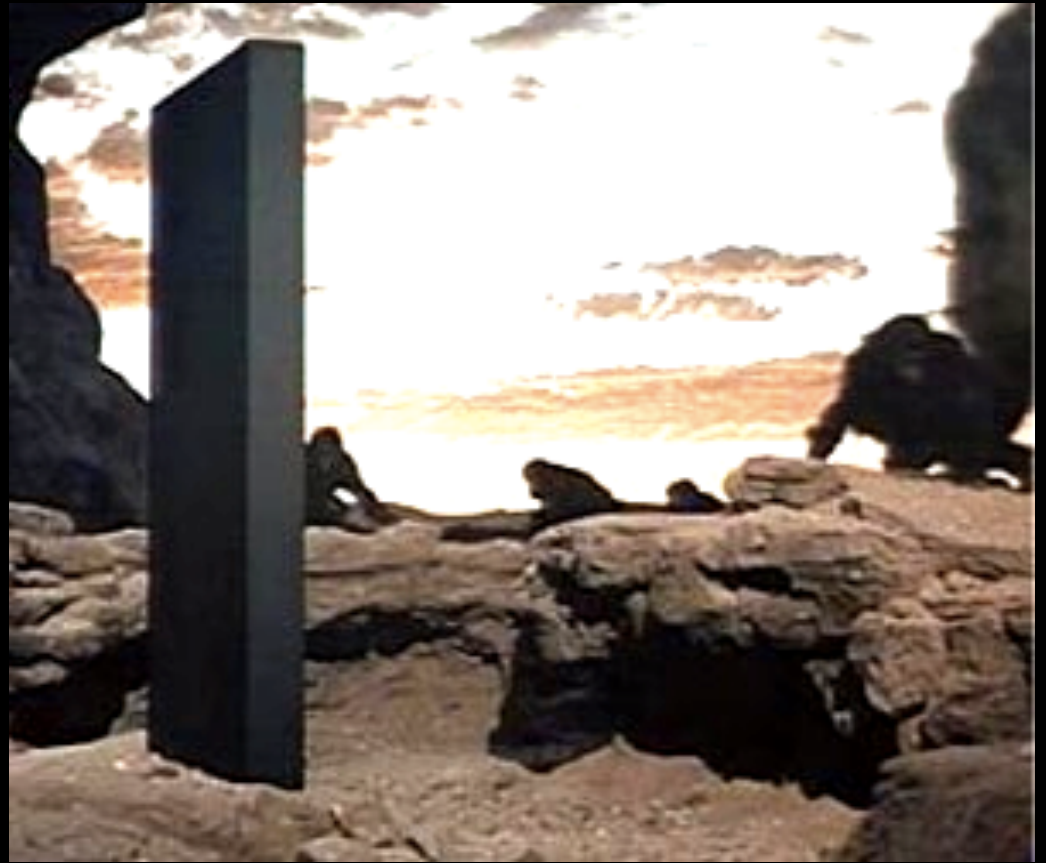


The human brain consists of **100 billions of interconnected neurons** performing tasks in information storage, emotional and cognitive processing.



*Prof Alessandro Rossi*  
*Direttore Dpt di Neurscienze*  
*Facoltà di Medicina e Chirurgia Università*  
*degli Studi di Siena*



10 - 20 milioni di anni fa il primate si evolve. Scopre l' utilizzo delle ossa di altri animali come strumenti. Inizia la conoscenza.

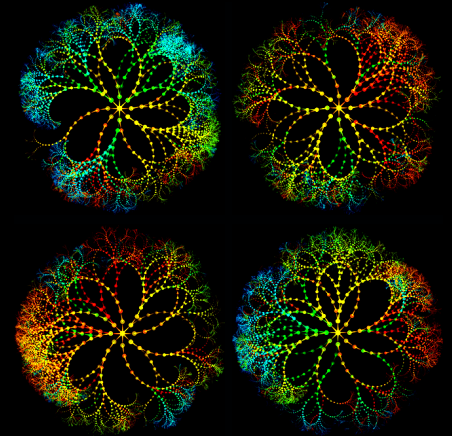
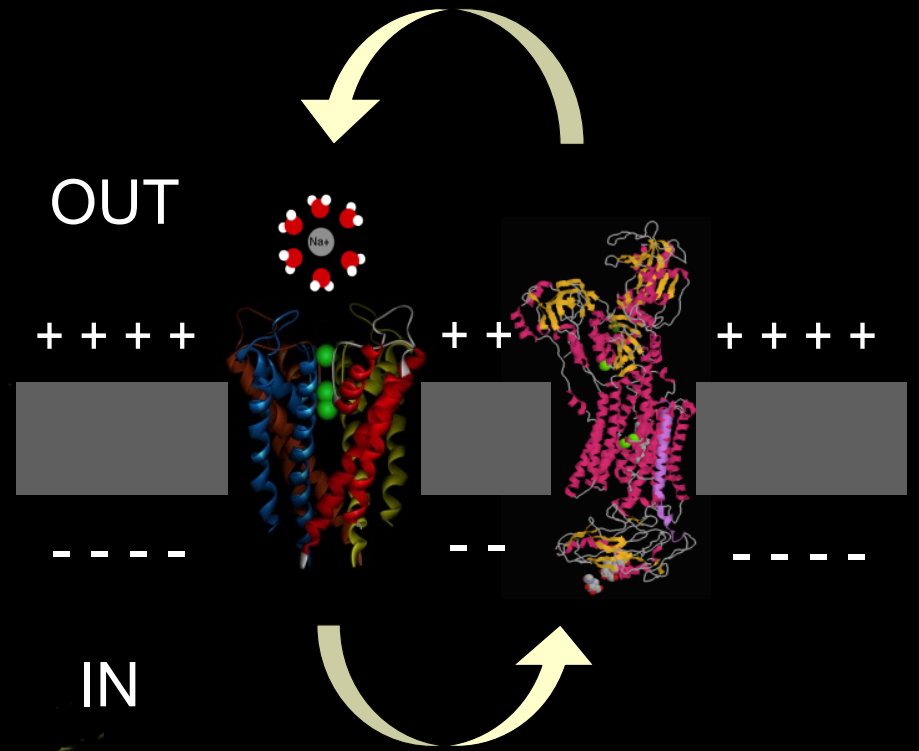
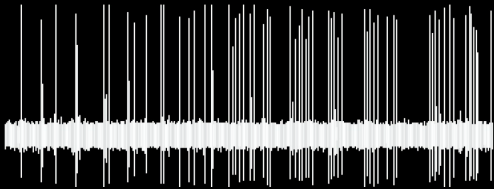
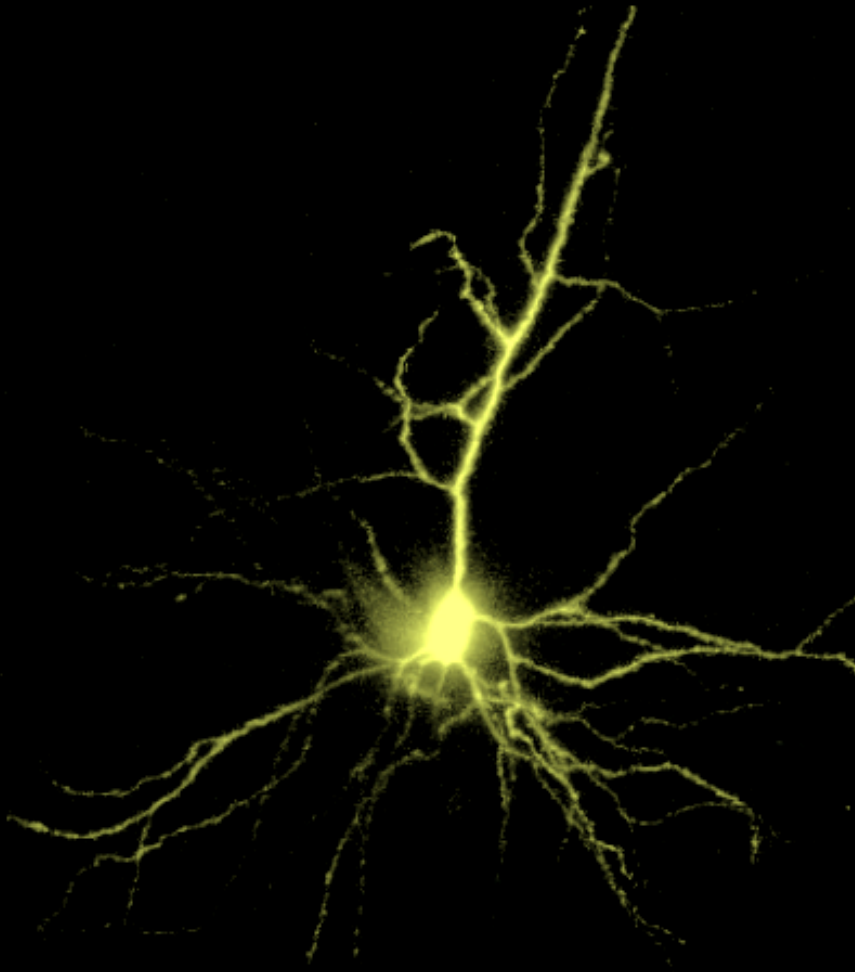
2001: A SPACE ODYSSEY . *Stanley Kubrick 1968.*



*Sir Charles  
Sherrington. The  
Nobel Prize in  
Physiology and  
Medicine 1932*

**...To move is all mankind can do, whether in  
whispering a syllable or in felling a forest...**

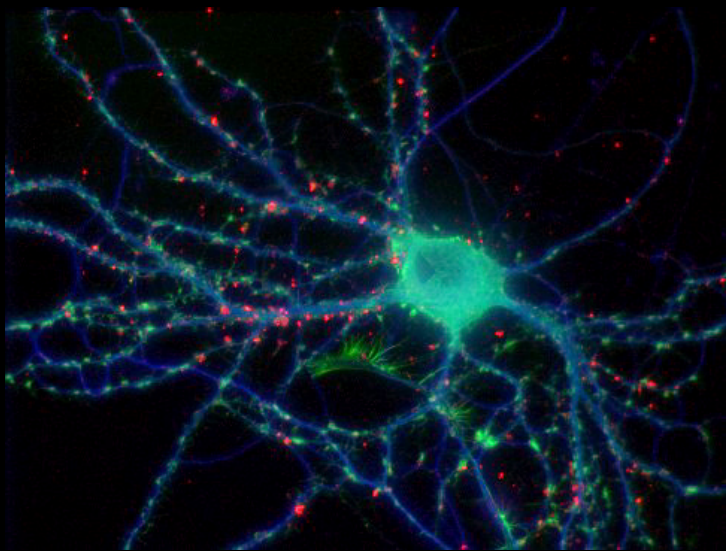
*Understanding the cellular basis of neural computation*



Il dominio del tempo

.....the analysis of single neurons is either totally hopeless or a dubious exercise in reading selected tea leaves.

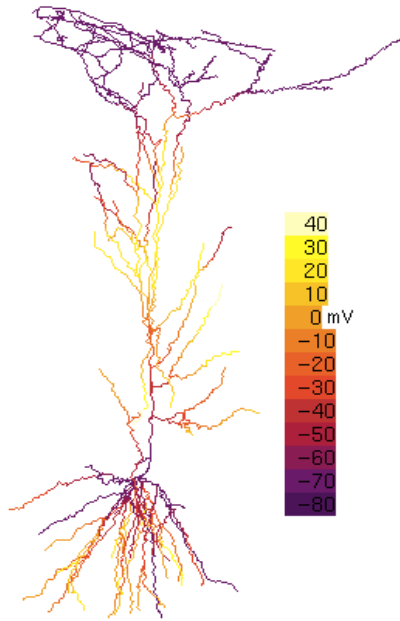
*E.E. Fetz*



# Il dominio dello spazio



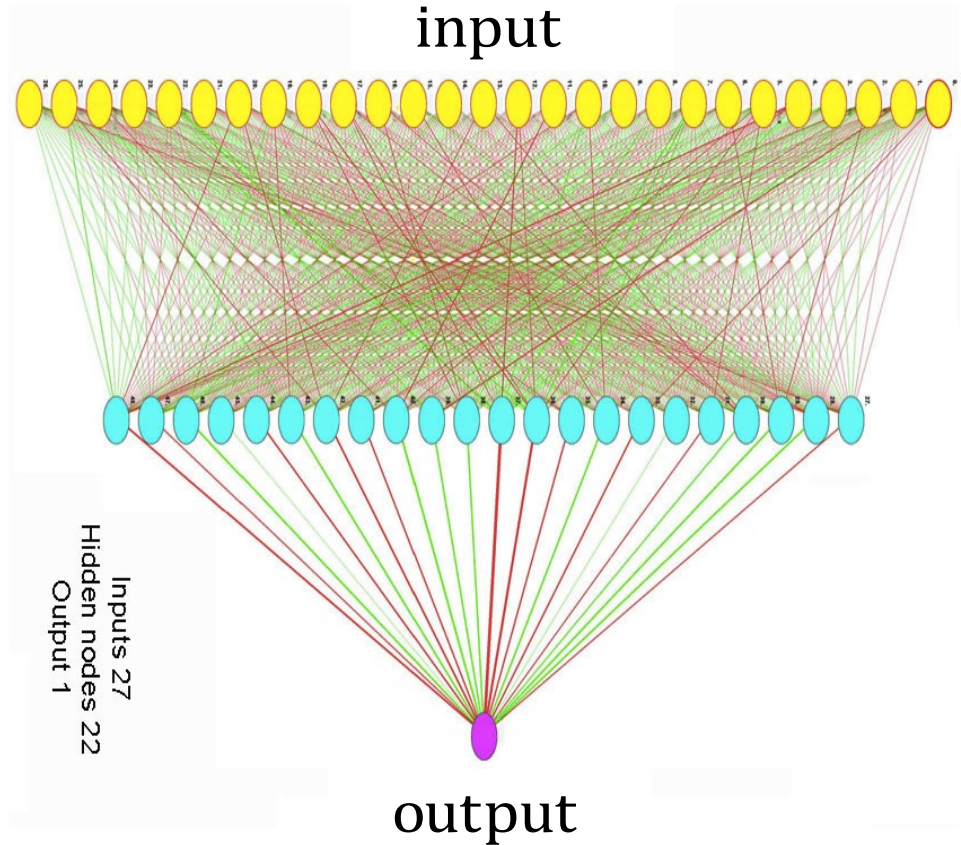
input



output



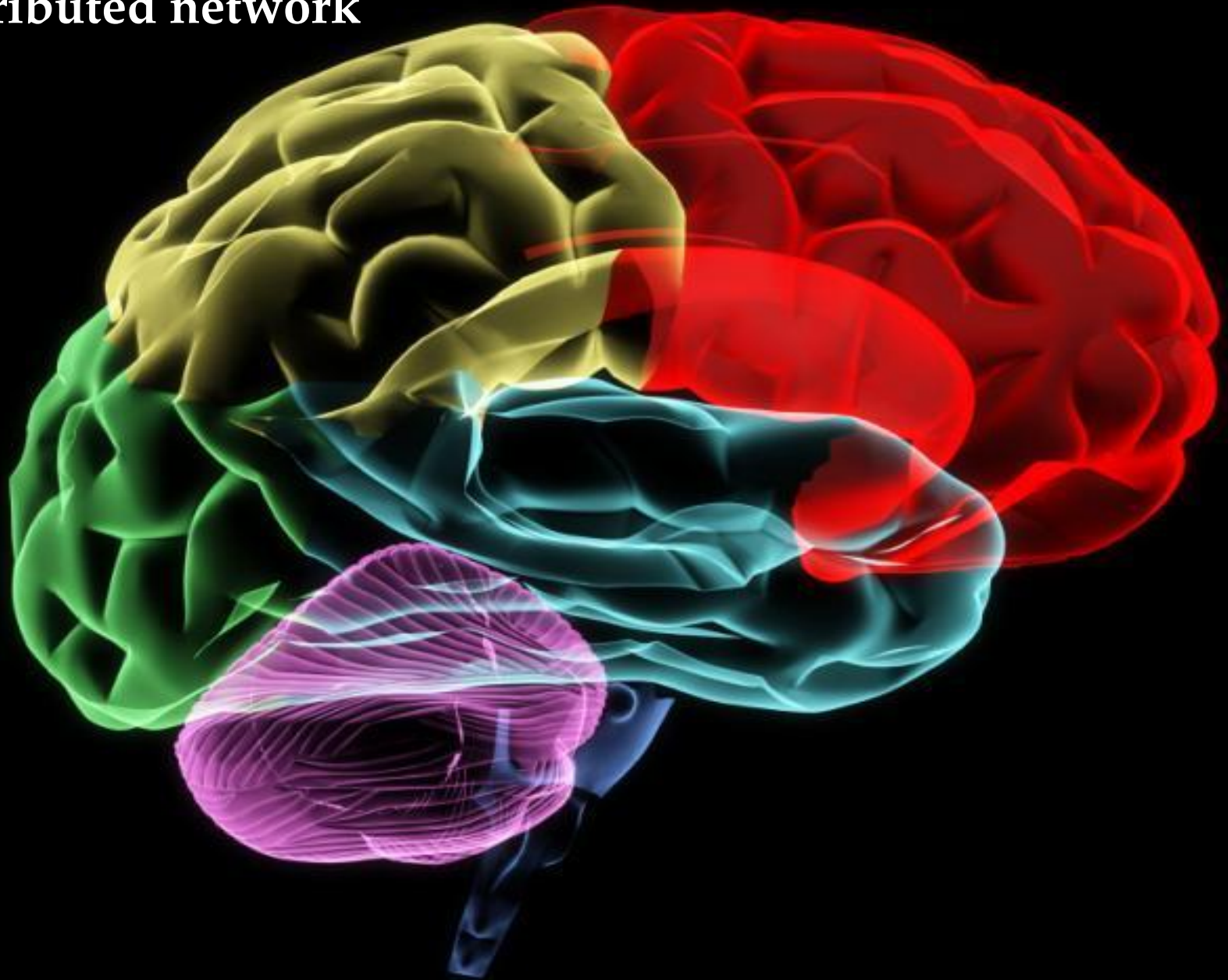
input



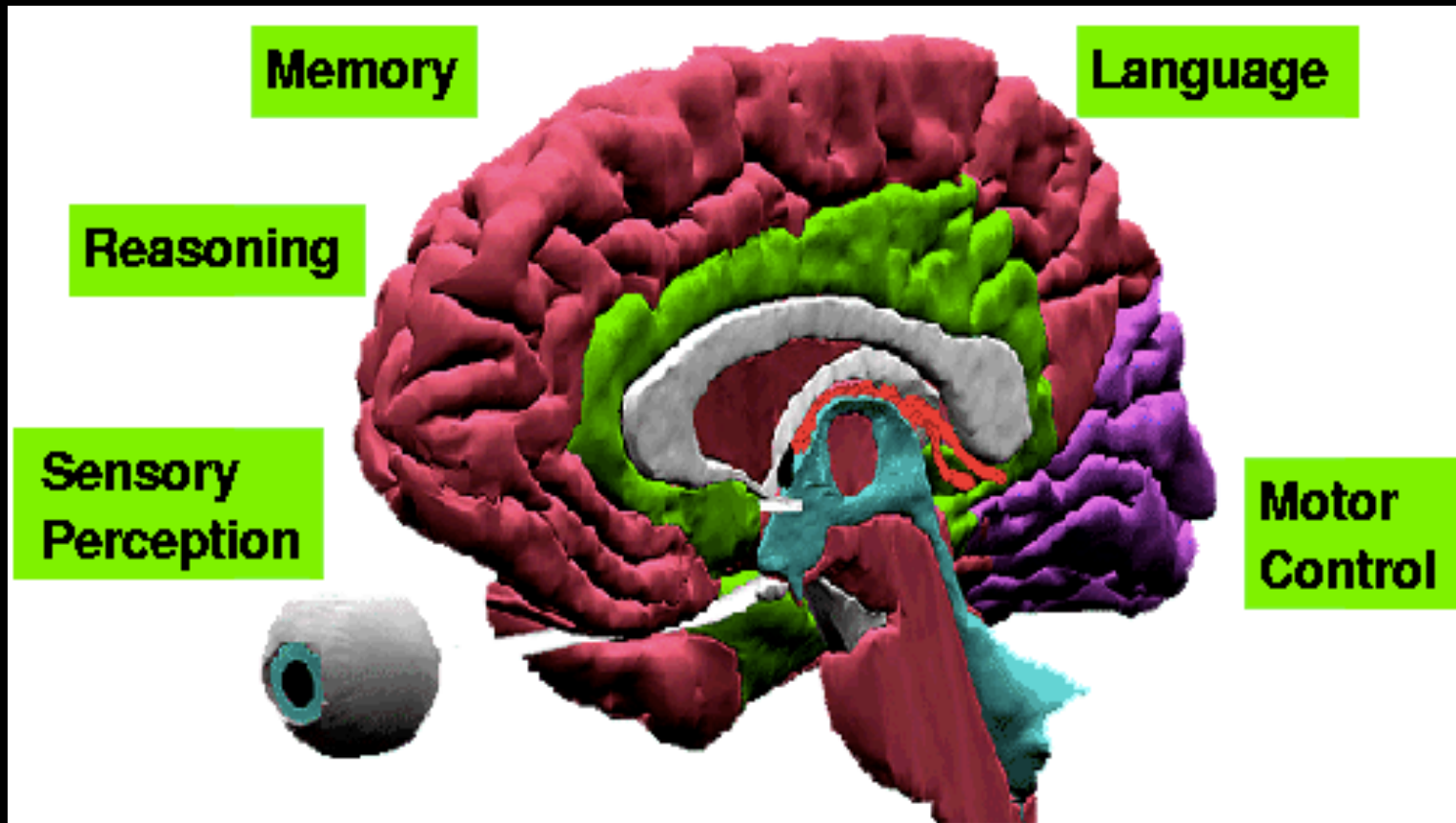
output



.....action is controlled by a distributed network

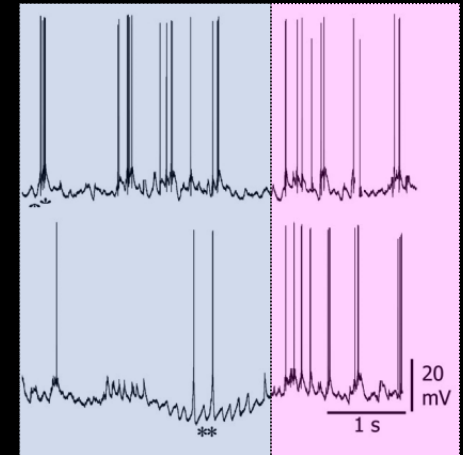


.....action is controlled by a distributed network





The CNS is a highly distributed system in which operations are executed in parallel.



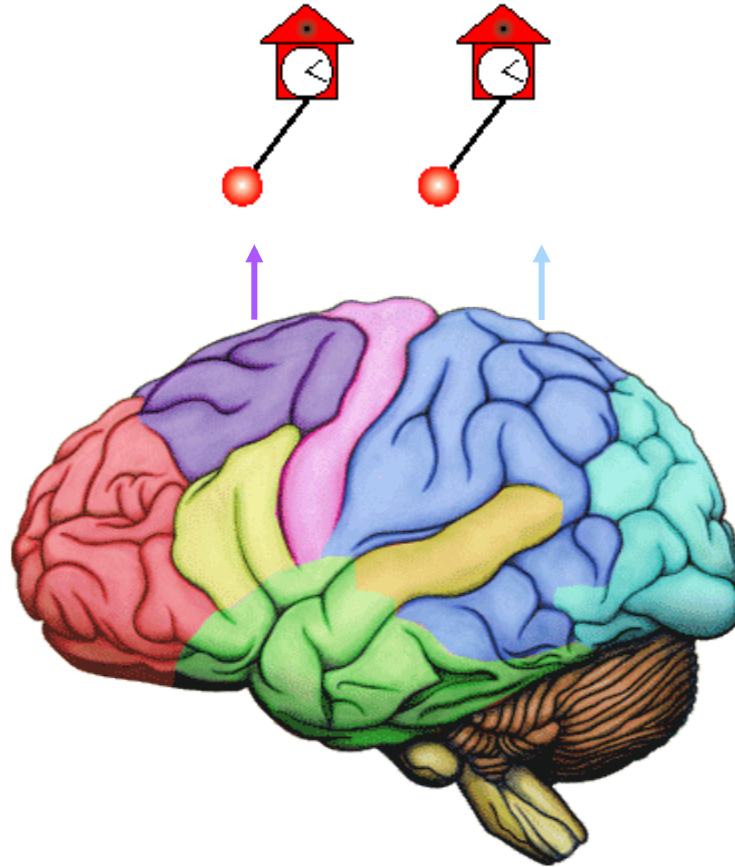
Asynchr

Synchr.

*...it raises the questions of how the computations occurring simultaneously in spatially segregated processing areas are coordinated and bound together to give rise to coherent percepts and actions.*

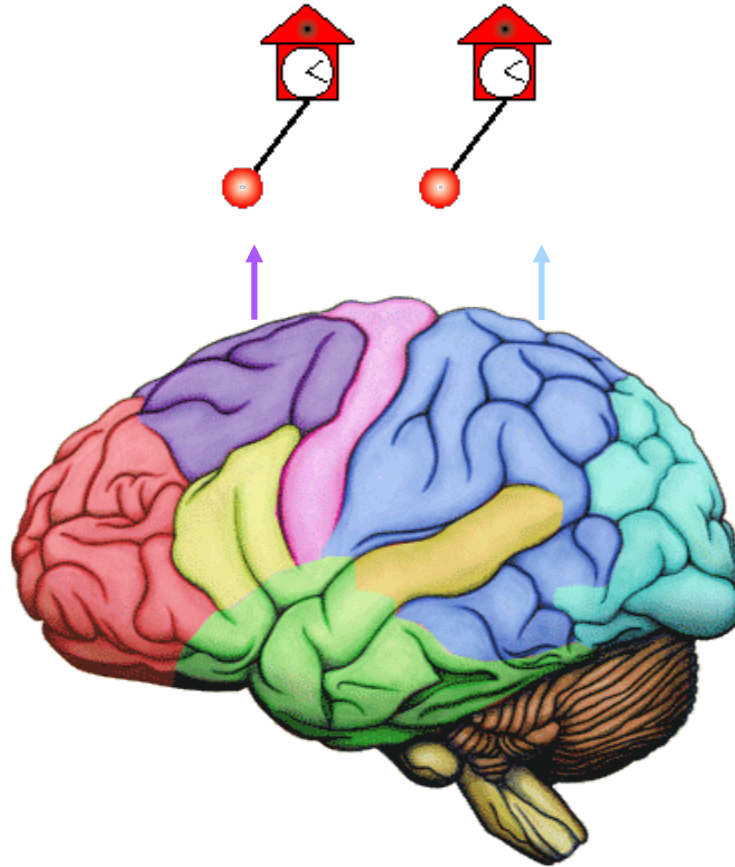
*Purely theoretical formulations of the **binding-by-synchrony hypothesis** were proposed earlier by Milner (1974) and von der Malsburg (1981), recently the Singer's lab was the first to obtain experimental evidence supporting the of synchrony as a relational code.*

Neural a-synchrony



**Binding by synchrony**

Neural synchrony = cognitive functions



**Binding by synchrony**

*.....action is controlled by a distributed network*

- *Dimensione comunicativa*
- *Dimensione interpretativa*
- *Dimensione emotiva*
- *Dimensione mnesica o di memoria*

*Funzione motoria*

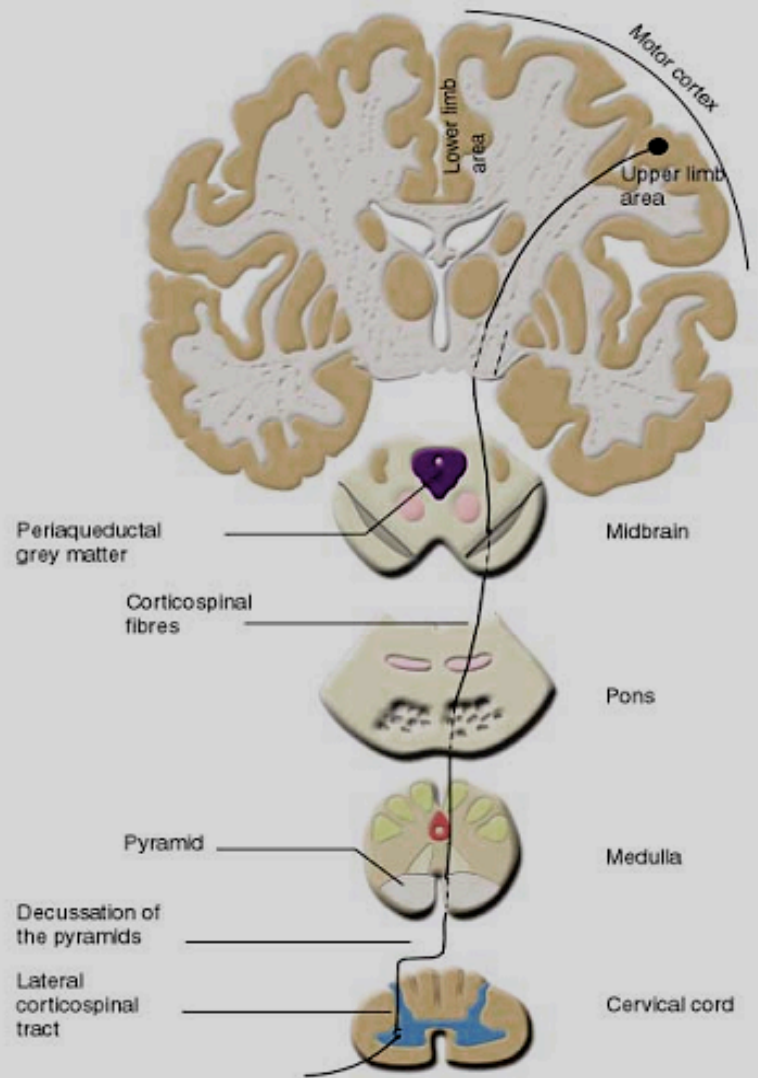
*Funzione sensoriale*

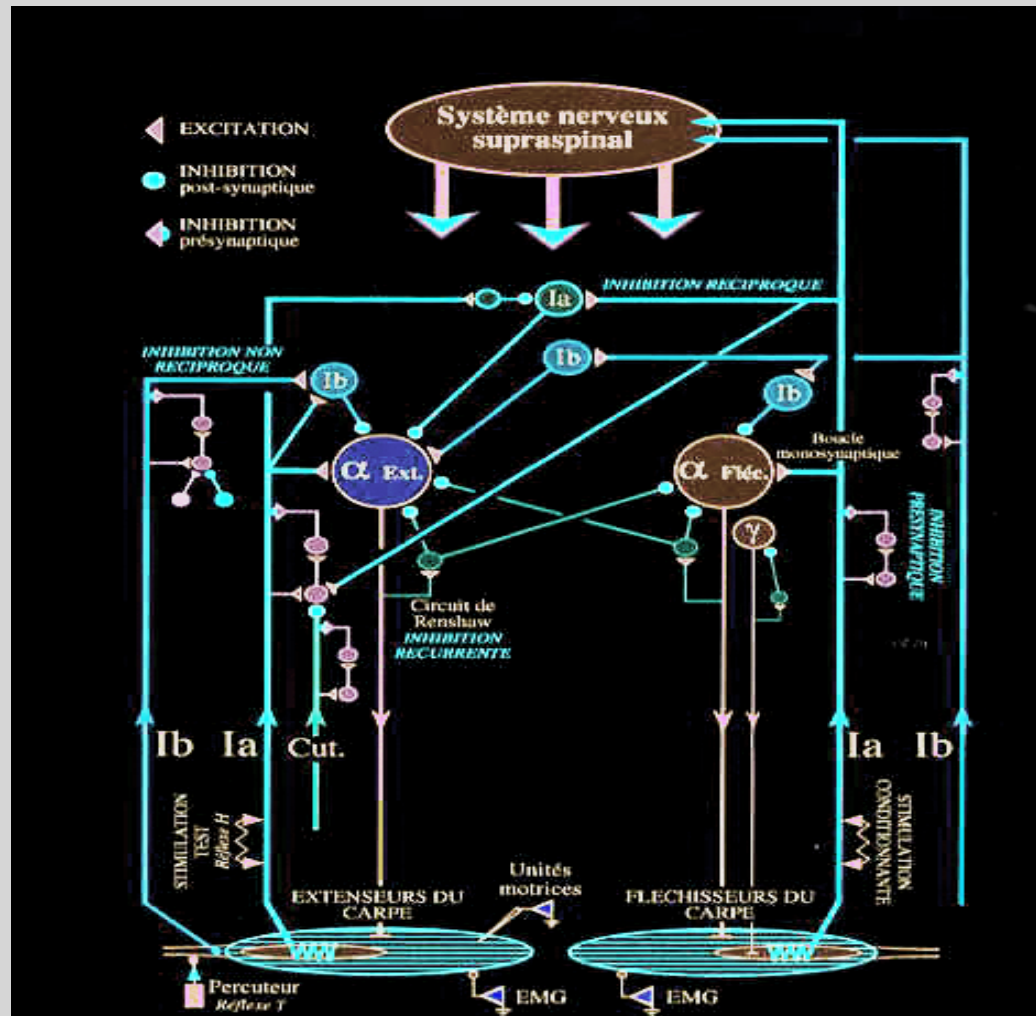
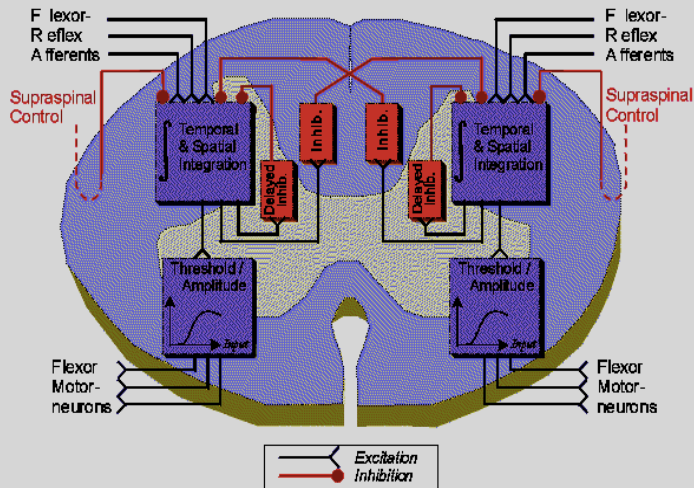
*Funzione cognitiva*

*Memoria*

*Funzione affettiva  
motivazionale*







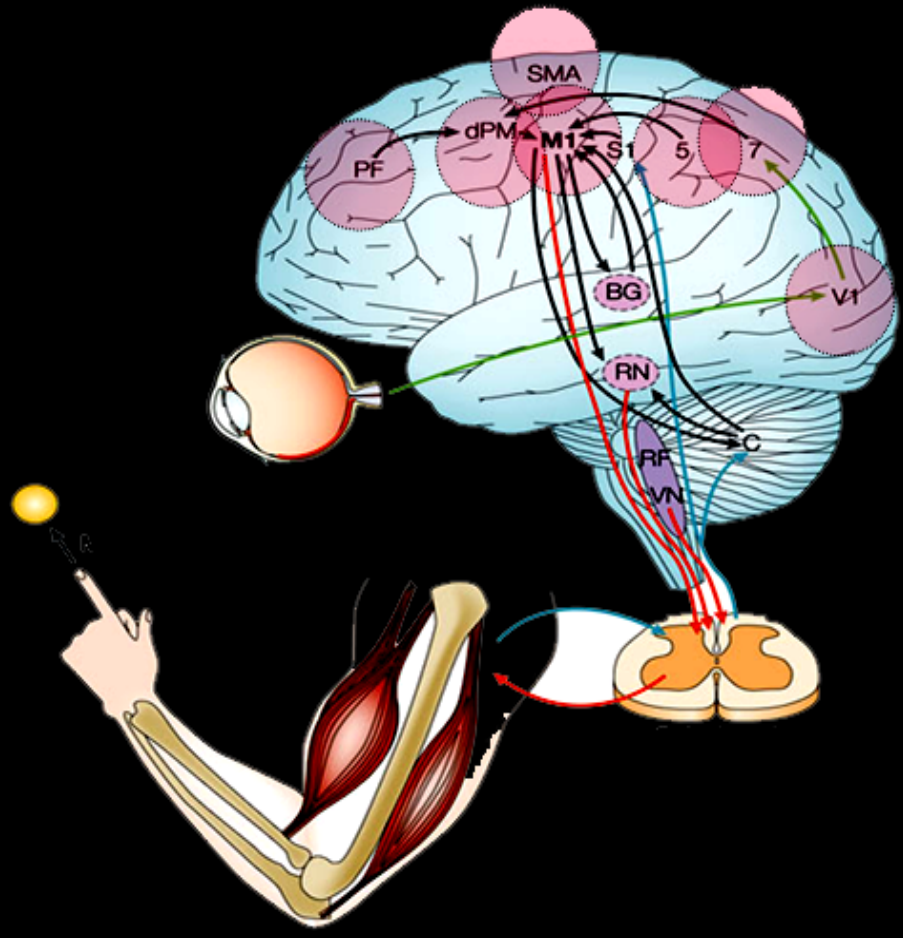
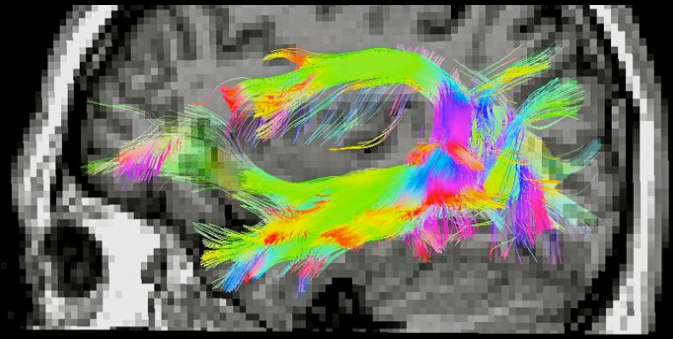
**Figure 1. Réseaux spinaux moteurs et sensoriels de l'unité myotatique du carpe**

Lors de contractions volontaires, la décharge d'une unité motrice dépend non seulement des afférences supraspinales mais aussi des afférences sensorielles disponibles. De nombreux mécanismes inhibiteurs spinaux modulent en amont et en aval du motoneurone la commande motrice volontaire. Ces inhibitions sont soumises elles-mêmes à des régulations supraspinales et sensorielles. Noter l'homologie particulière de l'inhibition récurrente (Aymard et al. 1995, 1997; Rossi et al. 1995).

**Figure 1. Motor and sensory spinal pathways in the wrist myotatic unit**

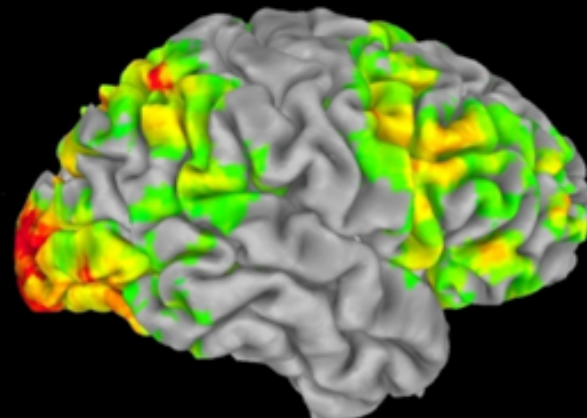
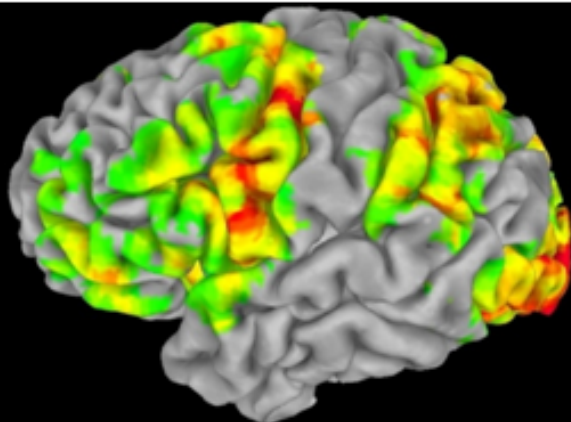
During voluntary contraction, the firing pattern of a single motor unit depends not only on supraspinal inputs but also on sensory inputs. Numerous inhibitory mechanisms are liable to change the voluntary motor command before and after the motoneurone. These inhibitions themselves are continuously altered by supraspinal and sensory inputs. It is worth noting that the Renshaw cells may present atypical connections in the wrist motor nuclei (Aymard et al. 1995, 1997; Rossi et al. 1995).

.....action is controlled by a distributed network

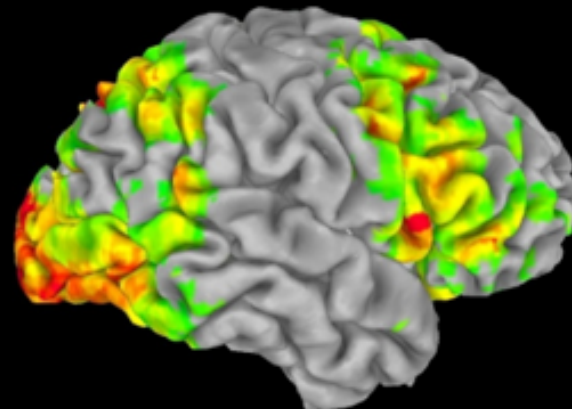
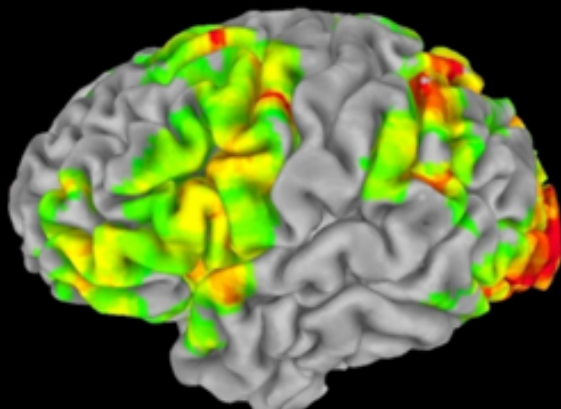


- IDEA (what is my goal?)
- PLAN (how do I achieve it?)
- PROGRAM (which muscles contract? How much?)
- EXECUTION (send out motor commands)
- MOVEMENT

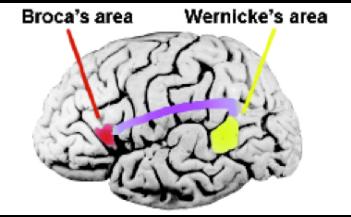
Action



Intention

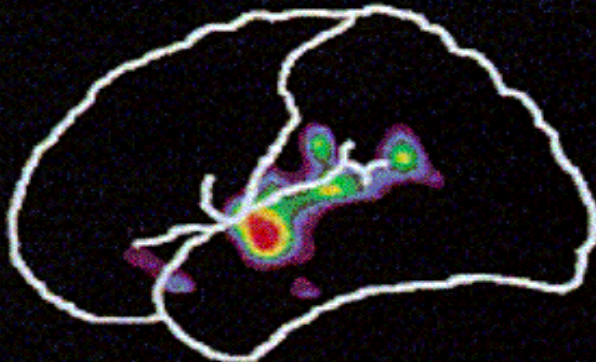




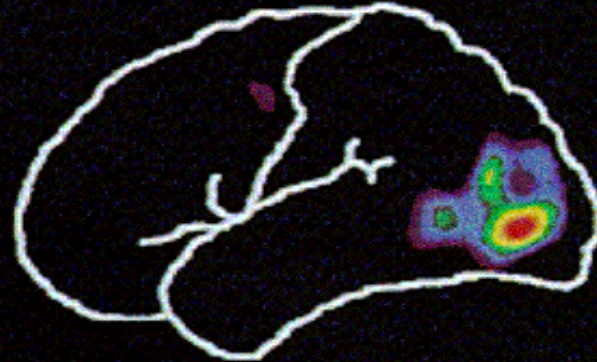


Expressive language function

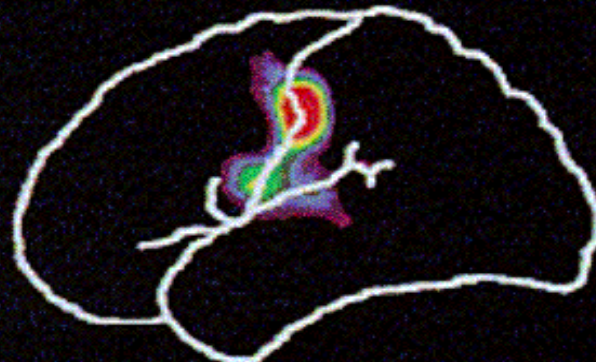
Receptive language function



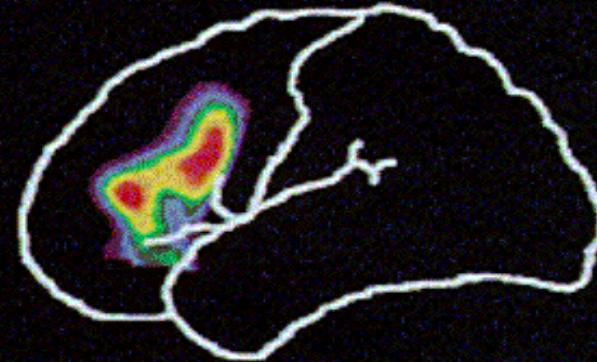
Ascolto di parole



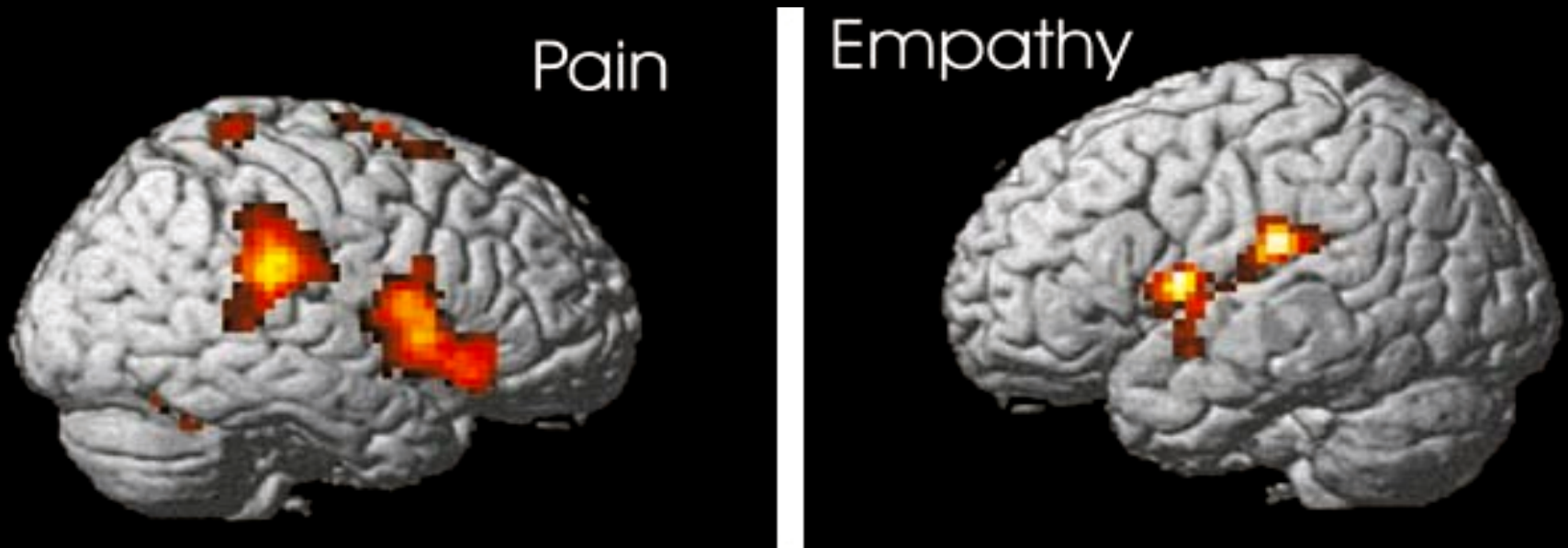
Vista di parole



Lettura di parole



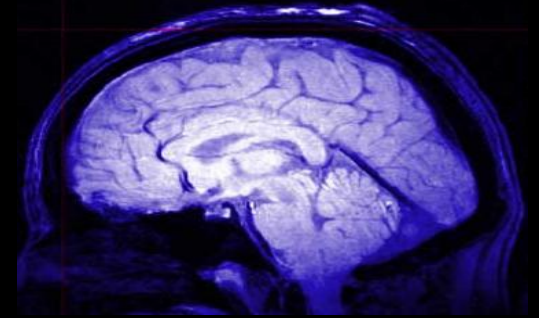
Produzione di parole



Functional brain imaging shows that some of the same regions of the brain are activated by personal pain, at left, and by empathy over the pain.



- **The nervous system is built for actions.**



- **Movements** are parts of actions, and actions have to satisfy the needs of the organism and secure survival of the species.

- Therefore, **actions** must be guided by messages from the internal milieu as well as from the environment.

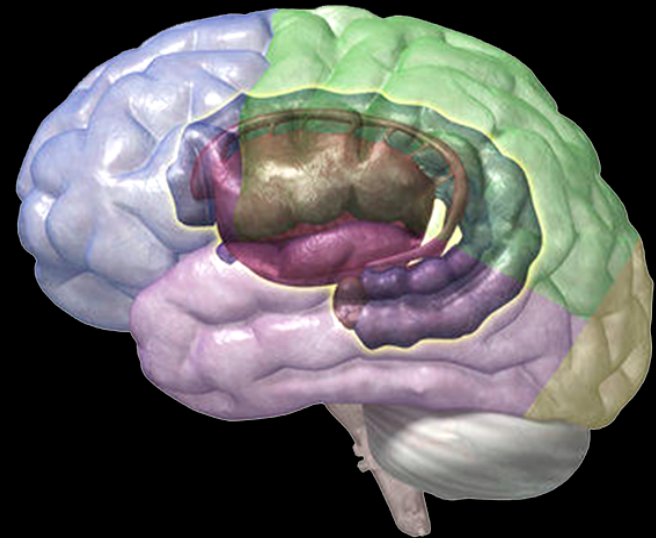
- Actions are directed **towards goals**.



L'azione è motivata da processi cognitivi ed emotivi



While our feelings and emotions come from the limbic system, the neocortex controls our verbal ability, judgment, planning, and creative thinking. There is **constant communication** between the emotional brain and the neocortex, and together they shape our beliefs, behaviors and motor actions.



MOTIVAZIONI BIOLOGICHE  
INNATE

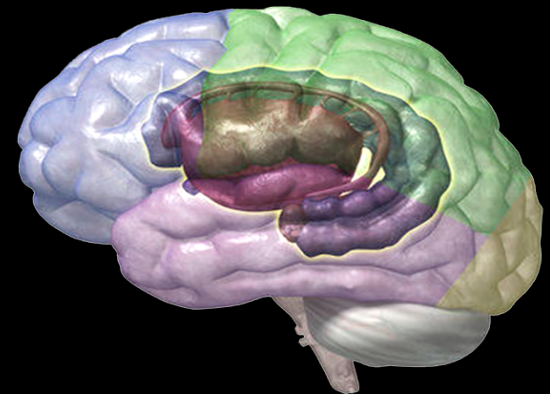
MOTIVAZIONI PSICOLOGICHE-  
COGNITIVE



MOTIVAZIONE



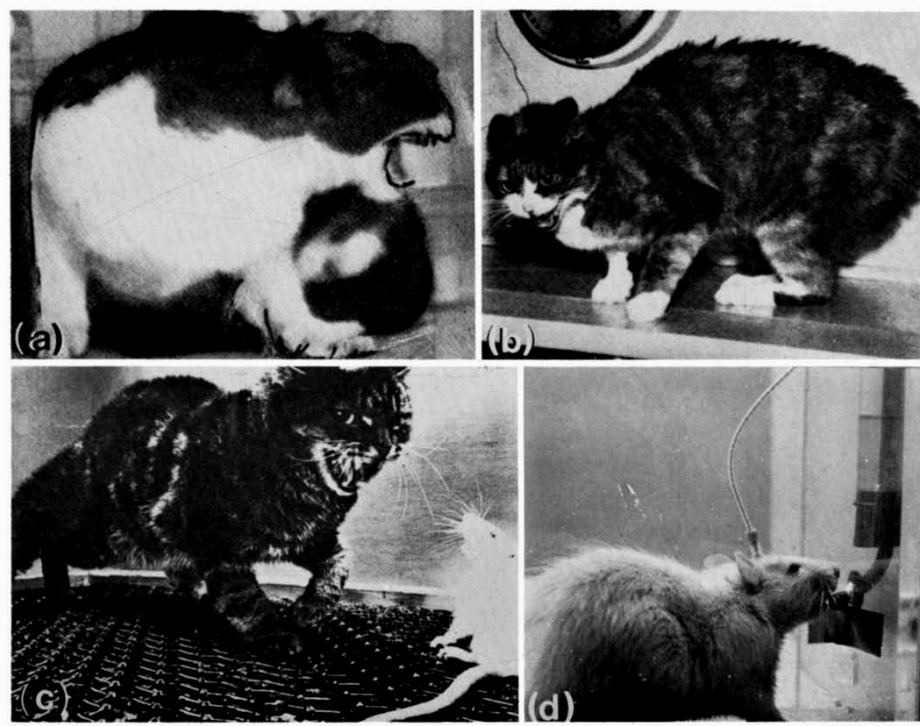
AZIONE



## MOTIVAZIONI BIOLOGICHE INNATE

Decerebrate animals with an intact brain stem are capable of performing crude but coordinated locomotor and oral motor activities .

Decorticate animals are capable to show motivational processes (Sherrington, 1910; Shik and Orlovsky, 1976; Dubner et al., 1978).



A) Affective-defensive behavior observed by Hess (1957) during electrical stimulation of the **lateral hypothalamus**

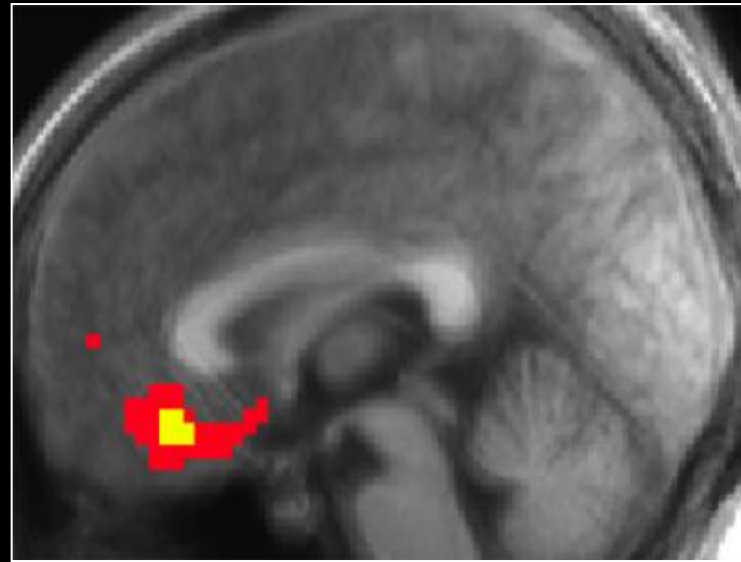
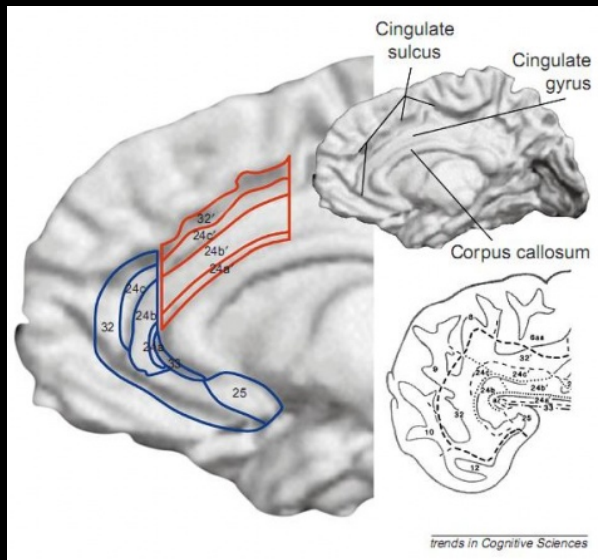
B) Defense reaction elicited by **hypothalamic stimulation** (Brown et al., 1969).

C) Attack behavior elicited in the cat by electrical stimulation of the **lateral hypothalamus** (Flynn, 1967).

D) Drinking of water elicited by electrical stimulation of the lateral hypothalamus of a rat (Mogenson and Stevenson, 1966).



# MOTIVAZIONI PSICOLOGICHE-COGNITIVE



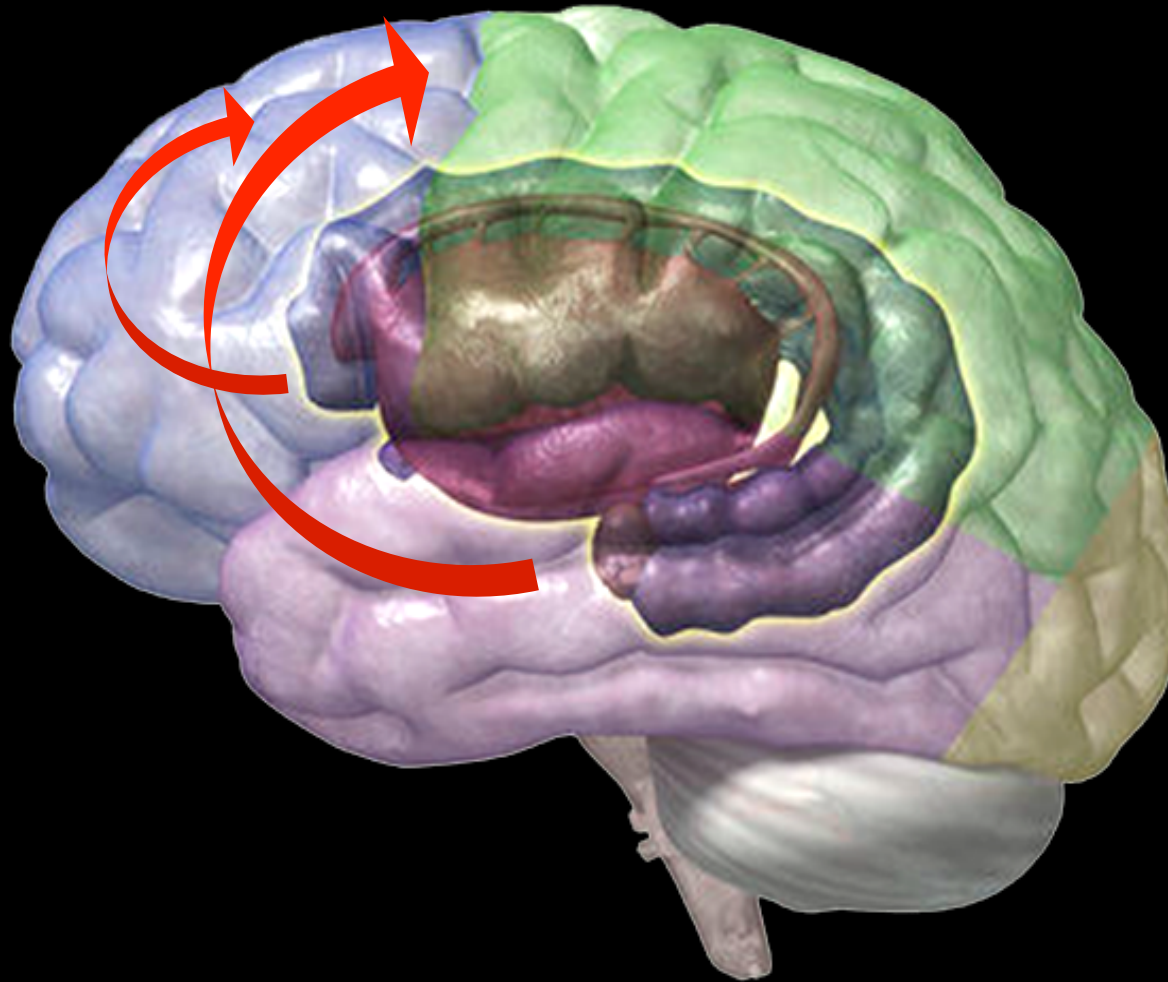
As a whole, cingulate cortex integrates input from various sources  
Cingulate cortex includes specific processing modules for sensory, motor and cognitive information

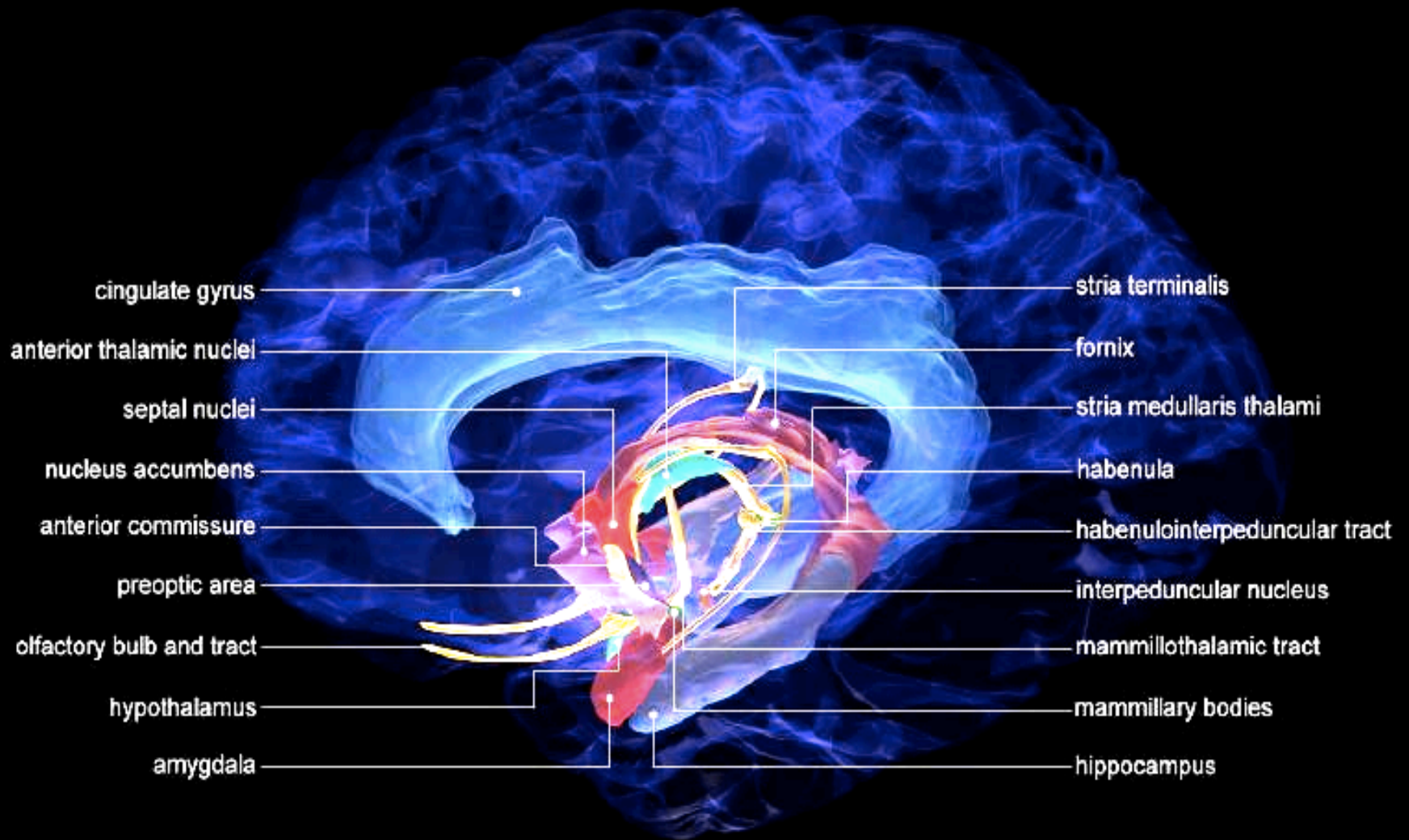
*Tomáš Paus*

PRIMATE ANTERIOR CINGULATE CORTEX: WHERE MOTOR CONTROL, DRIVE AND COGNITION INTERFACE

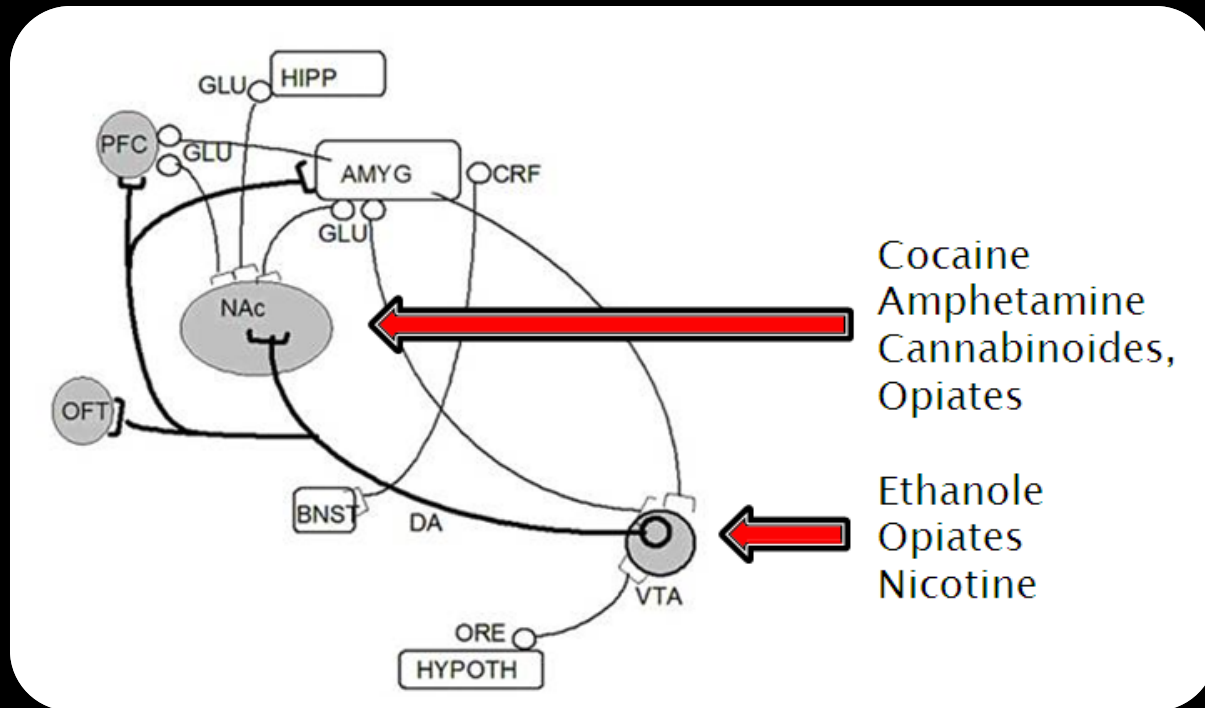
Nature Reviews, Neuroscience: 2: 417-424, 2001.

INTERFACE: biological (inherent) psychological-cognitive  
motivational processes





Il sistema di ricompensa dopaminergico costituisce un sistema emozionale che si è evoluto per motivare un progresso nella ricerca di comportamenti funzionali al raggiungimento di uno scopo.

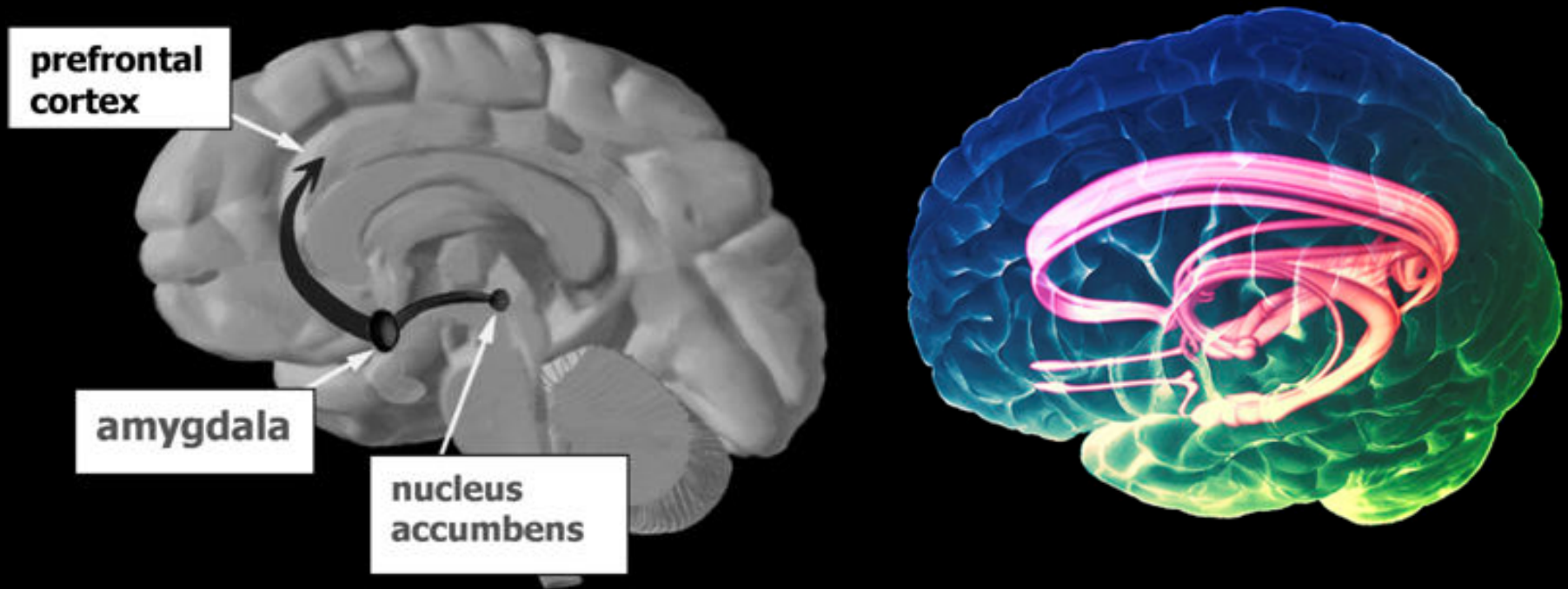


Addiction, the persistent, compulsive and uncontrolled use of a drug or activity despite adverse consequences.

The **accepted view of reward** is that when an activity increases dopamine (DA) transmission in the **nucleus accumbens**, the rise in DA is translated into a **motivational activity**

Early atrophy of pallidum and accumbens nucleus in Huntington's disease.  
*S J A Van Den Bogaard et al. Journal of Neurology; 258: 412-420, 2011.*

.....atrophy of accumbens nucleus and pallidum was apparent in premanifest HD.....







.....“Does cryonics as practiced today adequately preserve the synaptic connectivity of an entire human brain?”

.....“Can the standard chemical fixation and plastic embedding technique used for electron microscopic investigation of brain circuitry be adapted to preserve the entire human brain?”



Soon, people all over the world may have at least two reliable and proven ways to preserve their brains, including their **individual memories and identities**, after they die.