



# A Four Brain Trait Model based on Neurotransmitter-EEG matching



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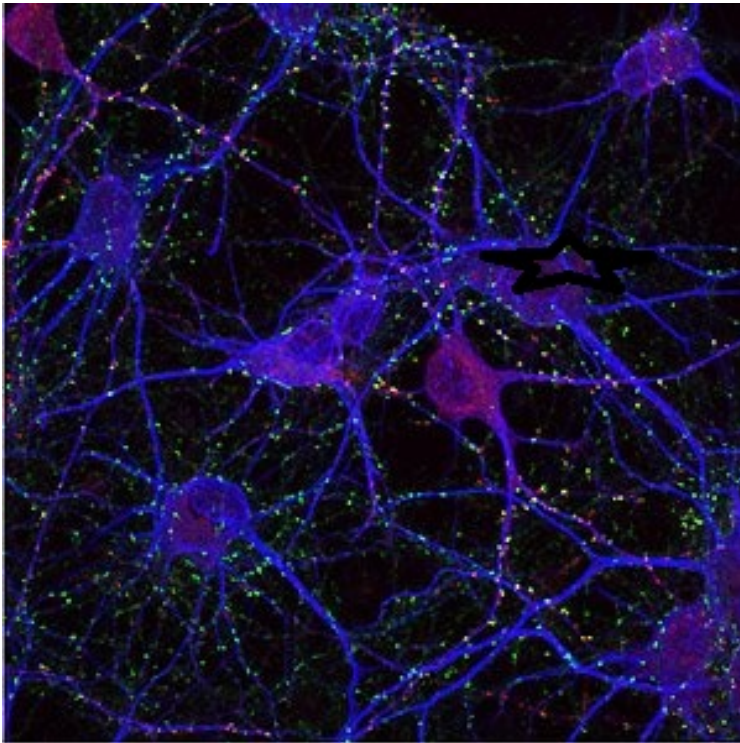


# Research : Four Brain Trait Model

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## ✓ The complexity of the Brain



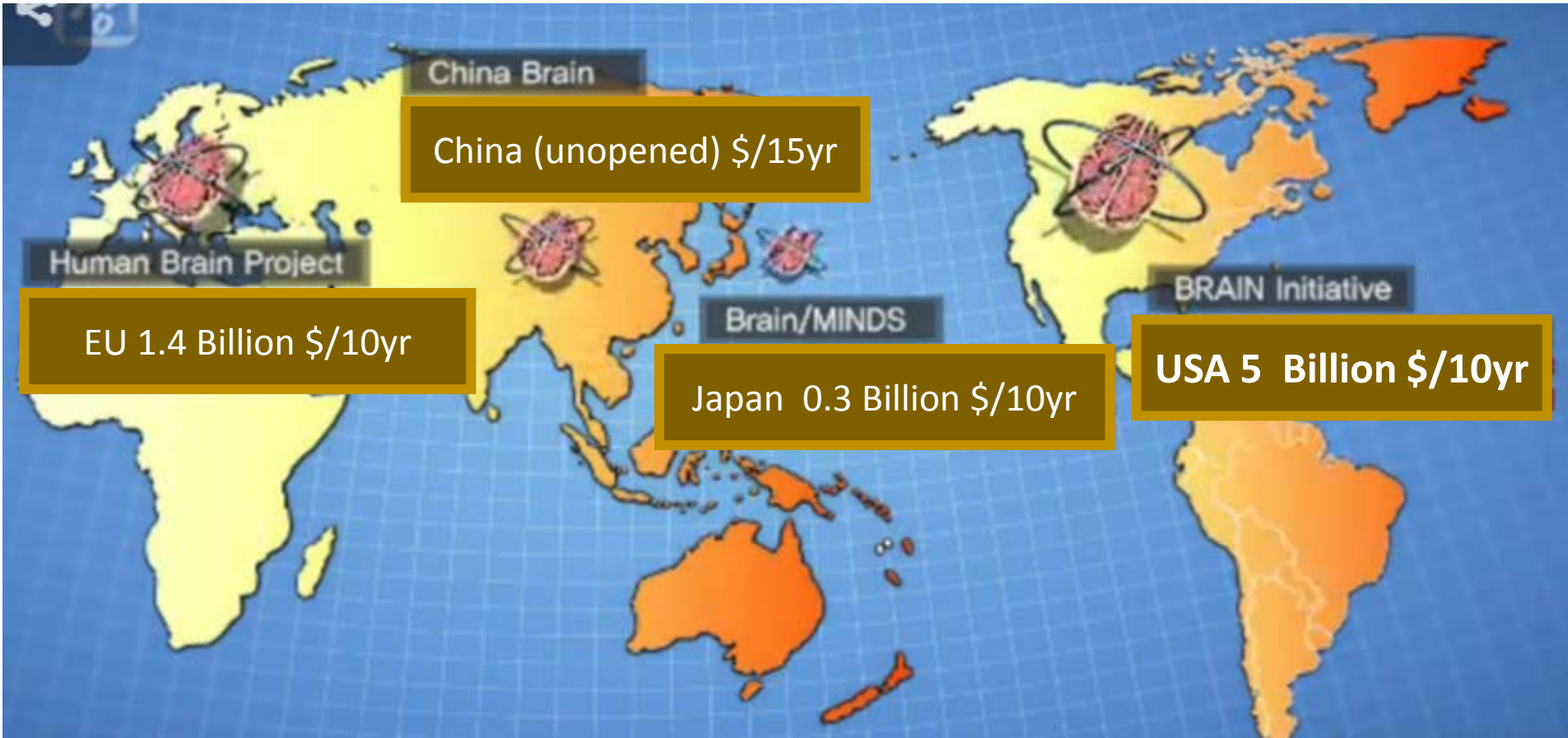
- $10^{12}$  neurons
- $10^{15}$  synaptic connections
- releasing and absorbing  $10^{18}$  neurotransmitter per second

Correspond to computer  
capable of processing  $10^{12}$  Gbyte per second  
, all in about 1.6 Kg of weight  
, and with a consumption of  $10^{-15}$ W

“Wider than the sky”

*The phenomenal gift of consciousness*  
by Gerald M. Edelman

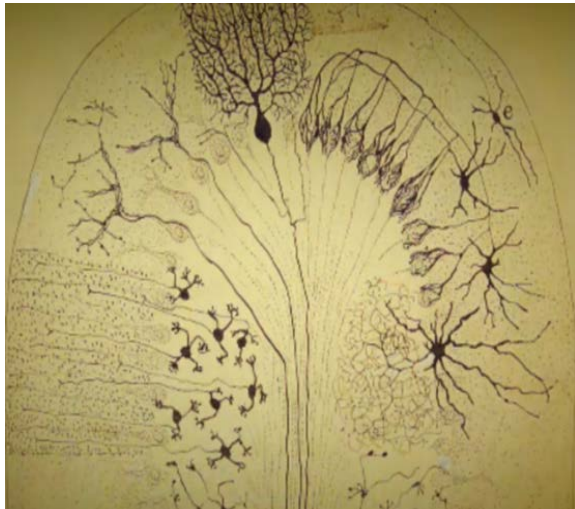
## ✓ Trend in Brain Research



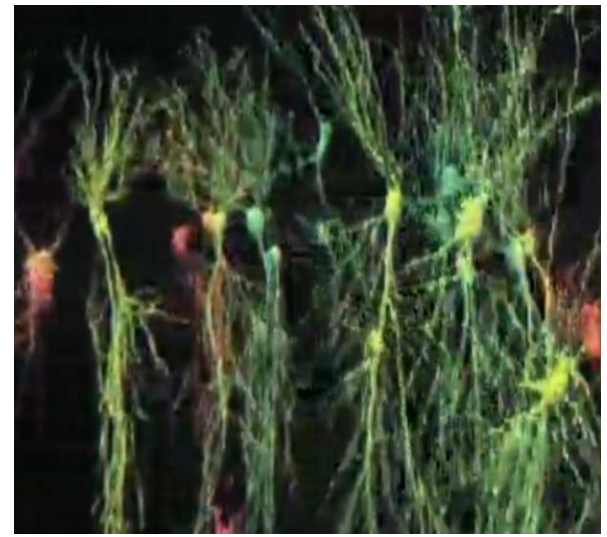
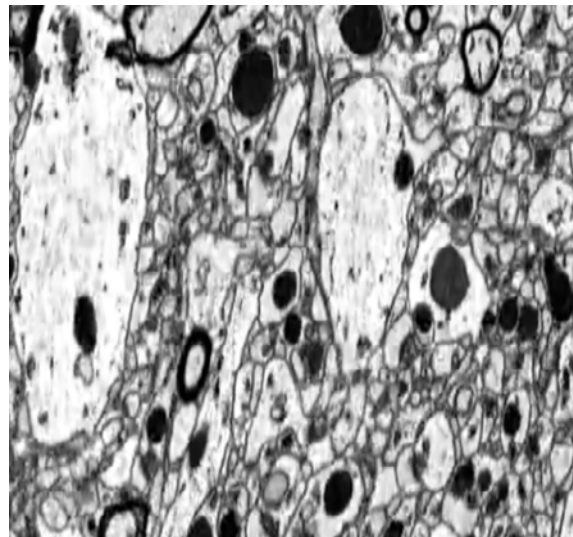
Try to show **how individual cells and complex neural circuits interact** to enable the brain process vast quantity of information, all at the speed of thought.



## From Cajal to modern image technology using 3D electron microscope



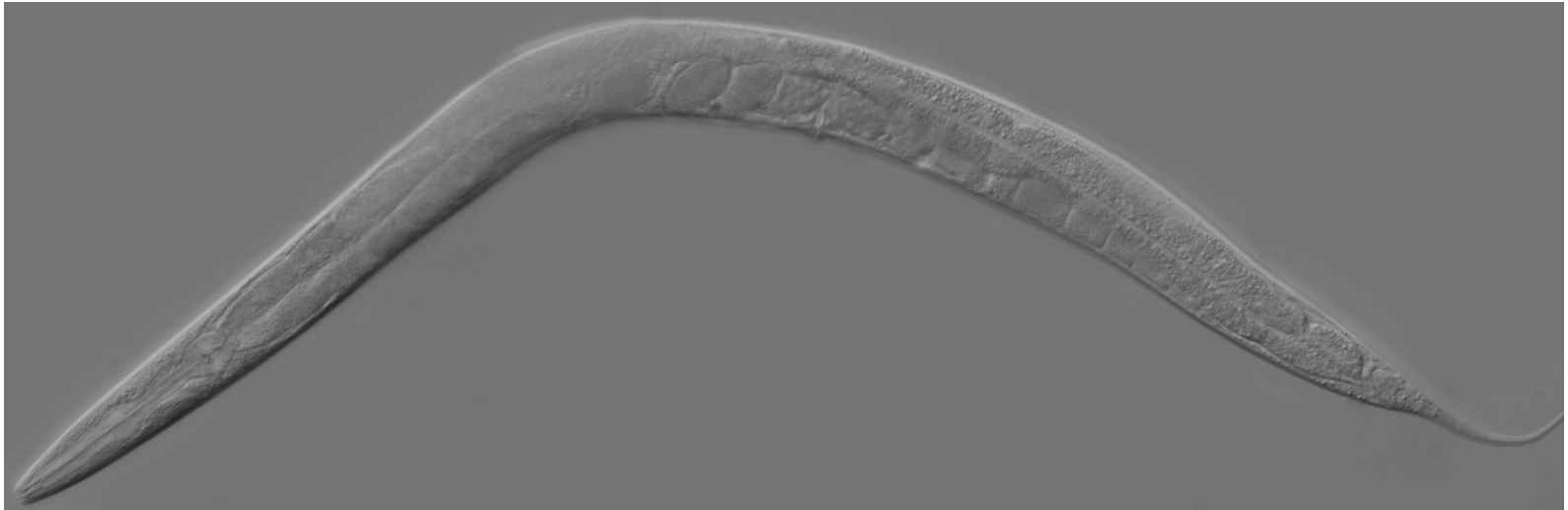
- Hand-sketch of nerve tissue by Santiago Ramón Cajal (Founder of neuro-histology)



- 3D electron microscope image of nerve tissue



**304 neuron vs  $10^{12}$  neuron**



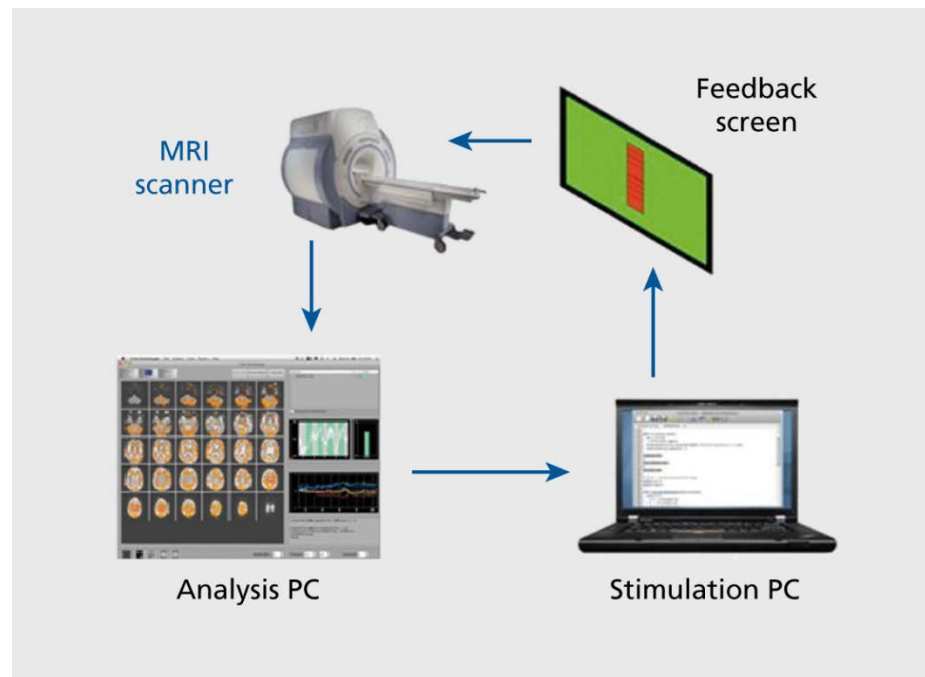
*Caenorhabditis elegans*

Scientists have mapped a tiny roundworm's entire nervous system.  
Did it teach them anything about its behavior?

- Mind controlling drone using brainwave



- Real-time fMRI neurofeedback setup



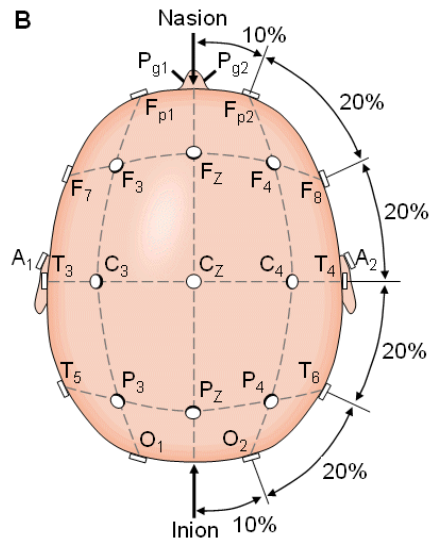
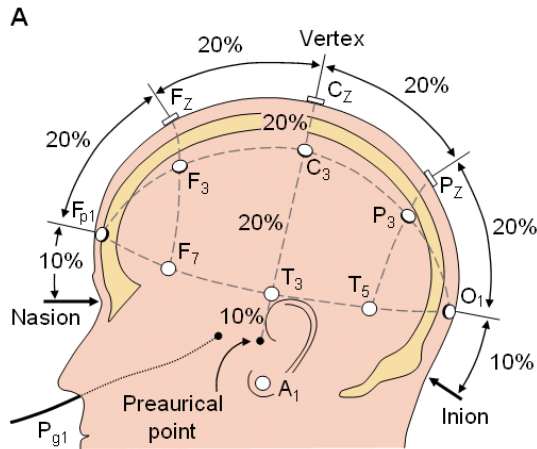


## ✓ EEG(electroencephalogram)

- pioneering work on electricity of animal bodies by **Luigi Galvani** (1737-1798) and on exposed animal cortex by **Richard Caton** (1875)
- **Hans Berger** (1929) provided the first electroencephalogram (EEG) of a living human. In the whole neuroimaging community, this Berger's finding is often evoked as a starting point.
- In order to record EEG, a set of electrodes are applied on the scalp so to establish electrical contact with the skin and in such a way to sample evenly the available scalp surface. To obtain congruence among different laboratories, standard placements have been proposed by **Herbert Henri Jasper** since 1958, basing the positioning on head anatomical landmarks



# ✓ EEG(electroencephalogram)



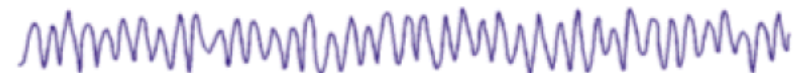
Beta ( $\beta$ ) 13-30 Hz

Frontally and parietally



Alpha ( $\alpha$ ) 8-13 Hz

Occipitally



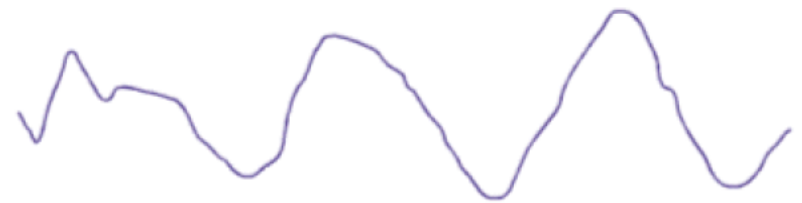
Theta ( $\theta$ ) 4-8 Hz

Children, sleeping adults



Delta ( $\delta$ ) 0.5-4 Hz

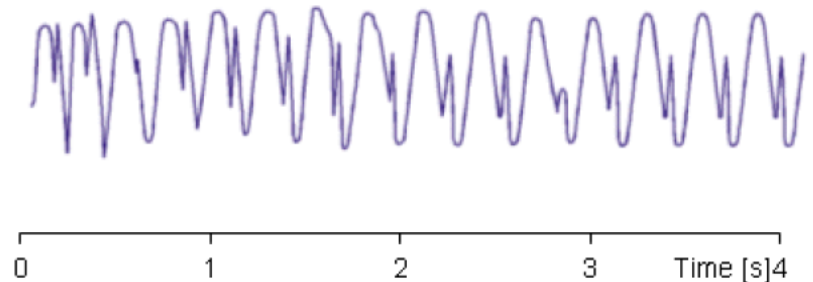
Infants, sleeping adults



Spikes 3 Hz

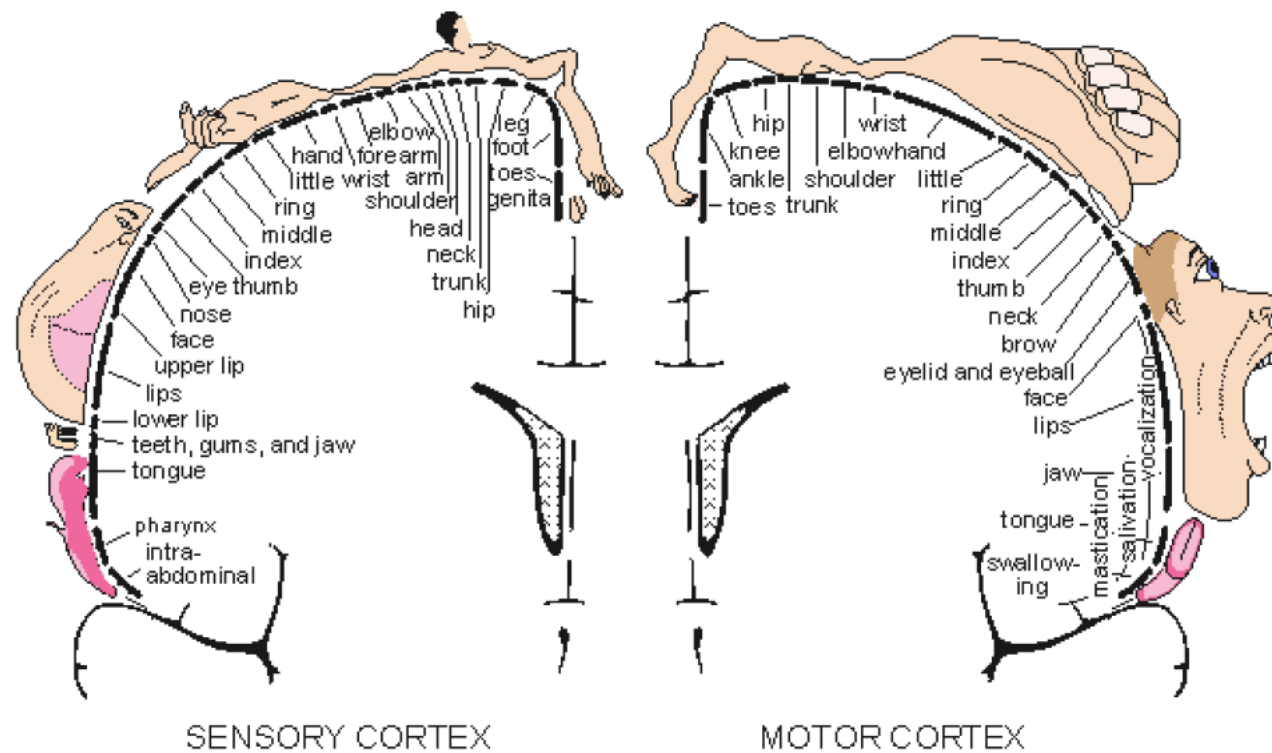
Epilepsy - petit mal

V [ $\mu$ V]

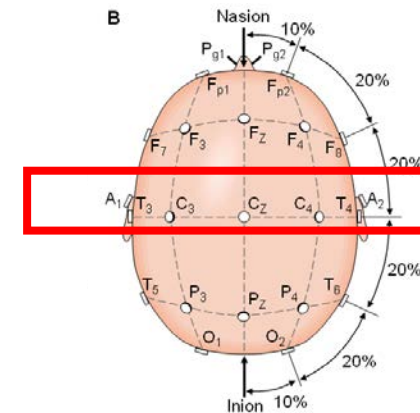


From top to bottom, normal (series 1 to 6) and abnormal (series 7) EEG traces. Figure from Malmivuo and Plonsey (1995).

# Slow cortical potentials under the Delta wave



The Somatotopic organization of sensory (left) and motor (right) functions in the neocortex. Figure from Penfield and Rasmussen, 1950.





## ✓ Four systems of the Brain vs. Four Trait

**1. Dopamine System : Executive function**

**2. Acetylcholine System : Memory function**

**3. Serotonin System : Affective function**

**4. GABA System : inhibitory function**

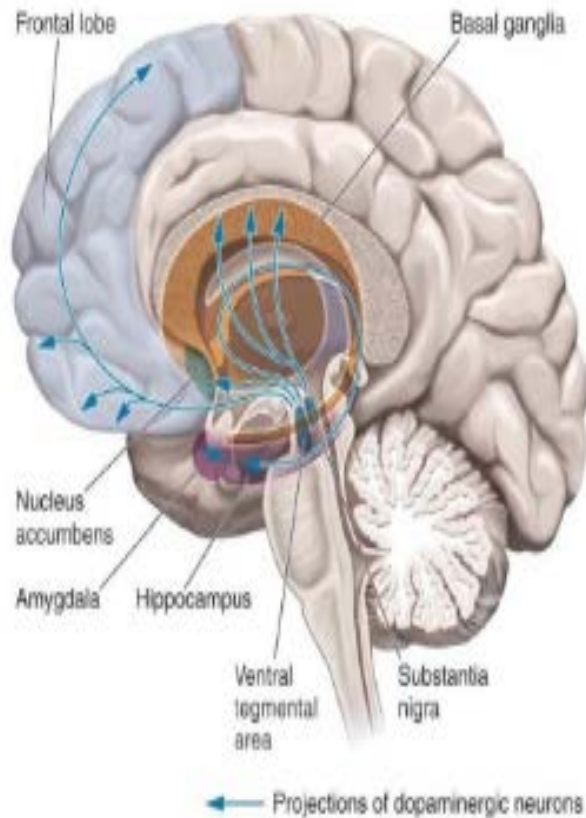
**1. Dopamine Trait**

**2. Acetylcholine Trait**

**3. Serotonin Trait**

**4. GABA Trait**

# 1. Dopamine System : Executive function

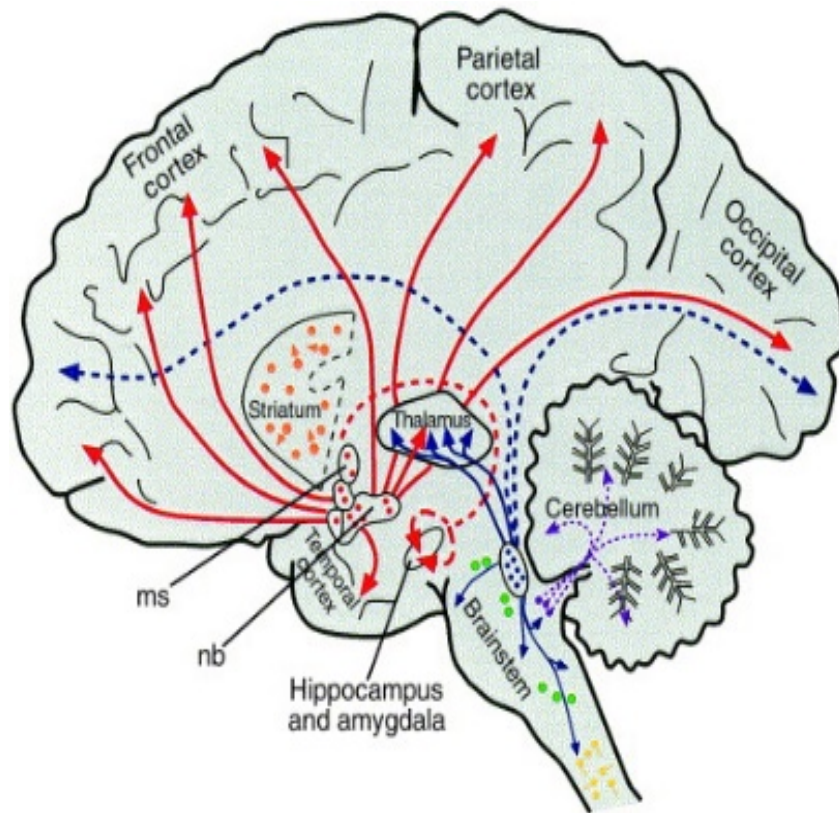


- Mesolimbic pathway
  - Reinforcement
- Mesocortical pathway
  - Planning
- Nigrostriatal pathway
  - Movement

## Powerful Dopamine Trait

Powerful, reflexively fast, quick witted, Strong willed who knows exactly what you want and how to get it, highly rational, Comfortable with facts and figures than with feelings and emotions, Strategic thinking, Masterminding, inventing, problem solving, interested in knowledge and intellect, Challenging, Establishing relationships than nurturing (CEO, Doctor, Scientist)

## 2. Acetylcholine System : Memory function

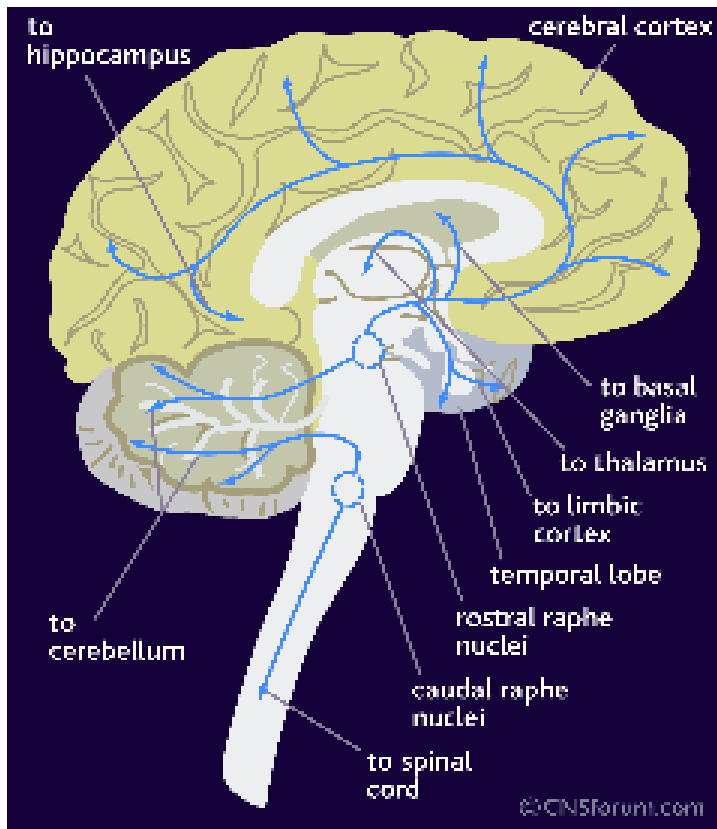


### Creative Acetylcholine Trait

Constantly taking others into consideration. Flexibility, Creativity and impulsivity as long as it introduces something new(meaningful), intuitive and innovative, share enthusiasm with others. Extremely sociable. Love meeting and greeting. Eternal optimist, Altruism and benevolence(Ideal counselors, meditators, think tank members, yoga and meditation instructors, religious leaders, public service)



### 3. Serotonin System : Affective function

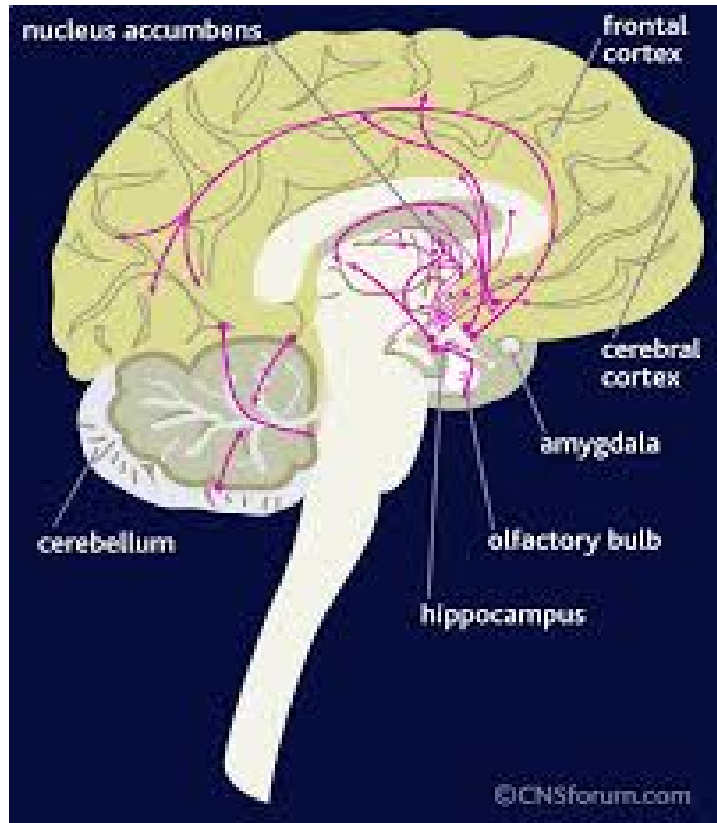


#### Playful Serotonin Trait

Really know how to enjoy themselves. How to live in the moment. Ability to rest, regenerate, serenity. Keep any conversation animated. If you don't consider work play, it's not worth doing. Activity with danger ; bungee jumping, motor boat, all night carousing ; Who get to play with the most advanced and expensive tools. Passionate in relationship but refuse to be tied down; special fondness in children, not in commitment-best aunt or uncle. Broad relationship but not deep. Desire for new experiences. Experiencing too much excitement or not getting enough sleep. Loads of pasta, potatoes, fried foods ; virtually no vegetables, whole grains and fish(ideal for requiring for motor skills, hand-eye coordination, flexibility, crisis management; construction workers, truck drives, ambulance driver, hair stylist, computer programmer, movie star, fashion model.)



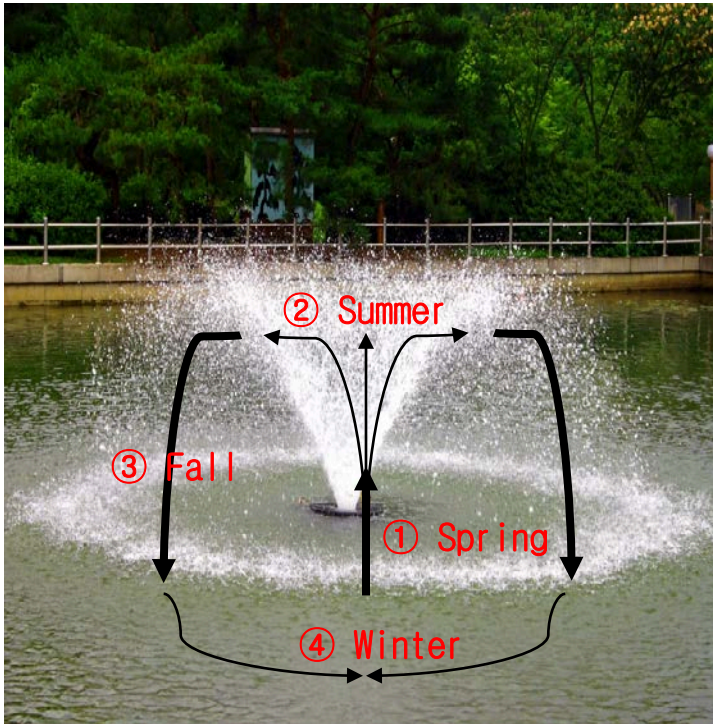
## 4. GABA System : inhibitory function



### Stable GABA Trait

Organized, consistent, stable, punctual, capable. Ideal candidate for making small yet significant improvement. Not given broad swings of emotion or outburst of anger, pleasure from fulfillment of every obligation; highest regard for tradition and institution; look forward to group activity, Tidying up is a relaxing pleasure, Rigid schedule, Routine .(administrators, accountants, security officers, nurse, technicians, air traffic controller, bus drivers, home-makers)

# ✓ A Fountain Model of the Four Trait

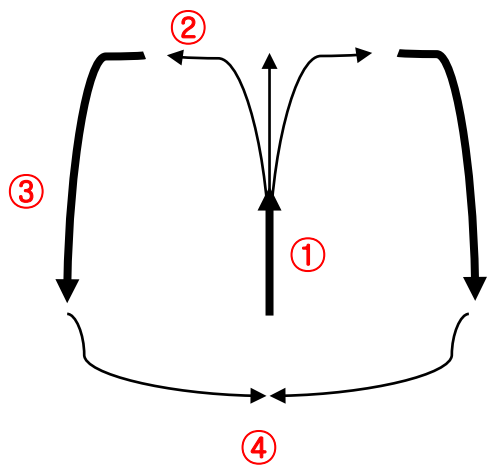


- ① **Powerful ascending**  
→ Driving force of dopamine trait
- ② **Wide spreading**  
→ Divergence of acetylcholine trait
- ③ **Falling down**  
→ Relax and enjoy of serotonin trait
- ④ **Gathering**  
→ Convergence(Cohesion) of GABA trait

## \* notes \*

- The fountain model was originally devised by Prof. Shin, DaeJin University.

**Yin-Yang-O-Haeng (陰陽五行)  
and the neurotransmitter  
for the 1 year cycle**



Spring  
Dopamine  
太陽  
木 3.8

☰  
☷  
2.7

Acetylcholine  
Summer

小陽

Fall  
Serotonin

太陰

4.9

5.10

土

☷  
☷

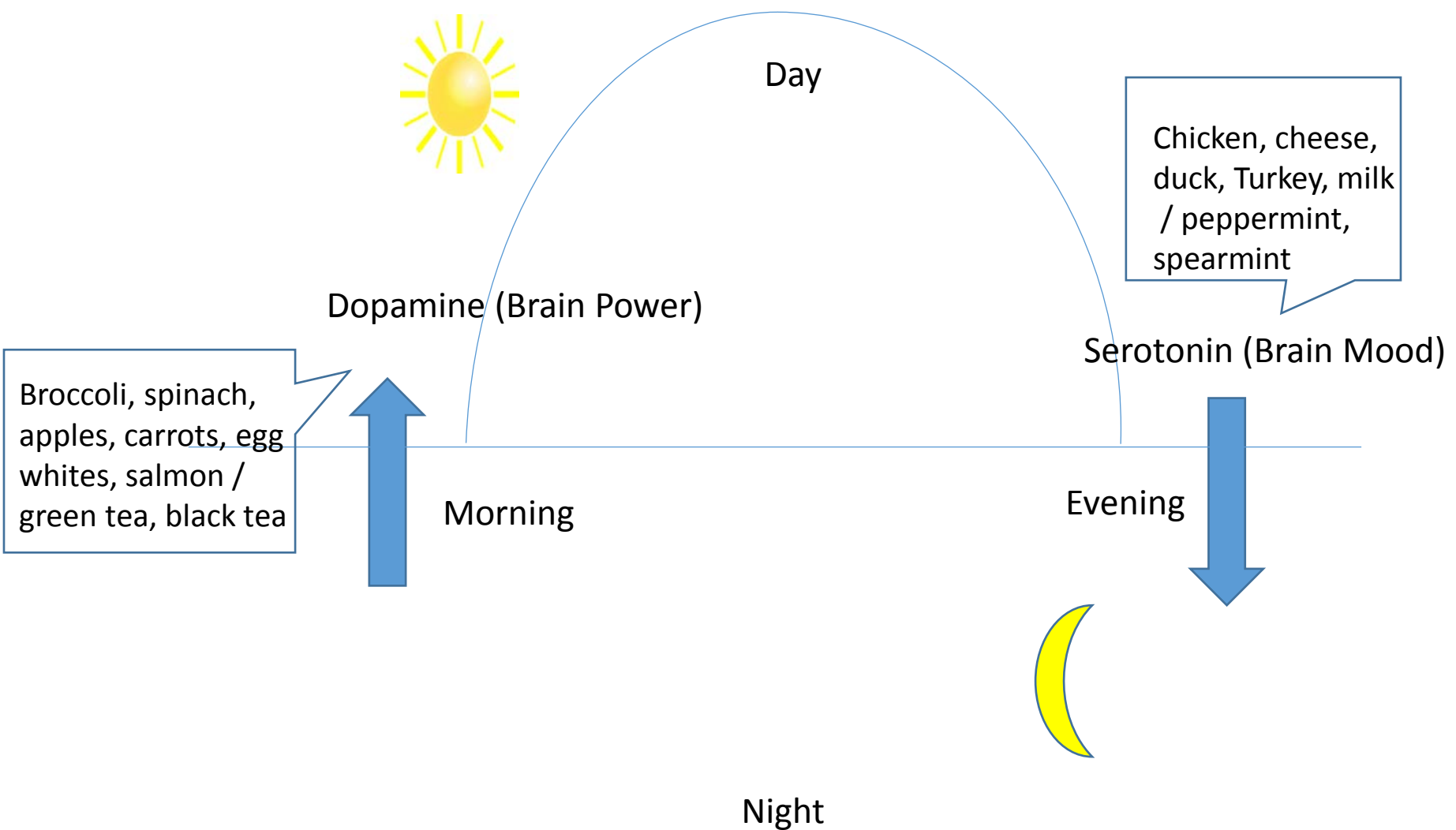
GABA  
小陰

1.6

Winter

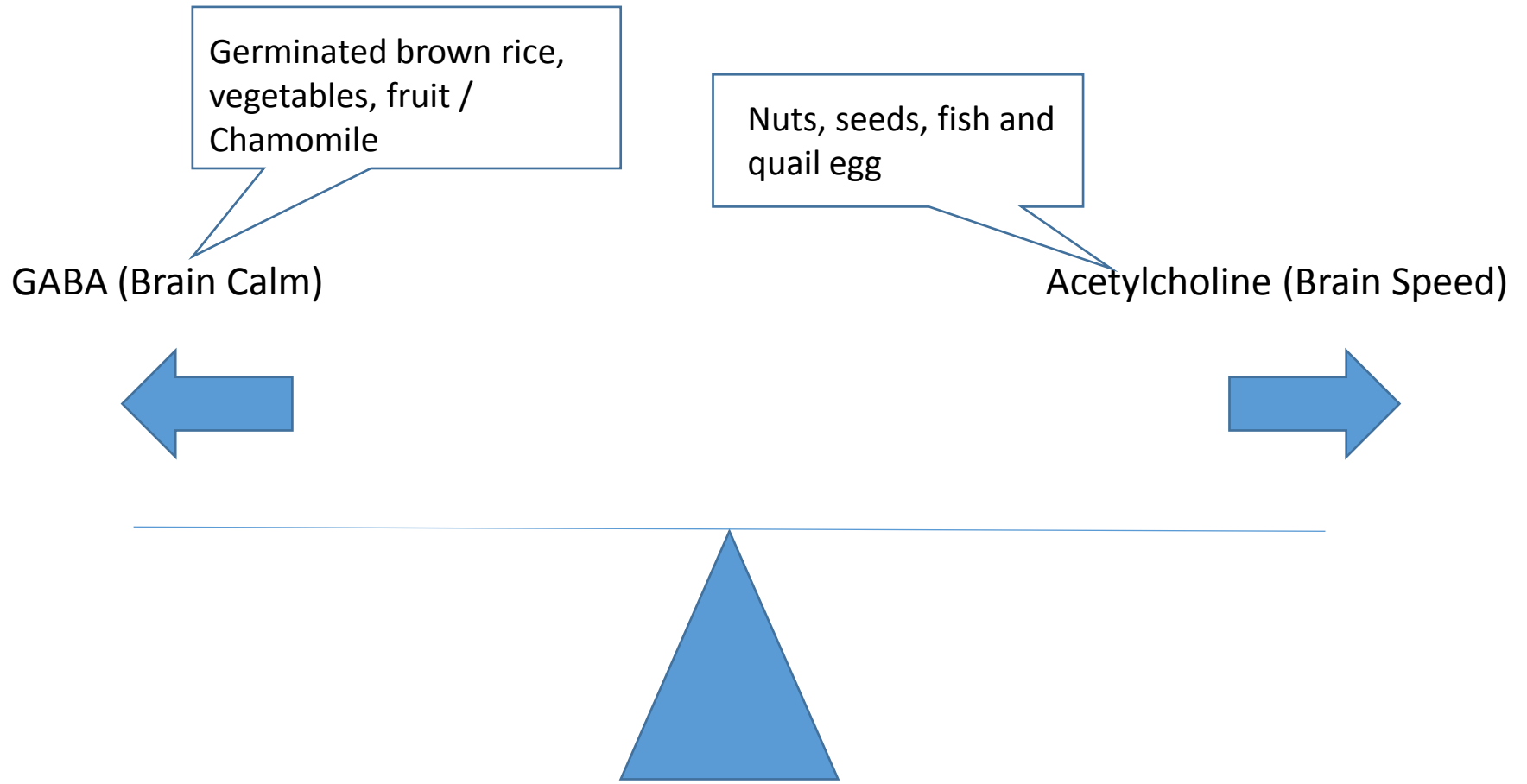
☷  
☷

# Yin-Yang-O-Haeng (陰陽五行) and the neurotransmitter for the 1 day cycle



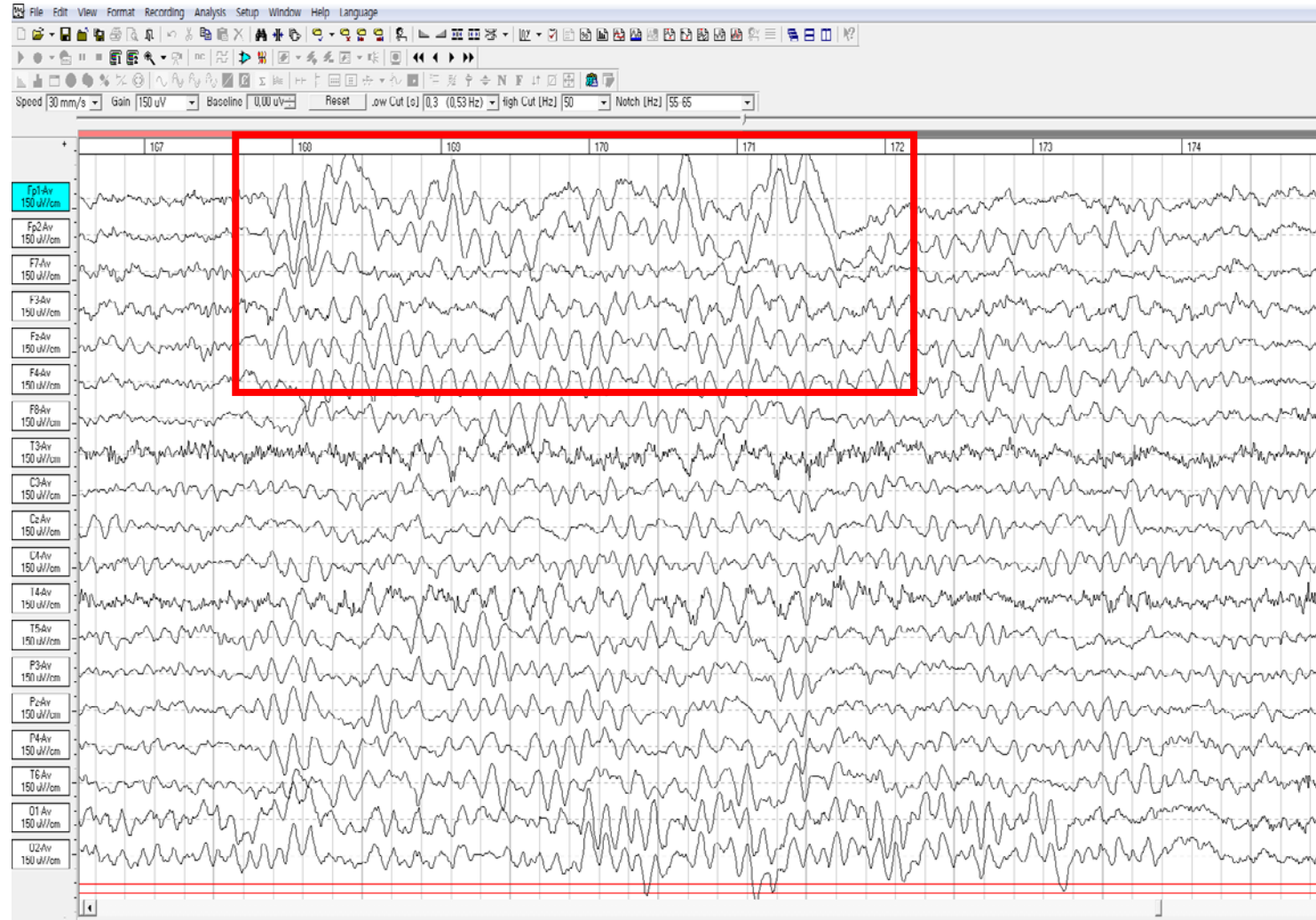
[Activities of dopamine and serotonin in the period day]





[Activity of acetylcholine and GABA ]

# ✓ EEG and neurotransmitter (Dopamine issue)



Game addiction, ADHD (DCE556, 12 years old)

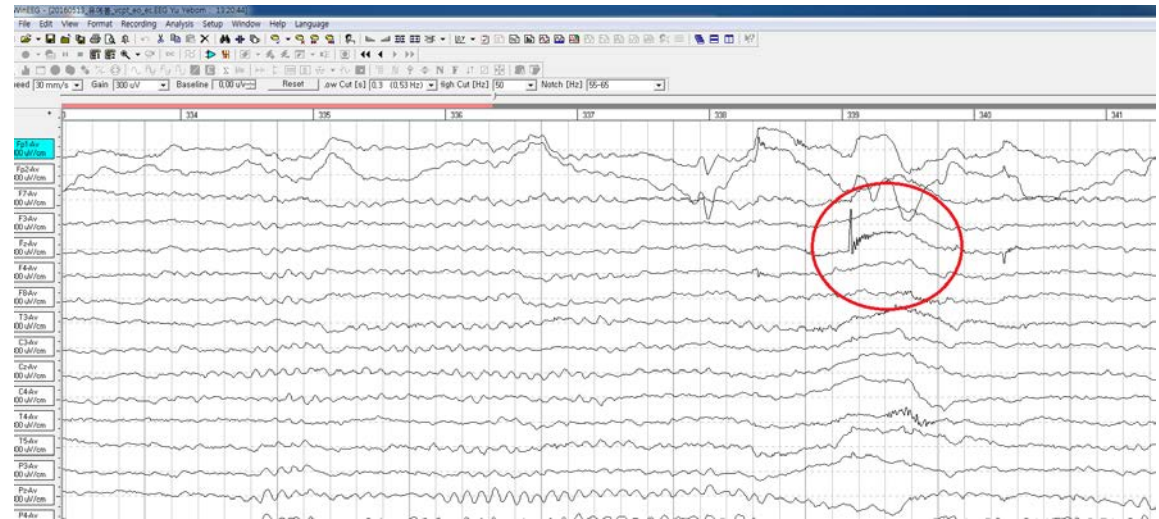
# ✓ EEG and neurotransmitter (GABA issue)



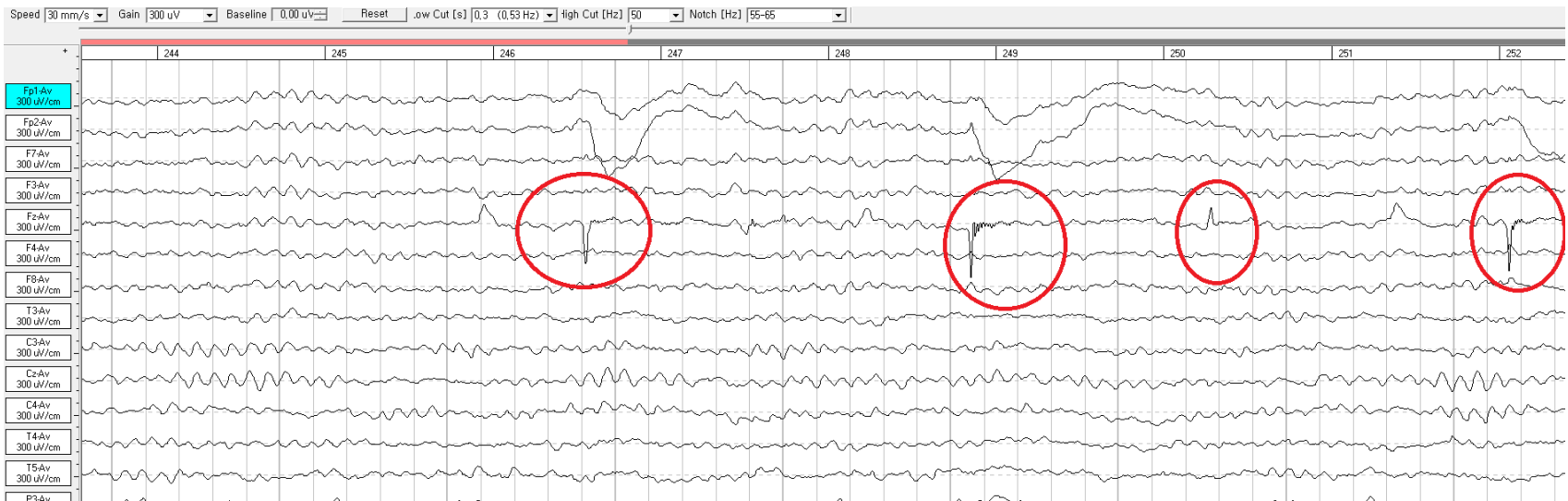
Do overly shy. Asthma, frequent urination (DCE 0900, 6 years old)

# ✓ EEG and neurotransmitter (GABA issue)

Transient spike and wave



Sharp waves





“智者 與天地同 有春夏秋冬之氣 每事 任意用之  
謂之智慧勇力 人可用陰陽然後 方可謂人生也”  
-濟生 43, 典經 -

The Wise man have all the rhythms of the nature, so to speak, rhythm of the spring, rhythm of the summer, rhythm of the autumn and rhythm of the winter. She/he can utilize freely and maximally all the rhythm appropriately according to the timing and situations. So, it could be called sincere wisdom and power. After a person can use all the rhythms of the nature, simply yin(autumn, winter) and yang(spring, summer), the person could fulfill her/his mission of life.

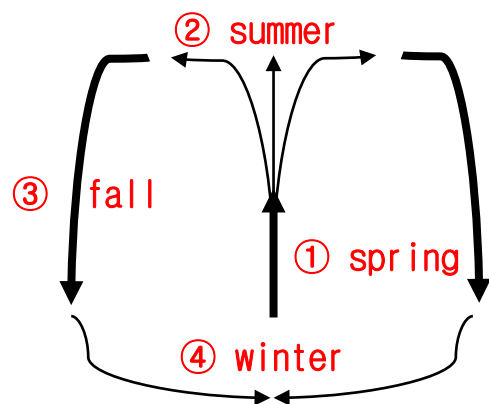
From The bible of Daesoonjinriheo





# Research : Four Brain Trait Model Background

To find neurophysiological mapping for the 4 brain trait model



	Spring	Summer	Fall	Winter
東醫壽 世保元	太陽人	少陽人	太陰人	少陰人
MBTI	NT	NF	SF	ST
四君子	竹	菊	蘭	梅
Neurotra nsmitter	Dopamine	Acetylcholine	Serotonin	GABA
<b>EEG</b>	?	?	?	?

## Research : Four Brain Trait Model Method and Analysis

431 adult participants were enrolled the study in which they answered Brian trait questionnaires and their whole brain EEGs were recorded during 4 minutes eye closed rest condition.

100 participants were selected in which 4 groups of strongest 25 participants in each brain trait group, respectively.

The grand average of the spectral characteristics of each brain trait group were displayed for comparisons.





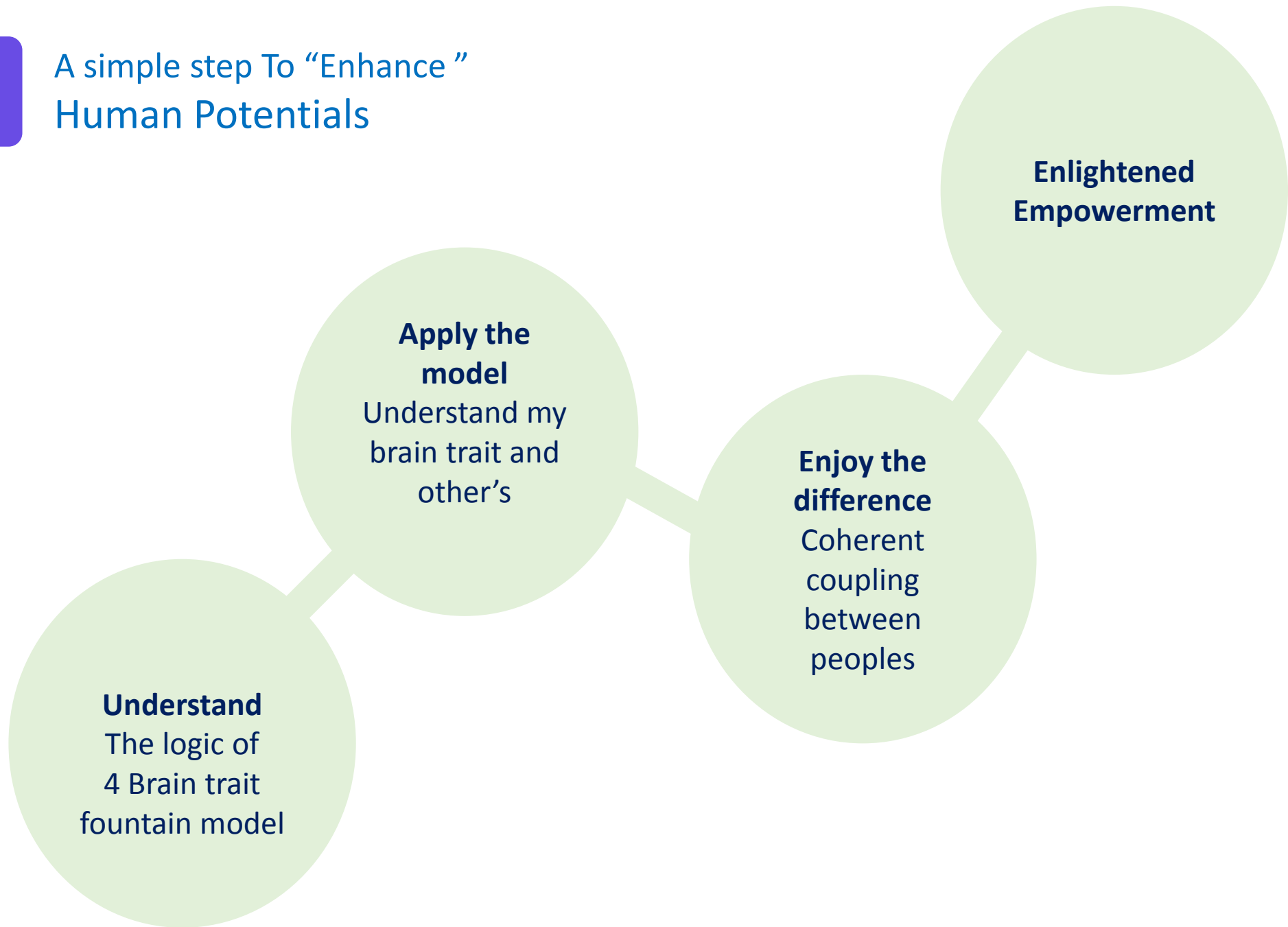
Four Brain Trait Model  
From research to real-life

**We will try to identify  
the physiological difference between different brain trait groups**

**We could understand and enjoy the difference and further practice  
a training toward harmonizing with other brain trait people.  
These maybe a universal contents of religious practices.**



## A simple step To “Enhance ” Human Potentials



## Special Thanks to

Seung Wan Kang<sup>1)2)3)</sup>, PI of this study, Director of Data center.

Jin Young Kim<sup>1)2)</sup>, IRB development and Recruiting participants

Kyung Hye Park<sup>1)</sup>, EEG Measurement and meta data coding

Hwa Hyun Cho<sup>1)</sup>, EEG Measurement and meta data coding

1) Data center for Korean EEG, Seoul National University

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3) Assistant Professor, College of Nursing, Seoul National University

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*Thank you for your attention!*



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