

# USE-IT-OR-LOSE-IT

THE SPECIAL STATUS OF THE PRE-ADO-LESCENT BRAIN



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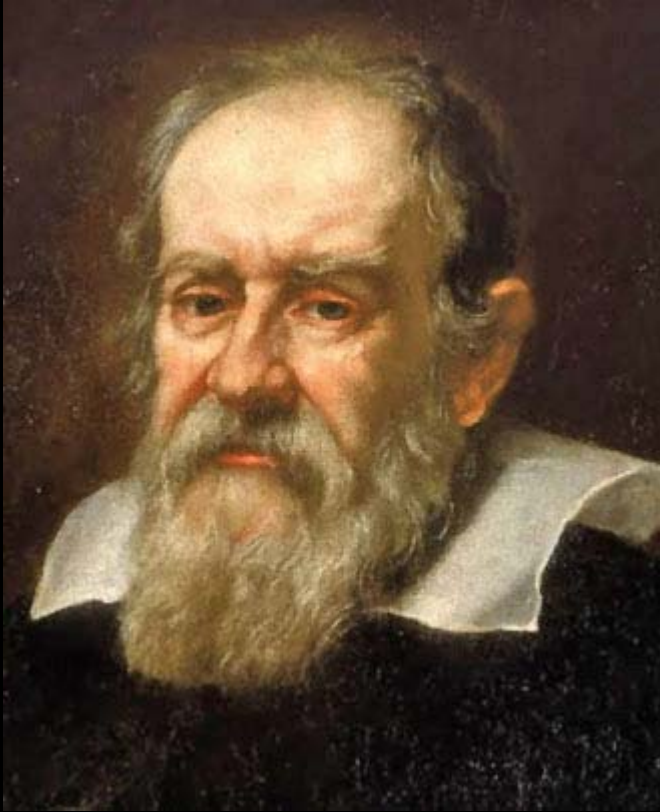


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FRAMEWORK  
BRAIN MATURATION  
GENERAL ISSUE  
NEUROPSYCHOLOGY  
IMAGING  
WHAT TO DO IN CLINICAL PRACTICE  
NEUROPSYCHOLOGICAL APRASIAL

FRAMEWORK

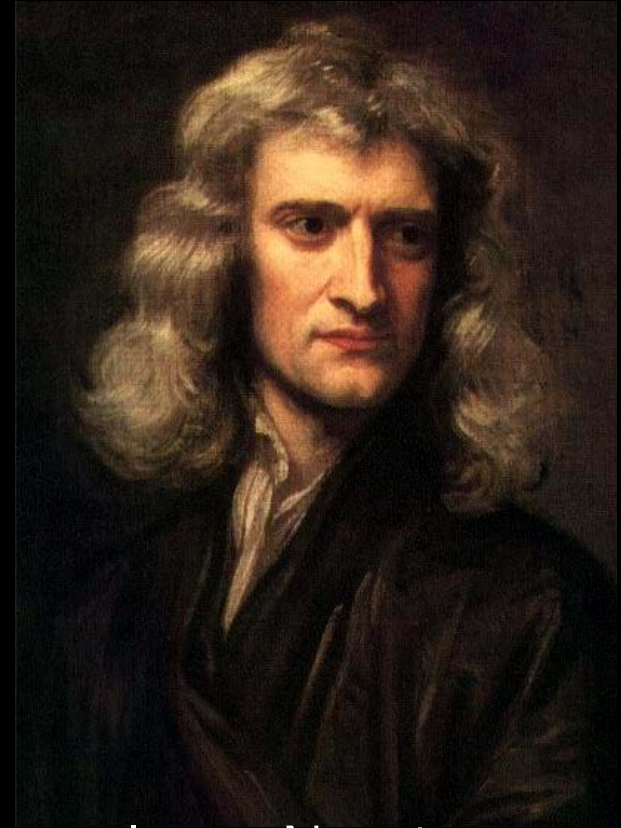
EVERY BODY HAVE SEEN  
THE MOON



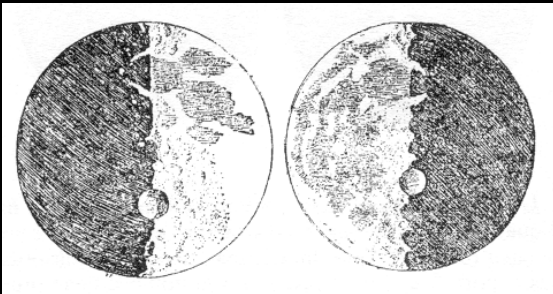
Galileo Galilei  
1564-1642

WHY WE  
KNOW  
THEM?

EVERY BODY HAVE SEEN  
SOMETHING TO FALL

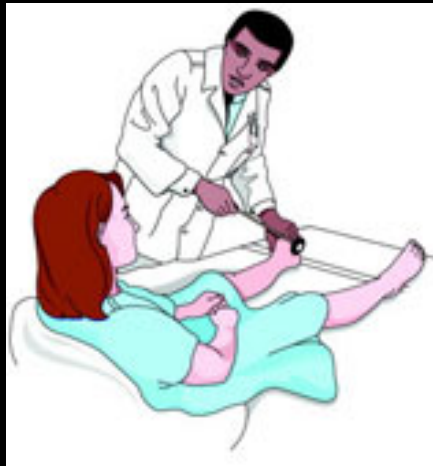


Isaac Newton  
1643-1727

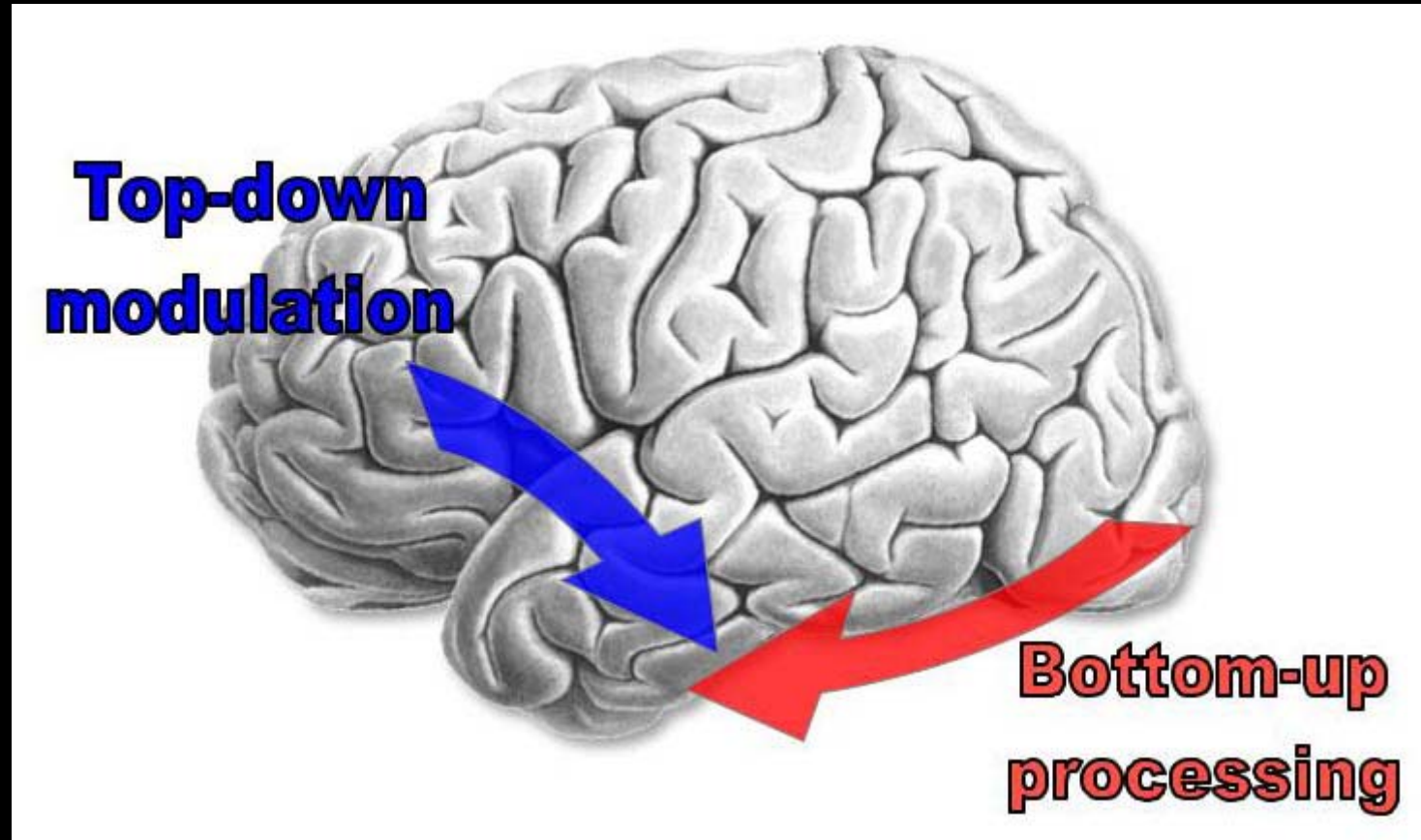




# WHAT TO WATCH? & HOT TO INTERPRET?



# GOAL-DIRECTED BEHAVIOR





# GOAL-DIRECTED BEHAVIOR



## PROBLEMATIC

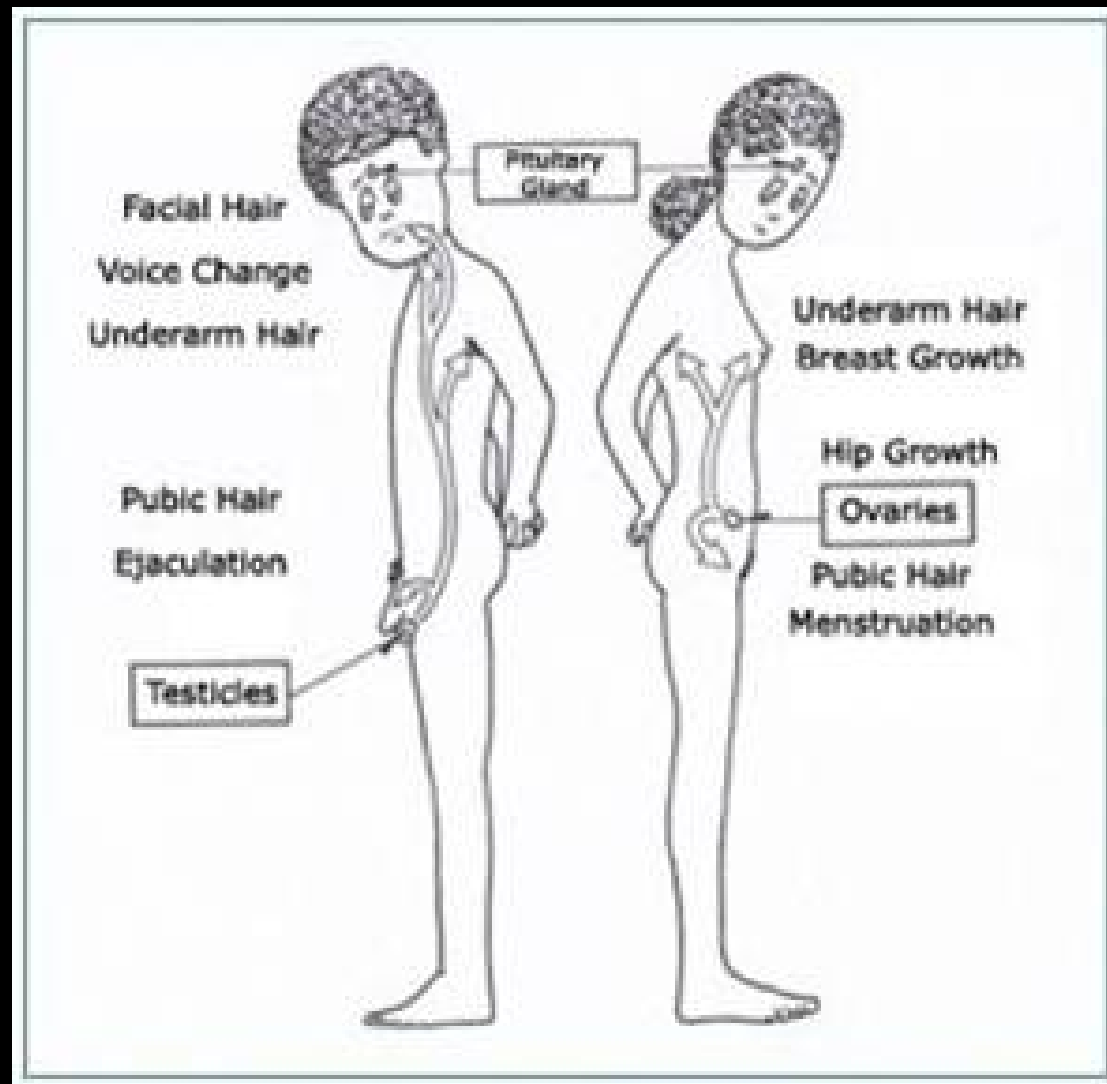
INFENCTION DISEASE (HIV)  
DRUGS ABUSE  
PATHOLOGICAL GAMBLING  
TECHNOLOGY MISUSE  
RISK BEHAVIOR

## HEALTH

NO INFENCTION DISEASE (HIV)  
PRESCRIBED DRUGS  
RESPONSIBLE GAMBLING  
TECHNOLOGY USE  
PROTECTIVE BEHAVIORS







USE THE  
CONDOM

MAKE  
SPORT

EAT GOOD  
FOOD

WELL  
SLLEP

# BEHAVIORS

NO  
CONDOM

NO  
SPORT

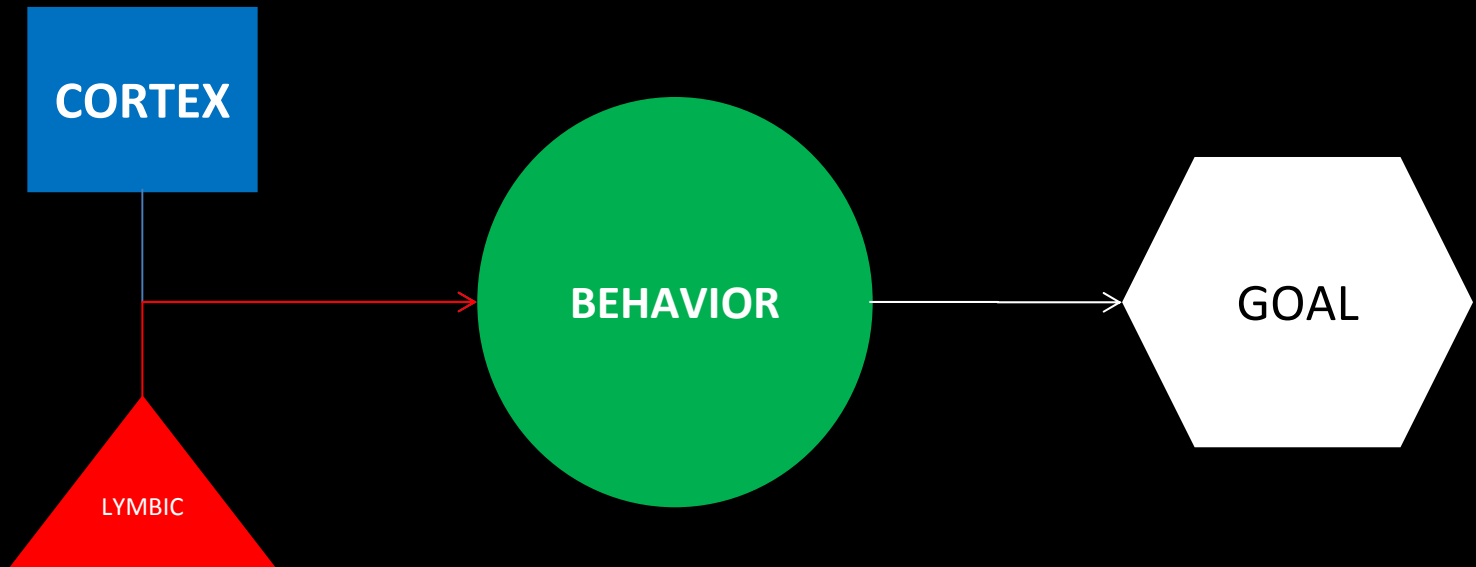
BAD FOOD

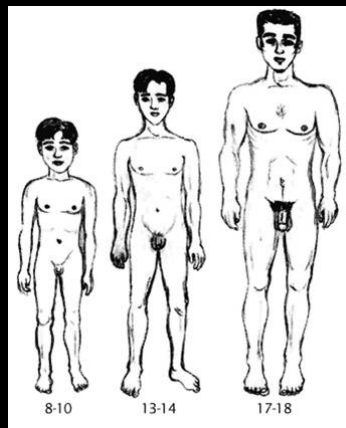
BAD SLLEP

# TO ACHIEVE A GOAL



# TO ACHIEVE A GOAL





# AGING?



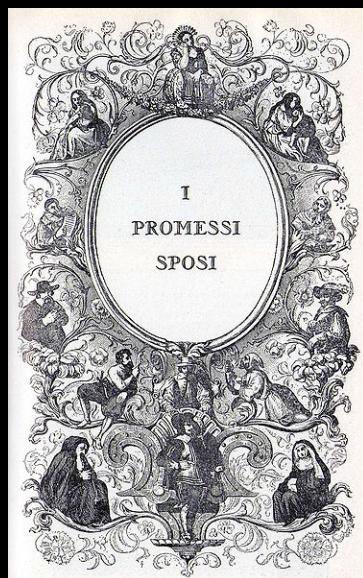
# CHIAVE DI VOLTA

La **chiave di volta** è una pietra lavorata (o "acconciata" o "concio") per adempiere a funzioni strutturali, posta al vertice di un arco o di una volta; chiude, con la sua forma a cuneo, la serie degli altri elementi costruttivi disposti uno a fianco dell'altro ed è quindi elemento indispensabile per scaricare il peso retto dall'arco sui pilastri laterali.

## ARCHITETTURA



## LETTERATURA



## CINEMA







CHIAVE DI VOLTA?



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"Something tells me we really haven't  
began to live yet."

# AGING?



**CHILDHOOD**

AGE GOAL-DIRECTED BEHAVIOR  
**NEVER COME BACK**

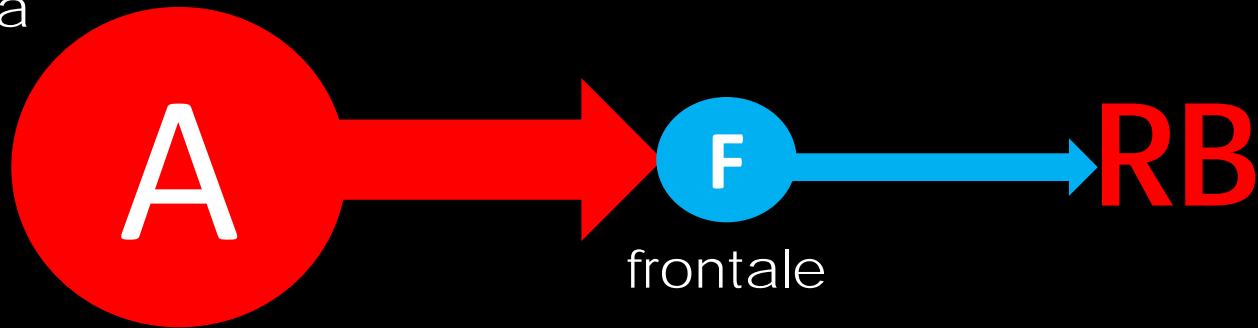
**ADULTHOOD**



# PRE-ADO-LESCENT BRAIN

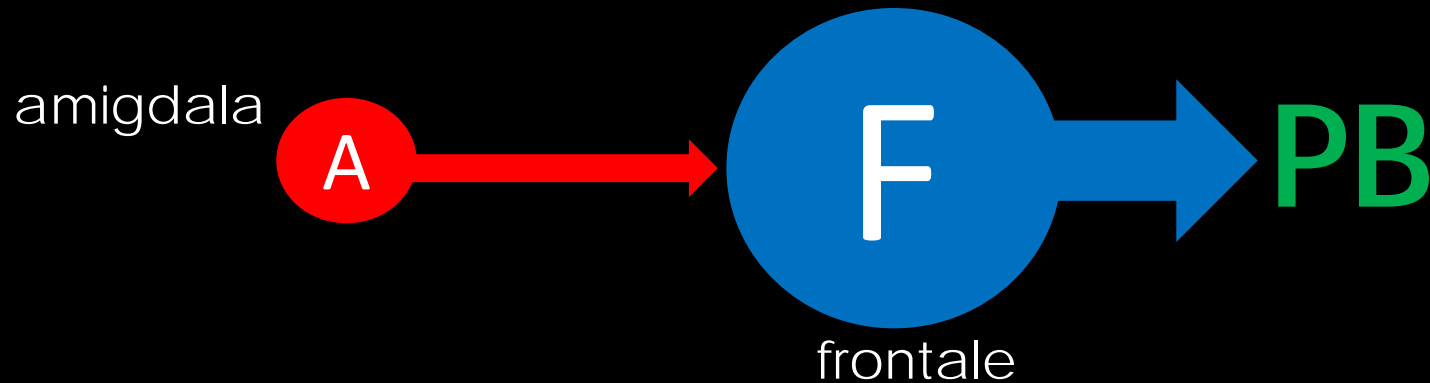
DRIVER > CONTROLLER

amigdala



# PRE-ADO-LESCENT BRAIN

CONTROLLER > DRIVER

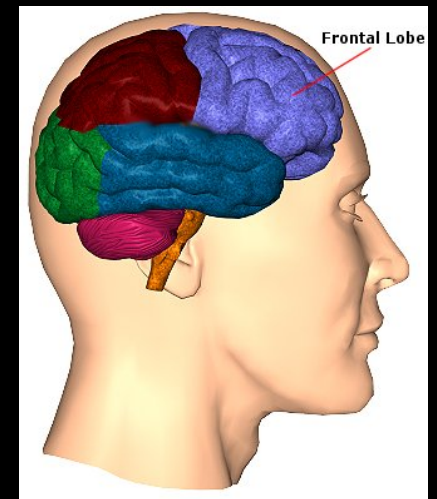
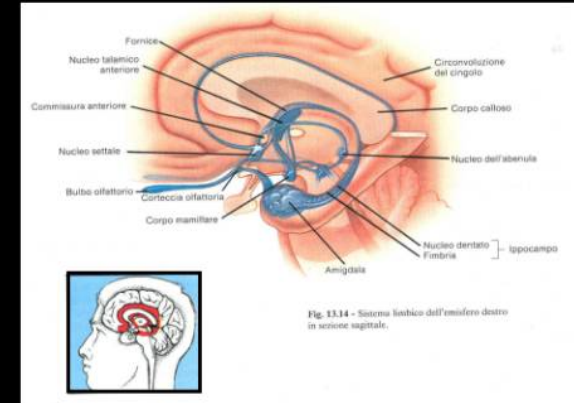


# NOT PATHOLOGY

$$C > D = PB$$

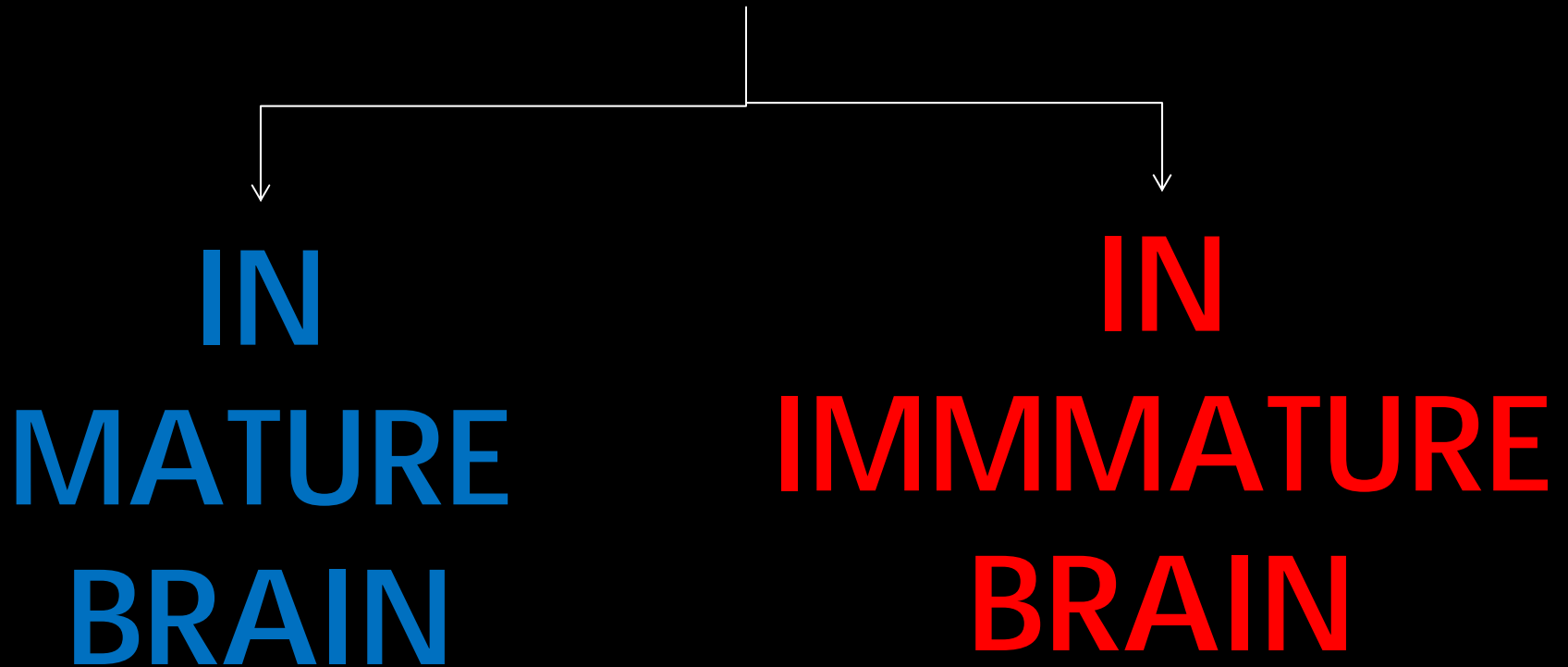
$$D > C = RB$$

**DRIVER**  
**=**  
**LYMBIC**  
**AGE?**  
**CONTROLLER**  
**=**  
**CORTEX**





# GOAL-DIRECTED BEHAVIOR



# BRAIN MATURATION

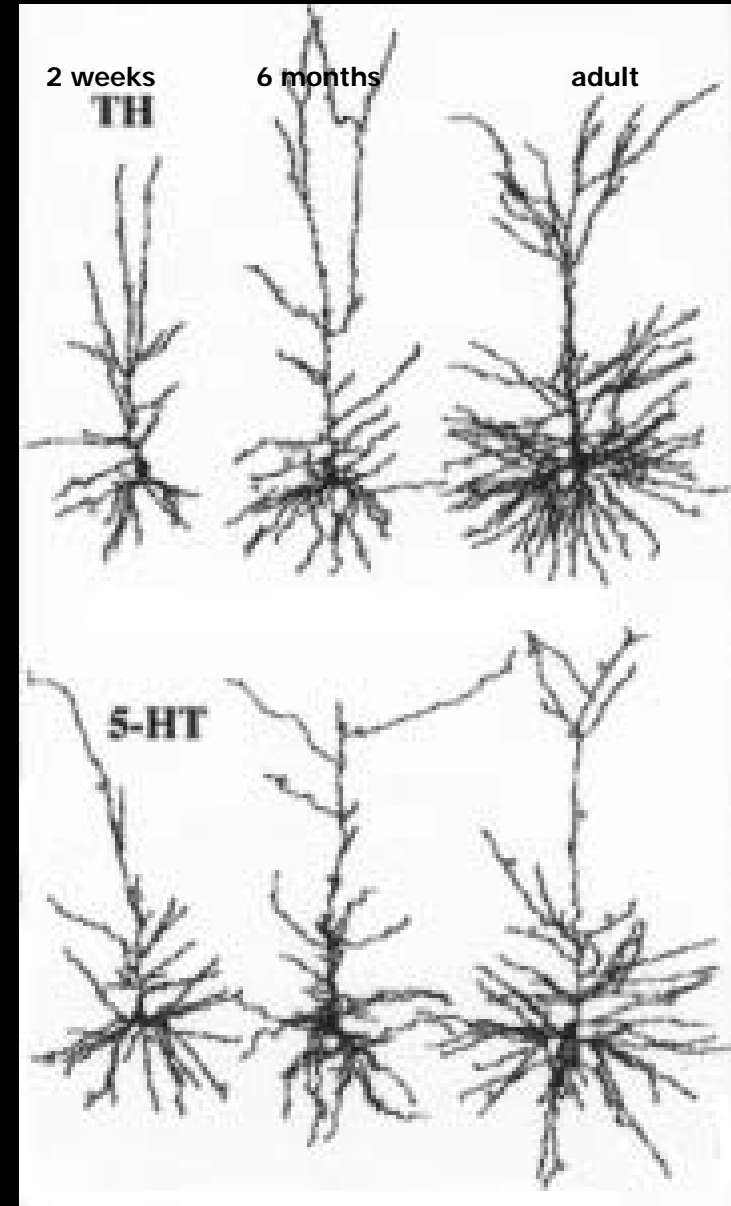
BRAIN MATURATION

IS FULLY COOKED  
AT BIRTH?

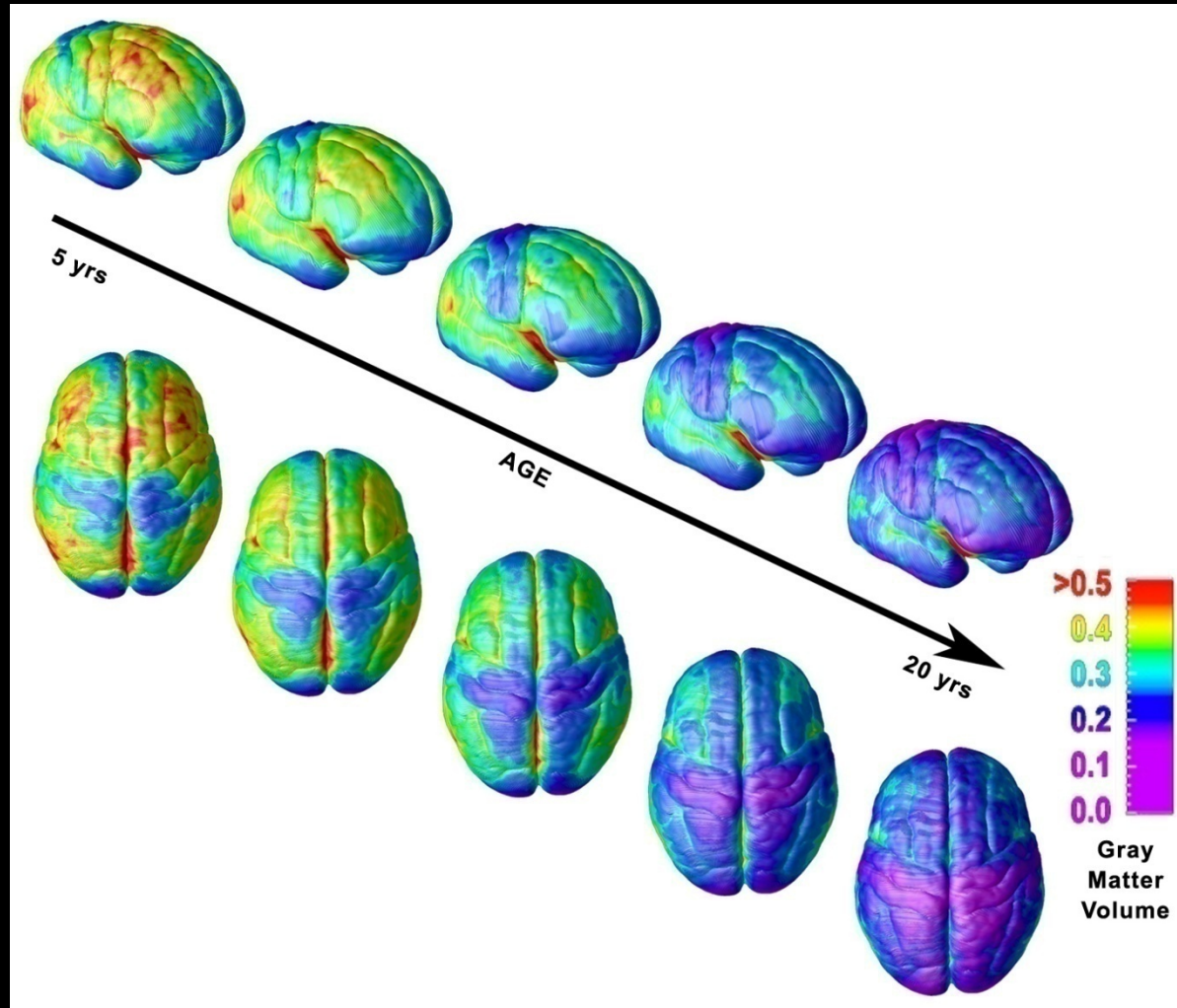
# BRAIN MATURATION

The brain is not fully grown at birth, not just in terms of its size, but in terms of the complexity of the networks of nerve cells that determine how it functions (Nowakowski, 1987).

While the number of nerve cells may not change much after birth, the richness and complexity of the connections between and among cells do, as does the capacity for these networks to process increasingly complex information.



# BRAIN MATURATION

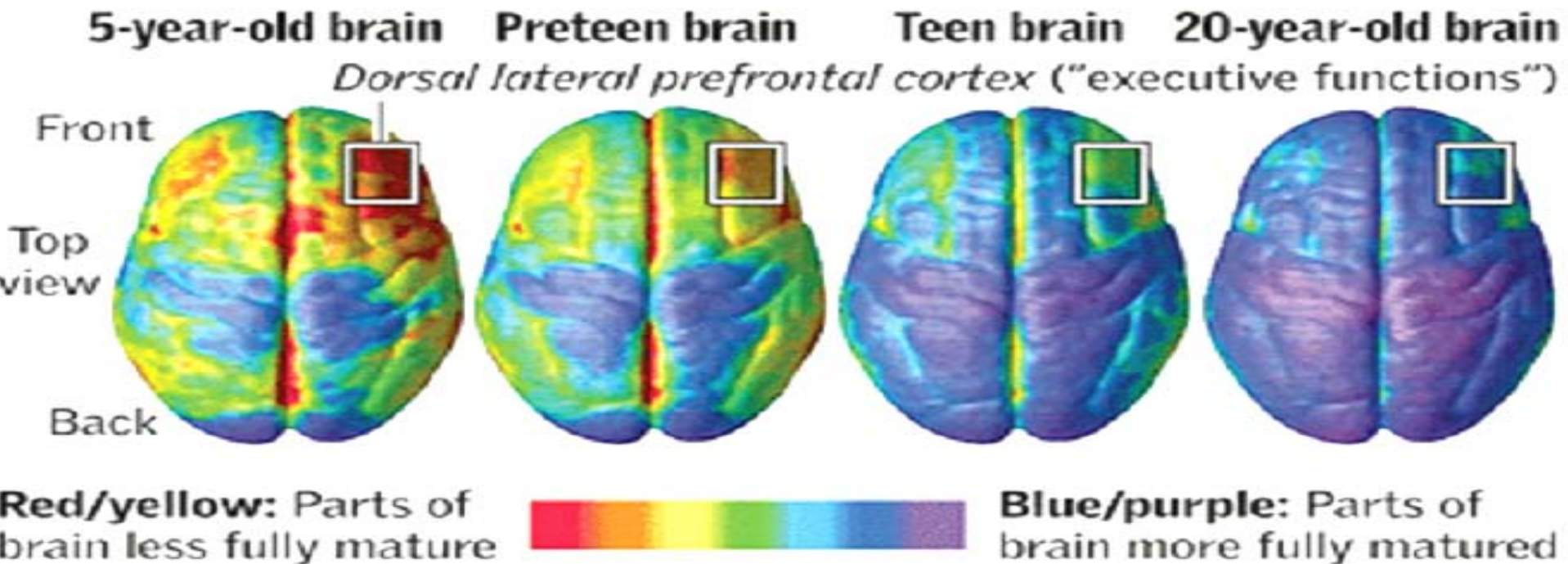


Nitin Gogtay MD, Jay N. Giedd MD, Leslie Lusk BA, Kiralee M. Hayashi BS, Deanna Greenstein PhD, A. Catherine Vaituzis, David H. Herman BS, Tom F. Nugent III AB, Liv Clasen PhD, Arthur W. Toga PhD, Judith L. Rapoport MD, and Paul M. Thompson PhD: *Dynamic Mapping of Human Cortical Development during Childhood through Early Adulthood*, *Proceedings of the National Academy of Sciences* 101(21):8174-8179, May 25 2004

# BRAIN MATURATION

## Judgment last to develop

The area of the brain that controls “executive functions” — including weighing long-term consequences and controlling impulses — is among the last to fully mature. Brain development from childhood to adulthood:



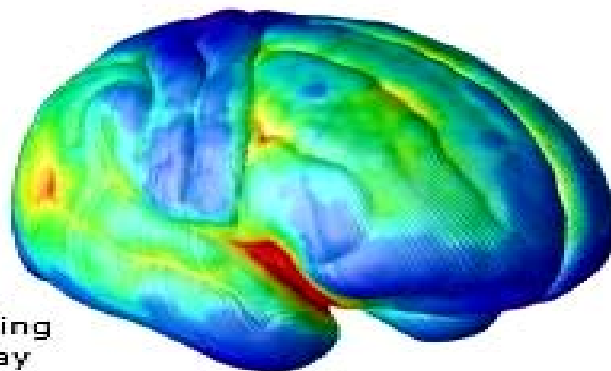
Sources: National Institute of Mental Health;  
Paul Thompson, Ph.D., UCLA Laboratory of  
Neuro Imaging

Thomas McKay | The Denver Post

# BRAIN MATURATION

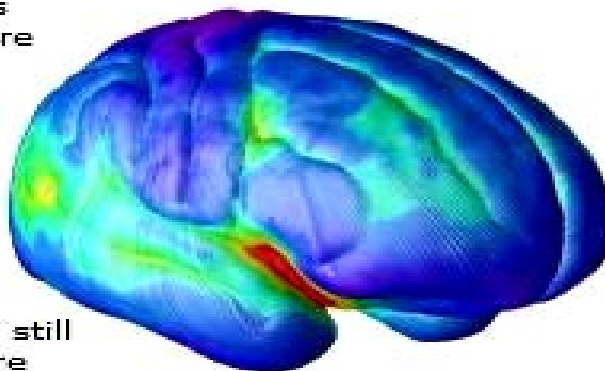
## **Age 12**

During adolescence, the brain is undergoing a lot of changes. Gray matter diminishes as neural connections are pruned.



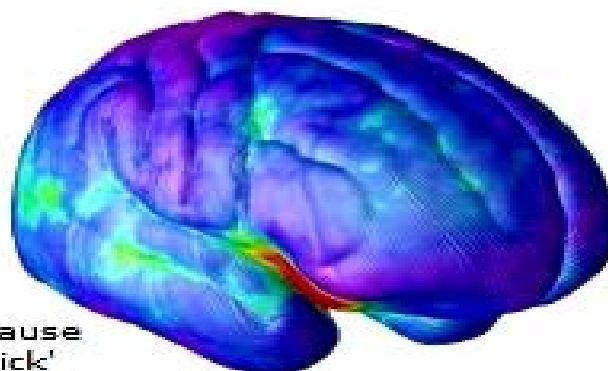
## **Age 16**

Because the brain is still developing, it is more sensitive to drugs.



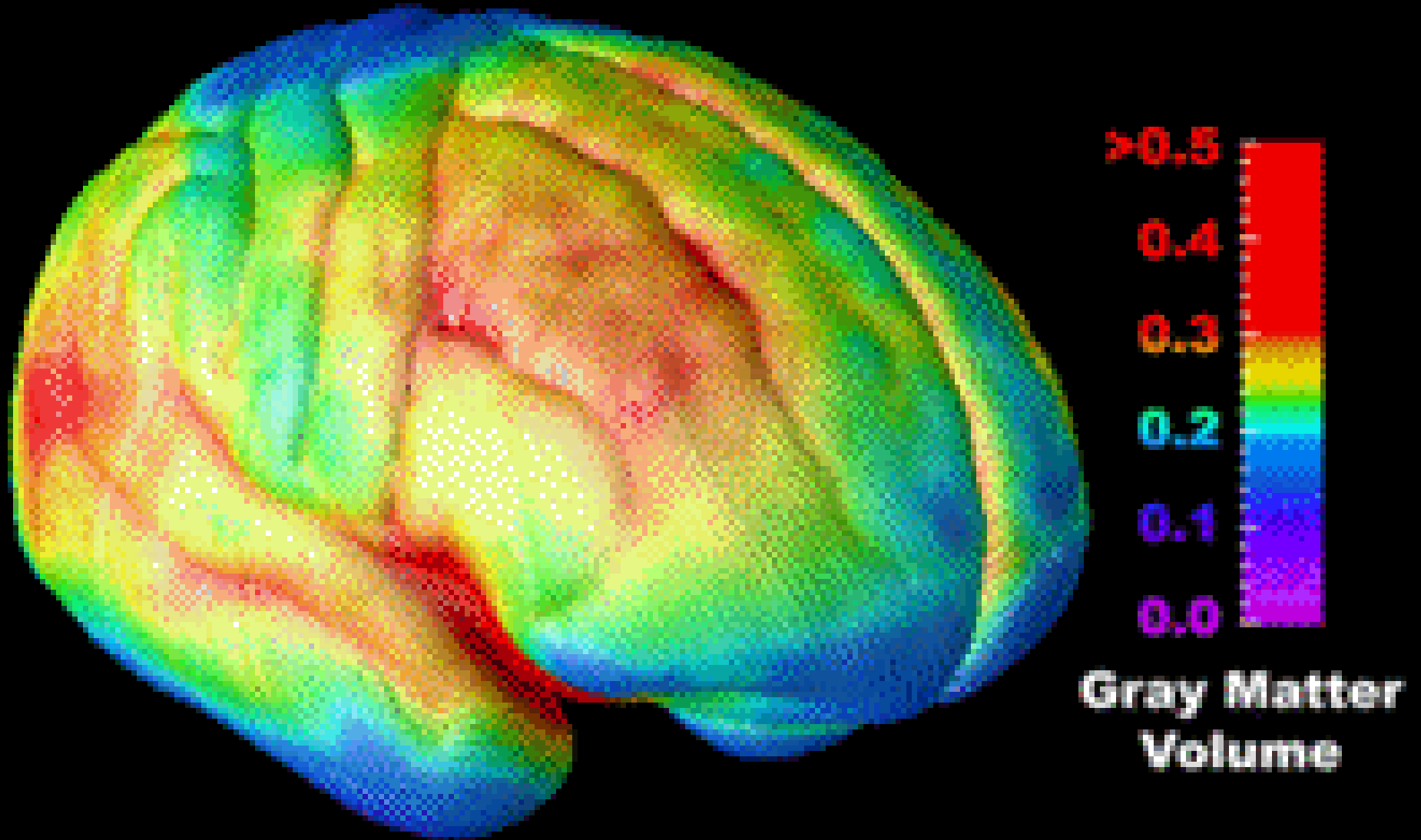
## **Age 20**

The changes drugs cause are more likely to 'stick' and become hardwired as addiction by adulthood.

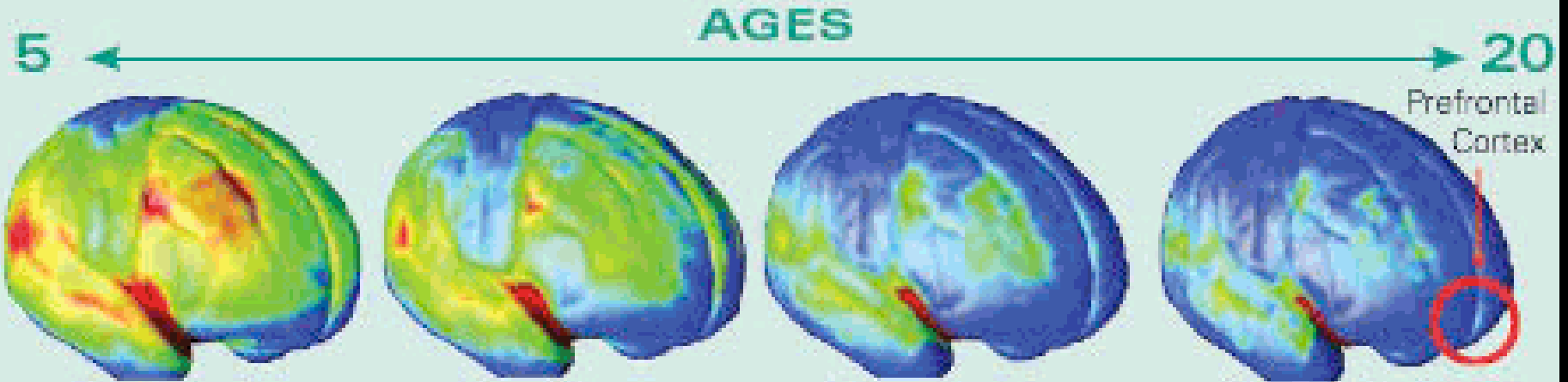




# BRAIN MATURATION



# BRAIN MATURATION



Blue represents maturing of brain areas.



# BRAIN DEVELOP RULES

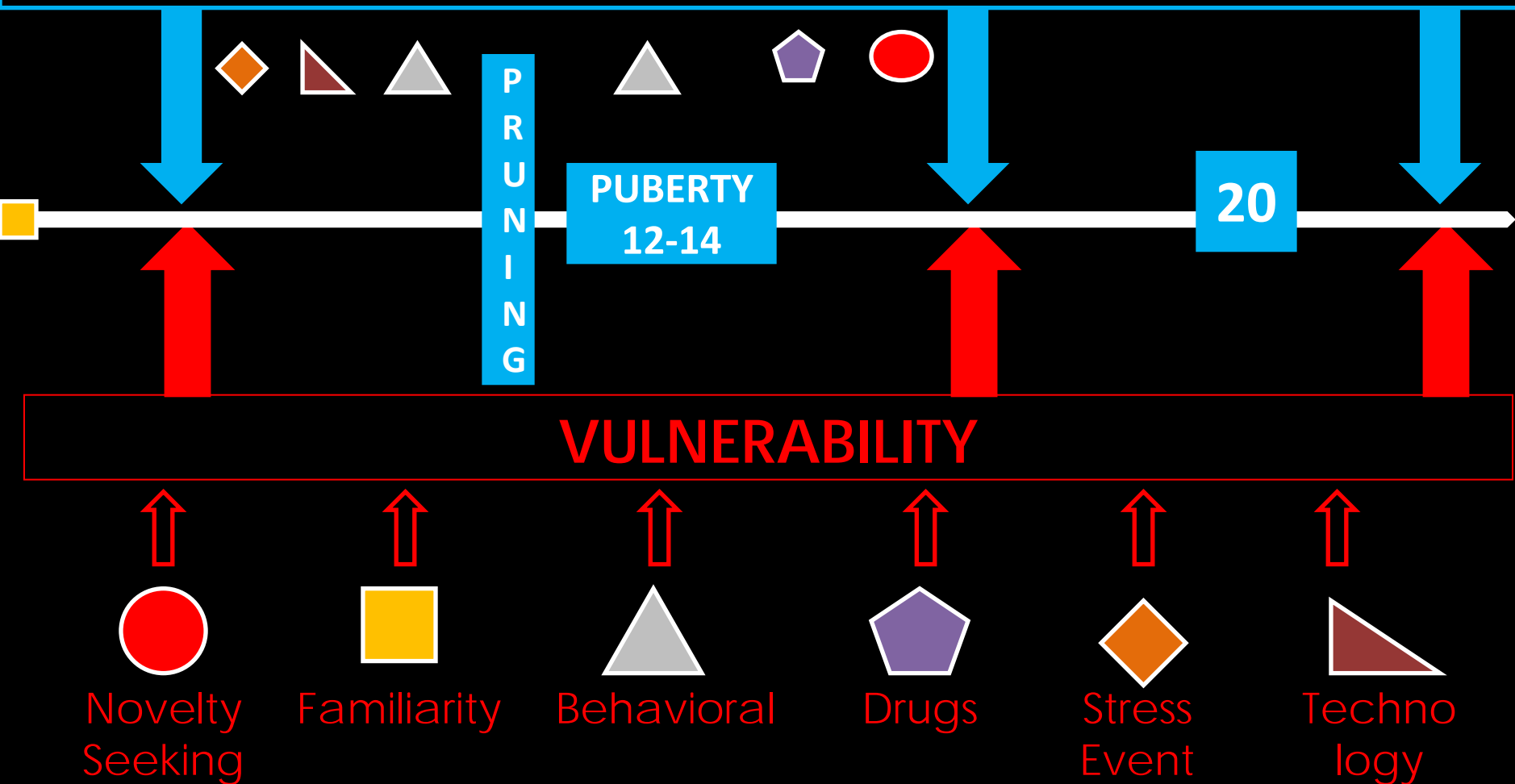
2°. MATURE I° LYMBIC AND II° CORTEX

$$F > A = PB$$

$$A > F = RB$$

# BRAIN DEVELOP RULES

## USE-IT-OR-LOSE-IT



# BRAIN DEVELOP RULES

Good rationale

Bad choice in the hit

$$A > F = RB$$

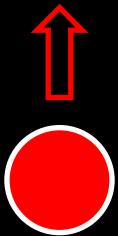
Good rationale

Better choice in the hit

$$A > F = R/PB$$

20

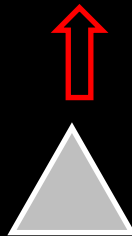
VULNERABILITY



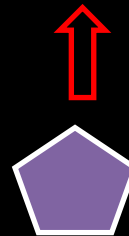
Novelty  
Seeking



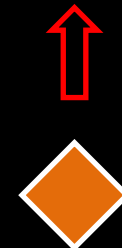
Familiarity



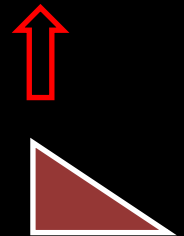
Behavioral



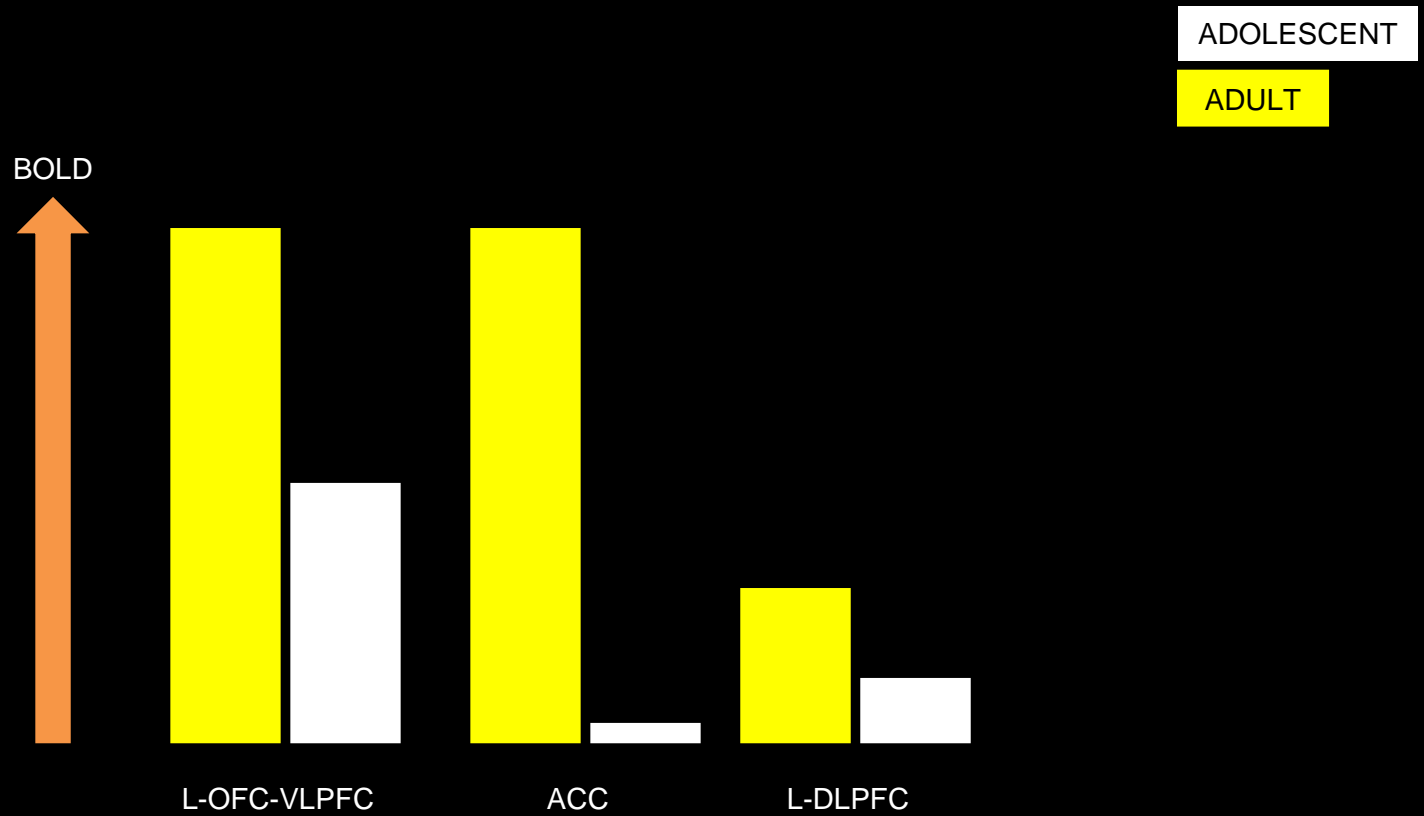
Drugs



Stress  
Event



Techno  
logy

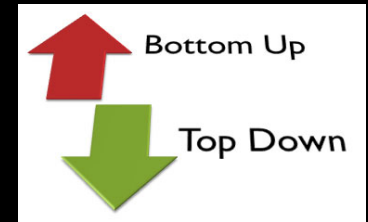


# BRAIN DEVELOP RULES



I°

TOP-DOWN / BOTTON-UP



II°

WAY



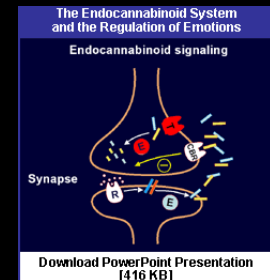
III°

TIMING



IV°

ENDOCANNABINOID



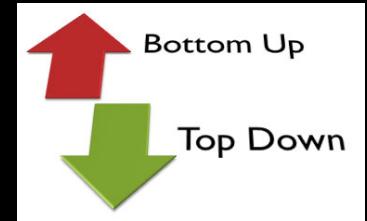
V°

USE-IT-OR-LOSE-IT



1°

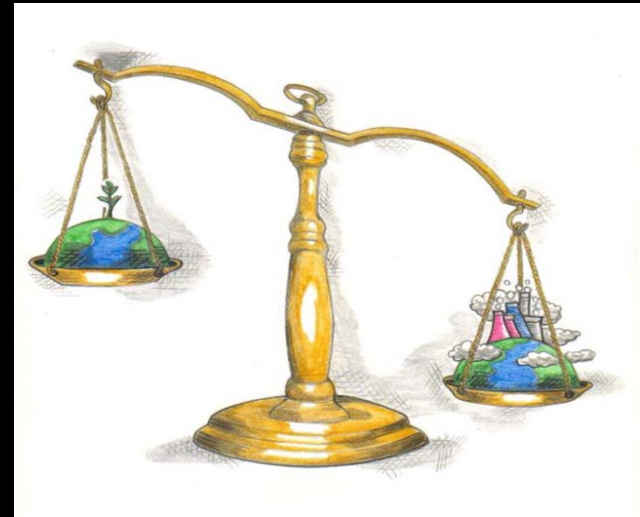
# TOP-DOWN / BOTTOM-UP



BETTER TO HAVE A  
HEALTH DNA



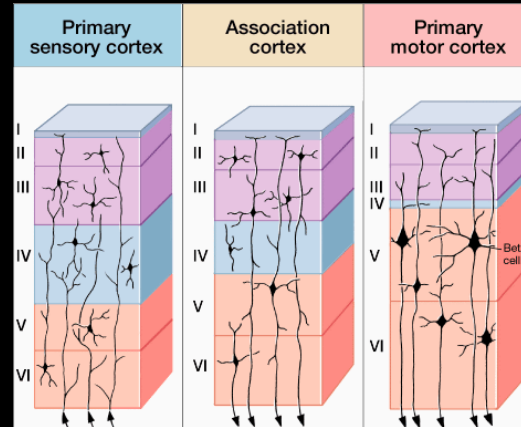
NEED TO HAVE A  
HEALTH ENVIORMENT



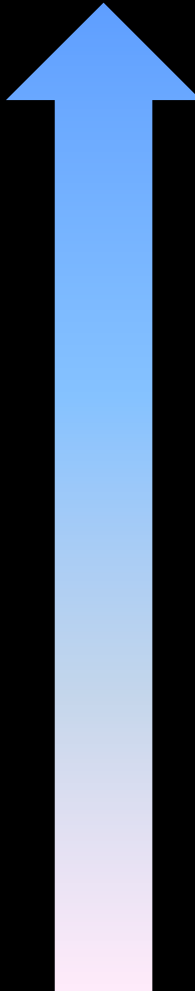
II°  
WAY



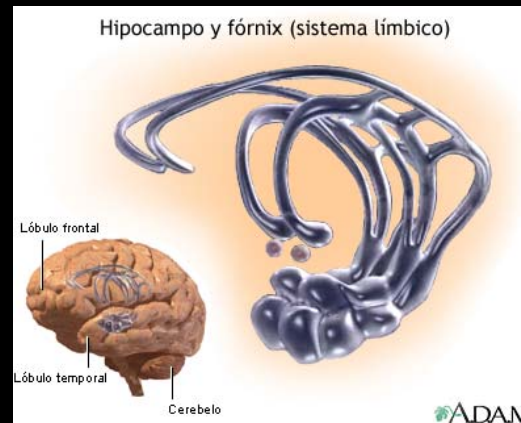
NEOCORTEX



DOPO

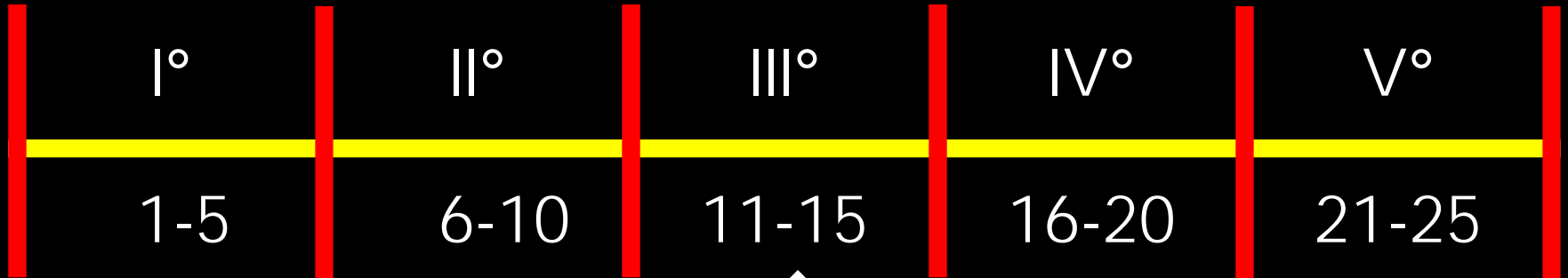


LYMBIC

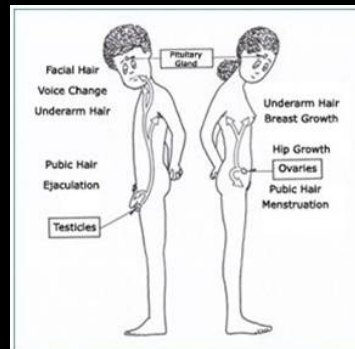


PRIMA

# III° TIMING

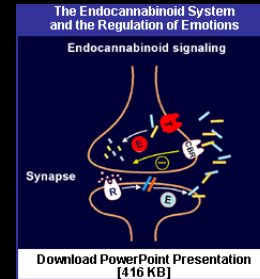


PUBERTY



V°

# ENDOCANNABINOID



*Conclusions:* Our results support the hypothesis that heavy cannabis use during adolescence may affect the trajectory of normal brain maturation. Due to concurrent alcohol consumption in five HCU subjects, conclusions from this study should be considered preliminary, as the DTI findings reported here may be reflective of the combination of alcohol and marijuana use. Further research in larger samples, longitudinal in nature, and controlling for alcohol consumption is needed to better understand the pathophysiology of the effect of cannabis on the developing brain.

Heavy cannabis use  
during adolescent  
may affect  
the trajectory  
of normal brain maturation.

V°

USE-IT-OR-LOSE-IT



ENVIRONMENT

HINIBITION

PERMISSION



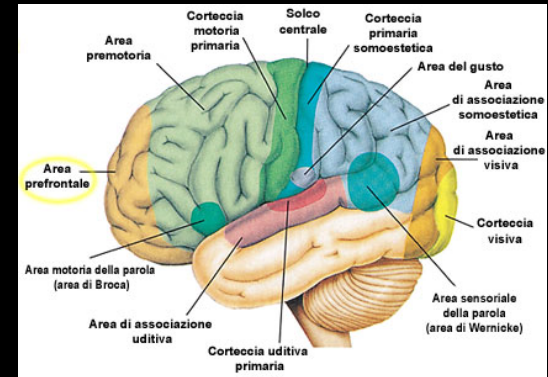
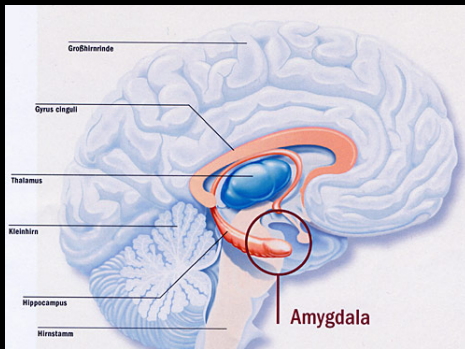
WAITING

# DECISION MAKING AGING

# BRAIN MATURATION



VS



Using fMRI, investigators at Harvard University showed teens and adults pictures of faces expressing different emotions (Baird et al., 1999). When trying to identify the emotions expressed by the faces, the teens activated their amygdala, which, as noted above, is involved in the primal assessment of fear. By contrast, adults activated the frontal lobes when performing the same task and were better able to correctly identify the emotions expressed on the faces. This investigation suggests that the adults and teens processed the same information using different parts of their brains and with different results.



# BRAIN MATURATION



VS

> RATIONALE  
AT REST

< RATIONALE  
IN EMOTION

A>F (on going)

RATIONALE  
AT REST

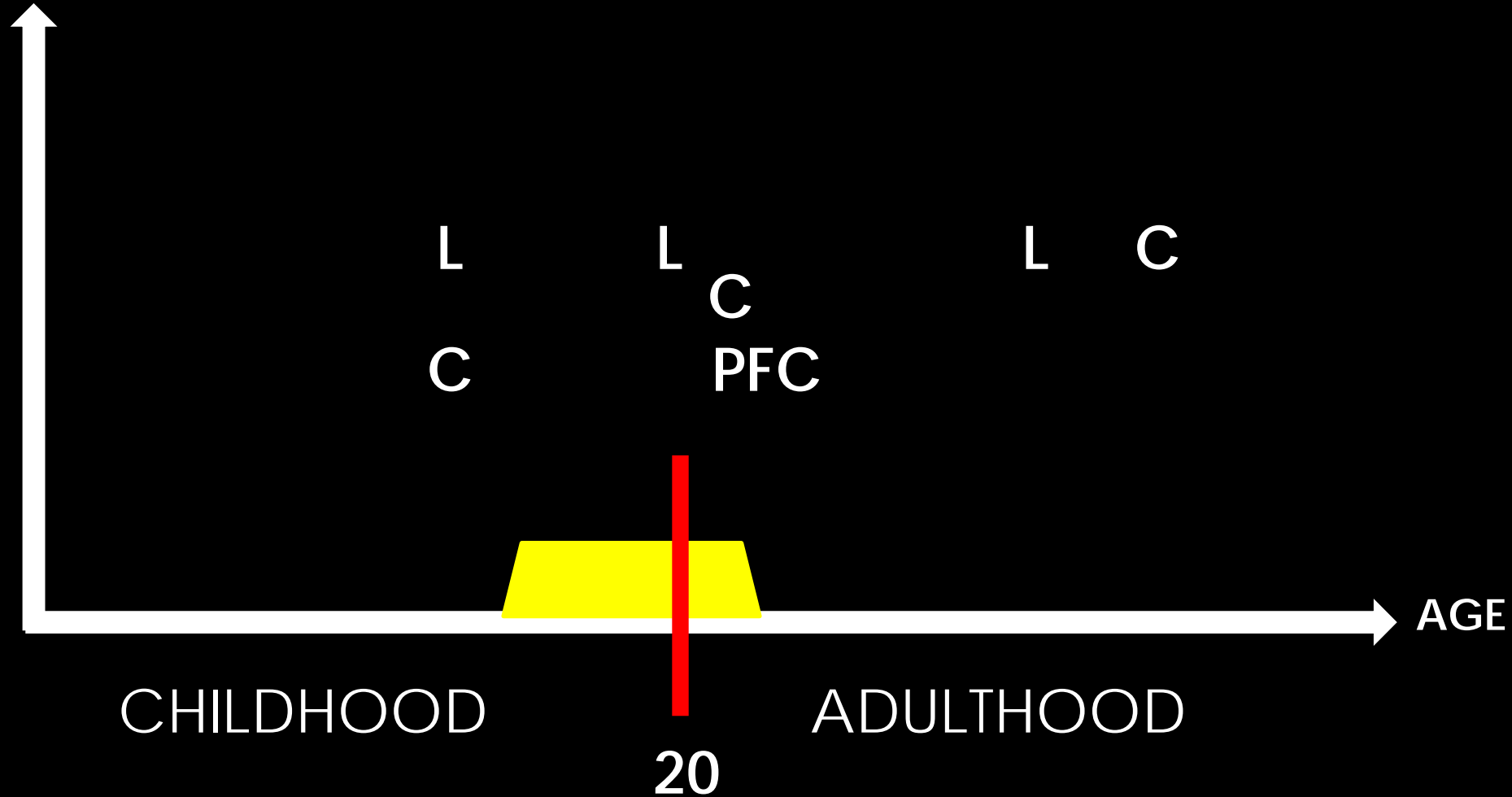
> RATIONALE  
IN EMOTION

F>A (on going)

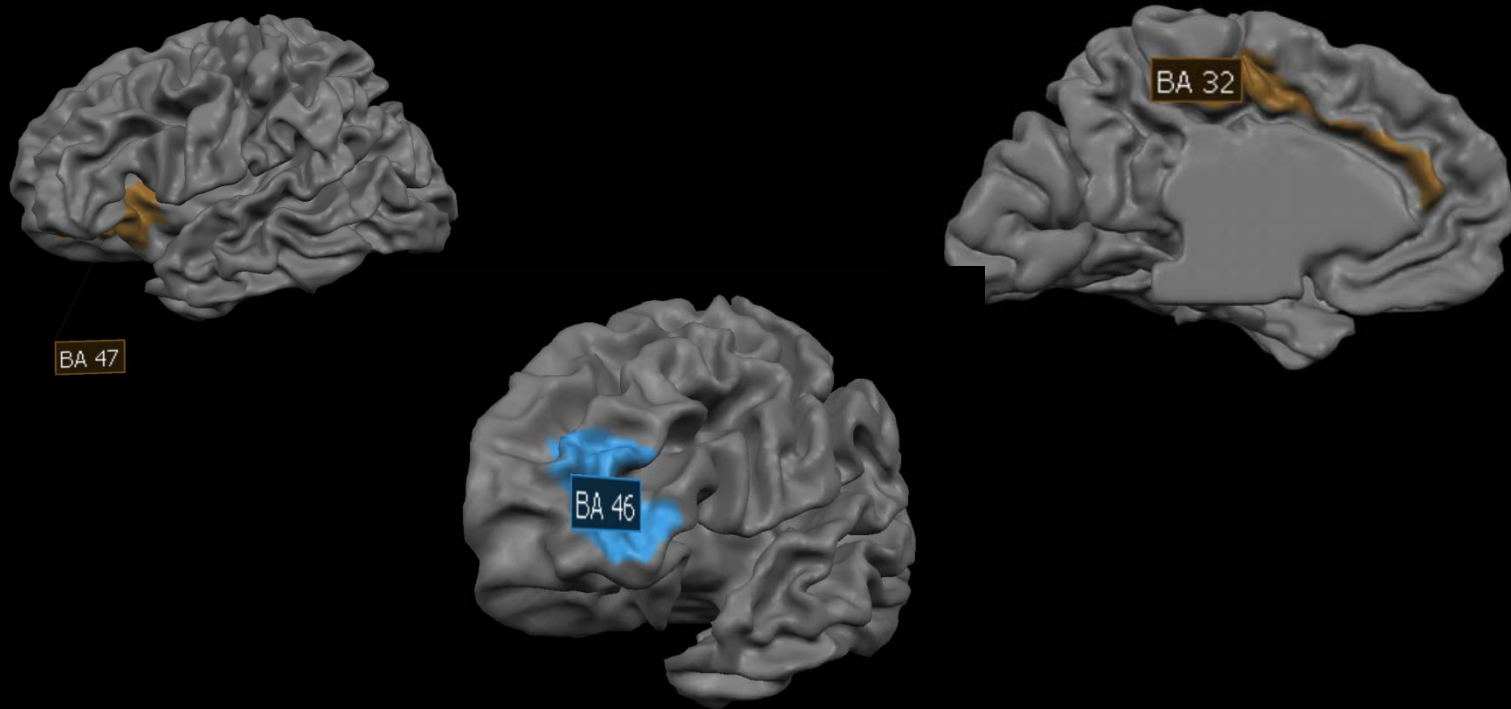
# BRAIN DEVELOP RULES

**PRESENT**  
**FUTURE**

MATURATION



# ADOLESCENT ENGAGE PREFRONTAL REGULATORY STRUCTURE TO A LESSER EXTENT THAN ADULT WHEN MAKING RISK ECONOMIC CHOICES

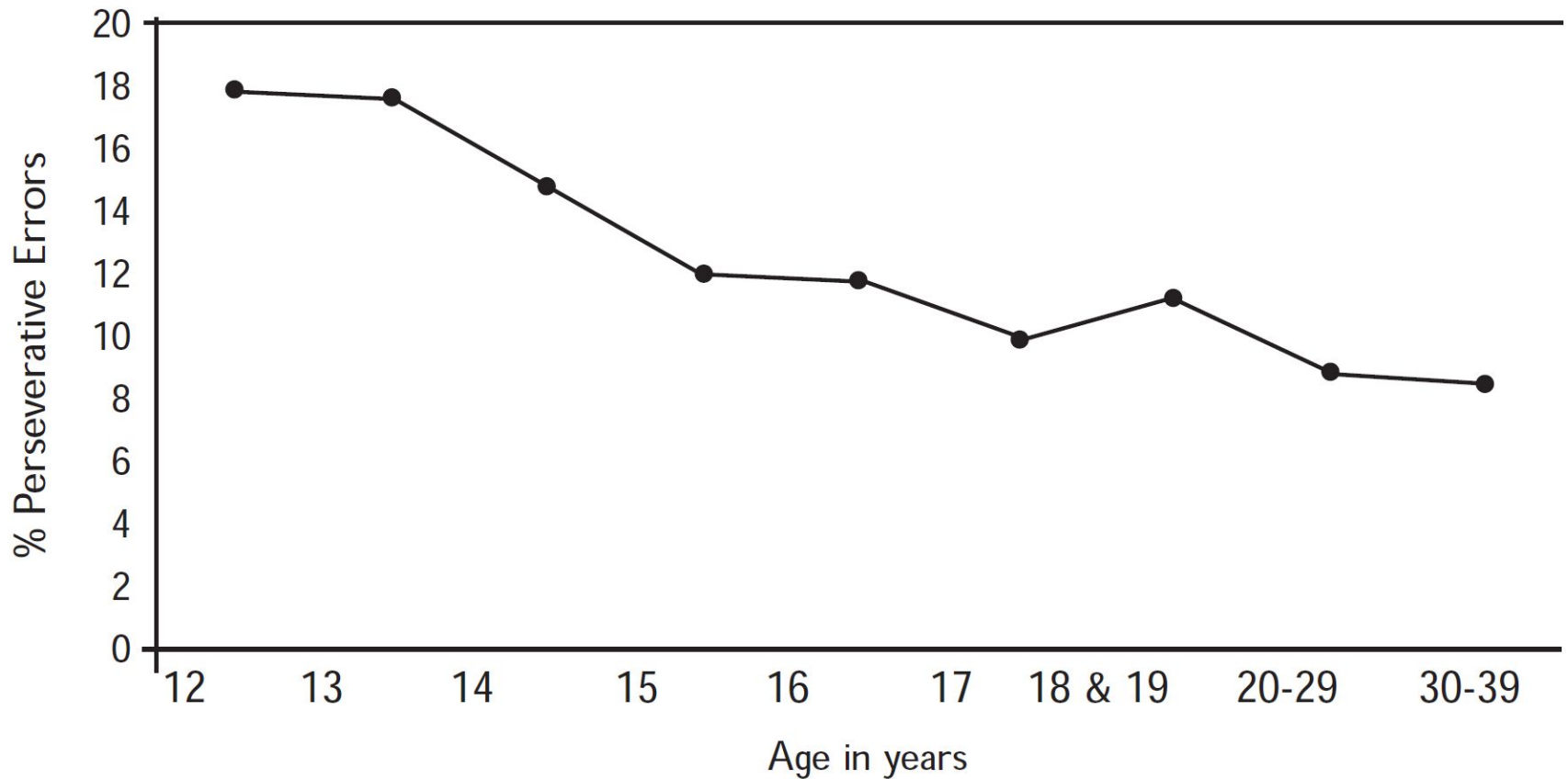


OFC/VLPFC and ACC were examined selectively since both have been implicated in reward-related processes, cognitive control, and resolution of conflicting decisions.

ADULT >OFC/VLPFC (BA 47) and dorsal ACC (BA 32) THAN ADOLESCENT

# BRAIN MATURATION

Figure 4: Developmental decline in perseverative errors on the Wisconsin Card Sorting Test (source: Heaton et al., 1993).



# INHIBITION

AGES 7-12 < INHIBIT

AGE 21-24 > INHIBIT

(Casey et al., 1997; see also Bedard et al., 2002).

BRAIN MATURATION

# INHIBITION

TEENS EXPENDS A GREAT DEAL OF  
EFFORT WHILE PERFORME WORKING  
MEMORY

Casey et al., 1997

# BRAIN MATURATION

“IF I DO X,  
THEN Y WILL HAPPEN”

Importantly, working memory requires the integrity of the frontal lobe, especially the prefrontal cortex

(Diamond & Goldman-Rakic, 1986)

BRAIN MATURATION

IMMEDIATE REWARD

CHILDHOOD

$A > F = RB$