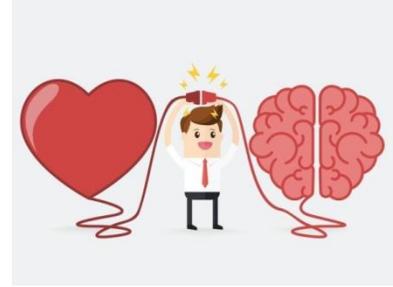


# Neurobiologie de « l'Amour »

*E. Hirsch, MP Valenti Hirsch*

## « Crise et Récompense »



**Les Dieux de l'Amour**



**Eros**



**Aphrodite**

### De l'Antiquité à ce Jour

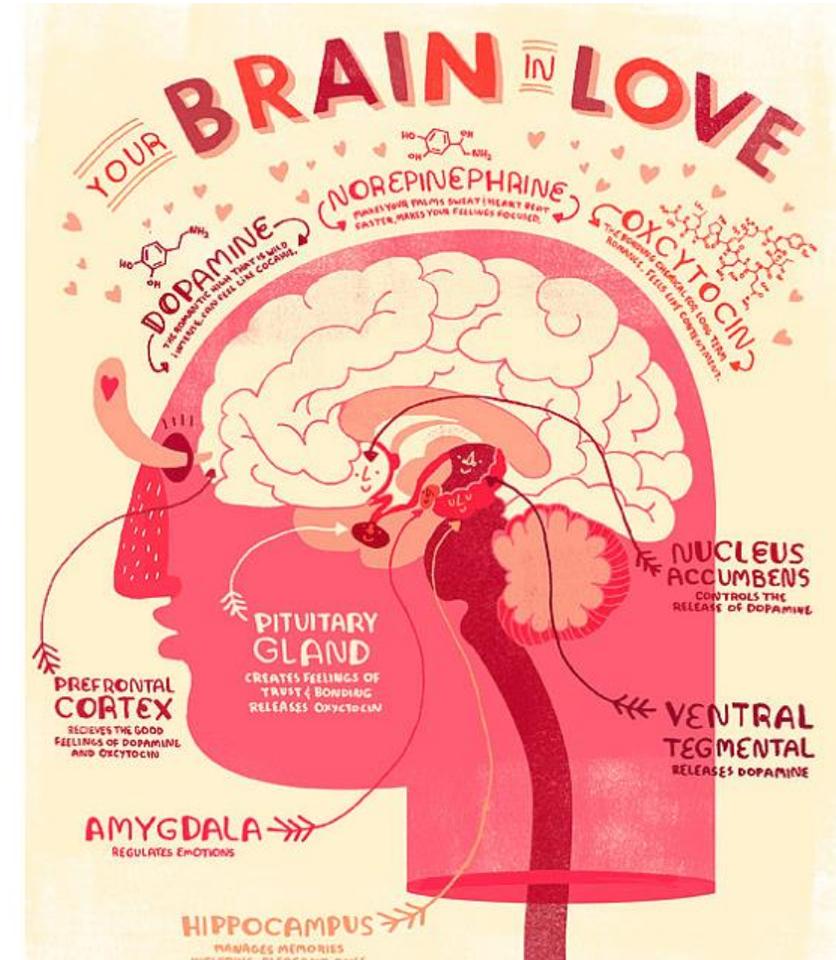
- **Le cœur et non le cerveau est le siège de l'état amoureux** et de nos émotions « *artère allant de l'annulaire gauche au cœur* » !
- **L'être humain nait amoureux** : son premier objet d'amour, celle qui le prend dans ses bras, pour le nourrir de lait et de sourires.
- **Sa vie, une longue quête d'amour**, satisfaite, contrariée, parfois tragique

# Neurobiologie de « l'Amour »



## Plusieurs façons d'« Être » en Amour

- Romantique, Attachement, Fidèle, Eternel, Vaillant
- Platonique, Non partagé (incompatible)
- Fou (celui qui fait « perdre la tête »),
- Timide (non avoué)
- Amitié, Sociable (pudique, sans passion, après plusieurs années de mariage)
- Familial, Dieu
- Propre (l'amour de soi dans le regard des autres)
- ...



# Neurobiologie de « l'Amour »

## *Vacances dans les Dolomites!*



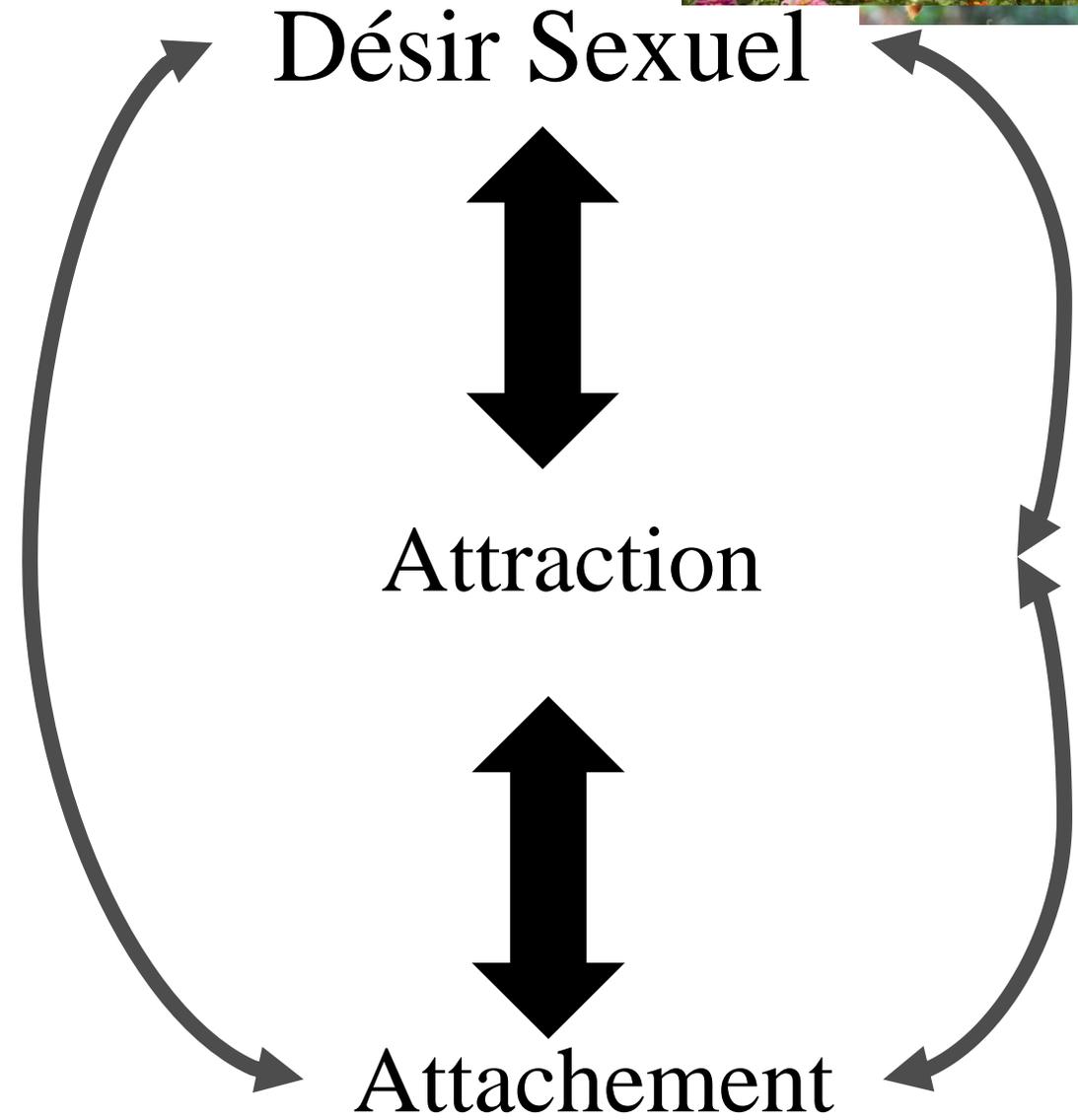
### Modèle Comportemental Humain?

*Si on me presse de dire pourquoi je l'aimais, je sens que cela ne se peut exprimer qu'en répondant : « parce que c'était lui, parce que c'était moi. »*

*La Boétie 1530-1563*

### ➤ **Systemes conservés dans l'évolution, interconnectés**

- ✓ *Modèles animaux*
- ✓ *Etudes chez l'Humain*

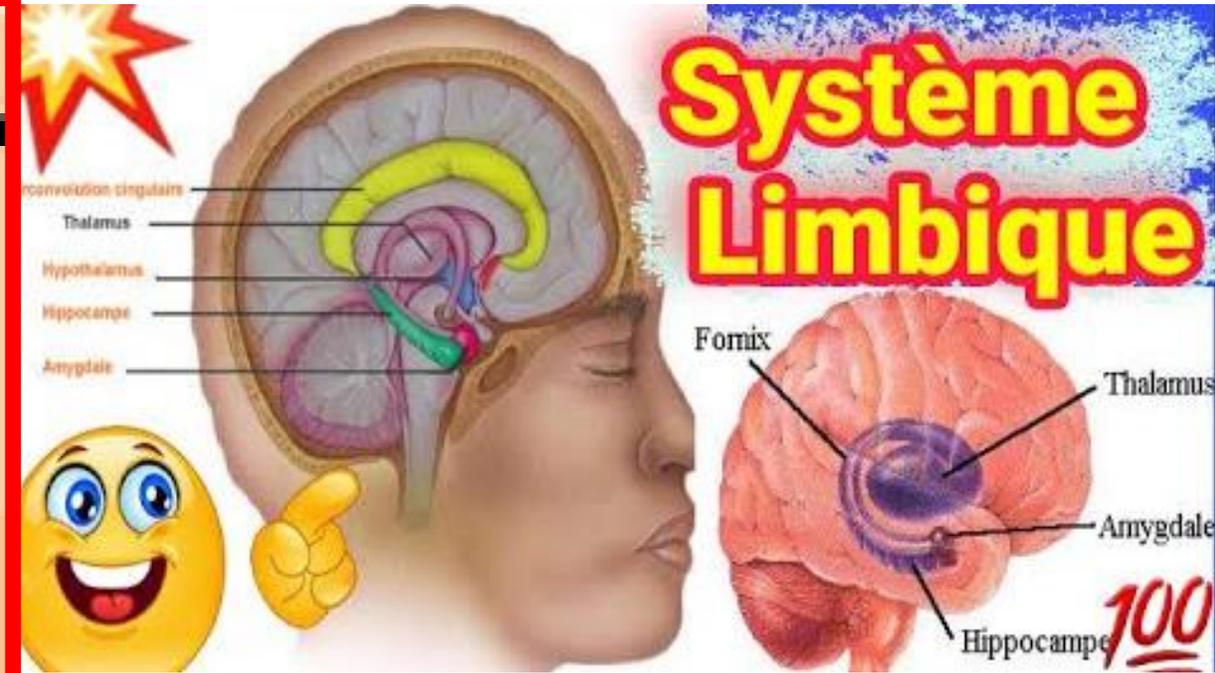


# Neurobiologie de « l'Amour »

## *Systeme Limbique*

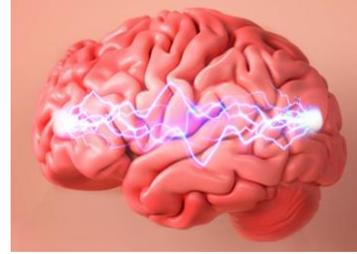


**Amygdales cérébrales:  
influencent le  
comportement et activités  
pour les rendre compatibles  
avec les besoins de  
l'organisme. Elle serait  
responsable de la réaction  
de colère entre autre**



[https://www.youtube.com/watch?v=uCzgVS\\_gj2o](https://www.youtube.com/watch?v=uCzgVS_gj2o)

# Que nous apprennent l'étude des Crises et Epilepsies ?



## Crise Epileptique et Epilepsie(s)

**Une crise d'épilepsie** est une manifestation transitoire se caractérisant par des signes et/ou de symptômes due à une activité neuronale anormale, excessive et/ou synchrone dans le cerveau.

**L'épilepsie** est un trouble du cerveau caractérisé par une prédisposition durable à générer des crises d'épilepsie et par les conséquences neurobiologiques, cognitives, psychologiques et sociales de cet état.

*Epileptic seizures and epilepsy: definitions proposed by the International League Against Epilepsy (ILAE) and the International Bureau for Epilepsy (IBE). Fisher RS et al. Epilepsia. 2005 Apr;46(4):470-2.*

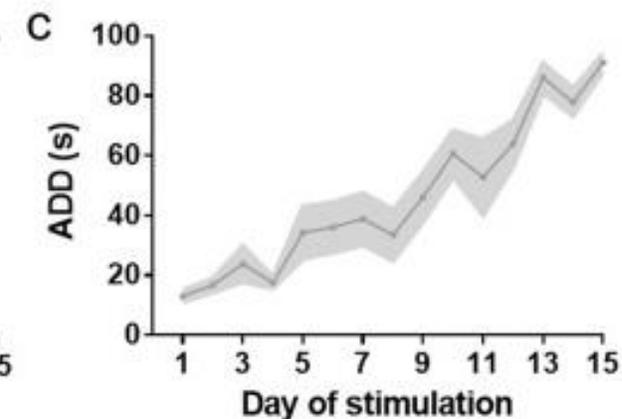
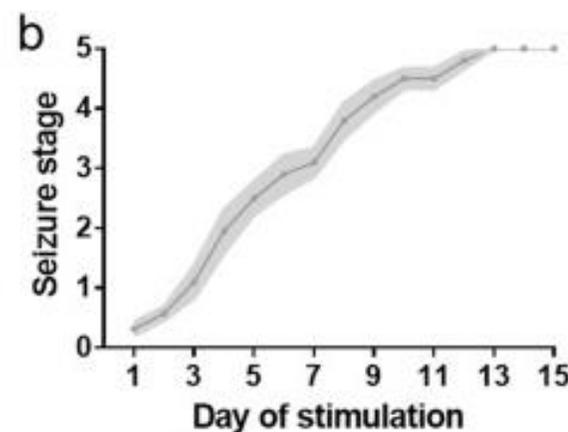
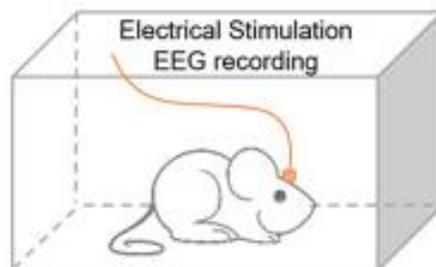
# Que nous apprennent l'étude des Crises et Epilepsies ?



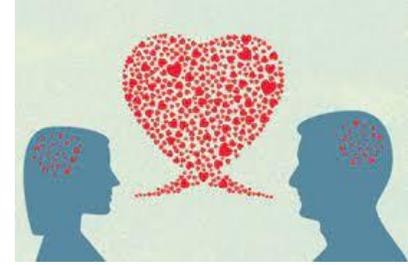
## « Kindling », Embrassement

McIntyre DC, Goddard GV. Transfer, interference and spontaneous recovery of convulsions kindled from the rat amygdala. *Electroencephalogr Clin Neurophysiol.* 1973 Nov;35(5):533-43.

**Stimulation Electrique Répétitive Infraliminaires**  
 « Limbique »  
 Amygdale, Hippocampe,...

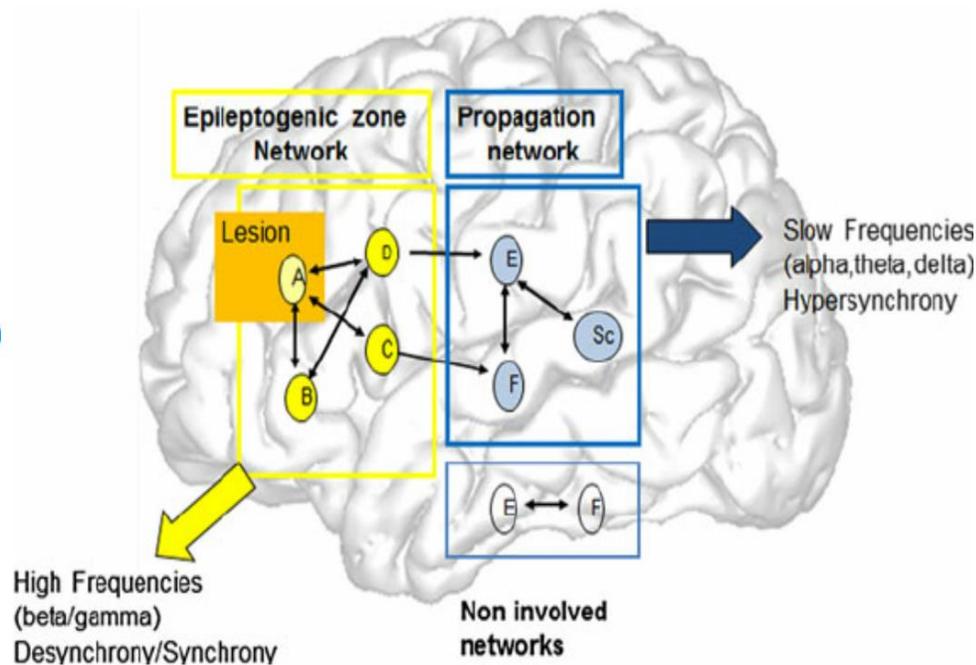


# Que nous apprennent l'étude des Crises et Epilepsies ?



## Classification des Crises Epileptiques

Début focal	
Avec altération de la conscience	Sans altération de la conscience
<b>Moteur</b> automatismes atonique clonique spasmes épileptiques hyperkinétique myoclonique tonique	
<b>Non-moteur</b> végétatif suspension d'activité cognitif émotionnel sensoriel	
Propagation bilatérale tonico-clonique	



## Non-Moteur

Végétatif

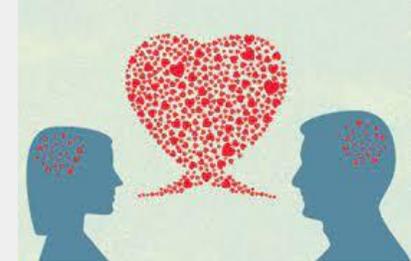
Suspension d'activité

Cognitif

Emotionnel

Sensoriel

# Que nous apprennent l'étude des Crises et Epilepsies ?



Does orgasm is an epileptic seizure



No, an orgasm is not an epileptic seizure.

Orgasm and epileptic seizures are two completely different physiological and neurological events. Orgasms are a natural and pleasurable response to sexual stimulation, while epileptic seizures are abnormal electrical activity in the brain that can result in various physical and mental symptoms. They are not related in any way.

## Orgasm Induced Seizures: A Rare Phenomenon - PMC

de SP Chaukimath · 2015 · Cité 13 fois — [3] **Sexual orgasm is not recognized as a stimulus for reflex epilepsy** according to the International League against Epilepsy. Seizures evoked b...  
[Abstract](#) · [Introduction](#) · [Case Report](#)



Orpha.net

<https://www.orpha.net> > OC\_Exp

## Orphanet: Orgasm induced seizures

Orgasm-induced seizures ... Orgasm-induced seizures is a **rare neurologic disease** characterized by complex partial seizures with or without secondary ...



Psychology Today

<https://www.psychologytoday.com> > ...

## The Truth About Sexual Seizures

11 janv. 2020 — **Temporal lobe seizures can be triggered by an orgasm**, or even cause orgasms. Orgasm-induced seizures occur much more commonly in women than in ...



MedicineNet

<https://www.medicinenet.com> > arti...

## Can Epileptics Have Orgasms? Seizures & Sexual Health

19 mai 2022 — **Many people with epilepsy can enjoy satisfying orgasms**. However, epilepsy and seizure disorders can have an impact on relationships and ...  
[Sex Problems](#) · [Seizures](#) · [Relationships](#)

# Que nous apprend la Neurobiologie chez l'Homme et l'Animal?

*Vacances dans les Dolomites!*



## Neurochimie

*Tomber amoureux amène notre corps à libérer un flot de produits chimiques de bien-être qui déclenchent des réactions physiques spécifiques. D'après Pat Mumby, Ph.D.*

### Dopamine

The rewarding chemical

- Completing a task
- Doing self-care activities
- Eating food
- Celebrating little wins



### Oxytocin

The love hormone

- Hugging your loved ones
- Playing with a dog
- Playing with a baby
- Holding hands



### Serotonin

The mood stabilizer

- Sun exposure (be sun safe)
- Meditating
- Running
- Being in nature



### Endorphin

The pain killer

- Laughing
- Exercising
- Dark chocolate
- Essential oils

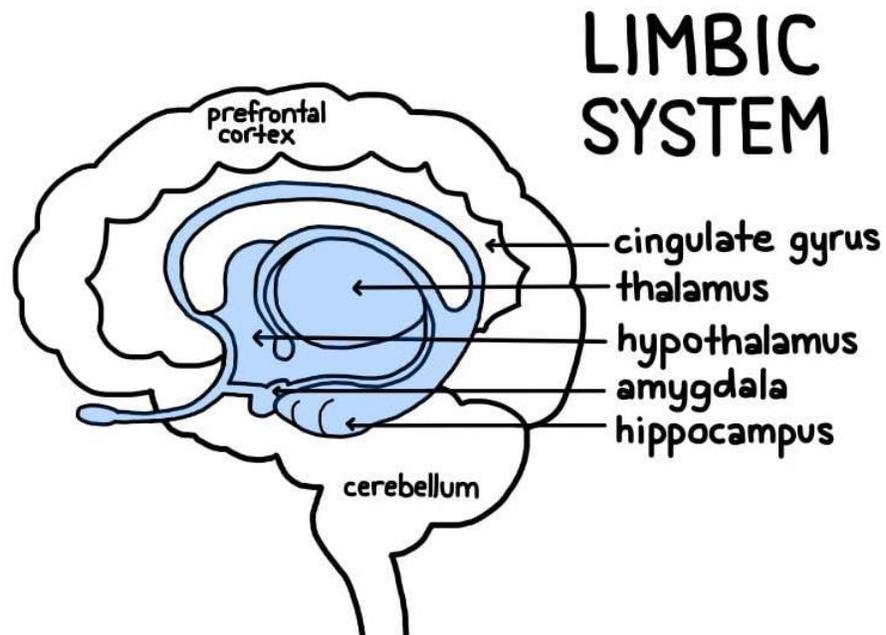


# Que nous apprend la Neurobiologie chez l'Homme et l'Animal?



## Réseaux

*Cet élixir d'amour interne est responsable à travers des Réseaux essentiellement limbiques qui sont à l'origine des manifestations végétatives comme: la rougeur de nos joues , la transpiration de nos paumes et de la course de notre cœur. D'après Pat Mumby, Ph.D*

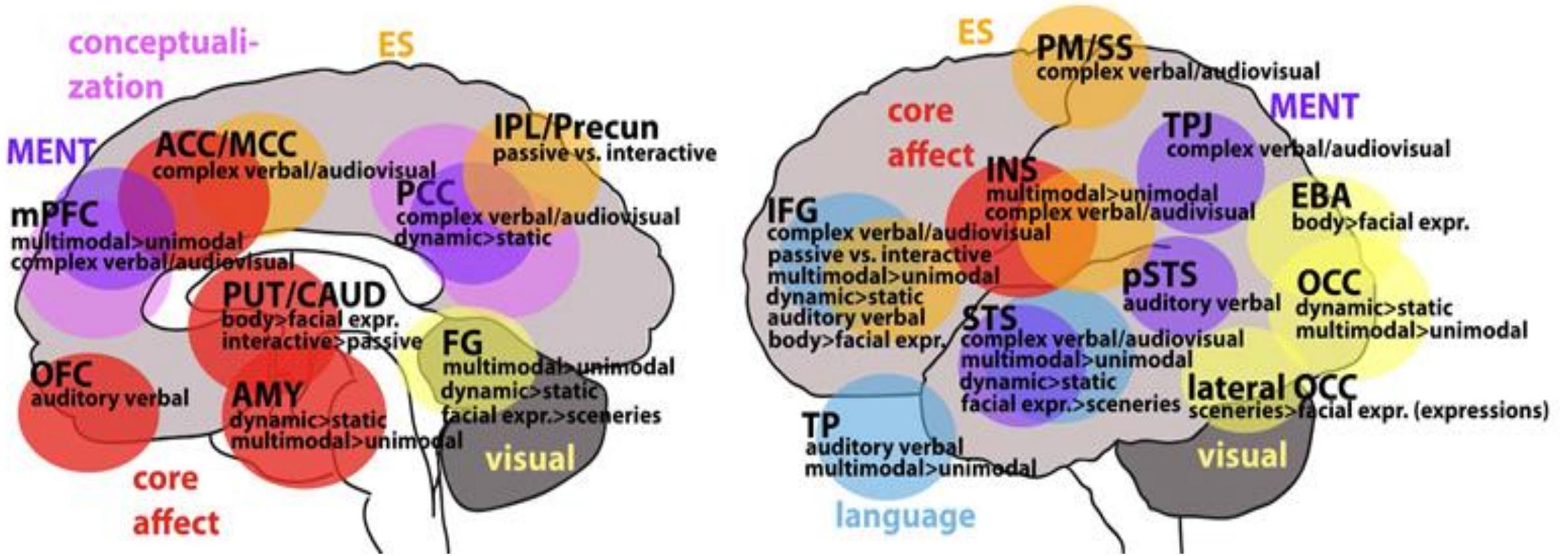


I love you with all my limbic system!

*Le système limbique, appelé parfois cerveau limbique ou cerveau émotionnel, est le groupe de structures de l'encéphale jouant un rôle très important dans le comportement et dans diverses émotions comme l'agressivité, la douleur morale, la peur, le plaisir ainsi que la formation de la mémoire.*

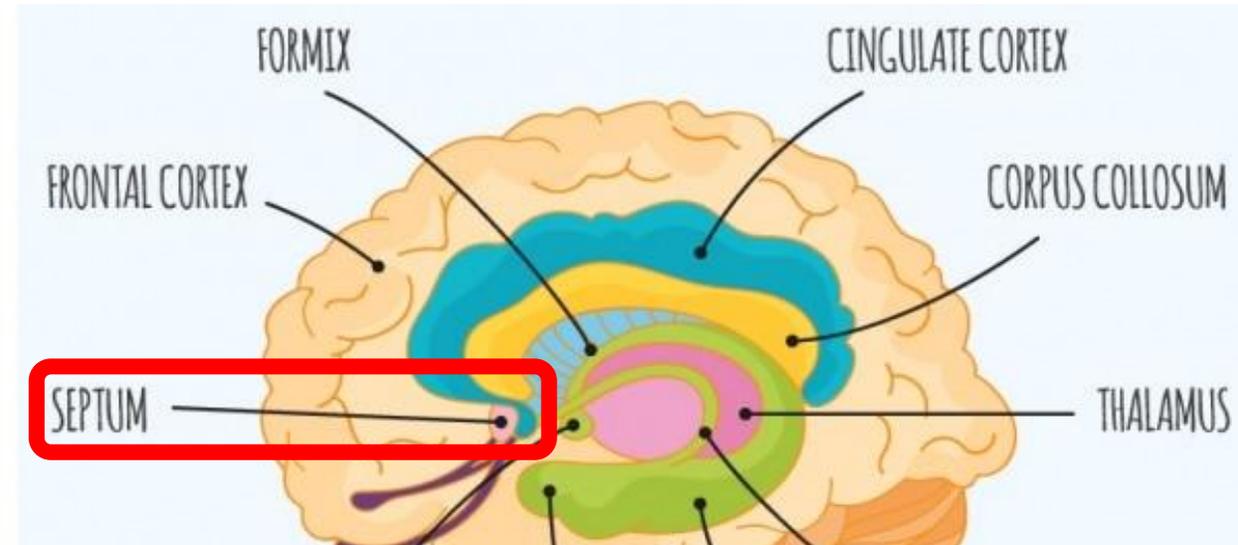
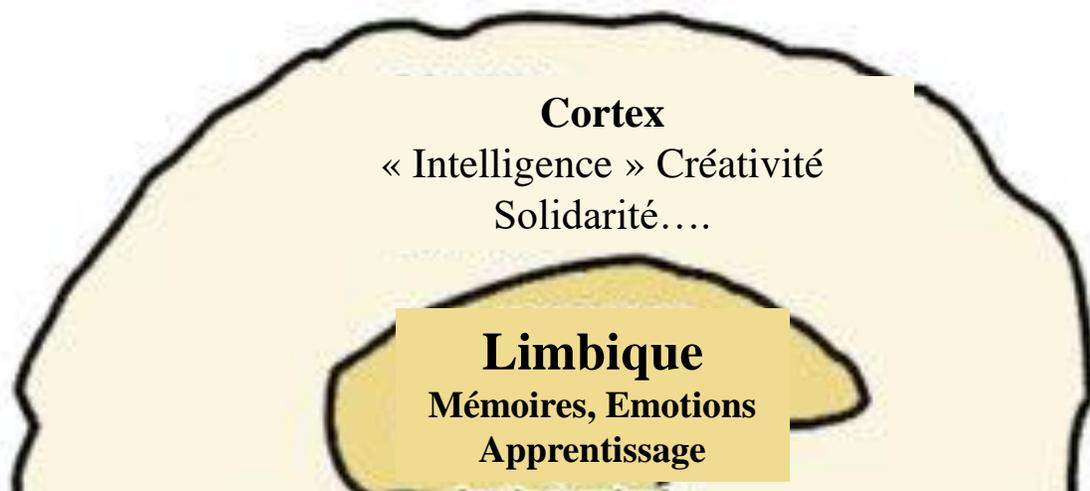
# Neurobiologie de « l'Amour »

## *Neo-Cortex et Système Limbique*



# Neurobiologie de « l'Amour »

## *Systeme Limbique*



ELSEVIER

Neuropsychologia 45 (2007) 2645–2659

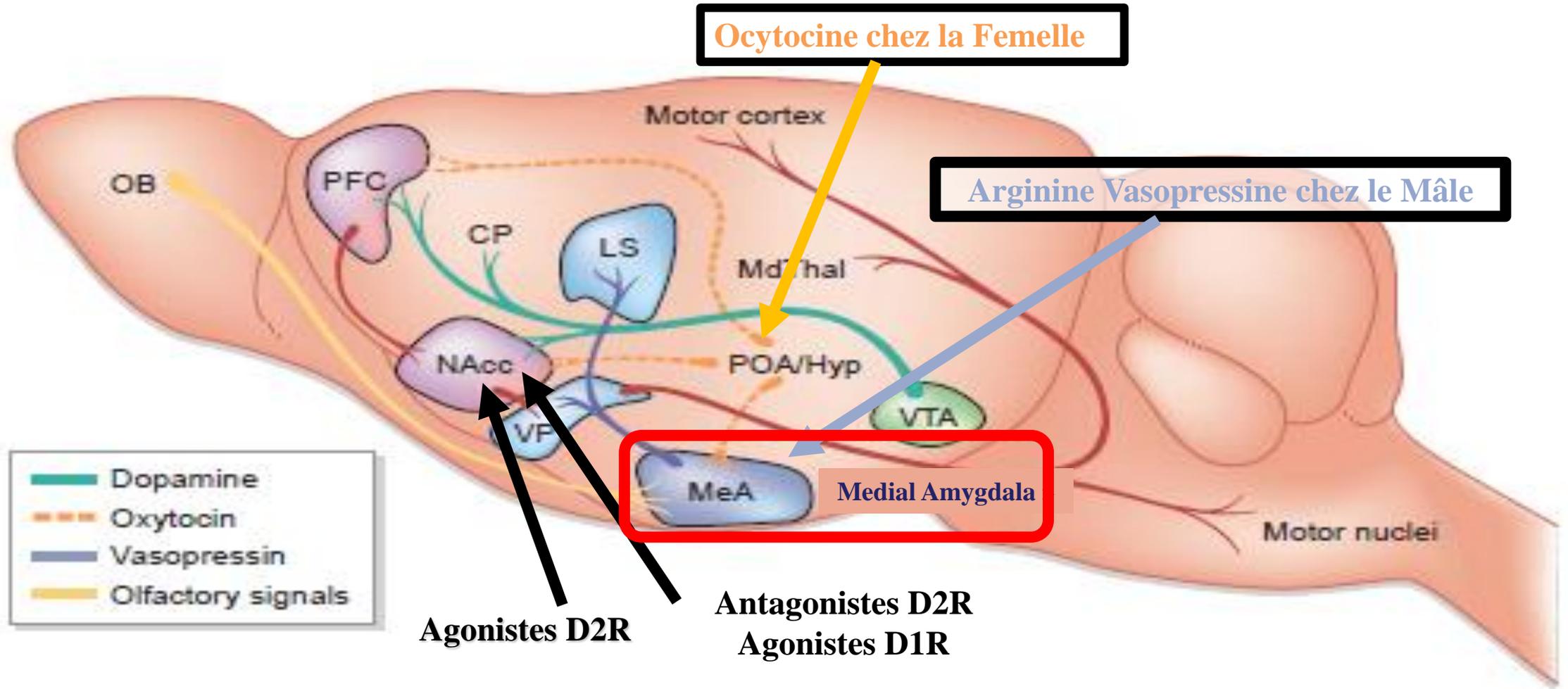
[www.elsevier.com/locate/neuropsychologia](http://www.elsevier.com/locate/neuropsychologia)

Reviews and perspectives

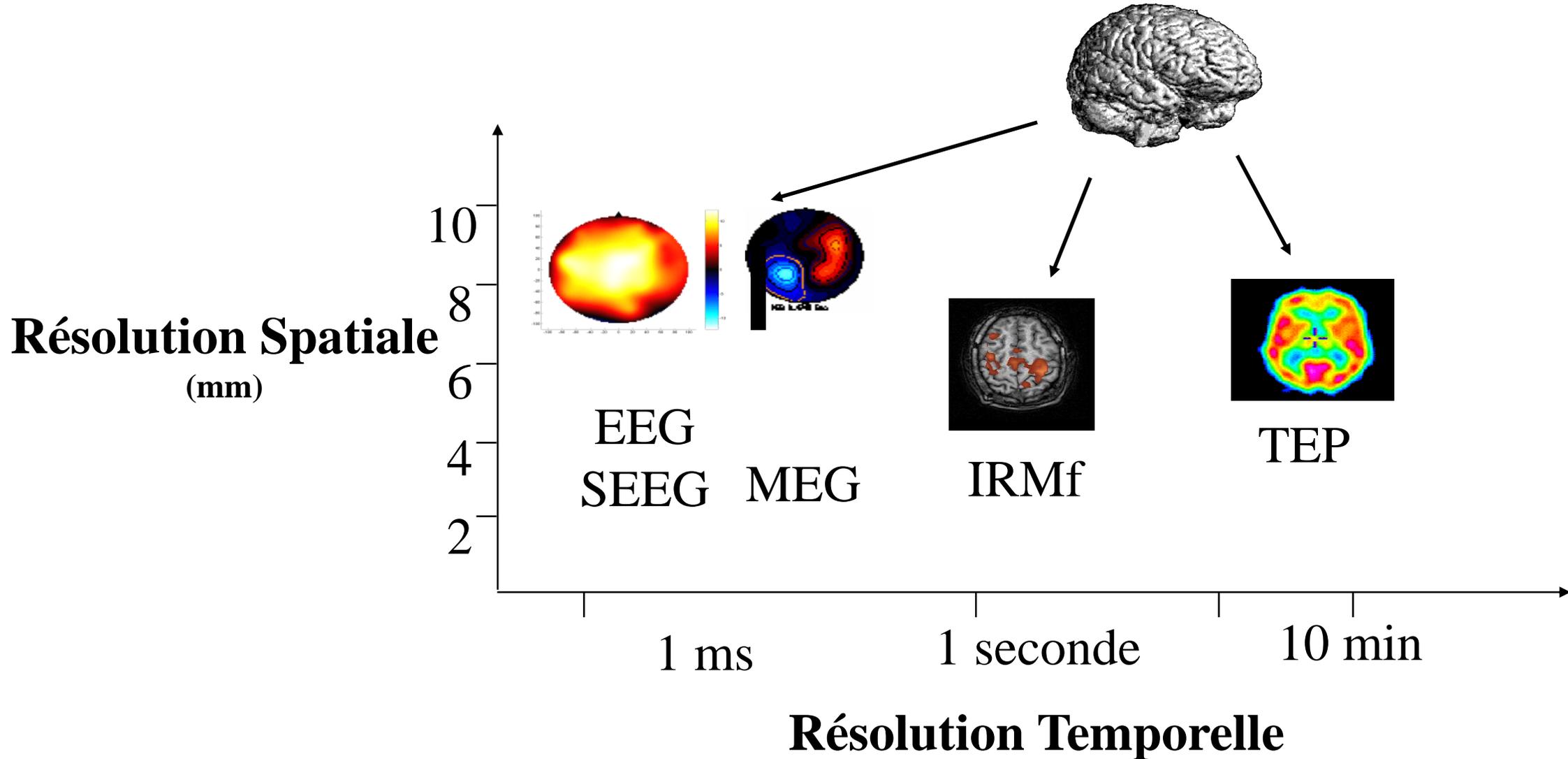
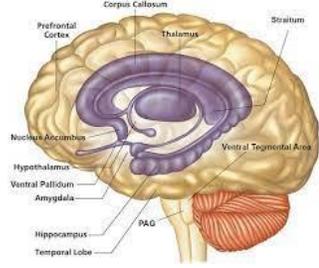
Toward an understanding of the cerebral  
substrates of woman's orgasm

Francesco Bianchi-Demicheli<sup>a,b</sup>, Stephanie Ortigue<sup>c,d,\*</sup>

# Que nous apprend la Neurobiologie chez l'Homme et l'Animal?



# Limites des Techniques d'Exploration du Cerveau



# Que nous apprend la Neurobiologie chez l'Homme et l'Animal?



## ➤ Préparation

- Neurochimie, Réseaux

## ➤ Action

- Neurochimie, Réseaux

## ➤ Récompense

- Neurochimie, Réseaux

## ➤ Déception

- Neurochimie, Réseaux

## Amour dans le Temps



# Crises Epileptiques Réflexes Induites par l'Acte de Masturbation?



Les crises épileptiques réflexes se produisent lorsque celles-ci surviennent en **réponse à un stimulus précis**, comme:

- Stimulation Lumineuse intermittente
- Bruit soudain
- Tâches langagières
- Certains mouvements

## Cas Cliniques 1

**FLE.Dan 2714172**

**né 14/06/1991**

**ATCD** Migraines

**15?-28 ans** Contraction « dystonique? » main lors de la masturbation puis ? Crise Focale Motrice Main G secondairement Tónico-Clonique

**EEG** Veille sommeil et mise en situation normaux

**IRM** « Dysplasie Hypoplasie temporale Droite? »

**Traitements** Lacosamide 300mg/j inefficace, Levetiracetam 3000Mg/j **Evolution** Favorable

- Tooth brushing- induced seizures: a case report. Koutroumanidis M et al. *Epilepsia*. 2001 May;42(5):686-8.
- Tooth-brushing epilepsy with ictal orgasms. Chuang YC et al. *Seizure*. 2004 Apr;13(3):179-82.
- Orgasm-induced seizures: male studied with ictal electroencephalography. *Seizure*. 2010 Jun;19(5):306-9.

# Amour dans le Temps



## ➤ Préparation

- Neurochimie, Réseaux

## ➤ Action

- Neurochimie, Réseaux

## ➤ Récompense

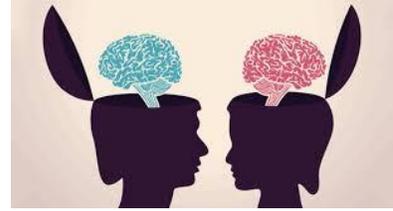
- Neurochimie, Réseaux

## ➤ Déception

- Neurochimie, Réseaux



# Préparation Les Androgènes



## Chez l'Homme:

➤ **Taux de testostérone** circulant chez l'homme corrélé à une plus grande activité sexuelle: *Expériences de supplémentation hormonale dans un contexte d'hypogonadisme acquis (chirurgical ou chimique).*

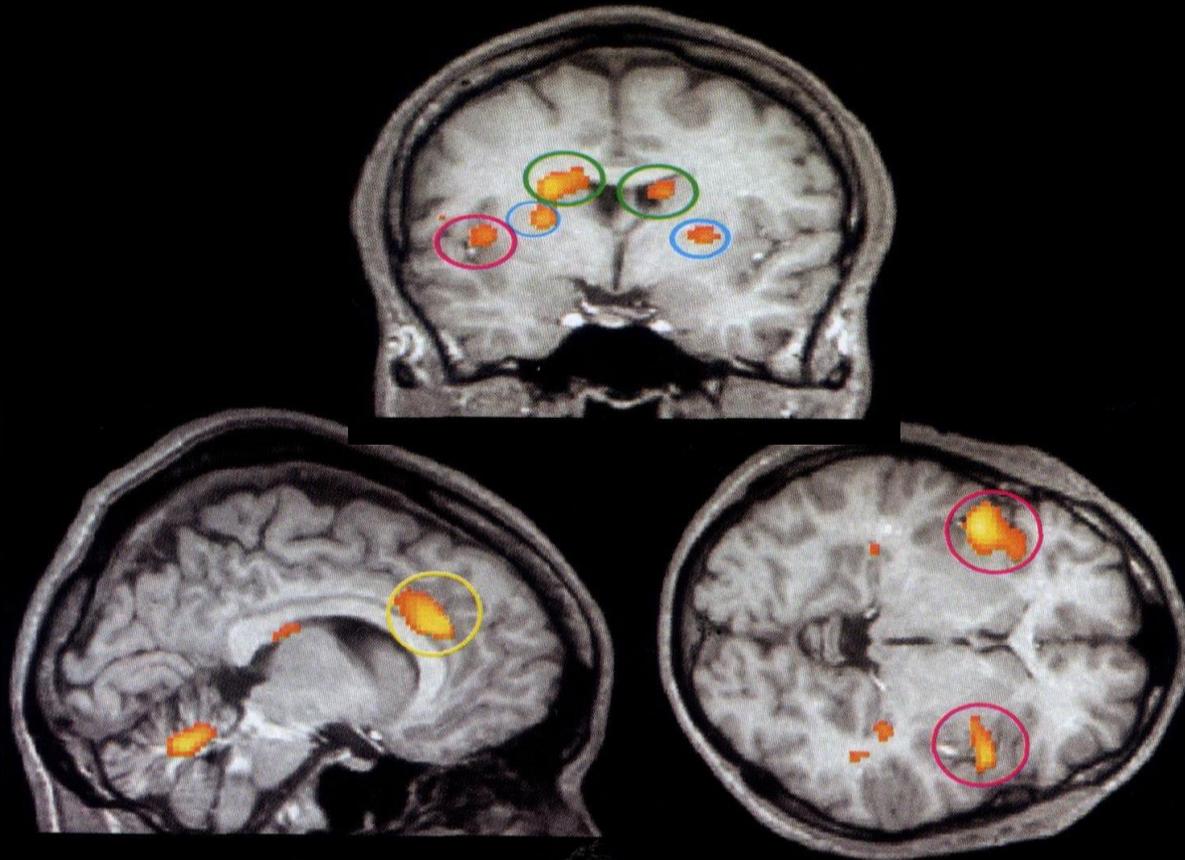
## Chez la Femme:

➤ Augmentation du désir sexuel chez la femme pendant et autour de l'ovulation: *Traitement par testostérone en patch des faibles désirs sexuels après la ménopause.*

*Bagatell et al., J Clin Endocrinol Metab. 1994; Van Goozen et al., Arch Sex Behav 1997; Anderson et al., J Clin Endocrinol Metab 1999; Tuiten et al., Arch Gen Psychiatry 2000; Davis et al., 2008)*

# Groupe de Sujets Amoureux, Visualisation des Photos de leur Partenaire vs Ami(e)s

## Activation

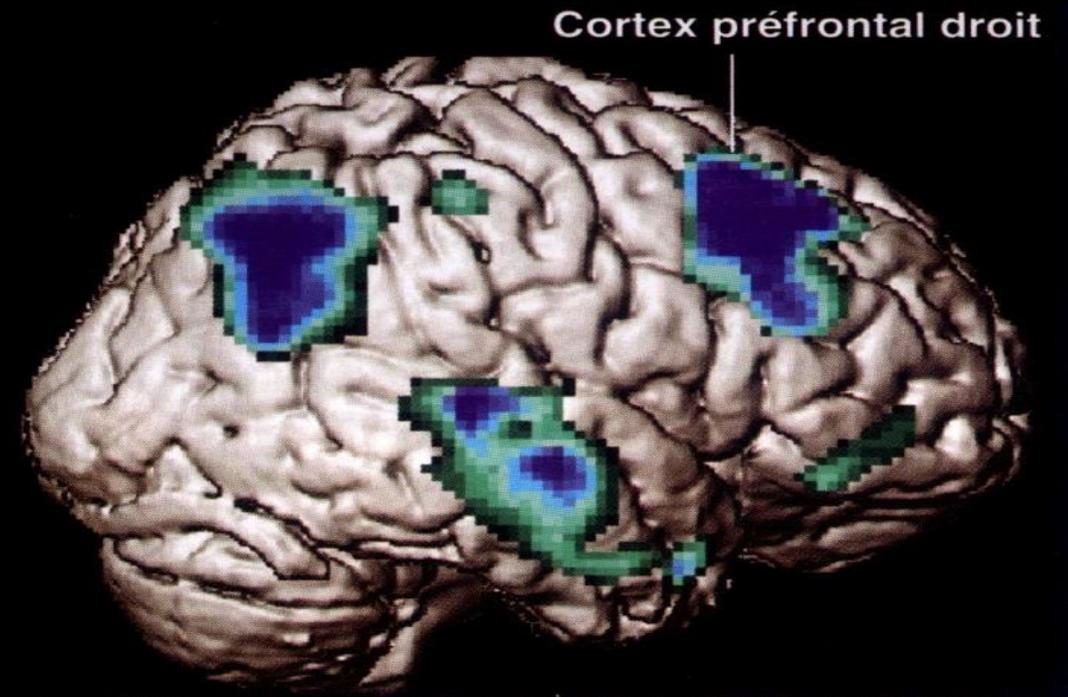


○ Cortex cingulaire

○ Insula

○ Noyau caudé

## Inhibition



*Hamann et al., Nature Neuroscience 2004*

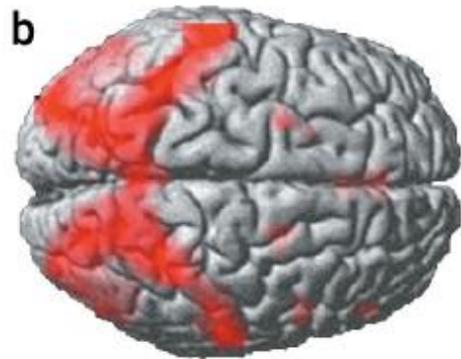
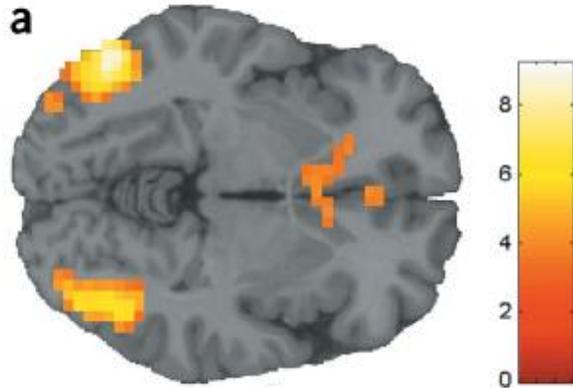
# Préparation

## Visualisation de Films Erotiques

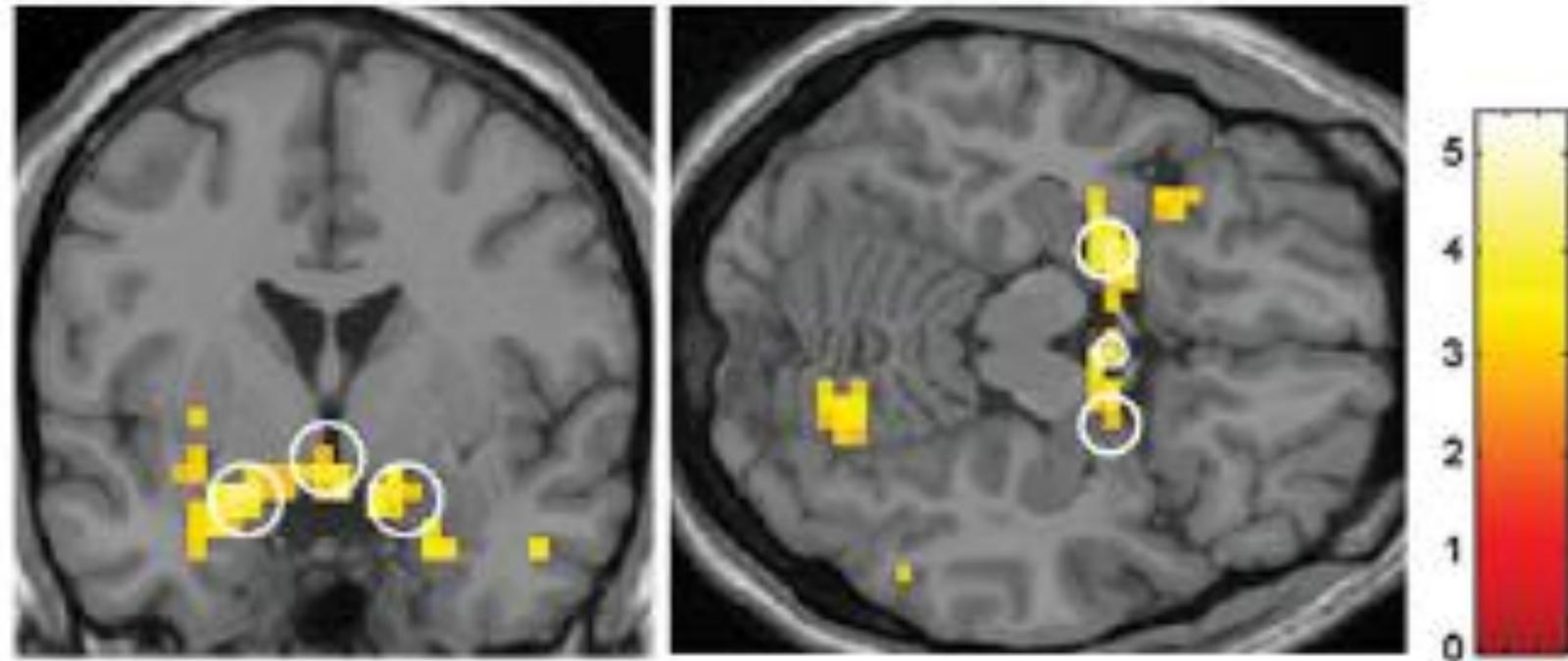


### Zones d'activation communes

Scènes érotiques de couple  
versus stimulus neutre



Films érotiques (hétéro) de couple versus stimulus neutre



# Amour dans le Temps



## ➤ Préparation

- Neurochimie, Réseaux

## ➤ Action

- Neurochimie, Réseaux

## ➤ Récompense

- Neurochimie, Réseaux

## ➤ Déception

- Neurochimie, Réseaux





# Action

## Neurobiologie de .....

### Magnetic resonance imaging of male and female genitals during coitus and female sexual arousal

Willibrord Weijmar Schultz, Pek van Andel, Ida Sabelis, Eduard Mooyaart



#### What is already known on this topic

It has been extremely difficult to investigate anatomical changes during the act of coitus and the female sexual response

Modern magnetic resonance imaging allows exploration of aspects of living anatomy

#### What this paper adds

Taking MR images of the male and female genitals during coitus is feasible

During 'missionary position' intercourse the penis has the shape of a boomerang

During female sexual arousal without intercourse the uterus rises and the anterior vaginal wall lengthens

The size of the uterus does not increase during sexual arousal

*British Medical Journal 1999*

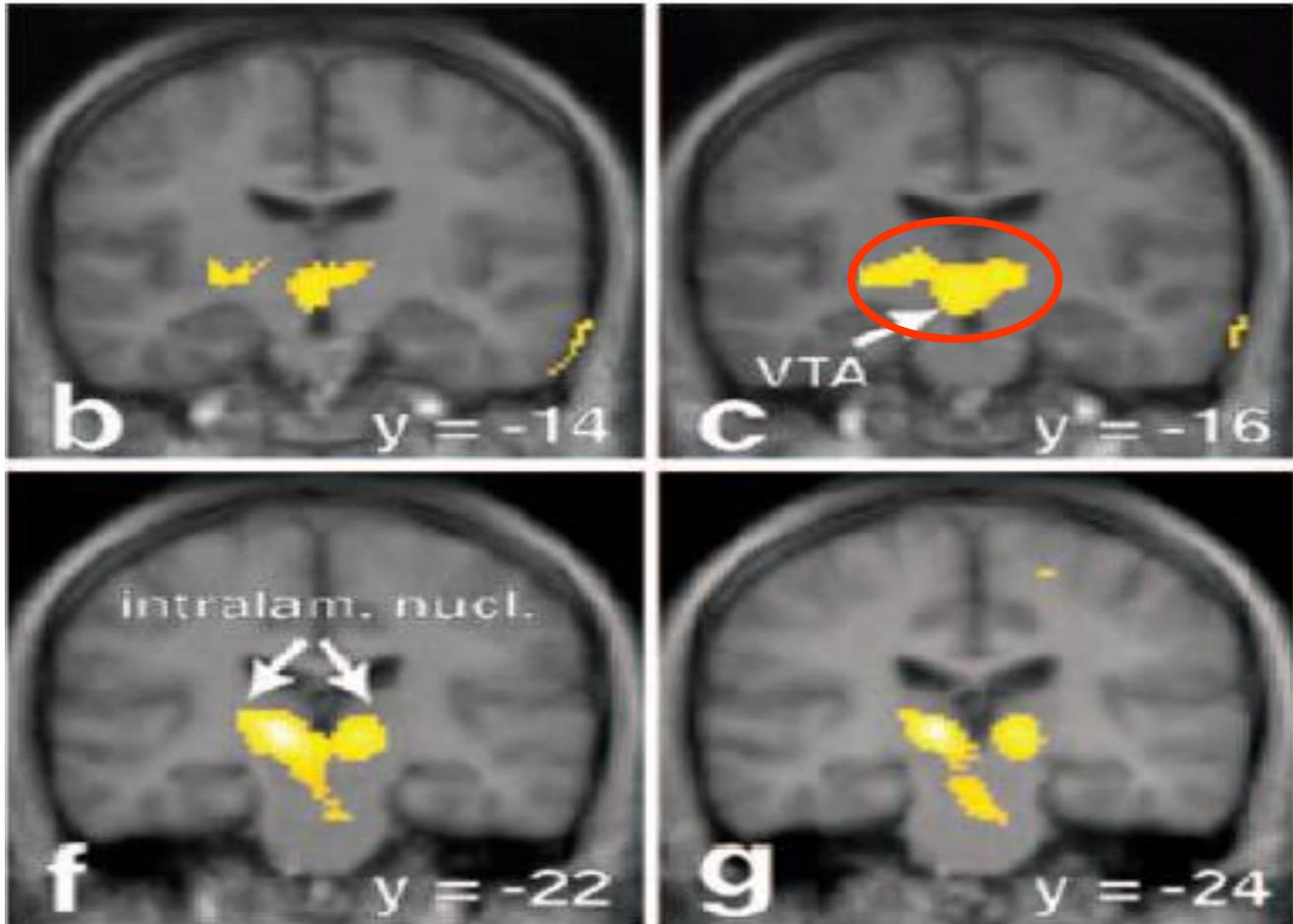
# Récompense

## Neurobiologie de l'Ejaculation

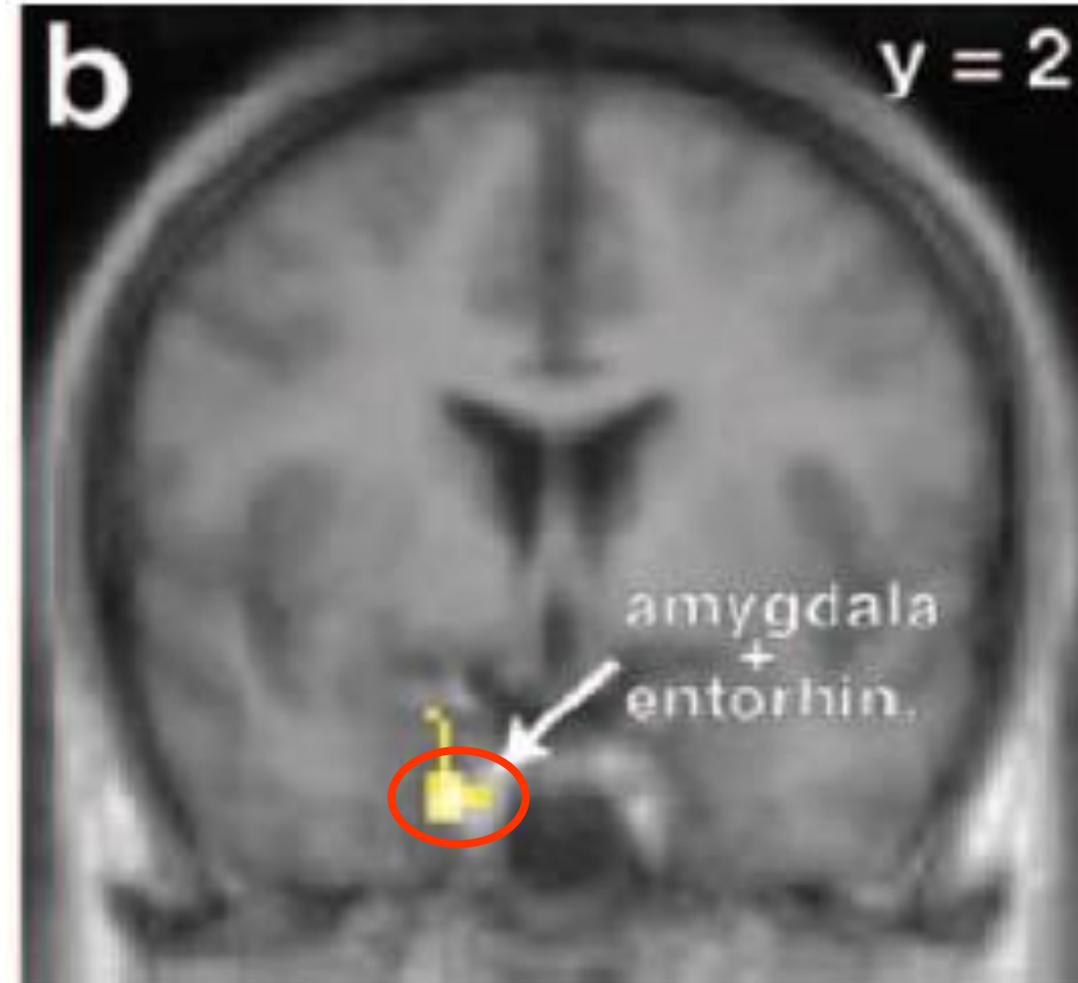
*Holstege et al. J Neuroscience 2003*



### Régions Activées



### Régions Inhibées



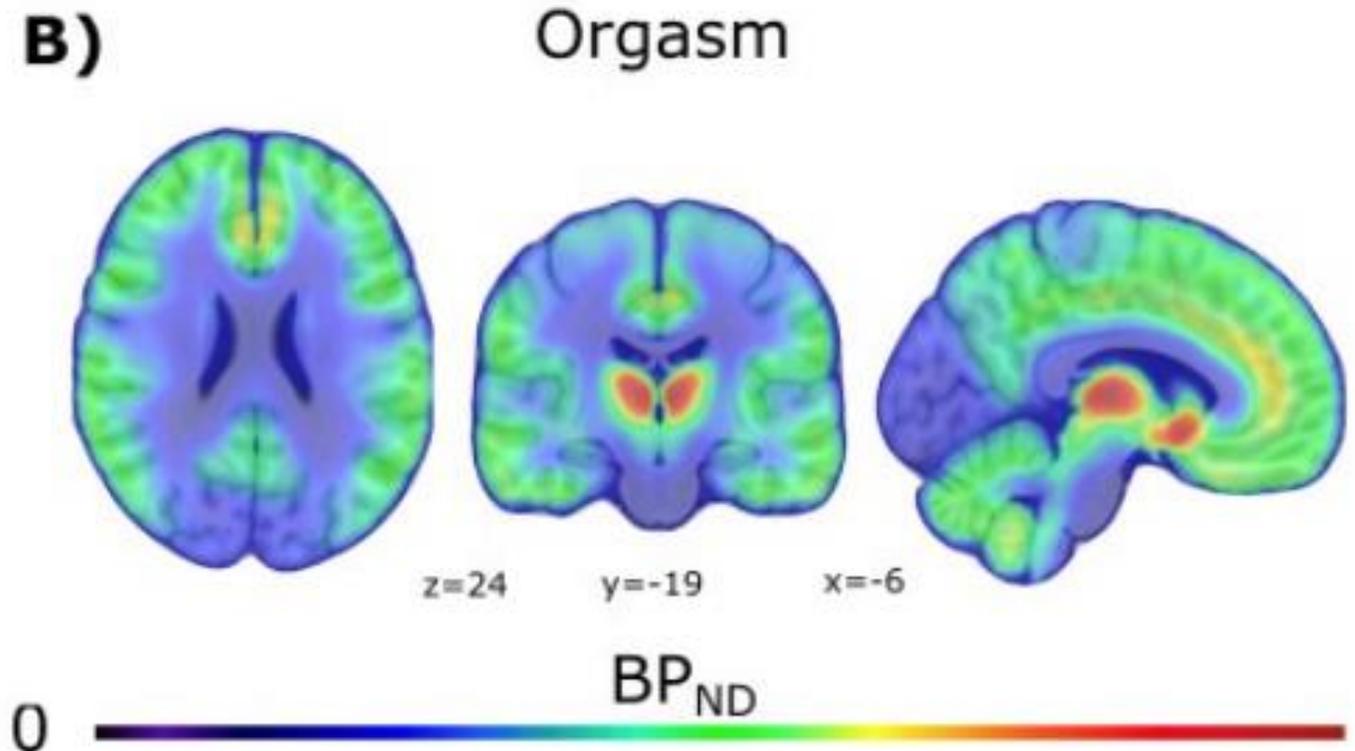
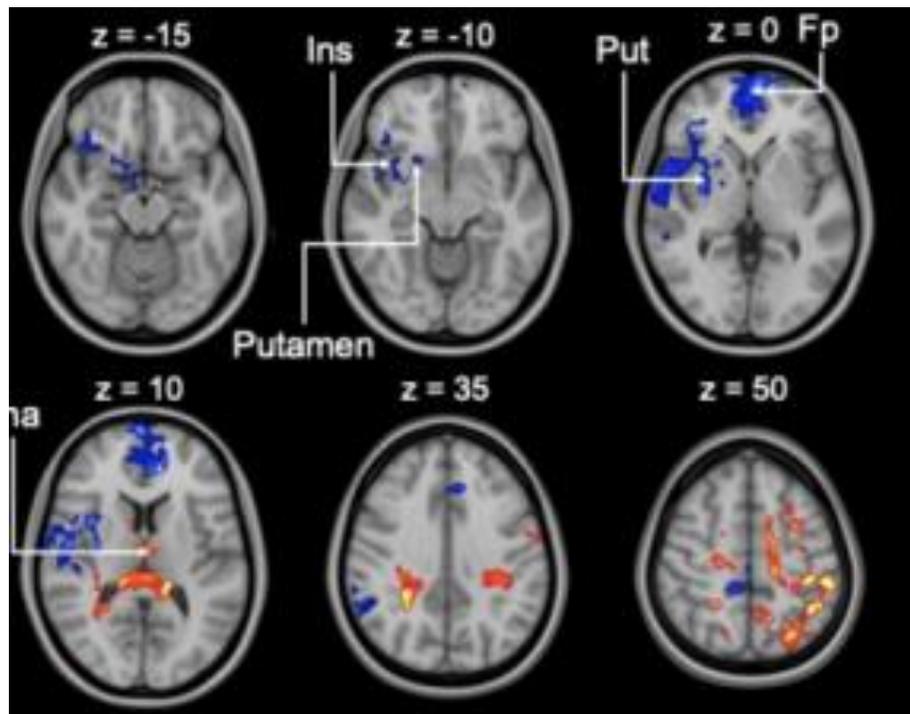
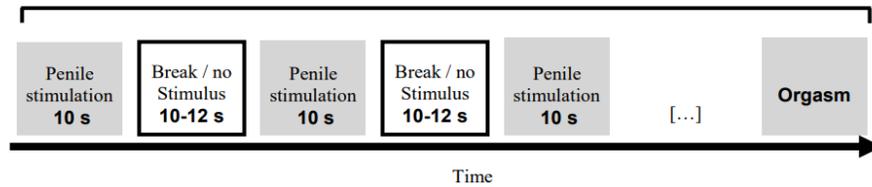
# Neurobiologie de « l'Amour »

## Récompense



Endogenous Opioid Release After Orgasm in Man: A Combined PET/Functional MRI Study. Jern P et al J Nucl Med. 2023 Aug;64(8):1310-1313.

Stimulation - rest blocks looped until orgasm is reached



# Crise Epileptique Orgasmique



## Cas Cliniques 2

« L'orgasme est présenté comme un modèle dans lequel la **stimulation sexuelle induit une amplification du couplage des systèmes oscillatoires mécaniques et neuronaux**, créant ainsi des **réseaux fonctionnels synchronisés au sein desquels de multiples processus de rétroaction positive se croisent de manière synergique pour contribuer à l'expérience sexuelle.** »

*What is orgasm? A model of sexual trance and climax via rhythmic entrainment. Safron A. Socioaffect Neurosci Psychol. 2016 Oct 25;6:31763.*

**Mme C Ros. 1399569**

**60 -66 ans** Sensation d'excitation physique, tension seins puis clitoridienne, sensation d'excitation psychique, orgasme.

Pas de sensation de troubles de la conscience

Survenu le soir, plus rarement en journée

**Durée brève** parfois en salves.

EEG normaux

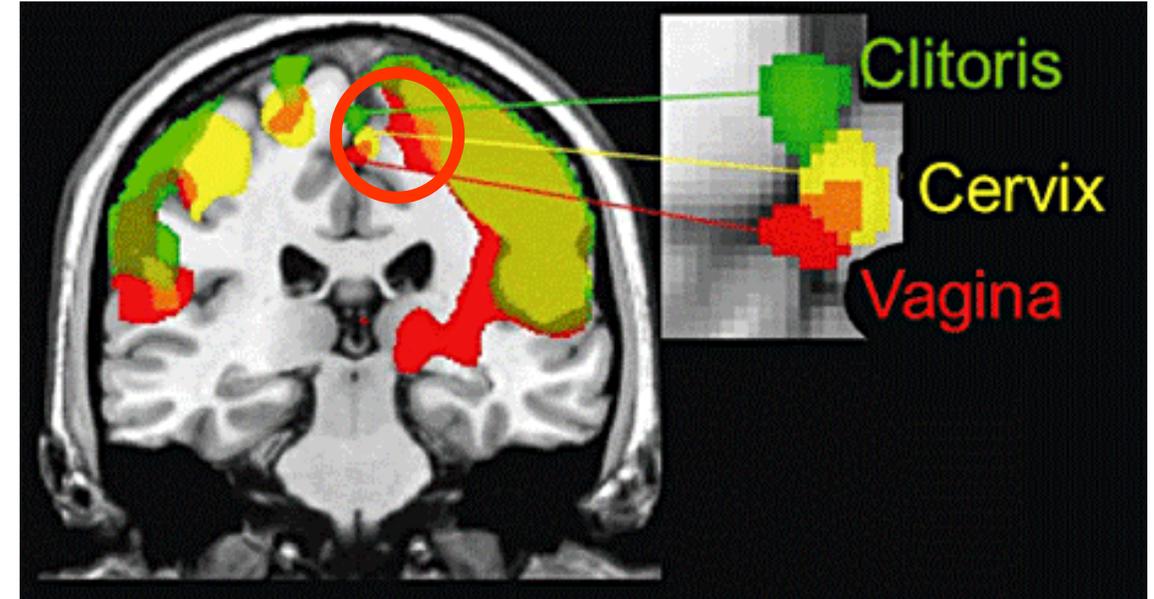
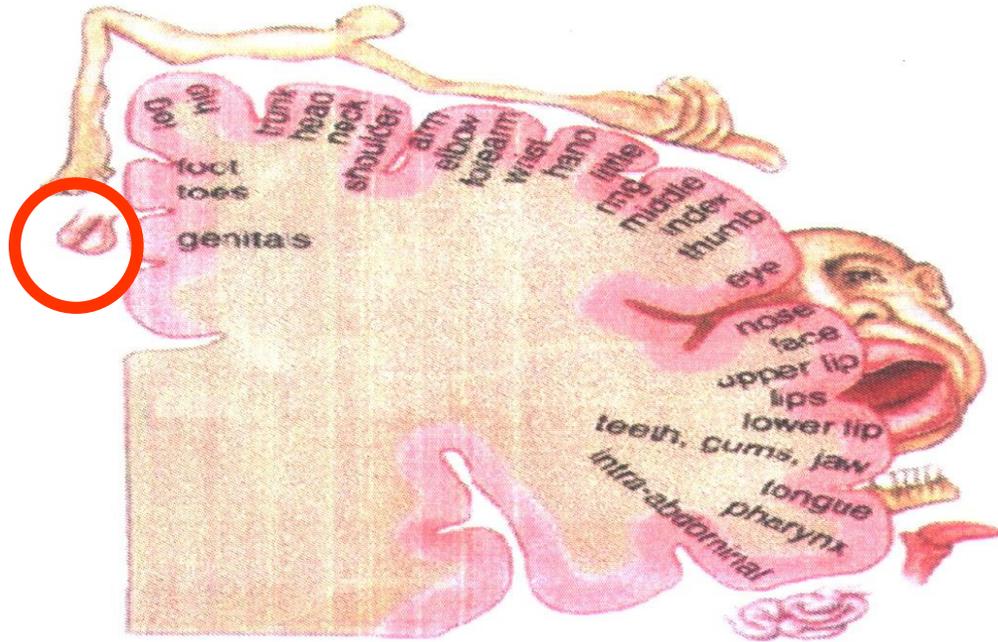
IRM: lésions vasculaires ou inflammatoires

**Traitement:** Lamotrigine 200mg/Jour

- Orgasmic epilepsy. Calleja J et al. Epilepsia 1988;29:635-9
- Orgasmic aura originates from the right hemisphere. Janszky J et al. Neurology. 2002 Jan 22;58(2):302-4.
- Epilepsy and Ecstatic Experiences: The Role of the Insula. Picard F et al. Brain Sci. 2021 Oct 22;11(11):1384.

# Préparation

## Représentation Organes Génitaux chez l'Homme et la Femme



PENFIELD and Jasper stated in 1954, "Curiously enough, no tactile sexual experience (in connection with a seizure) has ever been reported, so far as our experience goes, although such things could hardly be missed in these days of promiscuous consulting room confessions."<sup>1</sup>

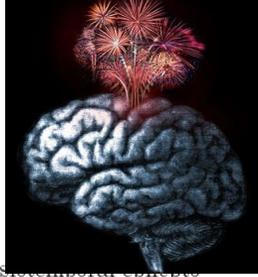


### Women's Clitoris, Vagina, and Cervix Mapped on the Sensory Cortex: fMRI Evidence

Barry R. Komisaruk PhD ✉, Nan Wise LCSW, Eleni Frangos BA, Wen-Ching Liu PhD, Kachina Allen PhD, Stuart Brody PhD

First published: 28 July 2011 | <https://doi.org/10.1111/j.1743-6109.2011.02388.x> | Citations: 36

# Crise Epileptique Orgasmique



## MANIFESTATIONS GÉNITALES ET « SEXUELLES » LORS DES CRISES EPILEPTIQUES PARTIELLES CHEZ L'HOMME

C. STOFFELS (1), C. MUNARI (1), A. BONIS (2), J. BANCAUD (1) (2) et J. TALAIRACH (2) (1)

(1) U. 97 INSERM sur l'épilepsie (Directeur J. BANCAUD), 2 ter, rue d'Alésia, 75014 Paris

(2) Service de Neurochirurgie fonctionnelle (Pr J. TALAIRACH), Hôpital Sainte-Anne,  
1, rue Cabanis, 75014 Paris

### Orgasmic aura originates from the right hemisphere

**Abstract**—The authors present a patient with right mesiotemporal epileptogenic region who experienced orgasmic epileptic aura. Twenty-two similar published cases were also evaluated. Among 15 patients with unilateral EEG foci, 13 (87%) had right and 2 (13%) had left focus. All of the nine patients who had sufficient data on ictal onset area had right-sided seizure onset. The authors suggest that orgasmic aura is an ictal lateralizing sign to the right hemisphere.

NEUROLOGY 2002;58:302-304

J. Janszky, MD; A. Szücs, MD; P. Halász, MD, PhD; C. Borbély, MSc; A. Holló, MD; P. Barsi, MD;  
and Z. Mirnics, MSc

	<i>Crises</i>	<i>Malades</i>
Erection	1	1
Manif. génitales « sensibles »	30	8
Masturbation	5	5
Orgasme	10	1
Activité sexuelle « dyspraxique »	7	4

# Orgasme est-il une Crise Epileptique ?



## EEG during masturbation and ejaculation

 Benjamin Graber

1985, Archives of Sexual Behavior

 1467 Views  13 Pages  2 Files ▾

 Psychology, Electroencephalography, Autonomic Nervous System, Humans, Spectral analysis ...more ▾

Show more ▾

# NON

The occurrence of a distinctive EEG pattern specifically related to sexual arousal and orgasm would provide a reliable and convenient means of identifying such events in the laboratory and would also provide clues to cerebral structures involved in the processes. EEG-polygraph recordings were obtained under rigorously controlled conditions in four normal male subjects during masturbation and ejaculation. The EEG data were subjected to both impressionistic and quantitative analyses. They showed no remarkable changes during the sequence of relevant physiological responses. The sole effect was a slight depression of alpha activity, a well-known nonspecific effect associated with changes in attention and arousal. Examination of the literature shows little agreement among reported results of studies of EEG changes during orgasm. It is likely that at least some reported changes were artifactual. It is concluded that the case for the existence of EEG changes specifically related to sexual arousal and orgasm remains unproven.

# POSITIVE REINFORCEMENT PRODUCED BY ELECTRICAL STIMULATION OF SEPTAL AREA AND OTHER REGIONS OF RAT BRAIN<sup>1</sup>

JAMES OLDS<sup>2</sup> AND PETER MILNER

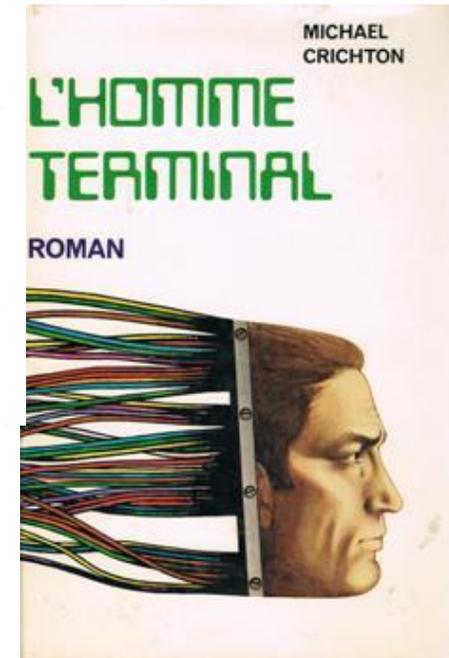
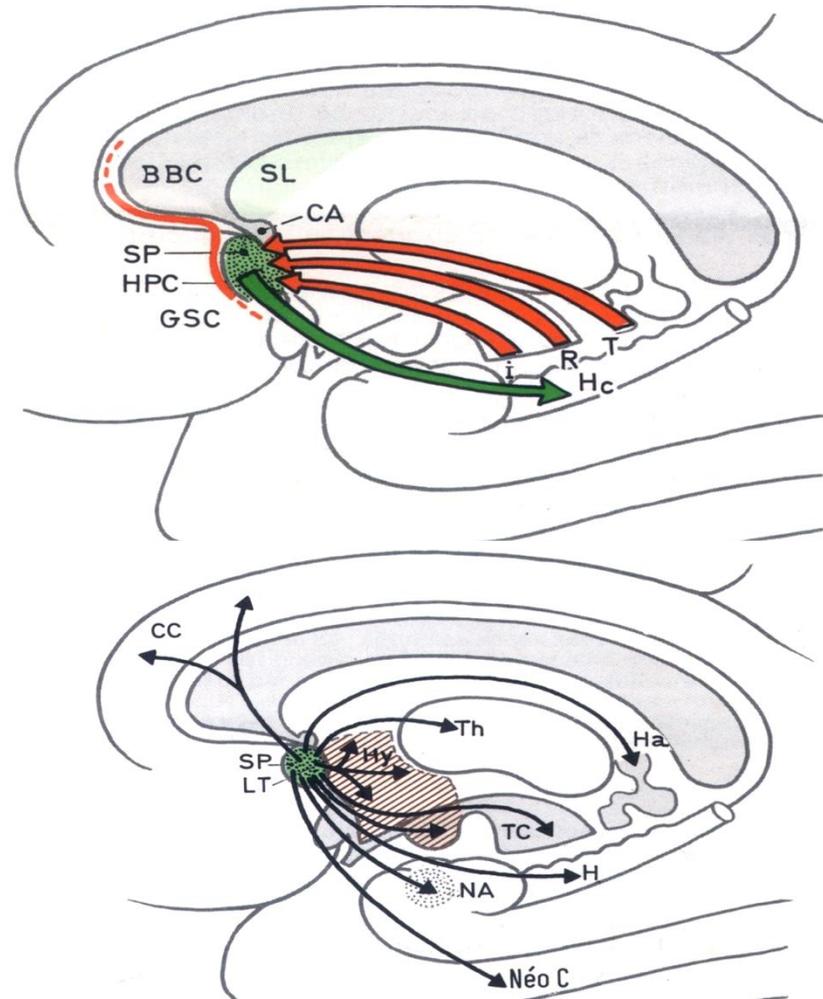
McGill University

## SUMMARY

A preliminary study was made of rewarding effects produced by electrical stimulation of certain areas of the brain. In all cases rats were used and stimulation was by 60-cycle alternating current with voltages ranging from  $\frac{1}{2}$  to 5 v. Bipolar needle electrodes were permanently implanted at various points in the brain. Animals were tested in Skinner boxes where they could stimulate themselves by pressing a lever.

(e) In septal area preparations, the control exercised over the animal's behavior by means of this reward is extreme, possibly exceeding that exercised by any other reward previously used in animal experimentation.

*Journal of Comparative and Physiological Psychology*,  
1954, 47(6) 419-427



12 avril 1972

# Orgasme est-il une Crise Epileptique ?

## *Crise Extrêmement Focalisée du Septum?*



THE JOURNAL OF NERVOUS AND MENTAL DISEASE  
Copyright © 1972 by The Williams & Wilkins Co.

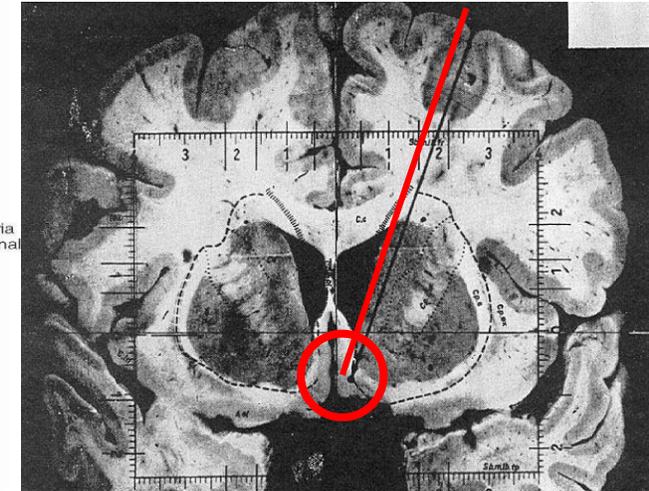
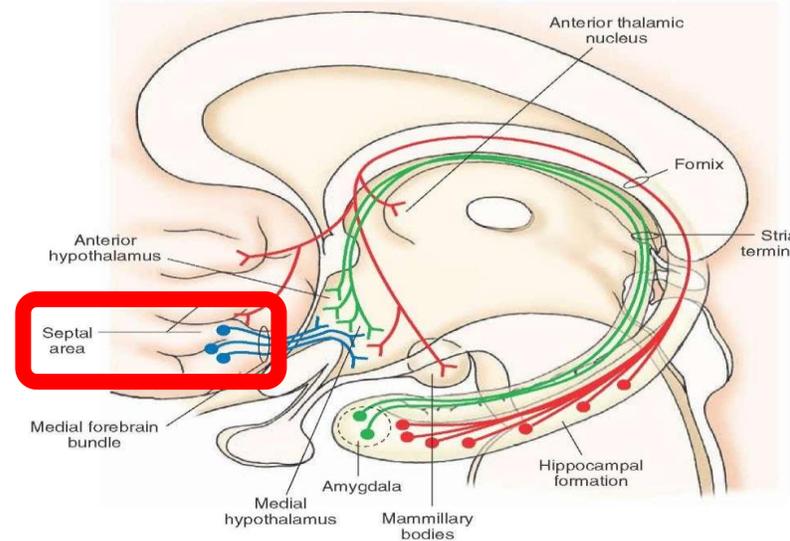
Vol. 154, No. 1  
Printed in U.S.A.

### PLEASURE AND BRAIN ACTIVITY IN MAN

DEEP AND SURFACE ELECTROENCEPHALOGRAMS DURING ORGASM

ROBERT G. HEATH, M.D., D.M.Sc.<sup>1</sup>

1972



other. Recording changes concomitant with the behavioral response were significant and consistent; most striking was the appearance of spike and slow-wave with superimposed fast activity in electroencephalograms from the septal region during sexual orgasm. In one patient distinct, but less dramatic, changes also occurred in the amygdalae, thalamic nuclei, and deep cerebellar nuclei. The other brain sites in which changes occurred are anatomically connected to the septal region and have previously been shown to be important sites in the pathways for emotional expression.

PLEASURE STIMULUS SEXUAL

ONSET OF ORGASM

lap

LF-LT Sc  
RF-RT Sc  
LF Cx  
CZ-RF Cx  
RF-RT Cx  
LO Cx  
L AMY  
R AMY  
L CBL DEN  
L CBL FAS  
LA SEP  
RM SEP  
TCG  
TCG  
L CAU  
LP SEP  
RP V L THAL  
RC NUC  
ERG

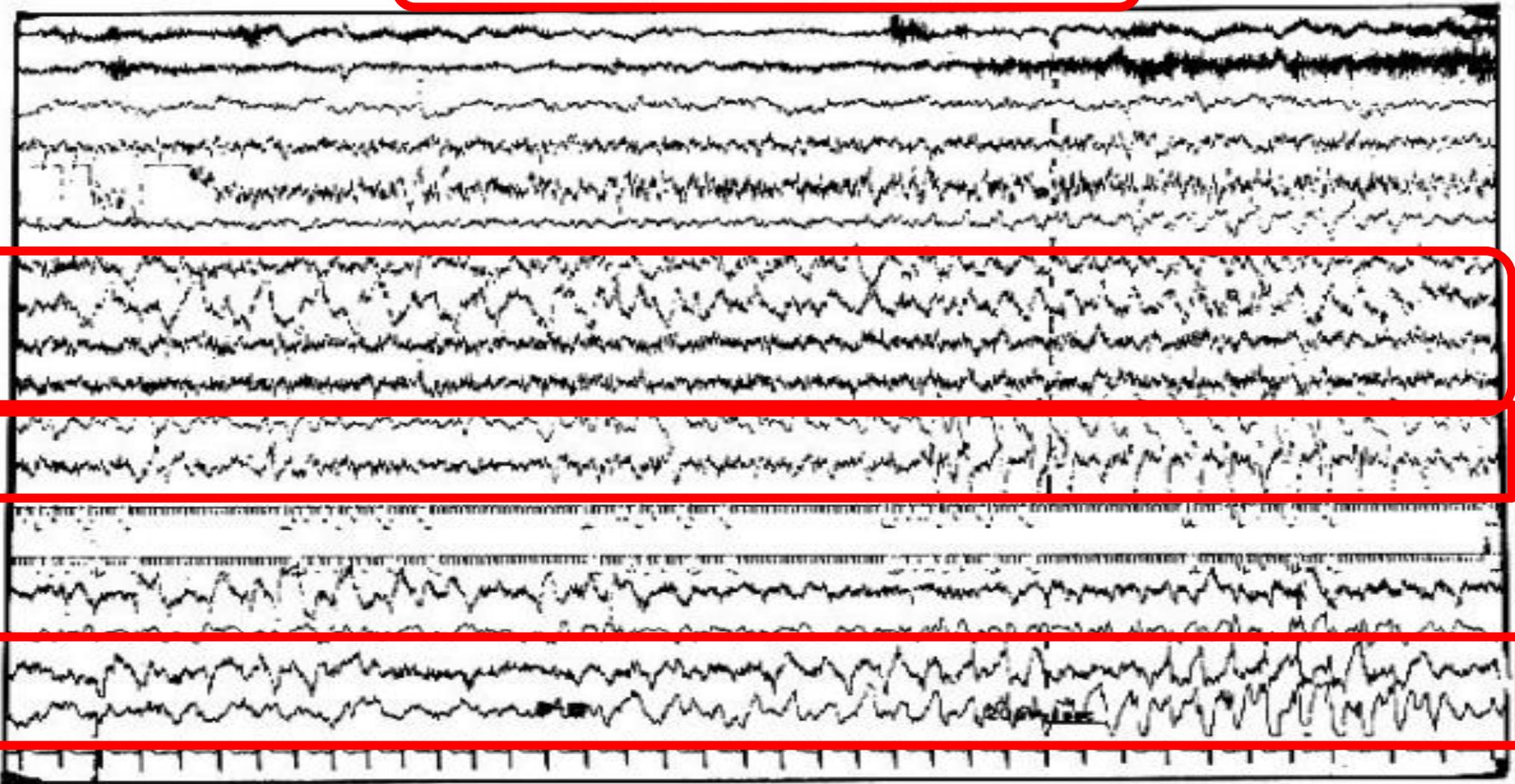
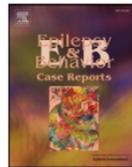
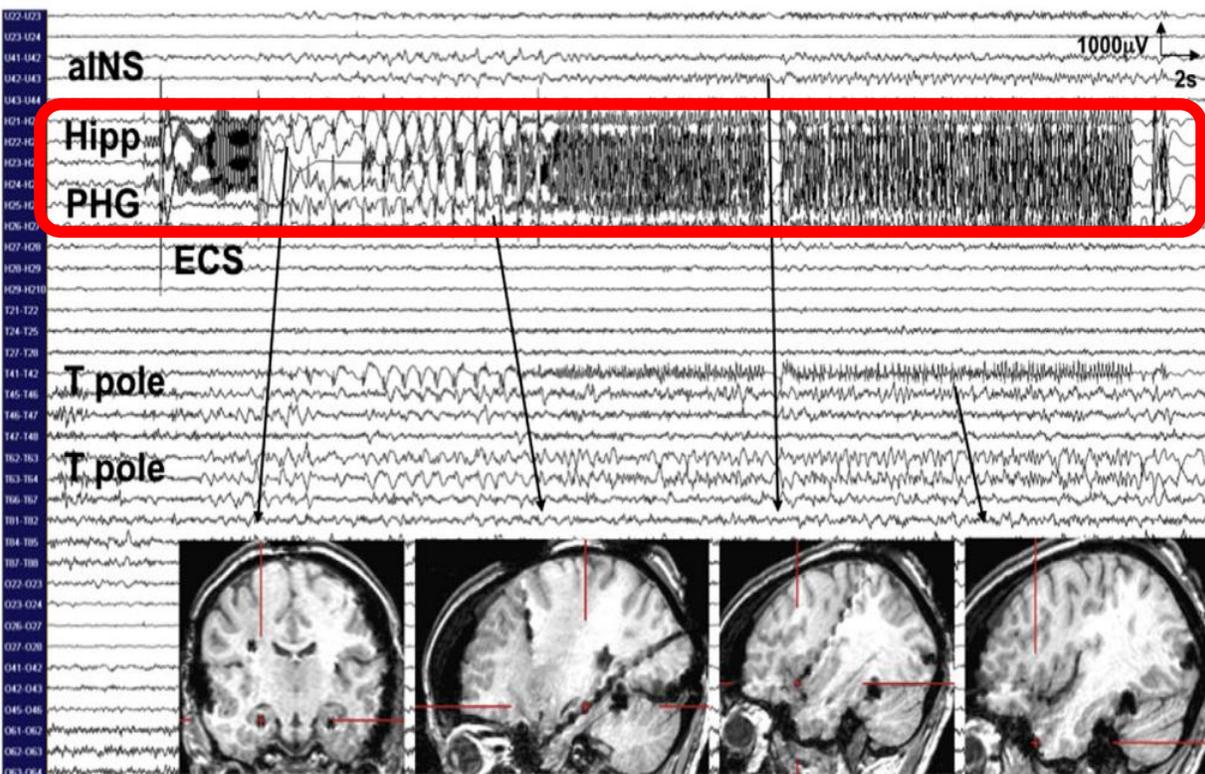


FIG. 5. Deep, cortical, and scalp electroencephalograms obtained from patient B-19 with onset of orgasm. (See key for leads under Figure 2.)

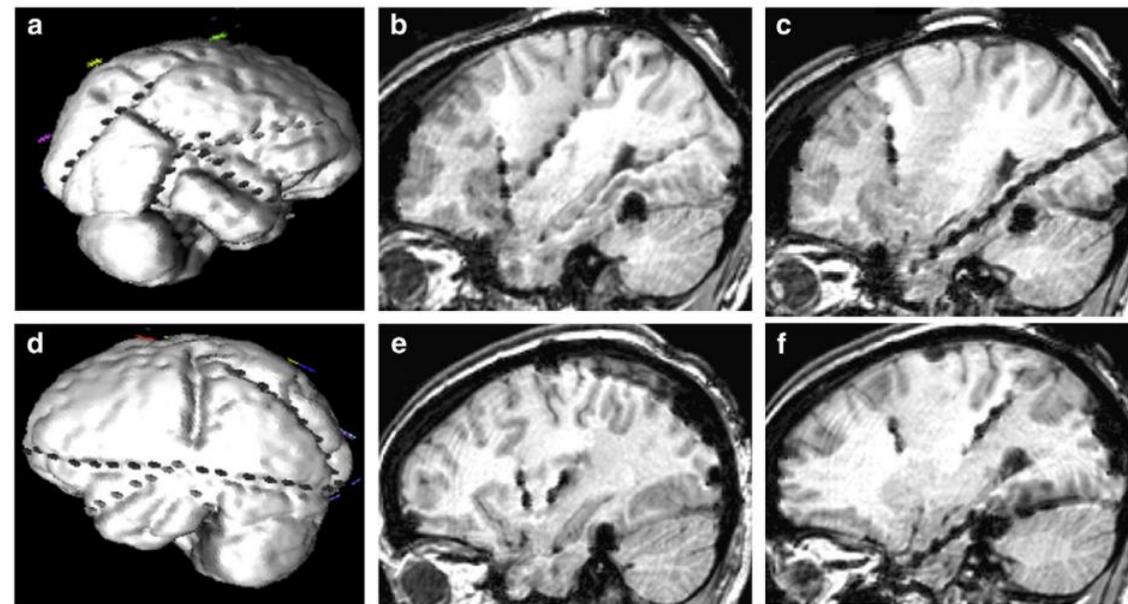


## Case Report

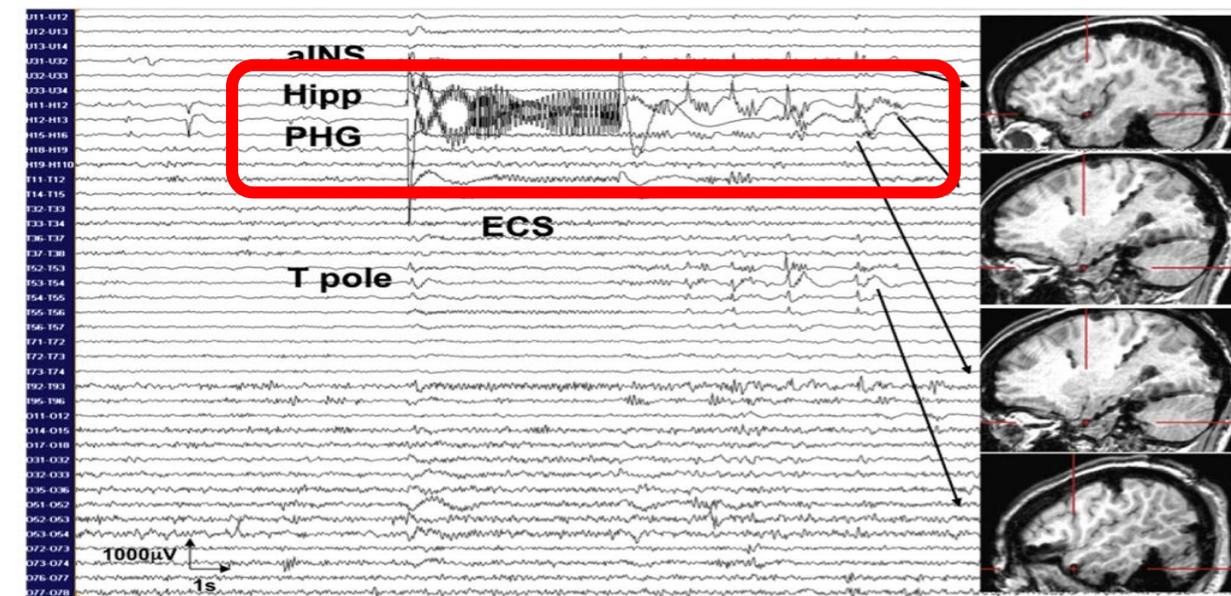
## Bilateral cortical representation of orgasmic ecstasy localized by depth electrodes ☆

Werner Surbeck <sup>a,\*</sup>, Alain Bouthillier <sup>b</sup>, Dang Khoa Nguyen <sup>c</sup>

**Fig. 3.** Stimulation of the right hippocampus at 1 mA generated orgasmic ecstasy while triggering a 45-second seizure discharge over the right hippocampus (Hipp), parahippocampal gyrus (PHG), the temporal pole (T pole), and the anterior insula (aINS).



**Fig. 1.** (a) Three-dimensional visualization of the right hemispheric subdural electrode arrangement. (b) Sagittal MRI view of the anterior and posterior insular electrodes on the right side. (c) Sagittal MRI view of the hippocampal electrode on the right side. (d) Three-dimensional visualization of the left hemispheric subdural electrode arrangement. (e) Sagittal MRI view of the left hemispheric subdural electrode arrangement.



**Fig. 2.** The patient reported orgasmic ecstasy following the stimulation of the left hippocampus (Hipp) at 3 mA. This stimulation was followed by an 18-second afterdischarge over the left hippocampus (Hipp), the parahippocampal gyrus (PHG), the temporal pole (T pole), and the anterior-inferior insula (aINS).

# Embracement du Septum

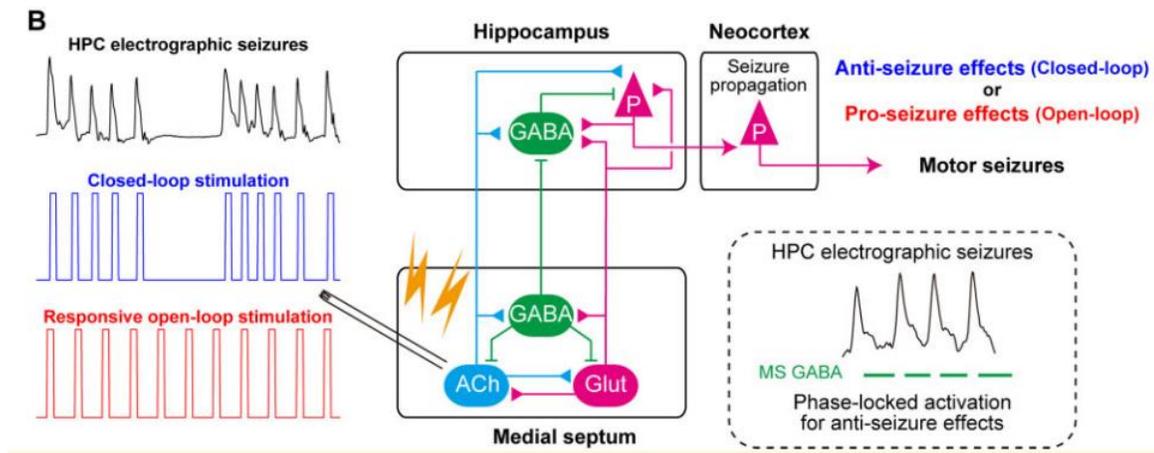
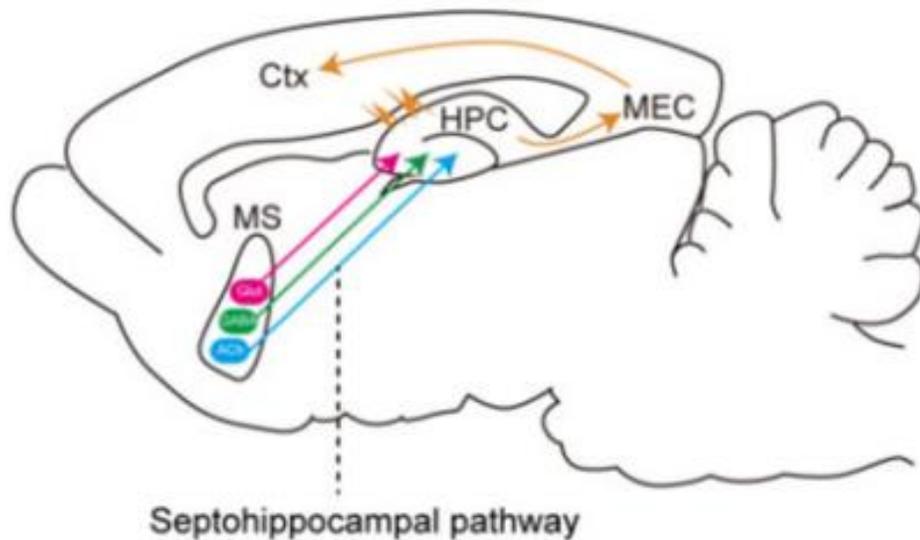


## Closed-loop stimulation of the medial septum terminates epileptic seizures

BRAIN 2021; 144; 885–908

 Yuichi Takeuchi,<sup>1,2,3</sup>  Márk Harangozó,<sup>1</sup> Lizeth Pedraza,<sup>1,3</sup>  Tamás Földi,<sup>1,3</sup>  
 Gábor Kozák,<sup>1</sup>  Qun Li<sup>1,3</sup> and  Antal Berényi<sup>1,3,4,5</sup>

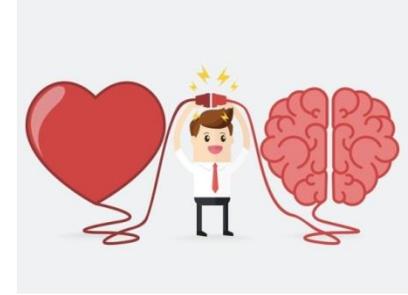
Generalization of seizures with HPC-origin



Sato M et al. [Experimental study on epilepsy using a "kindling preparation". Correlation between septal seizure development and psychomotor seizure]. No To Shinkei. 1976 Jul;28(7):667-79.

# Neurobiologie de « l'Amour »

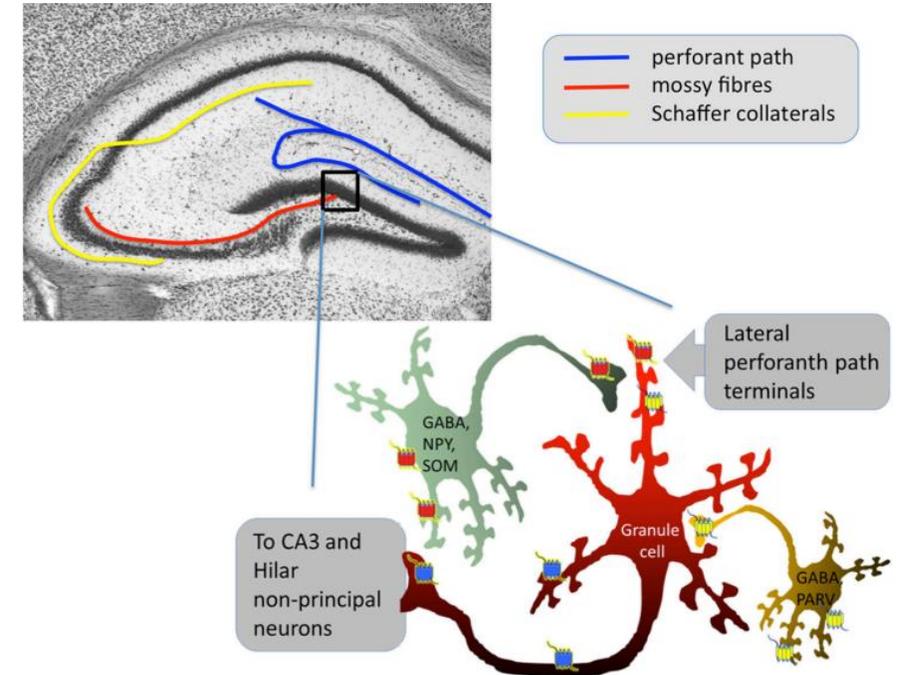
## Récompense et Déception



### The Opioid System in Temporal Lobe Epilepsy: Functional Role and Therapeutic Potential

Johannes Burtscher and Christoph Schwarzer\*

Department of Pharmacology, Medical University of Innsbruck, Innsbruck, Austria

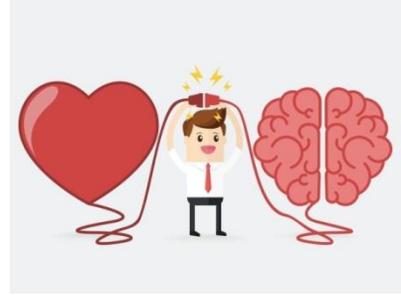


**FIGURE 1** | Simplified scheme of hippocampal dentate gyrus network control by opioid receptors. Blue represents KOPr, red DOPr and yellow MOPr for more detailed descriptions of the individual opioid systems' functions in the hippocampus, see Drake and Milner (1999), Rezaei et al. (2012), and Schwarzer (2009). DOPr is often located on GABAergic neurons containing neuropeptide Y (NPY) and somatostatin (SOM) (Commons and Milner, 1996), MOPr are often on GABAergic neurons containing parvalbumin (PARV) (Drake and Milner, 1999). Note that especially DOPr and MOPr could also be active as heterodimers. Activation of both, MOPr and DOPr has predominantly disinhibitory effects on granule cells.

**REVIEW**  
 07 August 2017

# Neurobiologie de « l'Amour »

## « Crise et Récompense »



## Conclusions et Perspectives

- « **Amour** » a de multiples facettes
- **Neurochimie et Réseaux** sous-tendent les émotions et comportements amoureux (préparation, action, récompense, déception..)
- **Orgasme** une crise épileptique ?
- **Récompense** en lien avec les endorphines
- **Déplétion en endorphine** post orgasmique participe-t-elle à la « déception » ?



# Que nous apprennent l'étude des Crises



## Optogenetic Stimulation du Septum ?

*Journal of Neurophysiology JA Niemeyer 28 janv 2022 online*

● stimulation ● seizure propagation ● seizure core

