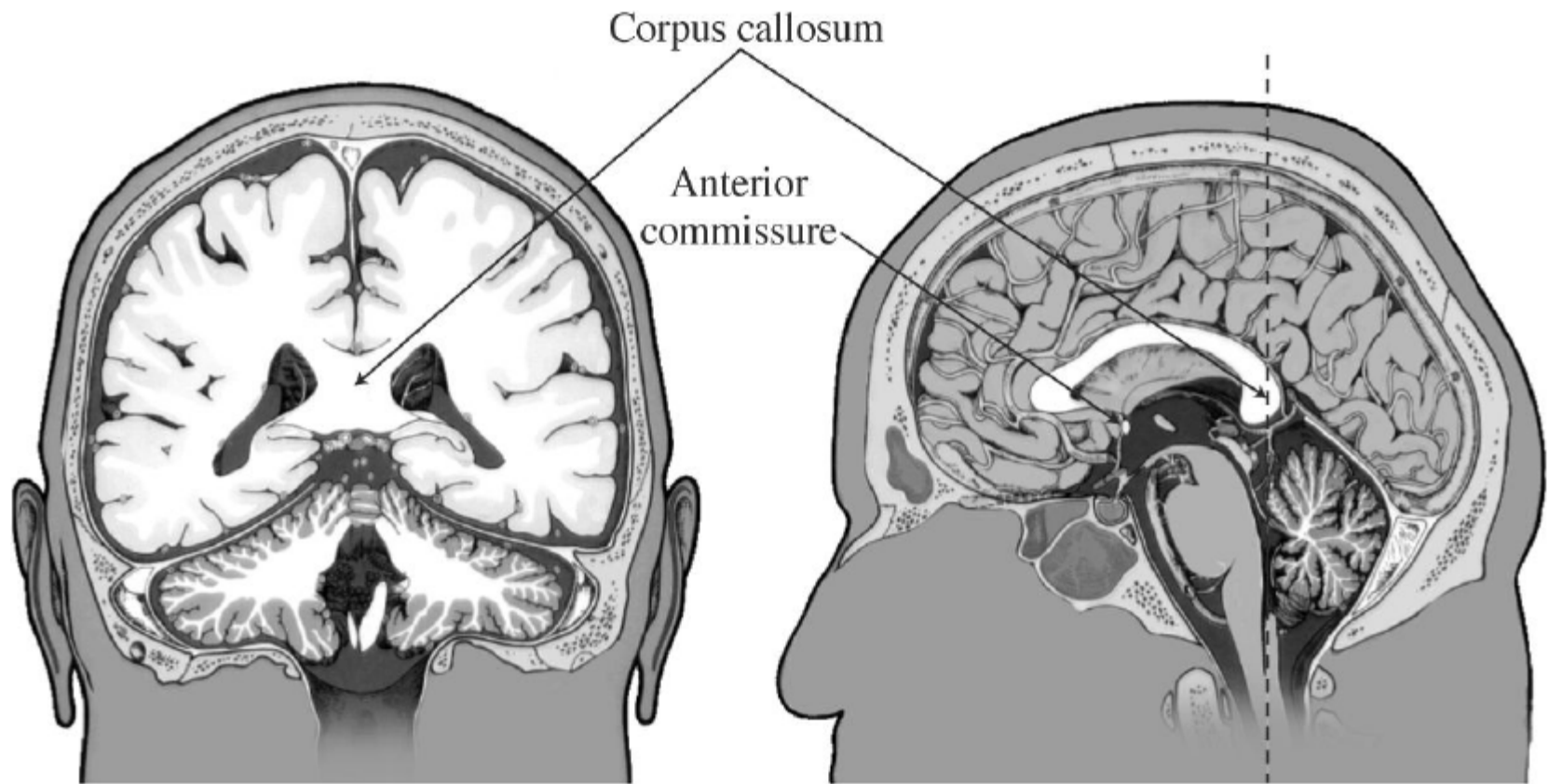
1913-1994



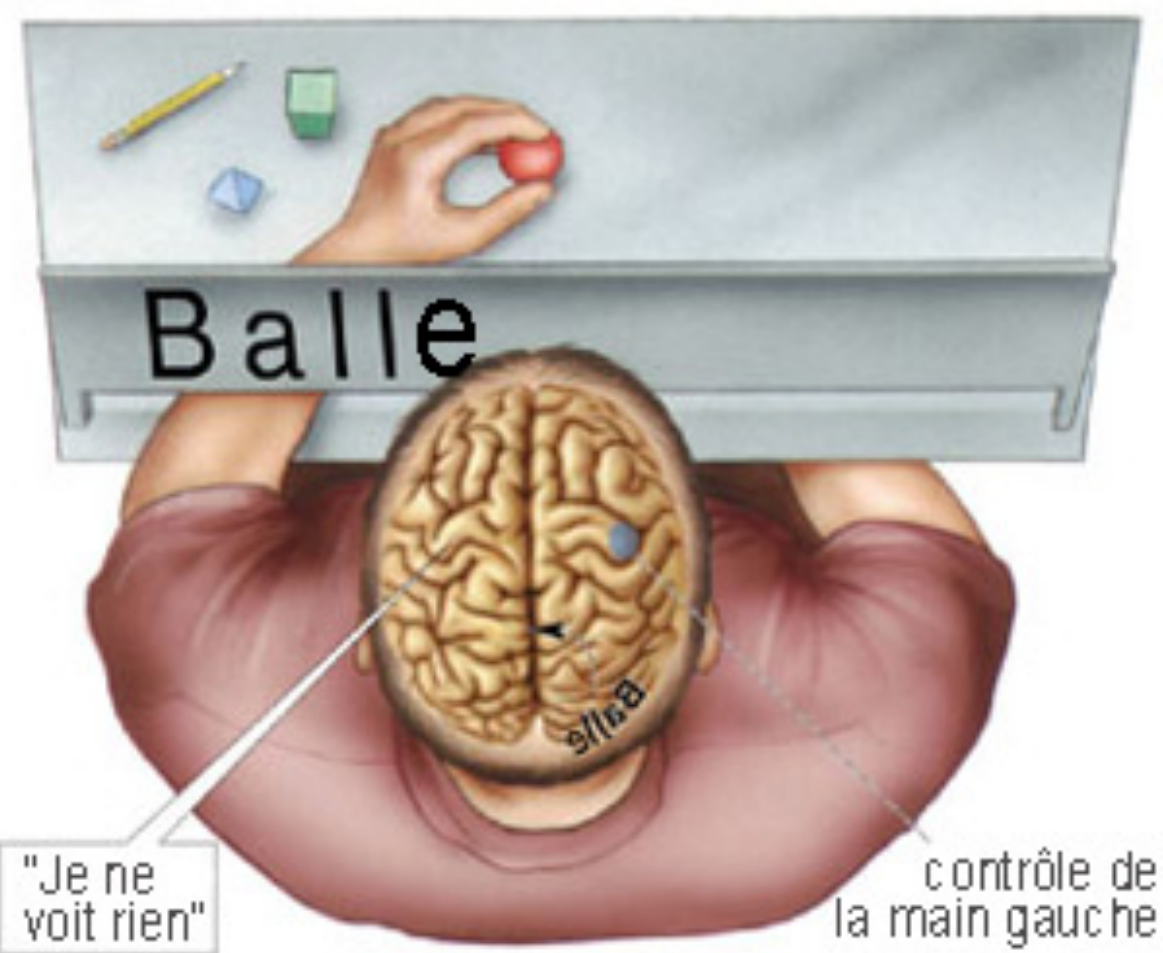
Cerveau gauche, cerveau droit

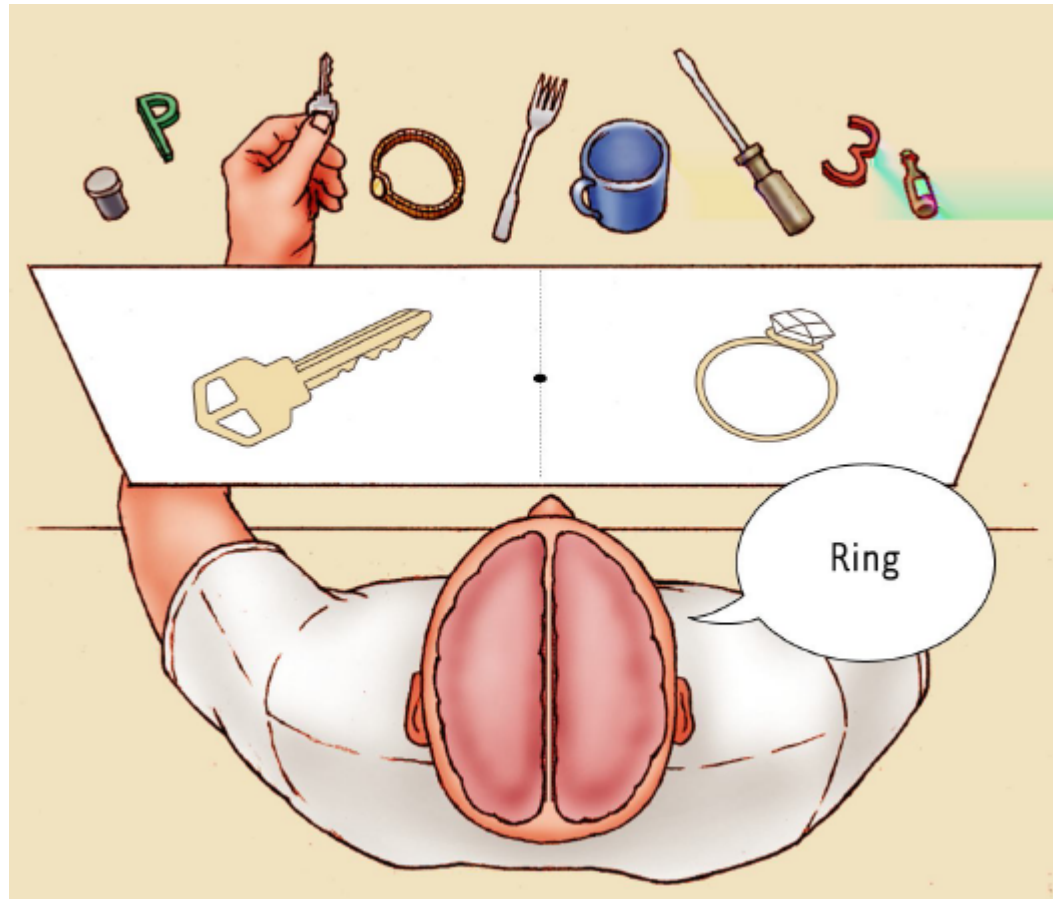
A partir des années 1950, il a étudié des patients « split brain »

Prix Nobel 1981

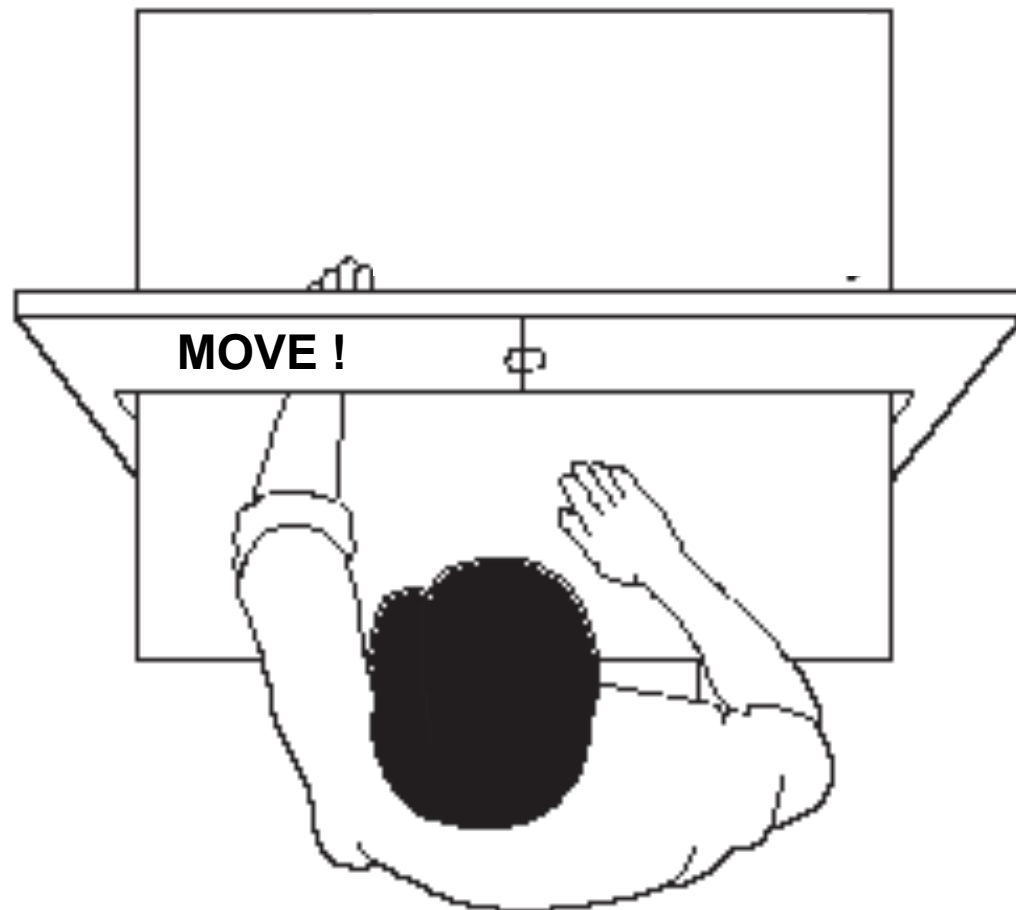


Kretschmann & Weinrich (1992)







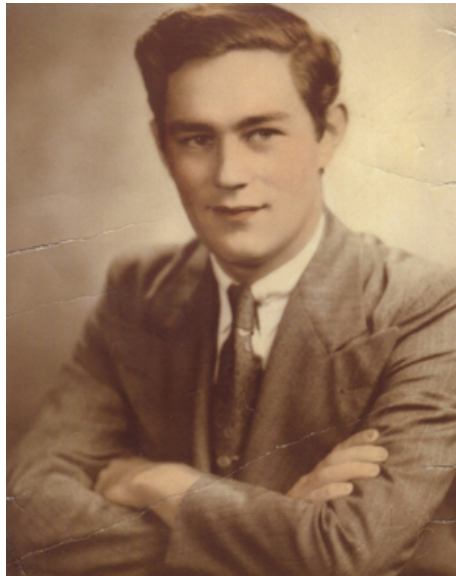


LOSS OF RECENT MEMORY AFTER BILATERAL HIPPOCAMPAL LESIONS

BY

WILLIAM BEECHER SCOVILLE and BRENDA MILNER

*From the Department of Neurosurgery, Hartford Hospital, and the Department of Neurology and Neurosurgery,
McGill University, and the Montreal Neurological Institute, Canada*

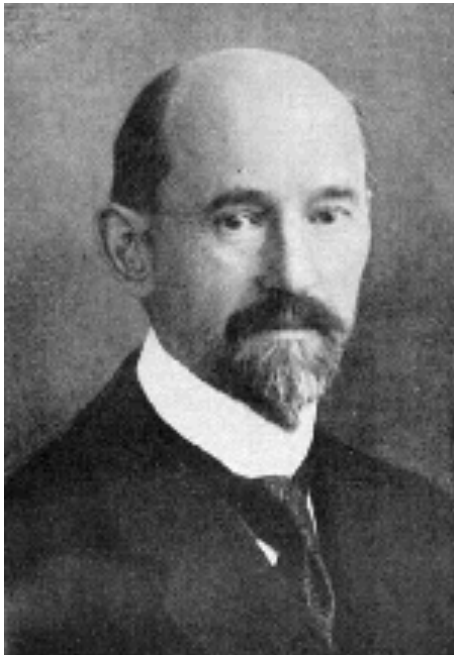


Le patient HM
Henry Gustav Molaison

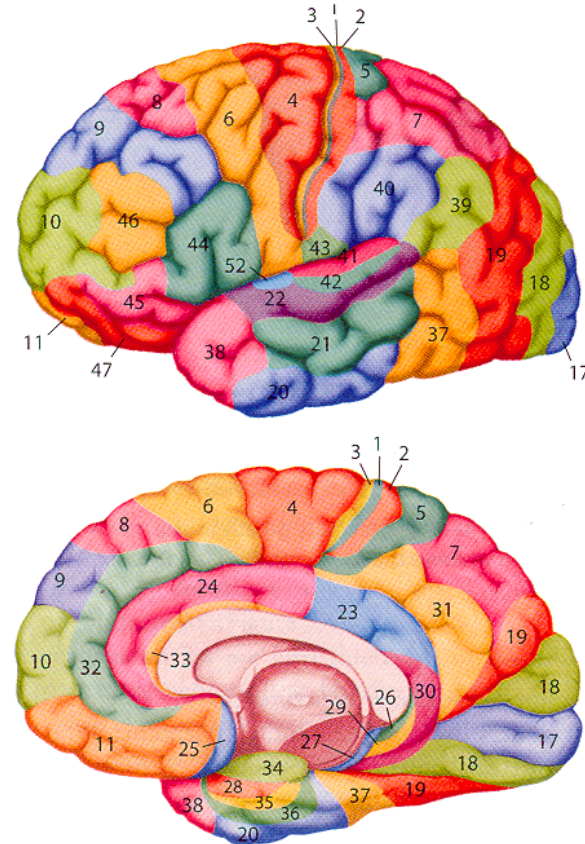
Deux découvertes importantes de la première moitié du 20^{ème} siècle

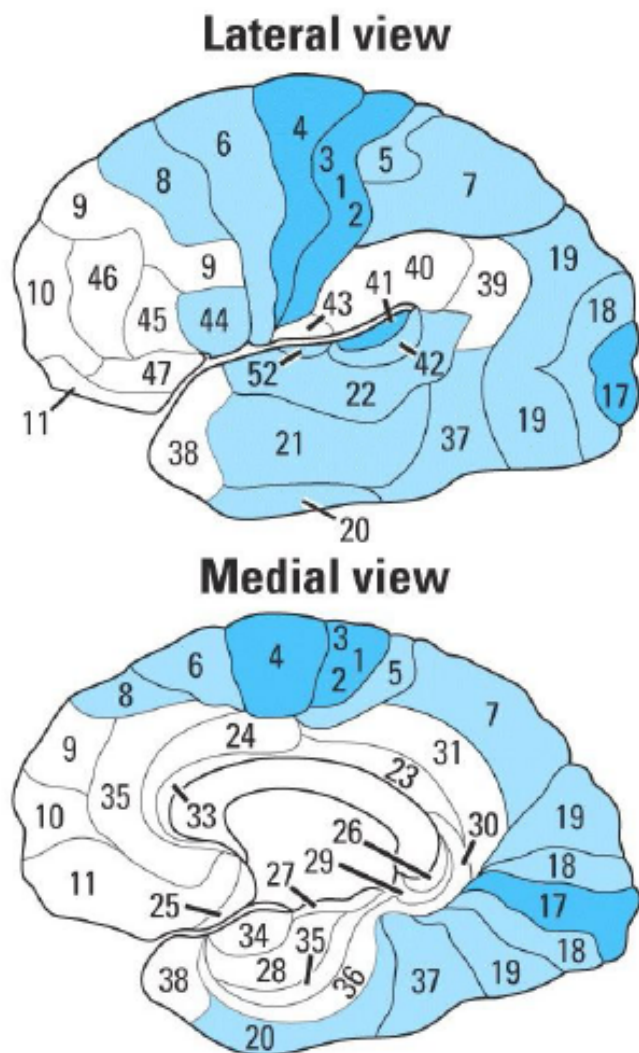
- Les aires de Brodmann
- Les homoncules de Penfield

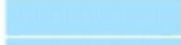
Brodmann, Korbinian
(1868-1918)



**1909 – le cortex est subdivisé
en 52 aires**



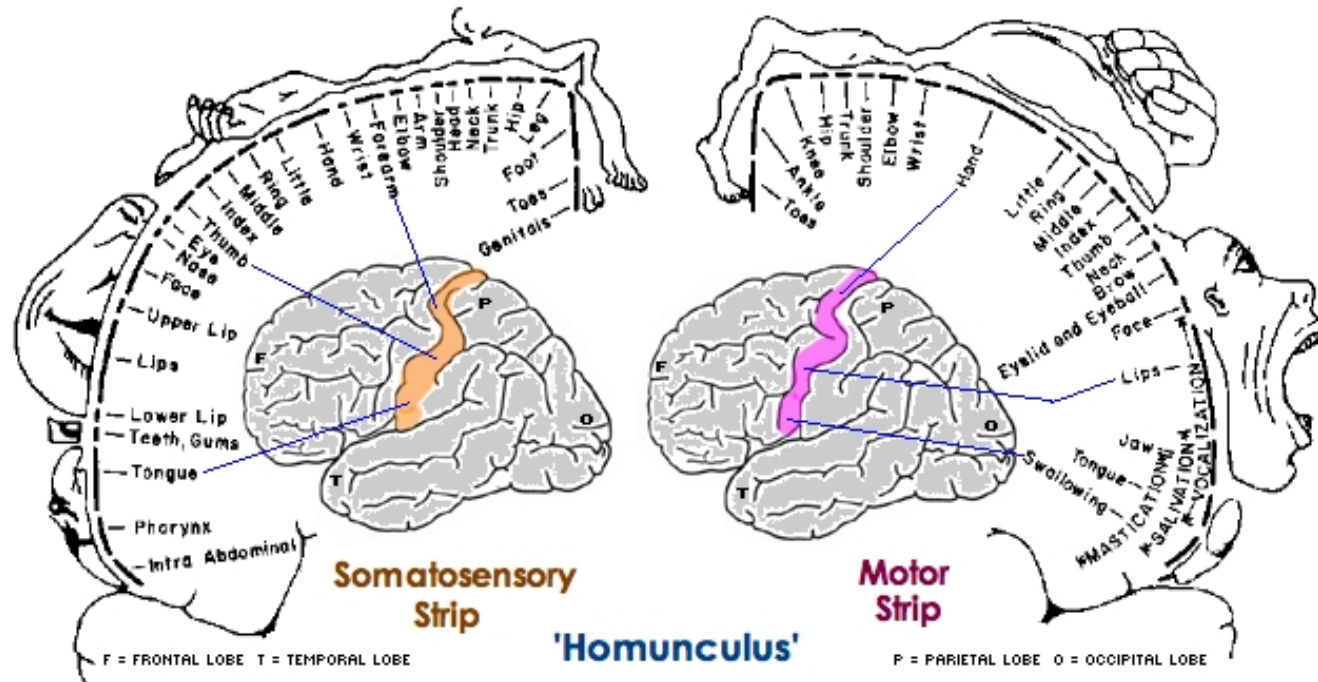
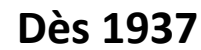


Function	Map code	Brodmann area
Vision		
primary		17
secondary		18, 19, 20, 21, 37
Auditory		
primary		41
secondary		22, 42 (Wernicke's area, 22)
Body senses		
primary		1, 2, 3
secondary		5, 7
Sensory, tertiary		7, 22, 37, 39, 40
Motor		
primary		4
secondary		6
eye movement		8
speech		44 (Broca's area)
Motor, tertiary		9, 10, 11, 45, 46, 47

Aire 4 : aire motrice primaire

Aires 1, 2, 3 : aires somatosensorielles primaires

(1891-1976)



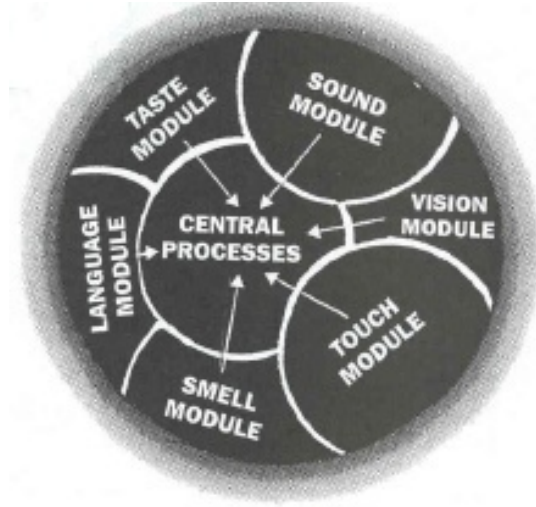
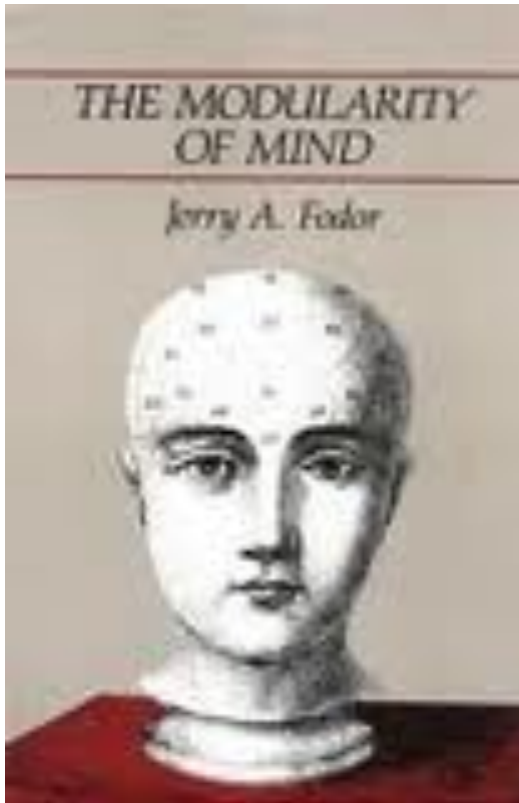


Ce à quoi nous ressemblerions si nos membres avaient une taille proportionnelle à celle des régions cérébrales correspondantes (perception, gauche; action, droite)

Deux notions importantes

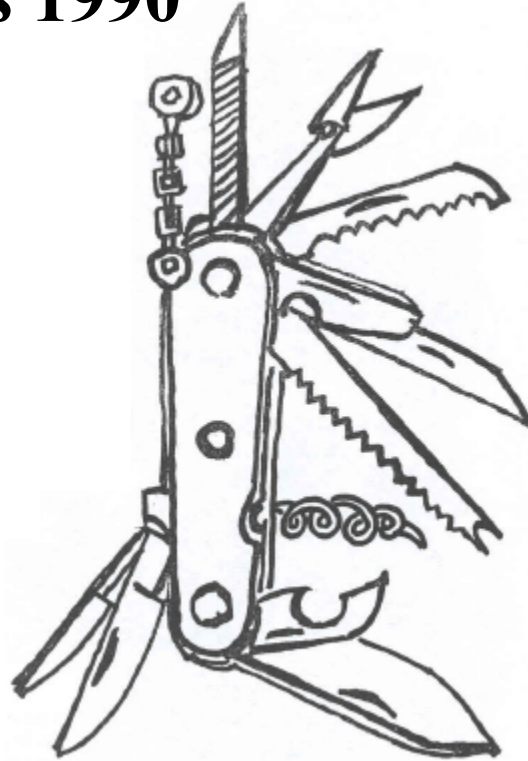
- La notion de modularité de l'esprit
(fonctionnelle)**
- La notion de plasticité cérébrale**

La modularité de l'esprit (1983)



Jerry Fodor (1935 -)

La psychologie évolutionniste début des années 1990



John Tooby (1952-)

&

Leda Cosmides (1957 -)

Tooby, J. & Cosmides, L. 1992 The psychological foundations of culture. In *The adapted mind: Evolutionary psychology and the generation of culture* (ed. J. Barkow, L. Cosmides, & J. Tooby), pp. 19-136. NY: Oxford University Press.

A WALK THROUGH HUMAN EVOLUTION

The newest fossils have brought scientists tantalizingly close to the time when humans first walked upright—splitting off from the chimpanzees. Their best guess now is that it happened at least 6 million years ago [Click here to read the cover story >>](#)

LAST COMMON ANCESTOR

It should have a mosaic of features reminiscent of both apes and humans—but that's true of several species already found, so identification might be tough

Orrorin tugenensis
("Millennium Man";
possible human ancestor)

Ardipithecus
ramidus kadabba

A. afarensis
(includes Lucy)

A. africanus

A. robustus

H. habilis

H. sapiens
MODERN
HUMANS

H. erectus

H. neanderthalensis

Chimpanzees

Gorillas

7

6

5

4

3

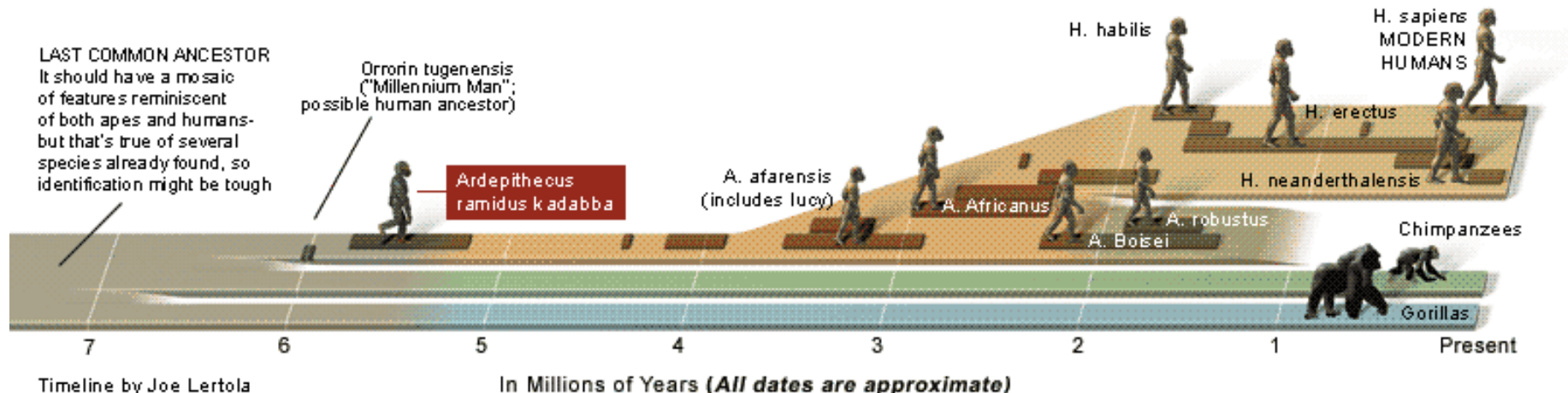
2

1

Present

Timeline by Joe Lertola

In Millions of Years (*All dates are approximate*)



« Selon l'approche évolutionniste de l'esprit, un bon nombre des mécanismes psychologiques qui permettent à l'homme d'interagir avec son environnement, sont des ***adaptations***, au sens de la théorie de la ***sélection naturelle***. Cela implique que ces mécanismes ont été sélectionnés par l'évolution pour leur capacité à répondre avec succès aux ***différents problèmes posés de manière récurrente par l'environnement physique et social*** dans lequel l'espèce humaine a émergé. »

Mercier & van der Henst, 2007

« Les psychologues évolutionnistes étudient les mécanismes psychologiques en tentant d'identifier les **problèmes adaptatifs**, c'est-à-dire les problèmes de survie et de reproduction, qu'ils permettent de résoudre. Ils ne se contentent pas de poser la question « *comment fonctionne un mécanisme psychologique particulier ?* » mais ils abordent aussi la question « ***quelle fonction ce mécanisme remplit-il ?*** ». »

Mercier & van der Henst, 2007

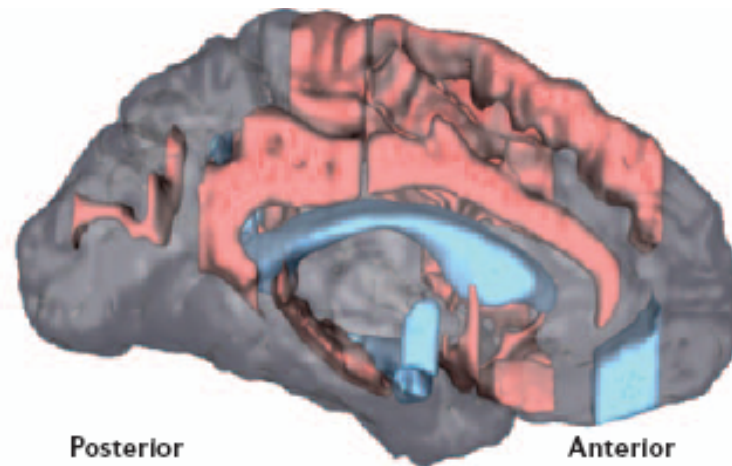
- Pour la psychologie évolutionniste les humains sont soumis aux mêmes processus évolutifs que les autres espèces
 - Les caractéristiques comportementales / psychologiques peuvent être héritées comme les caractéristiques physiques
 - Les comportements et la psychologie humaine peuvent être expliqués en terme d'évolution biologique

- Il faut un certain temps pour que la sélection naturelle puisse promouvoir de nouvelles adaptations.
- Il est en conséquence raisonnable de penser que notre esprit est construit pour résoudre les problèmes qui se posaient à nos ancêtres alors qu'ils faisaient partie de groupes de chasseurs cueilleurs nomades, et non les problèmes posés par la vie de bureau actuelle – ni même ceux posés par le développement de l'agriculture et de l'urbanisation au cours des 10 000 dernières années.

Why sex matters for neuroscience

Larry Cahill

Abstract | A rapidly burgeoning literature documents copious sex influences on brain anatomy, chemistry and function. This article highlights some of the more intriguing recent discoveries and their implications. Consideration of the effects of sex can help to explain seemingly contradictory findings. Research into sex influences is mandatory to fully understand a host of brain disorders with sex differences in their incidence and/or nature. The striking quantity and diversity of sex-related influences on brain function indicate that the still widespread assumption that sex influences are negligible cannot be justified, and probably retards progress in our field.



- Structures that are larger in the healthy female brain, relative to cerebrum size
- Structures that are larger in the healthy male brain, relative to cerebrum size

Box 2 | Evolutionary explanations for sex differences in the brain

What evolutionary explanations might be offered to account for widespread sex influences on brain function? In some cases, they seem obvious. For example, Kazuhito Tomizawa and his colleagues⁹¹ recently found that oxytocin, a hormone that is necessary for mammalian labour and lactation, improves both spatial memory and memory-related neurochemistry in the hippocampus of female mice that have had litters. The improved spatial memory has clear advantages, allowing a mother to wander further afield to find and recall locations of food and water and thereby better ensure the development and survival of her offspring.

In more general terms, the best developed idea concerns sexual selection, a concept originally proposed by Charles Darwin and developed more recently by David Geary⁹². Sexual selection refers to the competition for mates that occurs both within and between sexes. Extensive evidence from many species makes it clear that males and females have evolved different behavioural strategies to optimize their chances of successful mating. Females tend to compete with other females more subtly, in ways that may depend more heavily on the processing of finer details; for example, of social cues. Such evolutionary accounts may help to explain the heightened recall of detailed information in females found in several studies of human memory so far⁹³.

Regardless of the ultimate evolutionary explanations, it seems incontrovertible that males and females evolved under some similar, and some very different pressures. We should therefore expect *a priori* that their brain organization will be both similar in some respects, and markedly different in others. This is precisely the situation suggested by the sex difference literature.

La plasticité cérébrale

hydrocéphalie

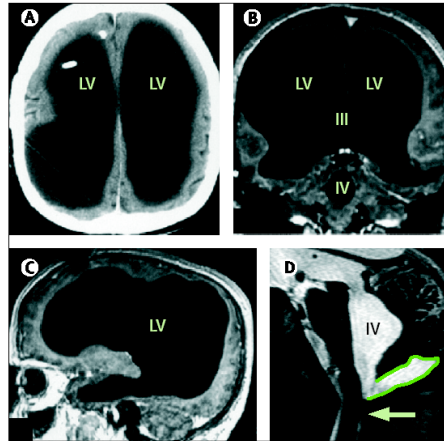
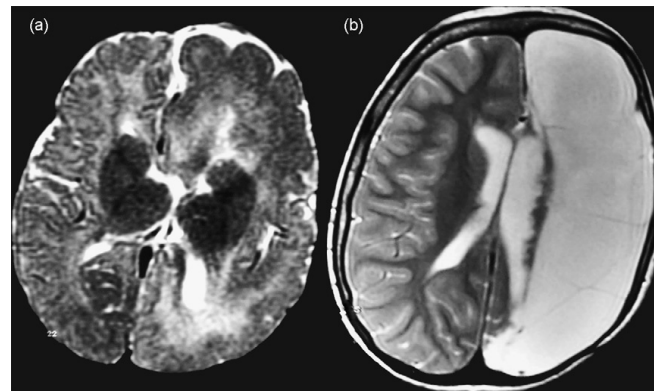


Figure: Massive ventricular enlargement, in a patient with normal social functioning
(A) CT; (B, C) T1- weighted MRI, with gadolinium contrast; (D) T2- weighted MRI.
LV=lateral ventricle. III=third ventricle. IV=fourth ventricle. Arrow=Magendie's foramen. The posterior fossa cyst is outlined in (D).

Hemisphèrectomie chez l'enfant



Speaking without Broca's area after tumor resection

Monique Plaza, Peggy Gatignol, Marianne Leroy, and Hugues Duffau

Laboratoire de Psychologie et Neurosciences Cognitives (UMR CNRS 8189), Université Paris Descartes, Service de Neurochirurgie, CHU Gui de Chauliac, Montpellier, France

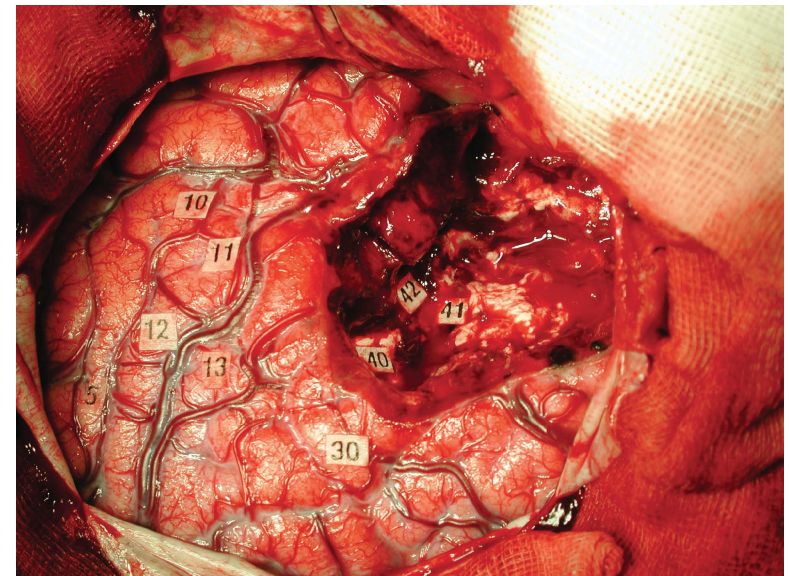
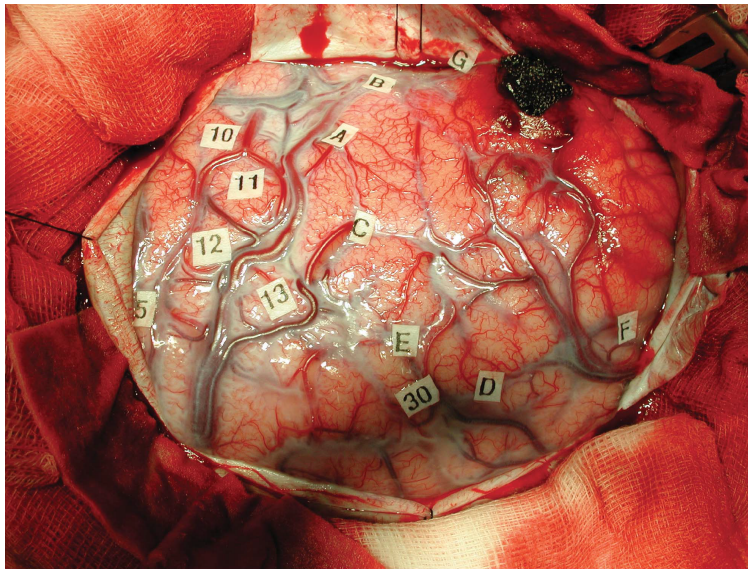
FV was a 27-year-old right-handed man working as a computer engineer. Right-handedness was documented using the Edinburgh inventory questionnaire (Oldfield, 1971).

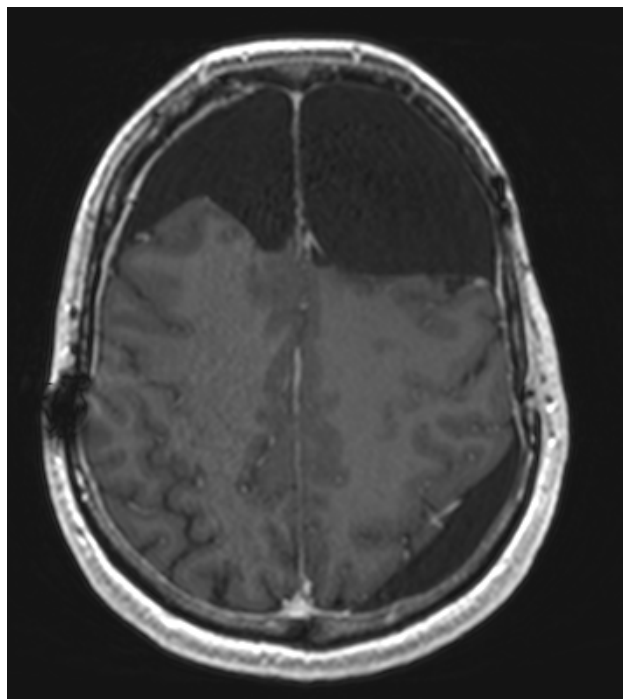
He had had word retrieval difficulties for 4–5 years, in marked increase for the past 2 years when he first consulted for generalized seizures. The neurological examination was normal, without either somatosensory or motor deficit, but the MRI revealed a tumor invading the left frontal lobe.

Speaking without Broca's area after tumor resection

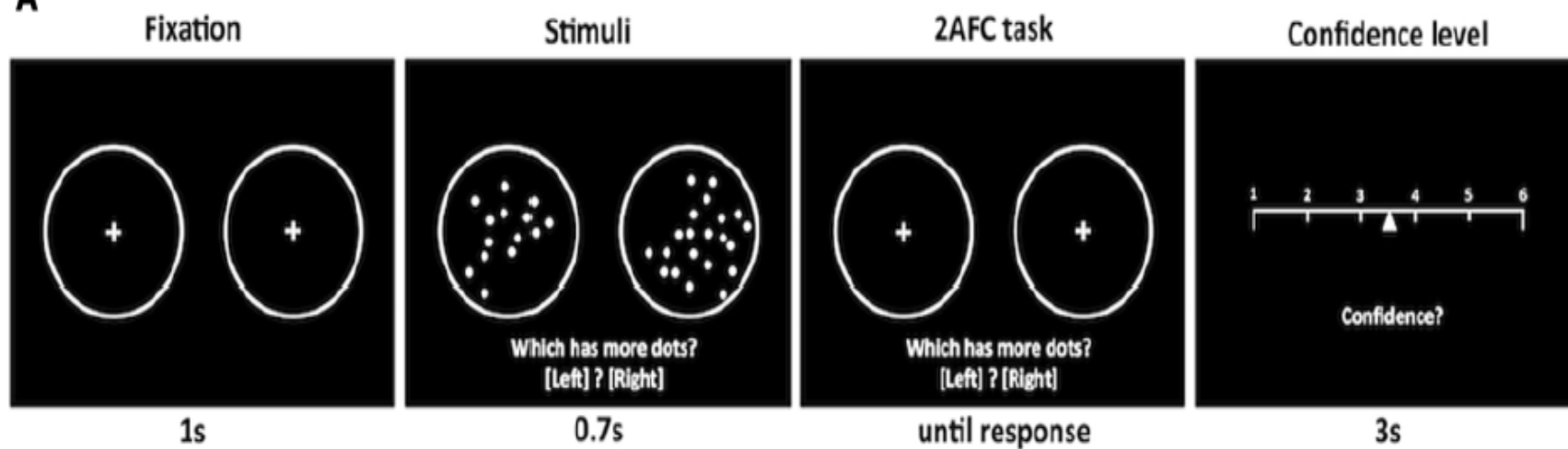
Monique Plaza, Peggy Gatignol, Marianne Leroy, and Hugues Duffau

Laboratoire de Psychologie et Neurosciences Cognitives (UMR CNRS 8189), Université Paris Descartes, Service de Neurochirurgie, CHU Gui de Chauliac, Montpellier, France



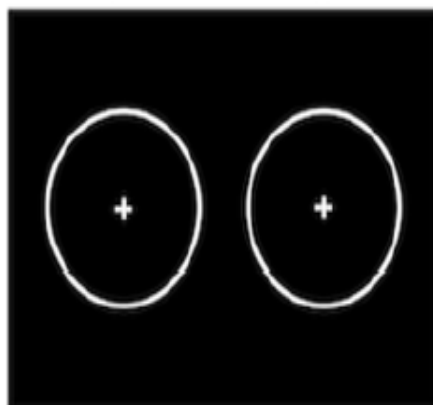


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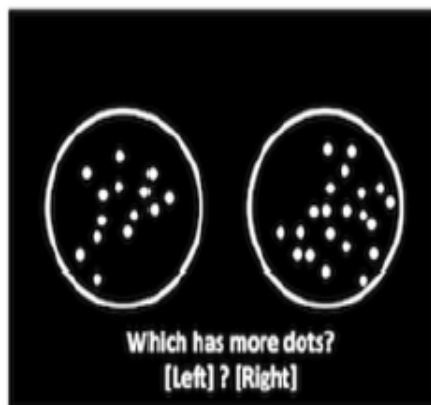
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Fixation



1s

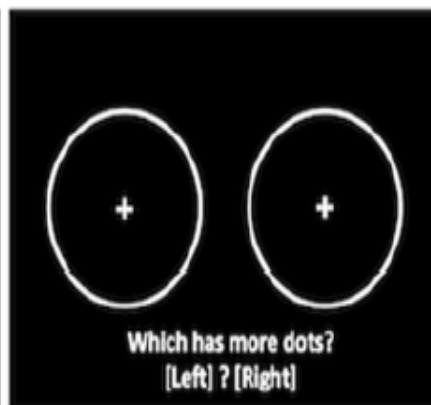
Stimuli



Which has more dots?
[Left] ? [Right]

0.7s

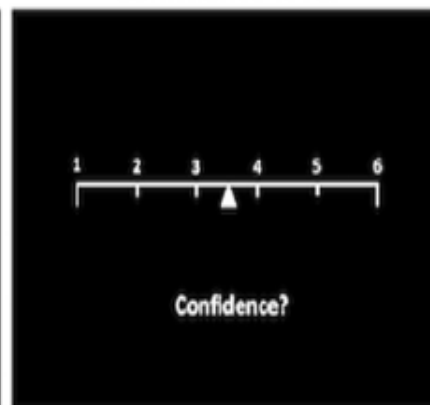
2AFC task



Which has more dots?
[Left] ? [Right]

until response

Confidence level

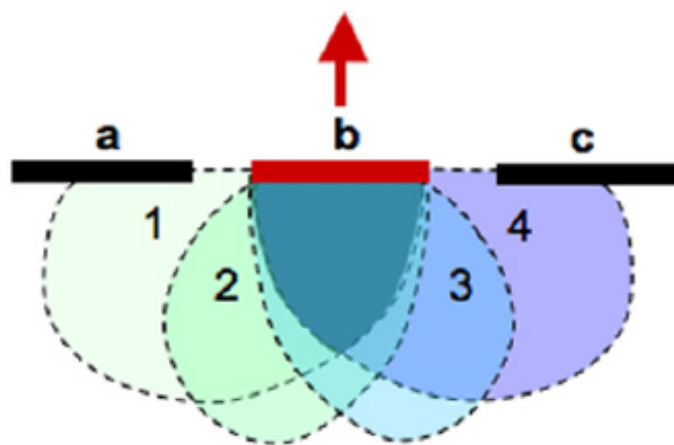


3s

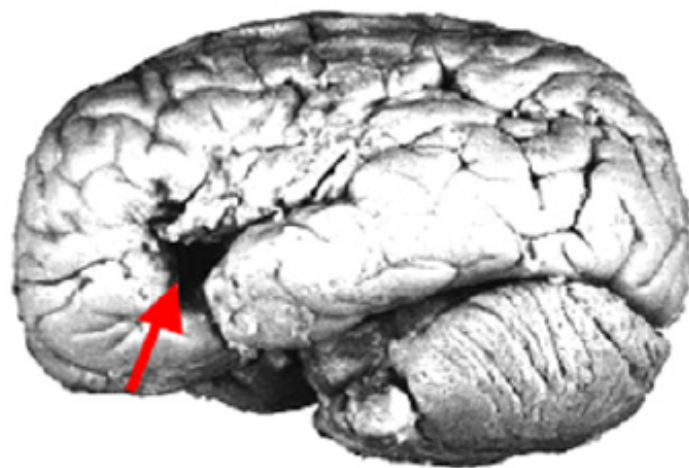
A

TOPOLOGICAL APPROACH

neurological deficit



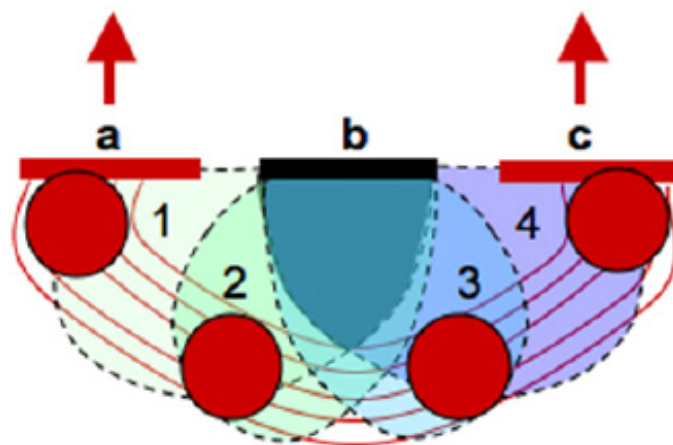
C



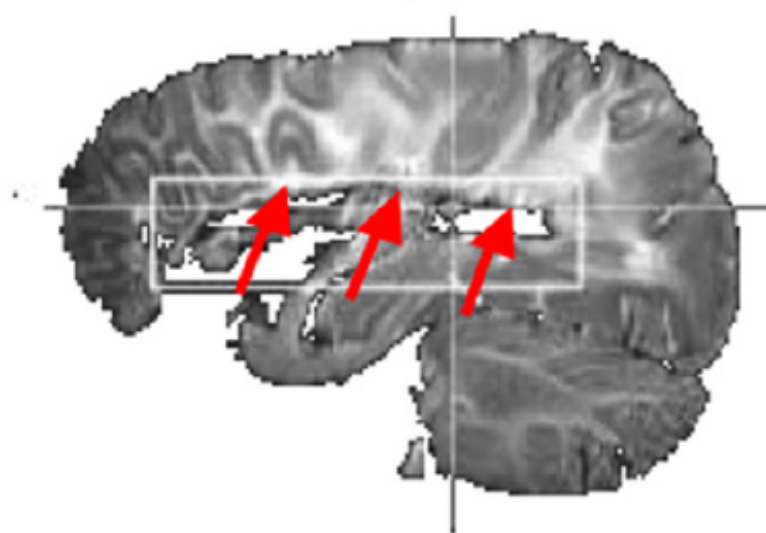
B

HODOLOGICAL APPROACH

neurological deficit



D



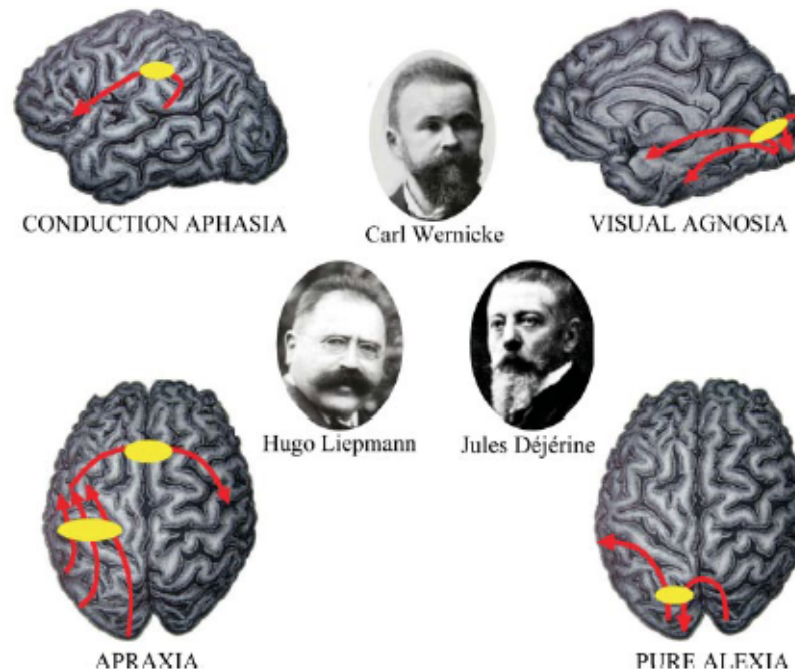


Fig. 2 The classical disconnection syndromes. The pathways implicated in each syndrome are shown in red with the causal lesion in yellow. Wernicke is linked to both conduction aphasia and associative agnosia, the lesion in the former disconnecting Broca's and Wernicke's areas, the lesion in the latter disrupting the outflow of the visual cortex to other brain areas. Liepmann is linked to apraxia where the left-hand motor area is disconnected from other brain regions. Déjerine is linked to pure alexia in which the visual verbal centre is disconnected from visual areas in both hemispheres. See text for further details.

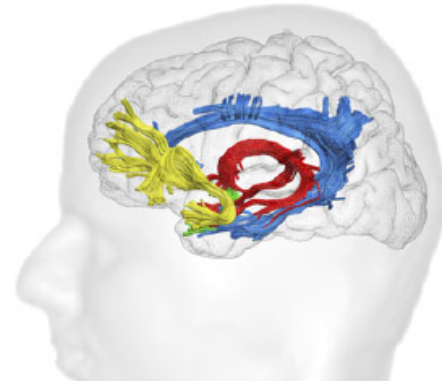
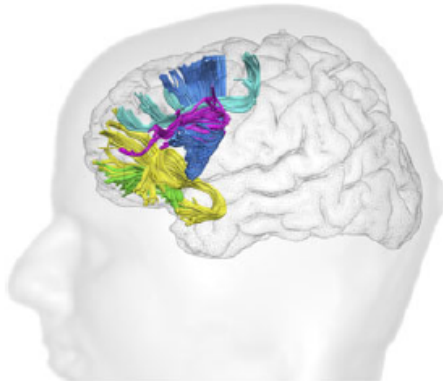
Dejerine J. 1895. Anatomie des Centres Nerveux. Paris: Rueff et Cie.

Wernicke C. 1874. Der Aphasische Symptomencomplex. Ein psychologische Studie auf anatomischer Basis. Breslau: Cohn & Weigert.

ORIGINAL ARTICLE

From Phineas Gage and Monsieur Leborgne to H.M.: Revisiting Disconnection Syndromes

M. Thiebaut de Schotten^{1,3,4}, F. Dell'Acqua^{1,2}, P. Ratiu¹, A. Leslie^{1,2},
H. Howells^{1,2}, E. Cabanis⁵, M. T. Iba-Zizen⁵, O. Plaisant⁶, A. Simmons²,
N. F. Dronkers^{7,8,9}, S. Corkin¹⁰, and M. Catani^{1,2}



PHINEAS GAGE

- Frontal Aslant Tract
- Uncinate
- Frontal Superior Longitudinal
- Frontal Inferior Longitudinal
- Frontal Orbito Polar

LOUIS VICTOR LEBORGNE

- Arcuate
- Superior longitudinal fasc. III
- Superior longitudinal fasc. II
- Frontal Aslant Tract
- Frontal Inferior Longitudinal
- Frontal Orbito Polar

HENRY MOLAISON

- Uncinate
- Fornix
- Anterior commissure
- Cingulum

Figure 5. Major tracts that were damaged in Gage (damage affected at least 30% of the tracts' volume, z-score = 1.7), in Leborgne (damage affected at least 55% of the tracts' volume, z-score = 1.29), and in Molaison (damage affected at least 5% of the tracts' volume, z-score = 1.39).

- Les fonctions cognitives ne sont pas localisées dans des régions discrètes du cerveau
- Les fonctions cognitives reposent sur l'activité coordonnées de régions cérébrales plus ou moins éloignées inter-connectées par des fibres de substances blanches.
- Des lésions des aires corticales ou des voies de connections sous-jacentes peuvent avoir des conséquences sur des régions éloignées au travers d'un **diaschisis** (dysfonction d'une région connectée à l'aire endommagée) ou d'une **dysconnexion** (dysfonction de 2 aires intactes connectées par un faisceau endommagé)

Un exemple d'étude récente

BRAIN

A JOURNAL OF NEUROLOGY

Inferring a dual-stream model of mentalizing from associative white matter fibres disconnection

Guillaume Herbet,^{1,2,3} Gilles Lafargue,^{4,5} François Bonnetblanc,^{6,7,8} Sylvie Moritz-Gasser,^{1,9} Nicolas Menjot de Champfleur¹⁰ and Hugues Duffau^{1,2}

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2 Institute for Neuroscience of Montpellier, INSERM 1051, Hôpital Saint Eloi, F-34091 Montpellier, France

3 University of Montpellier 1, F-34967 Montpellier, France

4 Functional Neuroscience and Pathologies Laboratory, EA-4559, Lille Nord de France University, F-59120 Loos, France

5 Department of Psychology, Lille Nord de France University (Lille3), F-59653 Villeneuve d'Ascq, France

6 Cognition, Action and Sensorimotor Plasticity Lab, INSERM U-1093, UFR STAPS, F-27877 Dijon, France

7 University of Montpellier 2, LIRMM, DEMAR team, CNRS, INRIA, F-34095 Montpellier, France

8 University Institute of France, F-75005 Paris, France

9 Department of Neurology, Gui de Chauliac hospital, F-34295 Montpellier, France

10 Department of Neuroradiology, Gui de Chauliac hospital, F-34295 Montpellier, France

Etude sur 93 patients

Preoperative assessment

Task adaptation



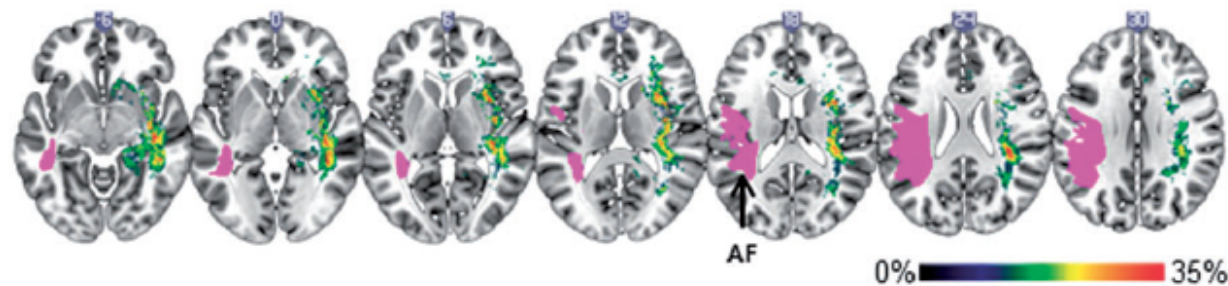
Playful Comforting
Irritated Bored

Original task



Playful Irritated

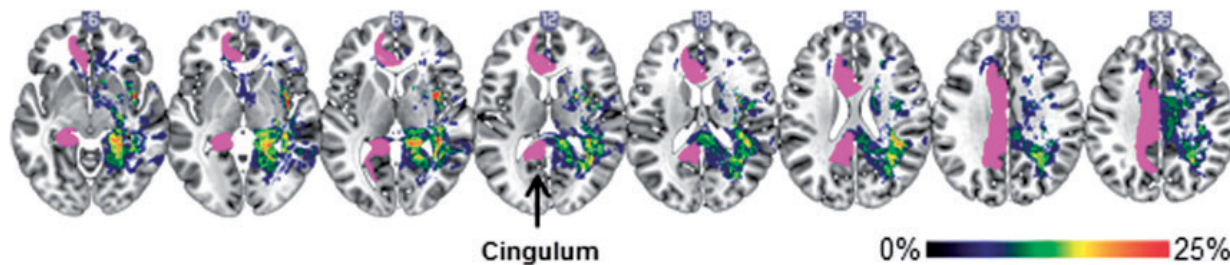
Dual-choice task based on
correct responses (the
correct and a outlying item)



Correct answer

Distracter

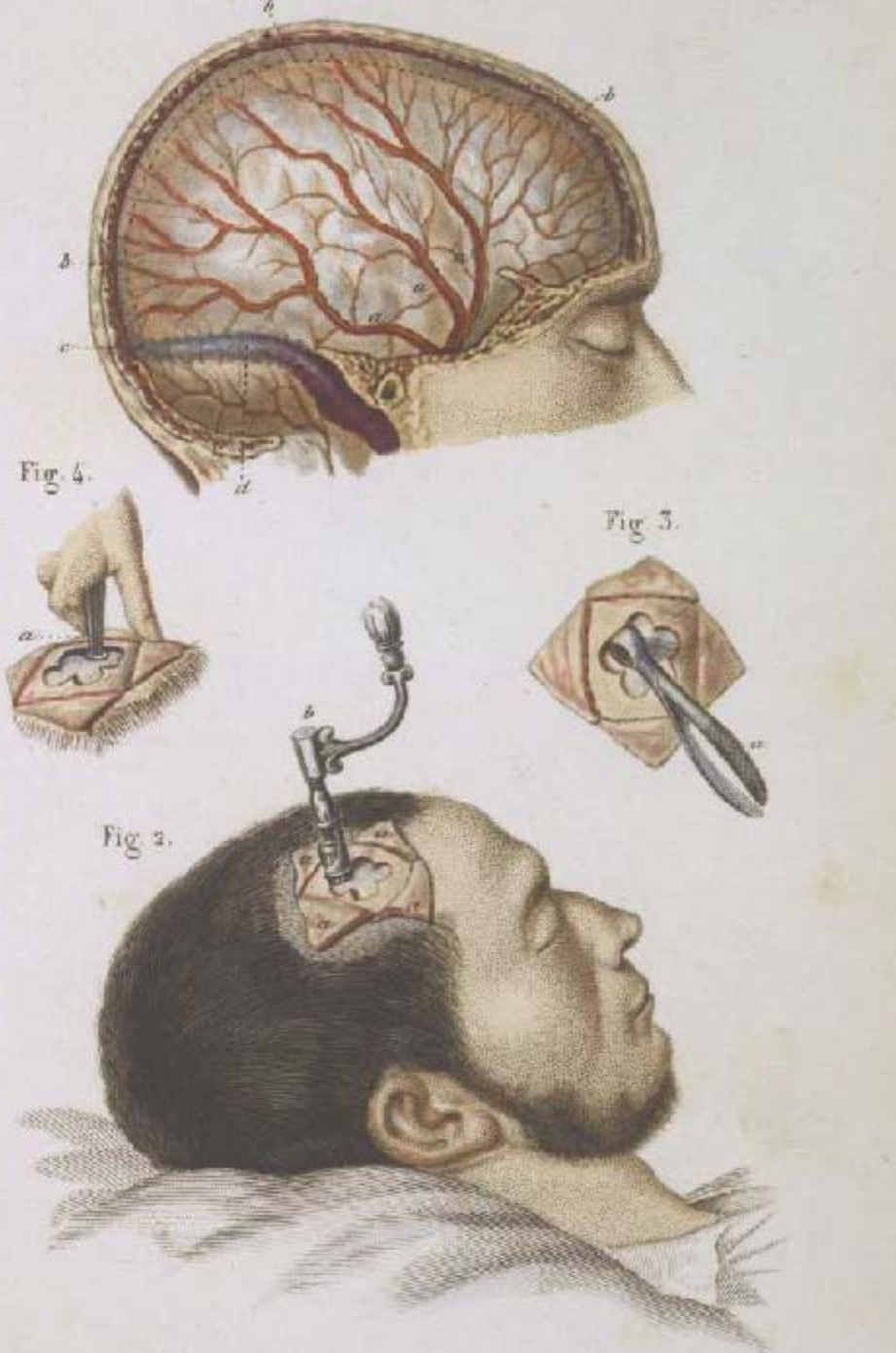
Distracter



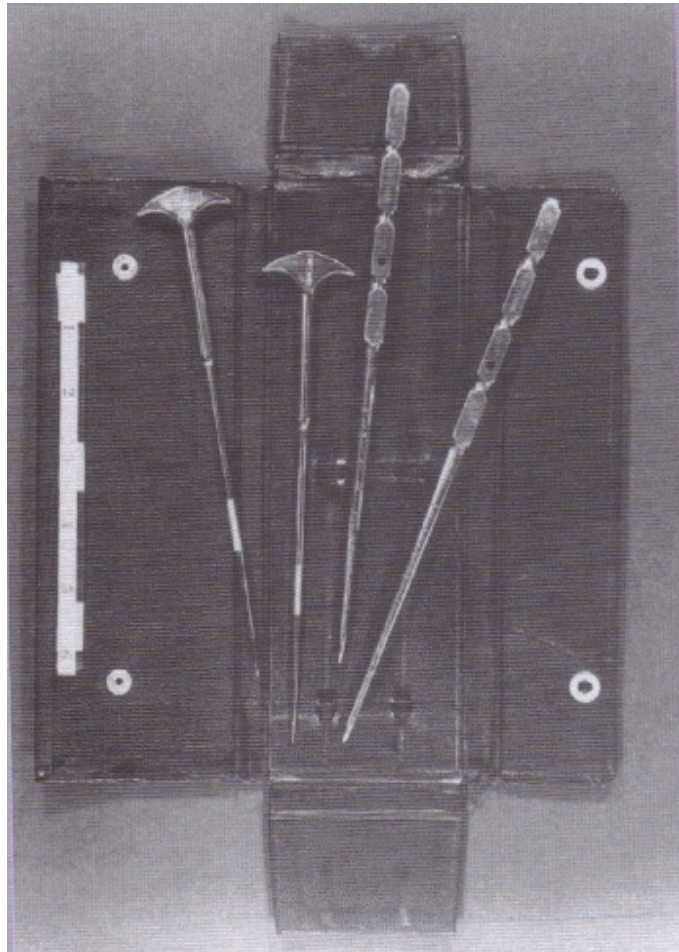
La psychochirurgie

La lobotomie (ou leucotomie)

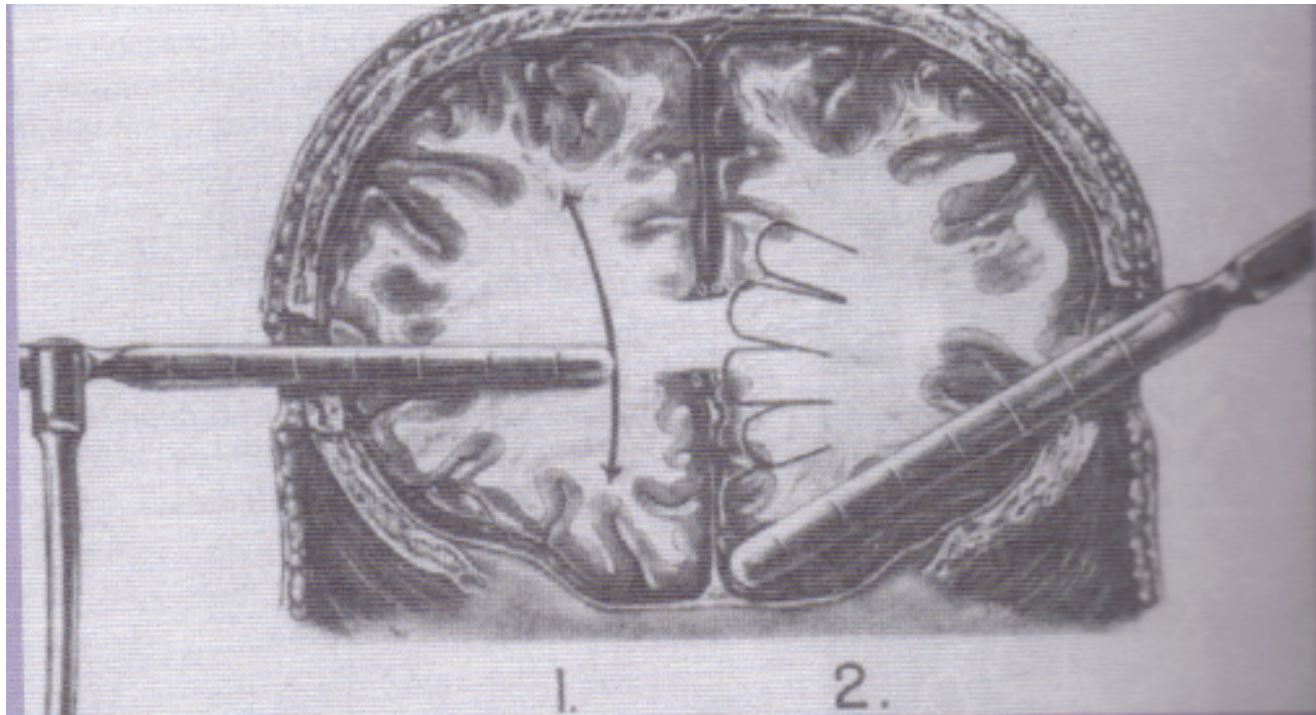
- La médication psychotrope, dans les années 1950, sonne le déclin de cette pratique



Trousse d'instruments pour lobotomie préfrontale



Deux façon de pratiquer une lobotomie : schéma de Freeman



Cas Carolyn Wilson, publié en 1990

- Brillante étudiante en médecine diagnostiquée schizophrène vers 1940, à l'âge de 26 ans
- Elle a « bénéficié » d'une lobotomie standard en 1947, puis a été examinée tous les 10 ans
- Son état a été remarquablement stable jusqu'à la fin de sa vie :
 - Elle mène chez elle une vie placide, sourit sans cesse, mange avec excès et sans discrimination, ne peut vivre seule, se perd dans la rue, ne peut écrire une lettre de plus de 150 mots et son style est infantile
 - QI préservé mais difficulté extrême dans les épreuves de résolution de problème, surtout quand les règles changent durant l'examen

Problèmes éthiques

- « Meurtre de la personnalité »
- Dès 1940, sévères critiques contre un « contrôle chirurgical du comportement »
 - risques de dérives vers des applications à la déviance sociale et à la délinquance.. à l'opposition politique....
 - Interventions sur le complexe amygdalien chez les sujets violents et de l'hypothalamus chez les déviants sexuels ont été pratiquées dans certains pays

Egas Moniz
1874-1955



Prix Nobel 1949 à
l'inventeur de la lobotomie
(ou leucotomie), Egas
Moniz

- Dans les années 1940, Walter Freeman dit avoir lobotomisé 3500 patients schizophrènes...

La neurochirurgie fonctionnelle aujourd'hui

Toujours pratiquée dans un cadre très strict

- **Capsulotomie** (interruption des voies entre CxPr et thalamus) en Suède pour les TOC... et en France depuis juin 2002 (avis du comité national consultatif d'éthique)
- **Cingulotomie** pour les dépressions graves aux EU (résection d'une partie du gyrus cingulaire)

Etats mentaux causés par la stimulation électrique directe du cerveau

Functional Organization of Human Supplementary Motor Cortex Studied by Electrical Stimulation

Itzhak Fried,¹ Amiram Katz,¹ Gregory McCarthy,^{1,2} Kimberlee J. Sass,¹ Peter Williamson,^{1,2} Susan S. Spencer,¹ and Dennis D. Spencer¹

¹Section of Neurosurgery and Department of Neurology, Yale University School of Medicine, New Haven, Connecticut 06510 and ²Neurology Service and Neuropsychology Laboratory, Veterans Administration Medical Center, West Haven, Connecticut 06516

The presence of somatotopic organization in the human supplementary motor area (SMA) remains a controversial issue. In this study, subdural electrode grids were placed on the medial surface of the cerebral hemispheres in 13 patients with intractable epilepsy undergoing evaluation for surgical treatment. Electrical stimulation mapping with currents below the threshold of afterdischarges showed somatotopic organization of supplementary motor cortex with the lower extremities represented posteriorly, head and face most anteriorly, and the upper extremities between these two regions. Electrical stimulation often elicited synergistic and complex movements involving more than one joint. In transitional areas between neighboring somatotopic representations, stimulation evoked combined movements involving the body parts represented in these adjacent regions. Anterior to the supplementary motor representation of the face, vocalization and speech arrest or slowing of speech were evoked. Various sensations were elicited by electrical stimulation of SMA. In some cases a preliminary sensation of "urge" to perform a movement or anticipation that a movement was about to occur were evoked. Most responses were contralateral to the stimulated hemisphere. Ipsilateral and bilateral responses were elicited almost exclusively from the right (nondominant) hemisphere. These data suggest the presence of combined somatotopic organization and left-right specialization in human supplementary motor cortex.

**Expérience
consciente de la
volonté d'effectuer
un mouvement
précis**

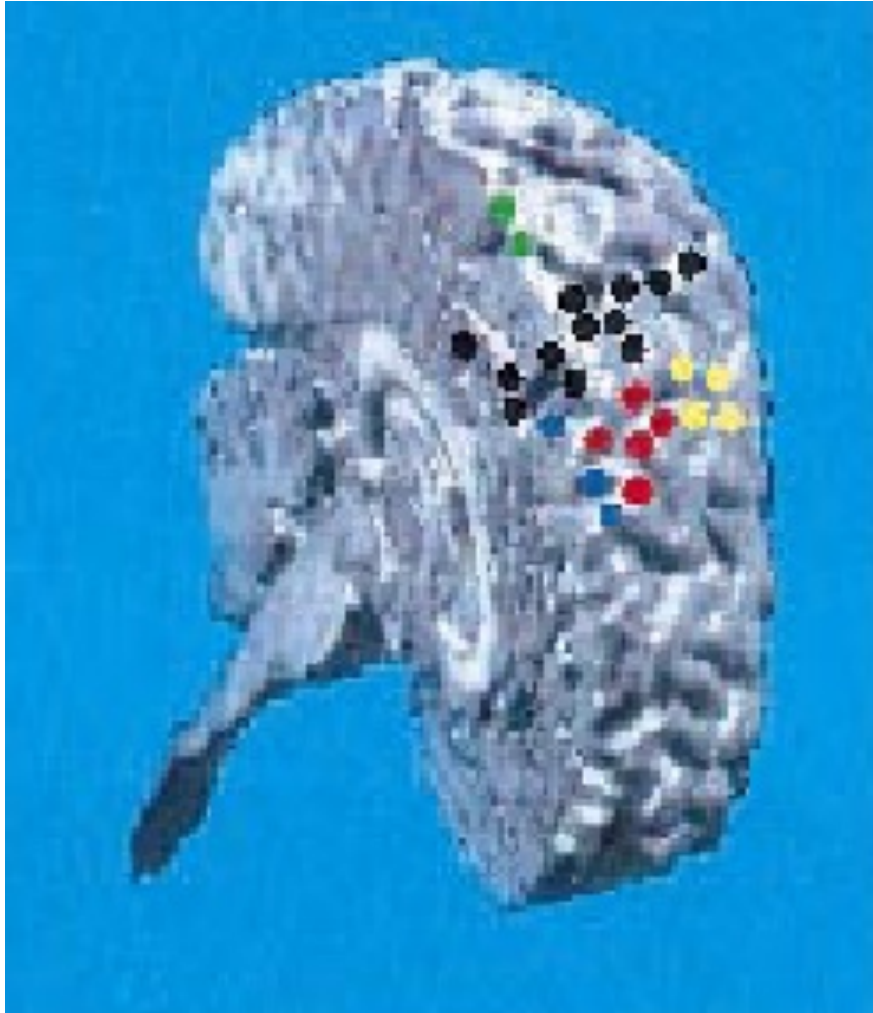
**déclenchée par le neuro-
chirurgien**

L'intention motrice



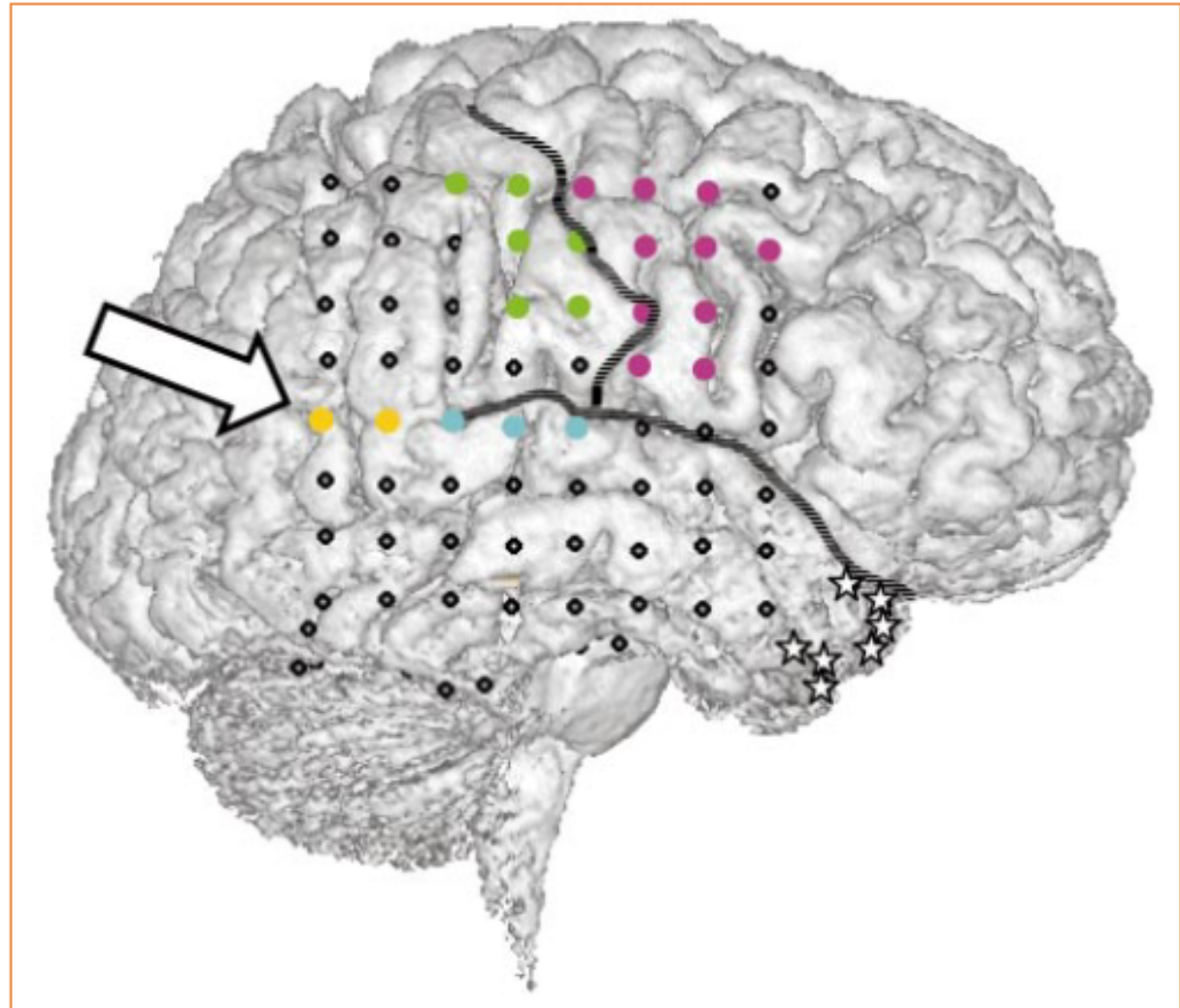
Fried et al. (1991). Direct stimulation of the supplementary motor area in man. A strip of electrodes is used to stimulate the cerebral cortex as part of pre-operative procedure before neurosurgery for severe epilepsy. When the SMA (electrodes outlined in red) was stimulated, subjects reported the sensation of an urge to move their limbs. More intense stimulation at the same locations provoked physical movements of the corresponding limb

*Éclats de rire induits par SE de la partie
antérieure de l'AMS*



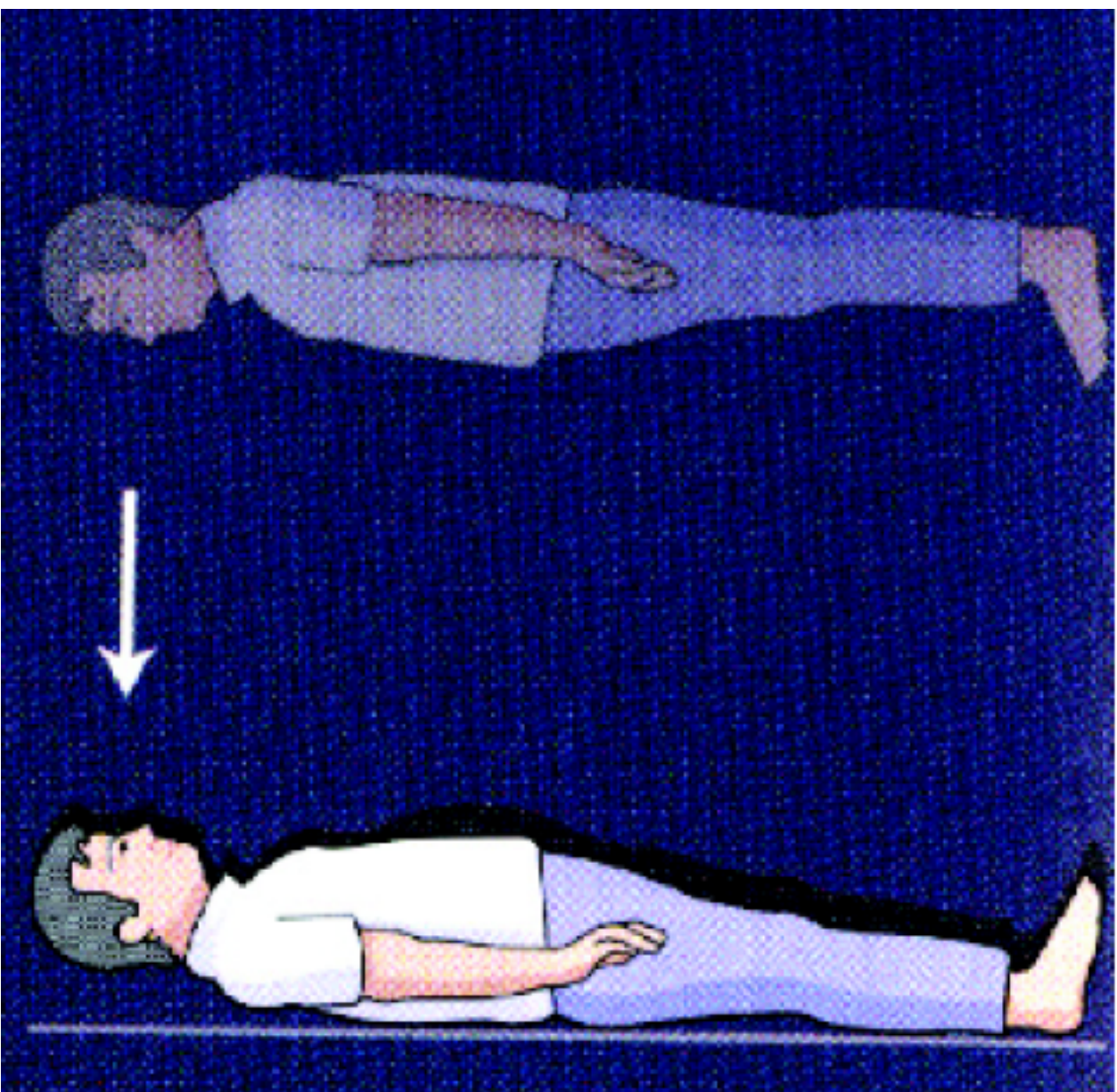
- Rires
- Interruption du langage
- Interruption de la capacité à nommer les objets
- Interruption des activités manuelles
- Mouvements impliquant les bras et les avant-bras
- Sensations de frôlement

Figure 1 Three-dimensional surface reconstruction of the right hemisphere of the brain from magnetic-resonance imaging. Subdural electrodes were implanted in the brain of an epileptic patient undergoing presurgical evaluation; the locations at which focal electrical stimulation (ES) evoked behavioural responses are shown: magenta, motor; green, somatosensory cortex; turquoise, auditory cortex. Yellow, site at which out-of-body experience (OBE), body-part illusions and vestibular responses were induced (arrow). Stars indicate the epileptic focus in the medial temporal lobe. Informed con-



sent was obtained from the patient and ES procedures conformed to the Declaration of Helsinki. Constant current (0.5–5.0 mA, 2-s train duration) was applied at 50 Hz in a bipolar manner through adjacent contacts⁴. Since undergoing a right anterior temporal lobectomy in 2000, the patient has been free of complex partial seizures.

De Ridder et al. (2007) Visualizing Out-of-Body Experience in the Brain, *The new England Journal of Medicine*



There is nothing paranormal about near-death experiences: how neuroscience can explain seeing bright lights, meeting the dead, or being convinced you are one of them

Dean Mobbs¹ and Caroline Watt²

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Approximately 3% of Americans declare to have had a near-death experience [1]. These experiences classically involve the feeling that one's soul has left the body, approaches a bright light and goes to another reality, where love and bliss are all encompassing. Contrary to popular belief, research suggests that there is nothing paranormal about these experiences. Instead, near-death experiences are the manifestation of normal brain function gone awry, during a traumatic, and sometimes harmless, event.

Un exemple d'étude récente

Disrupting posterior cingulate connectivity disconnects consciousness from the external environment

Guillaume Herbet^{a,b,c,*}, Gilles Lafargue^d, Nicolas Menjot de Champfleur^{b,e},
Sylvie Moritz-Gasser^{b,f}, Emmanuelle le Bars^{b,e}, François Bonnetblanc^{g,h}, Hugues Duffau^{a,b}

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^f Department of Neurology, Montpellier University Medical Center, Montpellier 34295, France

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ABSTRACT

Neurophysiological and neuroimaging studies including both patients with disorders of consciousness and healthy subjects with modified states of consciousness suggest a crucial role of the medial posteroparietal cortex in conscious information processing. However no direct neuropsychological evidence supports this hypothesis and studies including patients with restricted lesions of this brain region are almost non-existent. Using direct intraoperative electrostimulations, we showed in a rare patient that disrupting the subcortical connectivity of the left posterior cingulate cortex (PCC) reliably induced a breakdown in conscious experience. This acute phenomenon was mainly characterized by a transient behavioral unresponsiveness with loss of external connectedness. In all cases, when he regained consciousness, the patient described himself as in dream, outside the operating room. This finding suggests that functional integrity of the PPC connectivity is necessary for maintaining consciousness of external environment.

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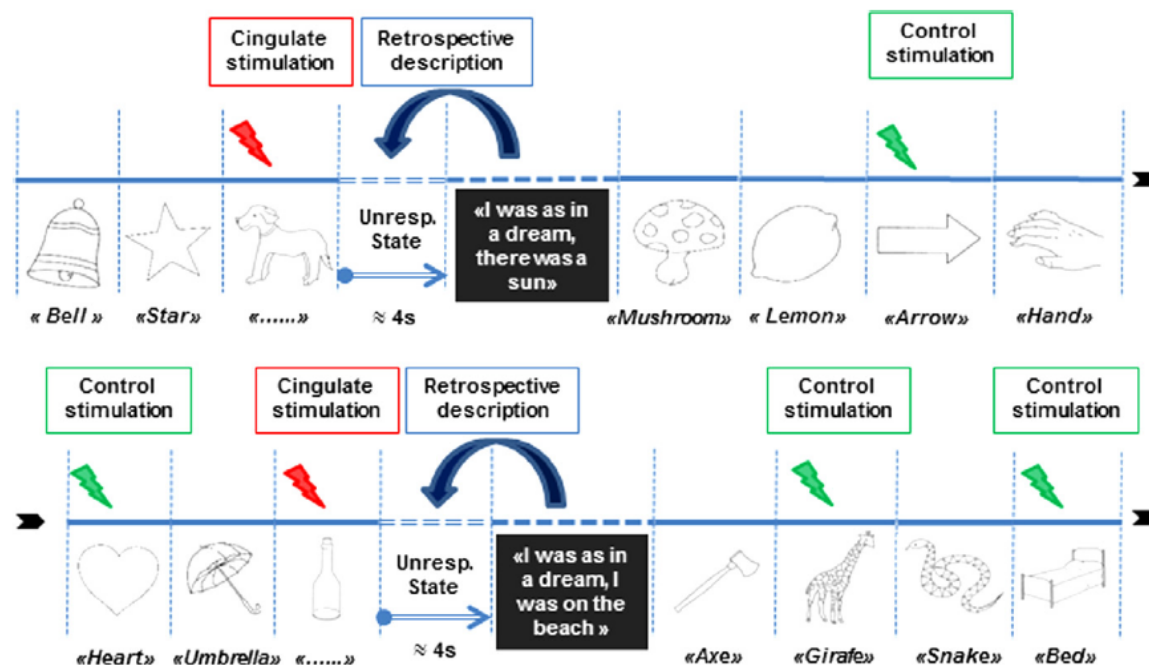


Fig. 2. Schematic description of the intraoperative protocol. Each responsive stimulation (red lightning; three stimulations sum-total applied on the same anatomical location) was followed by two no responsive control stimulations (green lightning; six stimulations sum-total applied on the anatomical space surrounding the responsive site, with a minimal distance of 5 mm that corresponds to the spatial resolution of the bipolar electrode). Note that the same protocol was applied regarding the “visual blur” phenomenon. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

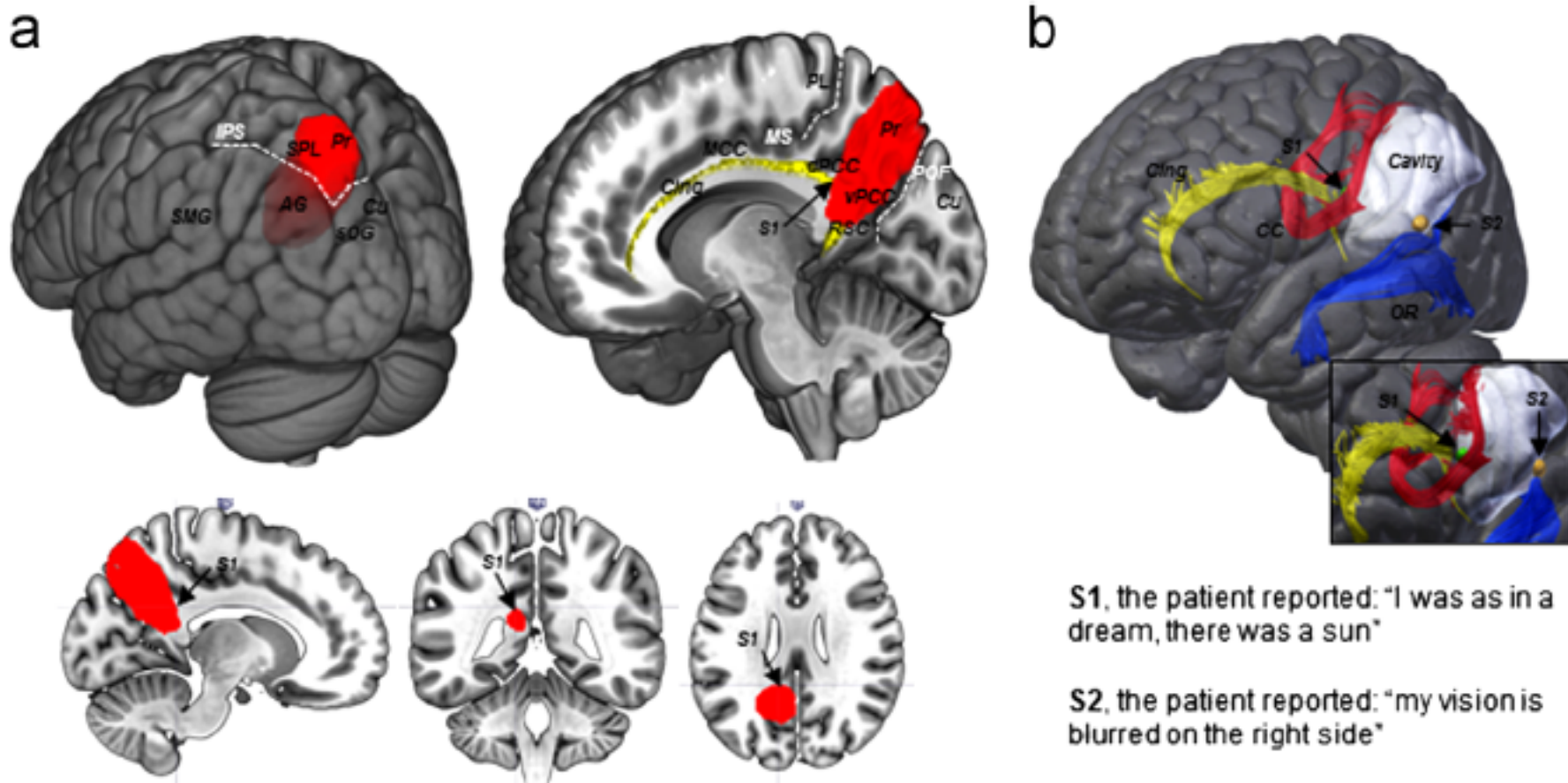


Fig. 1. Anatomical location of the "dream-like state" stimulation. (a) Location of the stimulation relative to the resective cavity. The "dream-like state" stimulation (S1) was applied on the white matter underlying the left posterior cingulate (black arrow, MNI coordinates: $-12, -44, 27$). (b) Tractography reconstruction. Whereas the "dream-like state" stimulation (S1) was identified close to the cingulum, the "visual blur" stimulation was identified close to optic radiations (S2). Pr=precuneus, PL=paracentral lobule, vPCC=ventral posterior cingulate cortex, dPCC=dorsal posterior cingulate cortex, MCC=middle cingulate cortex, RSC=retrosplenial cortex, SPL=Superior parietal lobule, Cu=cuneus, AG=angular gyrus, SMG=supramarginal gyrus, IPS=intraparietal sulcus, SOG=superior occipital gyrus, MS=marginal sulcus, POF=parieto-occipital fissure, Cing=cingulum, CC=corpus callosum, OR=optic radiations.

Le 21^{ème} siècle

- Banalisation de l'usage des outils d'observation du cerveau du cerveau dans la recherche en psychologie
- Implications sociales et éthiques de l'utilisation de ces techniques
 - dans les domaines de la justice et de la publicité par exemple, ou simplement lorsqu'il s'agit de mieux comprendre les aspects les plus intimes de la personne humaine

Vers une science de la subjectivité...

“In today ’s psychology, the subjective data of consciousness are legitimate objects of study that can be directly related, through modeling and neuroimaging, to objective aspects of cerebral architecture.” ***S. Dehaene***

Relating Introspective Accuracy to Individual Differences in Brain Structure

Stephen M. Fleming,^{1,*†} Rimona S. Weil,^{1,2,*} Zoltan Nagy,¹ Raymond J. Dolan,¹ Geraint Rees^{1,2}

The ability to introspect about self-performance is key to human subjective experience, but the neuroanatomical basis of this ability is unknown. Such accurate introspection requires discriminating correct decisions from incorrect ones, a capacity that varies substantially across individuals. We dissociated variation in introspective ability from objective performance in a simple perceptual-decision task, allowing us to determine whether this interindividual variability was associated with a distinct neural basis. We show that introspective ability is correlated with gray matter volume in the anterior prefrontal cortex, a region that shows marked evolutionary development in humans. Moreover, interindividual variation in introspective ability is also correlated with white-matter microstructure connected with this area of the prefrontal cortex. Our findings point to a focal neuroanatomical substrate for introspective ability, a substrate distinct from that supporting primary perception.

Neurosciences de la personnalité

Testing Predictions From Personality Neuroscience: Brain Structure and the Big Five

Psychological Science
21(6) 820–828
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sagepub.com/journalsPermissions.nav
DOI: 10.1177/0956797610370159
<http://pss.sagepub.com>


**Colin G. DeYoung¹, Jacob B. Hirsh², Matthew S. Shane³, Xenophon Papademetris⁴,
Nallakkandi Rajeevan⁴, and Jeremy R. Gray⁴**

¹University of Minnesota; ²University of Toronto; ³The Mind Research Network, Albuquerque, New Mexico; and ⁴Yale University

Abstract

We used a new theory of the biological basis of the Big Five personality traits to generate hypotheses about the association of each trait with the volume of different brain regions. Controlling for age, sex, and whole-brain volume, results from structural magnetic resonance imaging of 116 healthy adults supported our hypotheses for four of the five traits: Extraversion, Neuroticism, Agreeableness, and Conscientiousness. Extraversion covaried with volume of medial orbitofrontal cortex, a brain region involved in processing reward information. Neuroticism covaried with volume of brain regions associated with threat, punishment, and negative affect. Agreeableness covaried with volume in regions that process information about the intentions and mental states of other individuals. Conscientiousness covaried with volume in lateral prefrontal cortex, a region involved in planning and the voluntary control of behavior. These findings support our biologically based, explanatory model of the Big Five and demonstrate the potential of personality neuroscience (i.e., the systematic study of individual differences in personality using neuroscience methods) as a discipline.

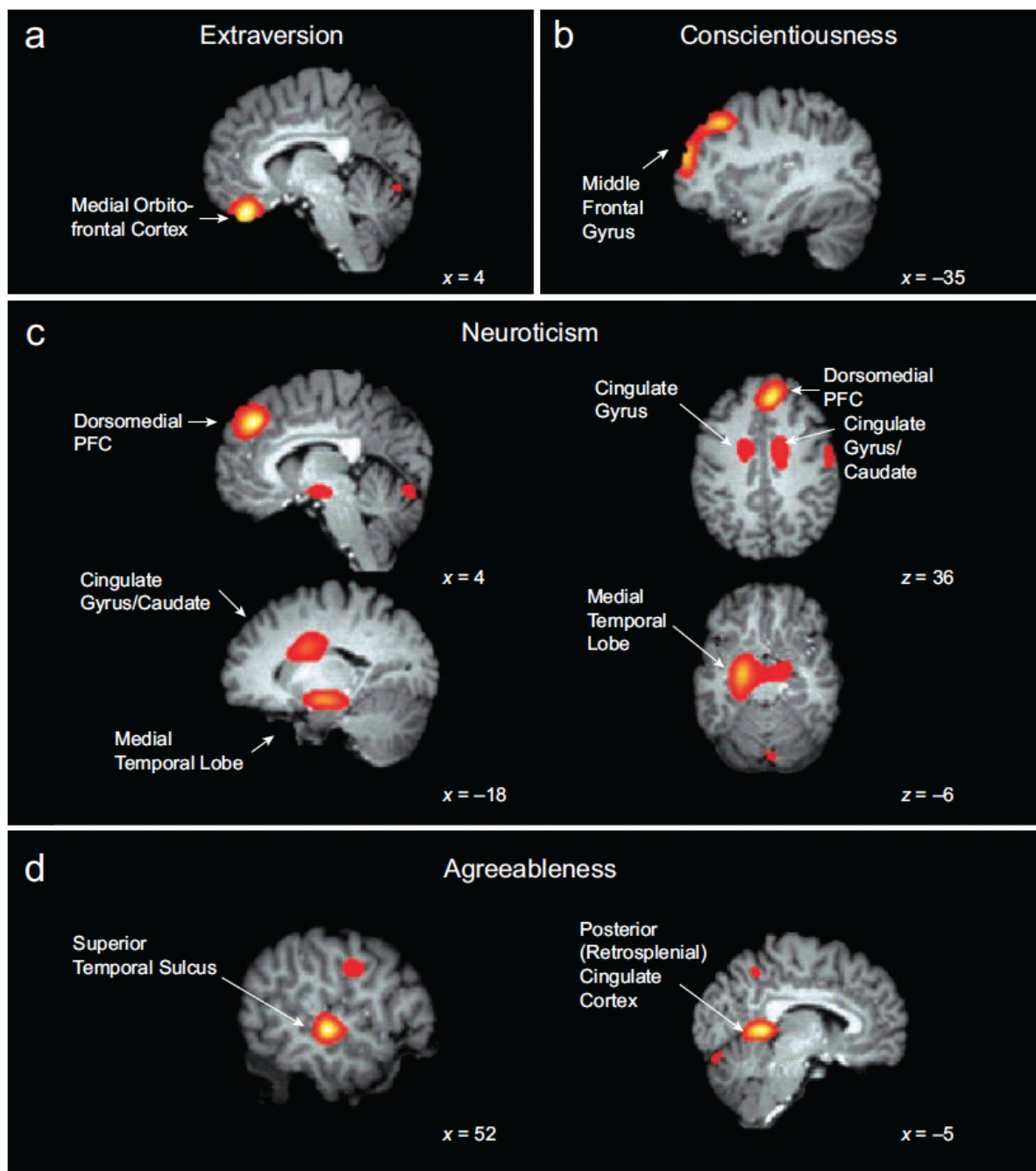


Fig. 1. Brain regions in which local volume was significantly associated with (a) Extraversion, (b) Conscientiousness, (c) Neuroticism, and (d) Agreeableness, as hypothesized (see also Table 1). Coordinates indicate the locations of the brain slices. Color is related to effect size, with lighter color signifying a larger effect, and darker color signifying a smaller effect. PFC = prefrontal cortex.

Neurosciences et expérience religieuse

Neural correlates of a mystical experience in Carmelite nuns

Mario Beauregard^{a,b,c,d,e,*}, Vincent Paquette^{a,c,e}

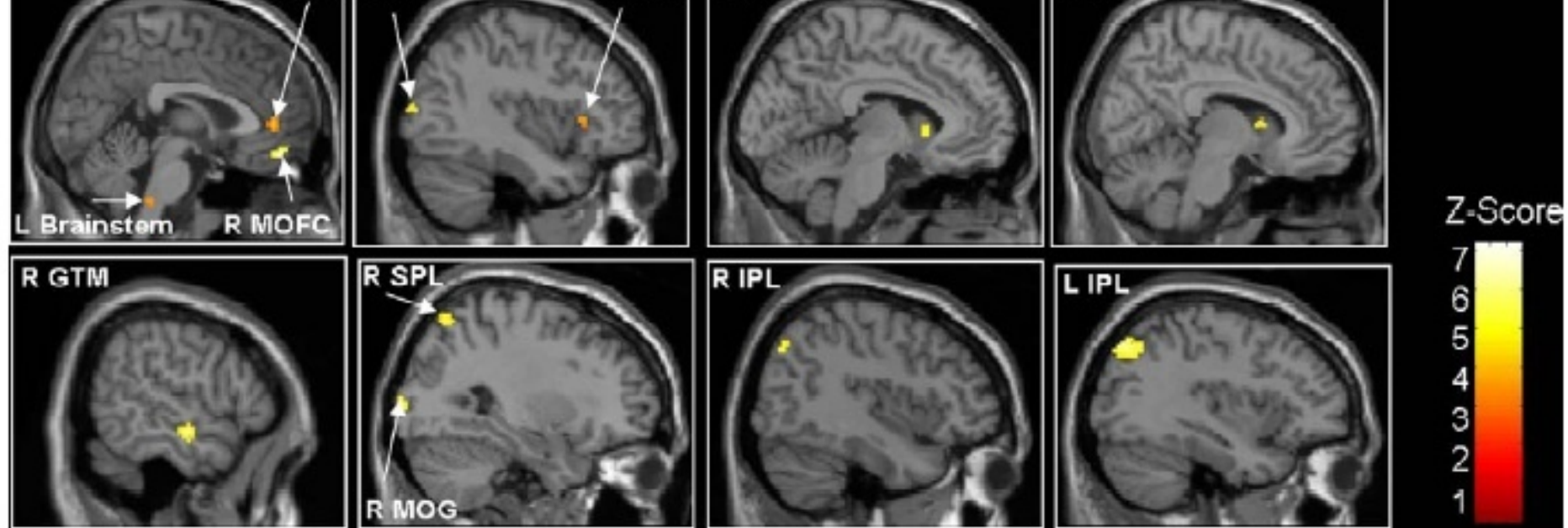
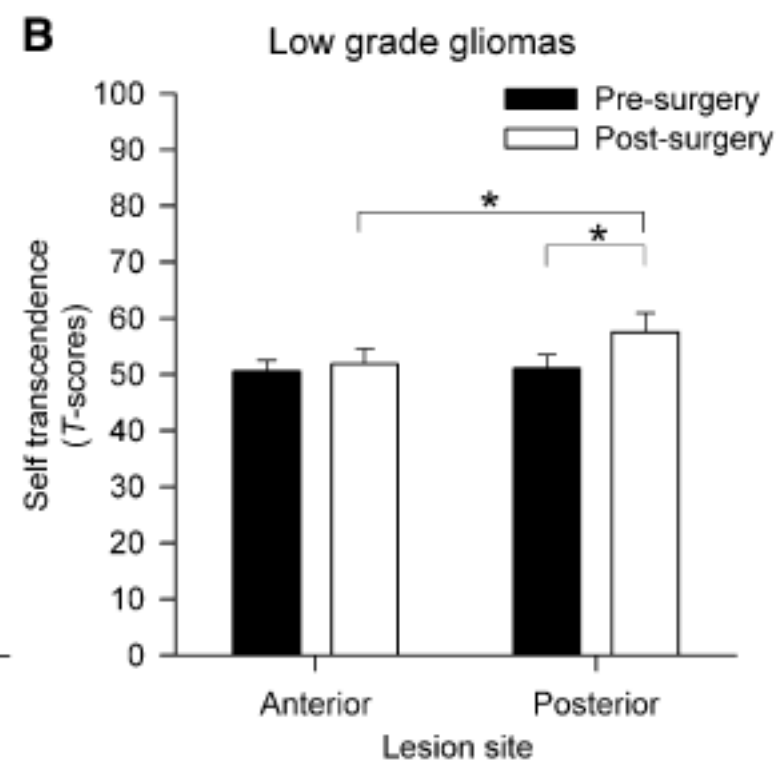
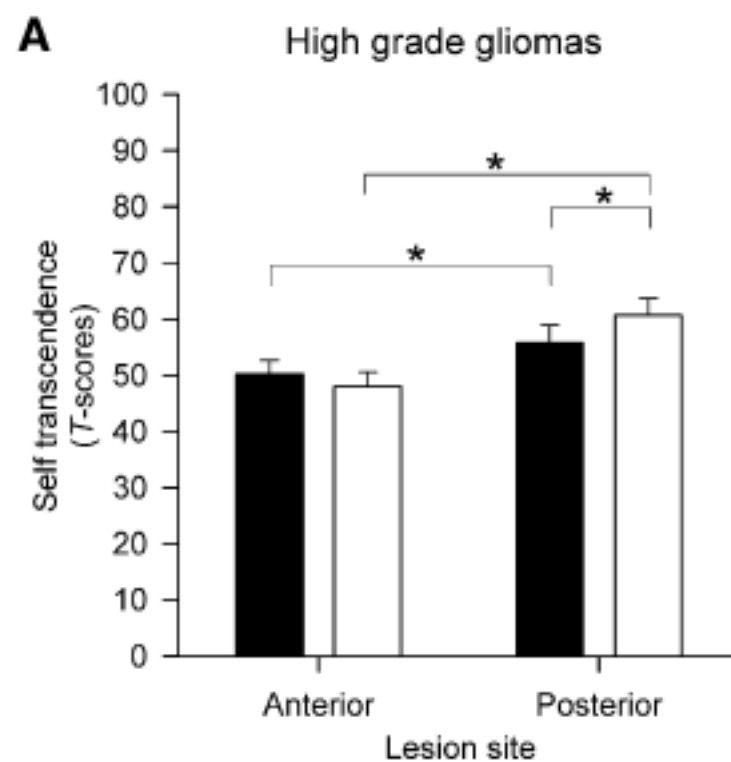


Fig. 1. Statistical activation maps during the Mystical condition. Images are sagittal sections for the data averaged across subjects. L: left; R: right.

Neural correlates of a mystical experience in Carmelite nuns, ***Neurosciences letters***, 2006

The Spiritual Brain: Selective Cortical Lesions Modulate Human Self-Transcendence

The predisposition of human beings toward spiritual feeling, thinking, and behaviors is measured by a supposedly stable personality trait called self-transcendence. Although a few neuroimaging studies suggest that neural activation of a large fronto-parieto-temporal network may underpin a variety of spiritual experiences, information on the causative link between such a network and spirituality is lacking. Combining pre- and post-neurosurgery personality assessment with advanced brain-lesion mapping techniques, we found that selective damage to left and right inferior posterior parietal regions induced a specific increase of self-transcendence. Therefore, modifications of neural activity in temporoparietal areas may induce unusually fast modulations of a stable personality trait related to transcendental self-referential awareness. These results hint at the active, crucial role of left and right parietal systems in determining self-transcendence and cast new light on the neurobiological bases of altered spiritual and religious attitudes and behaviors in neurological and mental disorders.



Neurosciences et Justice

Le cerveau à la barre des témoin !

Neuroscience - Law - The Brain on the Stand - Jeffrey Rosen - New ... <http://www.nytimes.com/2007/03/11/magazine/11Neurolaw.t.html?...>

The New York Times
nytimes.com

PRINTER-FRIENDLY FORMAT
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March 11, 2007

The Brain on the Stand

By JEFFREY ROSEN

- Pour la première fois en 2008, un tribunal Indien a retenu le résultat **d'un examen EEG comme preuve à charge pour condamner une jeune femme à la prison à perpétuité**
 - Accusée d'avoir empoisonné son ex-fiancé
 - Dans le monde entier, nombreuses contestations tant techniques qu'éthiques

Deceiving the law

Lie-detection tests have not been scientifically proven to reliably detect deception at an individual level, yet they are being marketed by several companies and have even been admitted as evidence in an Indian court. This calls for a critical appraisal of these technologies and regulatory measures to prevent misuse.

SCIENCE AND SOCIETY

Neuroscience and legal determination of criminal responsibility

Nigel Eastman and Colin Campbell

Abstract | Neuroscience is increasingly identifying associations between biology and violence that appear to offer courts evidence relevant to criminal responsibility. In addition, in a policy era of 'zero tolerance of risk', evidence of biological abnormality in some of those who are violent, or biological markers of violence, may be seized on as a possible basis for preventive detention in the interest of public safety. However, there is a mismatch between questions that the courts and society wish answered and those that neuroscience is capable of answering. This poses a risk to the proper exercise of justice and to civil liberties.

Confusion entre les questions pour lesquelles la société et les tribunaux souhaiteraient obtenir des réponses et les questions auxquelles les neurosciences cognitives sont réellement capables de répondre

Neurosciences du consommateur

- Neuromarketing
- vs
- Prévention en santé publique

Neural Predictors of Purchases, *Neuron* 2007



Figure 1. SHOP Task Trial Structure and Regressors

For task structure, subjects saw a labeled product (product period; 4 s), saw the product's price (price period; 4 s), and then chose either to purchase the product or not (by selecting either "yes" or "no" presented randomly on the right or left side of the screen; choice period; 4 s), before fixating on a crosshair (2 s) prior to the onset of the next trial. In regression models, preference was correlated with brain activation during the product and price periods, price differential was correlated with brain activation during the price period, and purchasing was correlated with brain activation during the choice period.

Neural Correlates of Behavioral Preference for Culturally Familiar Drinks

Samuel M. McClure,^{1,2} Jian Li,¹ Damon Tomlin,
Kim S. Cypert, Latané M. Montague,
and P. Read Montague*

Department of Neuroscience
Menninger Department of Psychiatry
and Behavioral Sciences
Baylor College of Medicine
1 Baylor Plaza
Houston, Texas 77030

Summary

Coca-Cola® (Coke®) and Pepsi® are nearly identical in chemical composition, yet humans routinely display strong subjective preferences for one or the other. This simple observation raises the important question of how cultural messages combine with content to shape our perceptions; even to the point of modifying behavioral preferences for a primary reward like a sugared drink. We delivered Coke and Pepsi to human subjects in behavioral taste tests and also in passive experiments carried out during functional magnetic resonance imaging (fMRI). Two conditions were examined: (1) anonymous delivery of Coke and Pepsi and (2) brand-cued delivery of Coke and Pepsi. For the anonymous task, we report a consistent neural response in the ventromedial prefrontal cortex that correlated with subjects' behavioral preferences for these beverages. In the brand-cued experiment, brand knowledge for one of the drinks had a dramatic influence on expressed behavioral preferences and on the measured brain responses.

neural responses, and the modulation of both by non-odor or nonflavor stimuli—that is, the sensory problem. Ultimately, such sensory discriminations and the variables that influence them serve to influence expressed behavioral preferences. Hence, there is another large piece of the problem to understand. For modern humans, behavioral preferences for food and beverages are potentially modulated by an enormous number of sensory variables, hedonic states, expectations, semantic priming, and social context. This assertion can be illustrated with a quote from Anderson and Sobel (2003) profiling the work of Small et al. (2003) on taste intensity and pleasantness processing:

"A salad of perfectly grilled woodsy-flavored calamari paired with subtly bitter pale green leaves of curly endive and succulent petals of tomato flesh in a deep, rich balsamic dressing. Delicate slices of pan-roasted duck breast saturated with an assertive, tart-sweet tamarind-infused marinade."

The text goes on further, but note that the sheer lushness of the description adds somehow to the appeal of the food described. Also notice one implicit point of the description: many levels of social, cognitive, and cultural influences combine to produce behavioral preferences for food and drink. The above description likely would not appeal to a strict vegan or an owner of a pet duck. Anderson and Sobel point out that the preferences indexed by their prose originated from the economic demands on our early forebears and were unlikely to have been strictly about aesthetic responses to food and drink.

However, the modern problem is different. Cultural influences on our behavioral preferences for food and

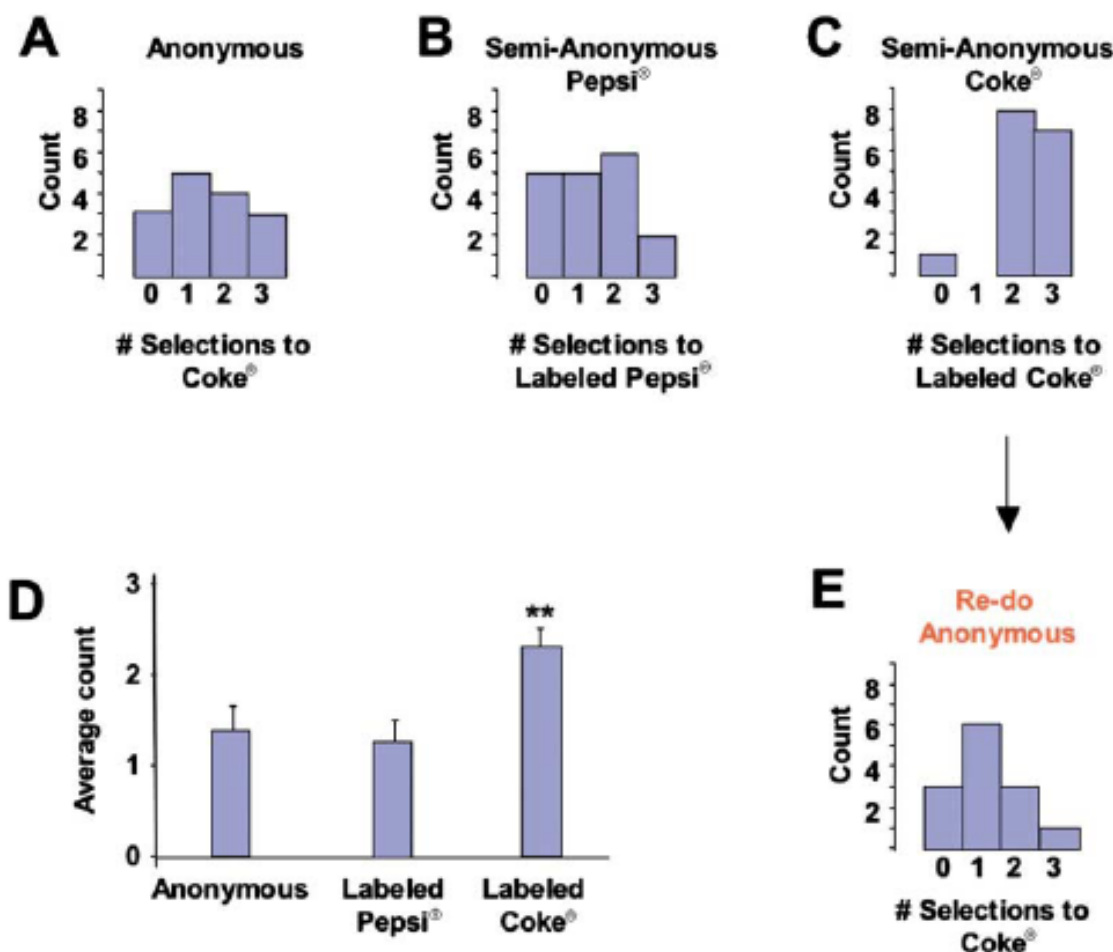


Figure 3. Effect of Brand Knowledge on Behavioral Preferences

(A) Histogram of subjects' preference in double anonymous task. The x axis indicates the number of selections made to Coke (maximum of three). Subjects showed no bias for either Coke or Pepsi.

(B) Histogram of subjects' behavior preference in semianonymous Pepsi task. The x axis indicates the number of selections to the Pepsi-labeled cup. Subjects showed no bias for either the labeled or unlabeled drink.

(C) Histogram of subjects' behavior preference in the semianonymous Coke task. The x axis indicates the number of selections to the labeled Coke. This preference distribution is different from the double anonymous task (Mann-Whitney U test, $n_1 = 16$, $n_2 = 16$, $U = 191.5$, $p < 0.05$) and semianonymous Pepsi task ($n_1 = 18$, $n_2 = 18$, $U = 225.5$, $p < 0.005$), with subjects demonstrating a strong bias in favor of the labeled drink.

(D) Average scores of subjects' preference (number of selections to Coke, labeled Pepsi, and labeled Coke, respectively) in the three behavioral tasks (A–C). Subjects tended to prefer the labeled Coke drink over anonymous Coke (one-way Student's t test, $p < 0.01$).

The Coke label had a bigger effect in biasing subjects' preferences than the Pepsi label (one-way Student's t test, $p < 0.005$).

(E) Subjects who participated in the semianonymous Coke task later completed the anonymous taste test. The distribution of people's preference is significantly different from the Coke-labeled task (Mann-Whitney U test, $n_1 = 16$, $n_2 = 13$, $U = 142.5$, $p < 0.01$) but no different from the results in (A).

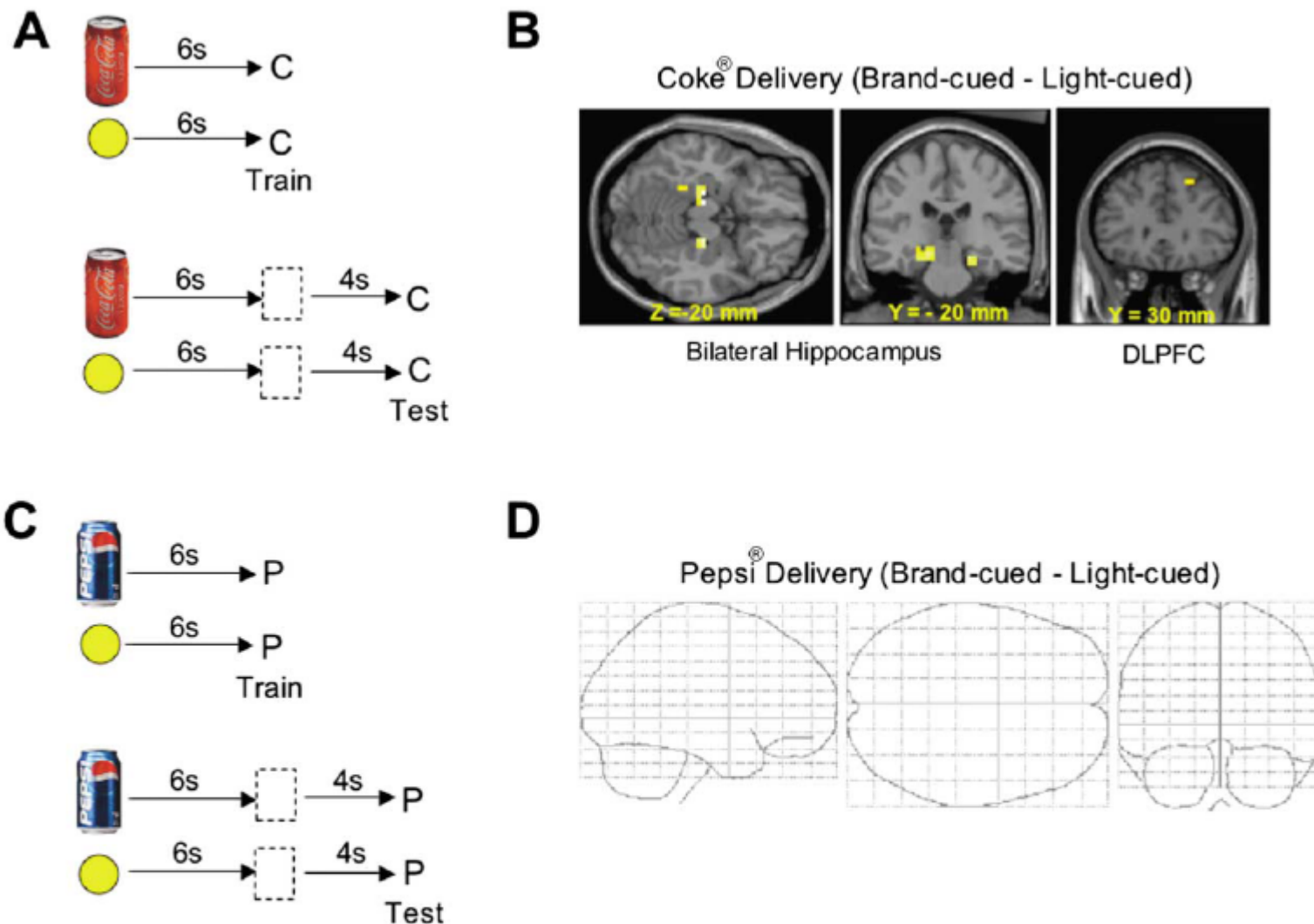


Figure 4. Effect of Brand Knowledge on Brain Responses in Semianonymous Tasks

(A) An image of a Coke can was used to cue the occurrence of Coke. A red or yellow circle (randomized across subjects) predicted the other. Both sodas delivered were Coke.

(B) Coke delivered following an image of a Coke can evoked significantly greater activity in several regions when contrasted against Coke delivered following a neutral flash of light. Significant activations ($p < 0.001$, uncorrected) were found bilaterally in the hippocampus (MNI coordinates $[-24, -24, -20]$ and $[20, -20, -16]$), in the left parahippocampal cortex (MNI coordinates $[-20, -32, -8]$), midbrain (MNI coordinates $[-12, -20, -16]$), and dorsolateral prefrontal cortex (MNI coordinates $[20, 30, 48]$). See Table 1 for details.

(C) In the scanner, an image of a Pepsi can was used to cue the occurrence of Pepsi. A red or yellow circle predicted the other soda, and both sodas delivered were Pepsi.

(D) No voxels survive $p < 0.001$ threshold (uncorrected) for the equivalent contrast in the semianonymous Pepsi experiment.