Trouble Letting Go:

Understanding the Adolescent Brain and Addiction

Maryland Center of Excellence on Problem Gambling

March 4, 2015

Frank J. Kros, MSW, JD
President, The Upside Down Organization

Brain Quiz!

T or F?

According to research by the journal CyberPsychology, those who spend more time socializing on Facebook are less happy than those who socialize face-to-face.

Brain Quiz! Answer

True!

Everybody looks happy on Facebook, leading a number of users to believe others are living a better life than they are….

Chou, H. and Edge, N., "They are Happier and Living a Better Life Than I Am: The Impact of Using Facebook on Perceptions of Other's Lives;" CyberPsychology, Behavior, and Social Networking (2011)

Brain Quiz!

T or F?

For every 100 girls expelled from public elementary and secondary schools each year, 335 boys are expelled.

Brain Quiz! Answer

True!

3.5 boys for every 1 girl are expelled from our public schools.

http://nces.ed.gov/programs/digest/d04/tables/dt04_144.asp

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Brain Quiz!

T or F?

Sitting in the front of the class results in higher grades regardless age or whether the seating is assigned or selected by the student.

Brain Quiz! Answer

True!

For 20 years research has consistently demonstrated that where you sit in class matters. Students who sit in front are more likely to remain focused, are less distracted and are viewed more favorably by teachers, resulting in higher grades.

Edu-Nova.com (published April 18, 2012)

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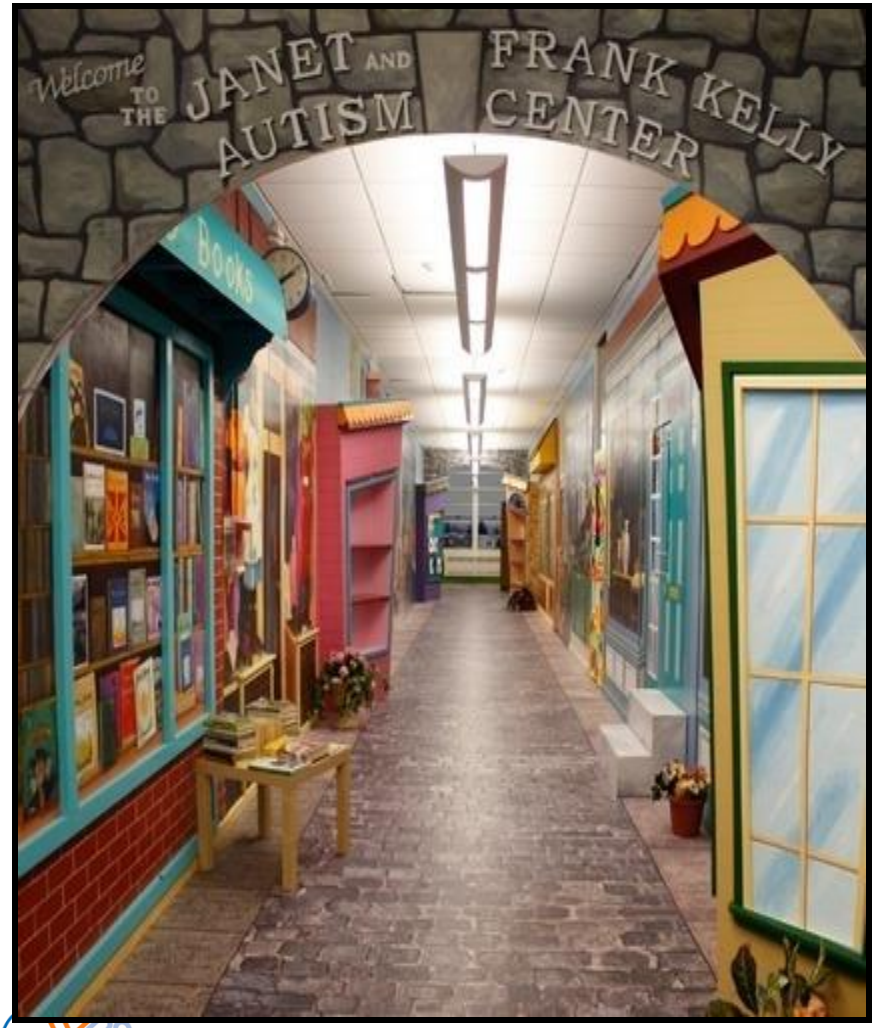
What's The Upside Down Organization?



- A unique learning organization to "**Help Adults Help Kids.**"
- **Nonprofit.** Benefits go to kids at The Children's Guild.
- **Applied Research.** We are operate schools, group homes, foster care, mental health and autism programs!
- **Word of Mouth Marketing**. Our participants "spread the word." If you benefit today, please tell someone about us!

www.upsidedownorganization.org

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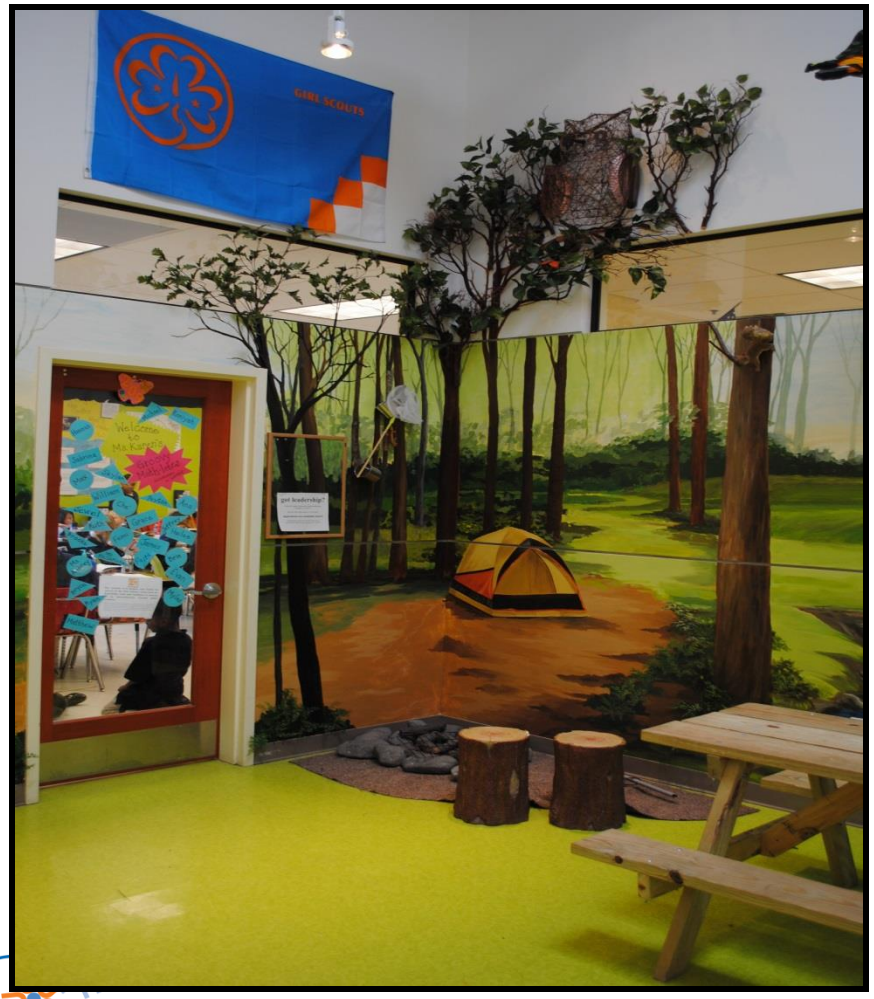
The Upside Down Organization



- Learning Experiences on topics such as *ADHD*, *Poverty*, *Executive Function*, *Adolescent Brain*, *Gender Differences* and more!
- Presented in 44 states and ***4 foreign countries.***
- Award-Winning!

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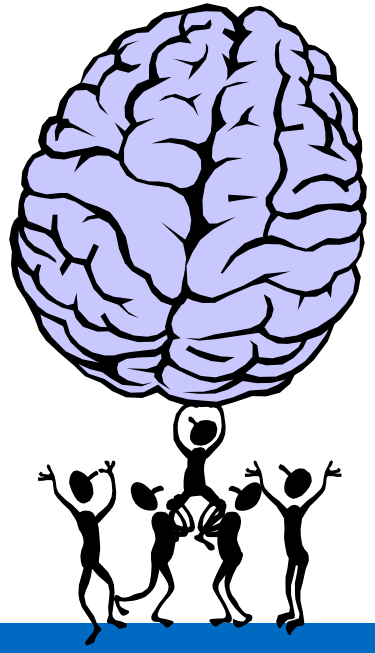
Today's Itinerary

1. *Let's Meet the Uniquely Unique Adolescent Brain*
2. *Cortisol: The Mysterious Motivator Known as "Stress"*
3. *Addiction in the Brain: The 4 "Whats"*
4. *Gambling, Addiction and the Brain*



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But First...

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How is *your* brain this morning?

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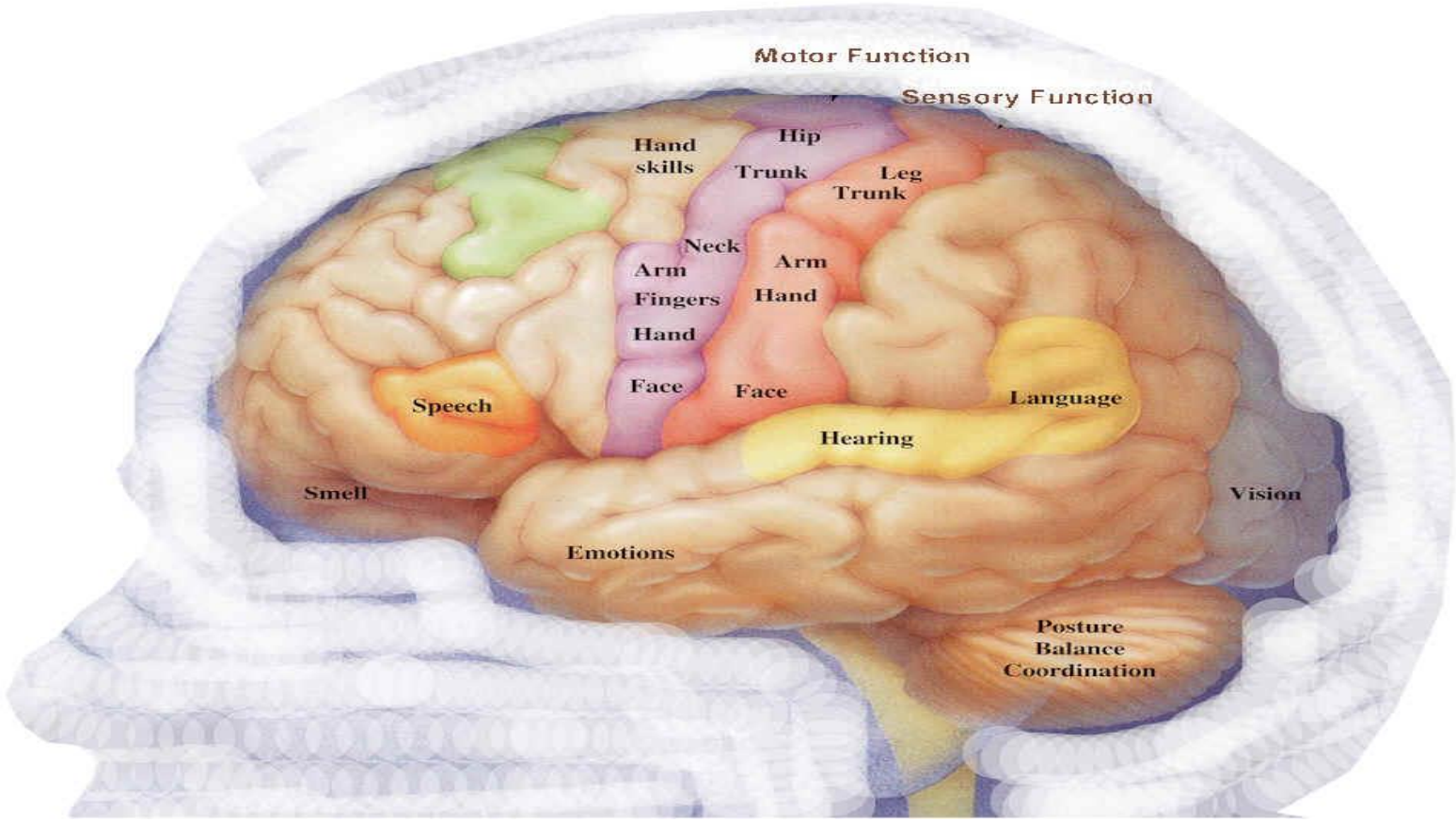
Brain Speed Test



Answer Out Loud…

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As Fast as You Can!

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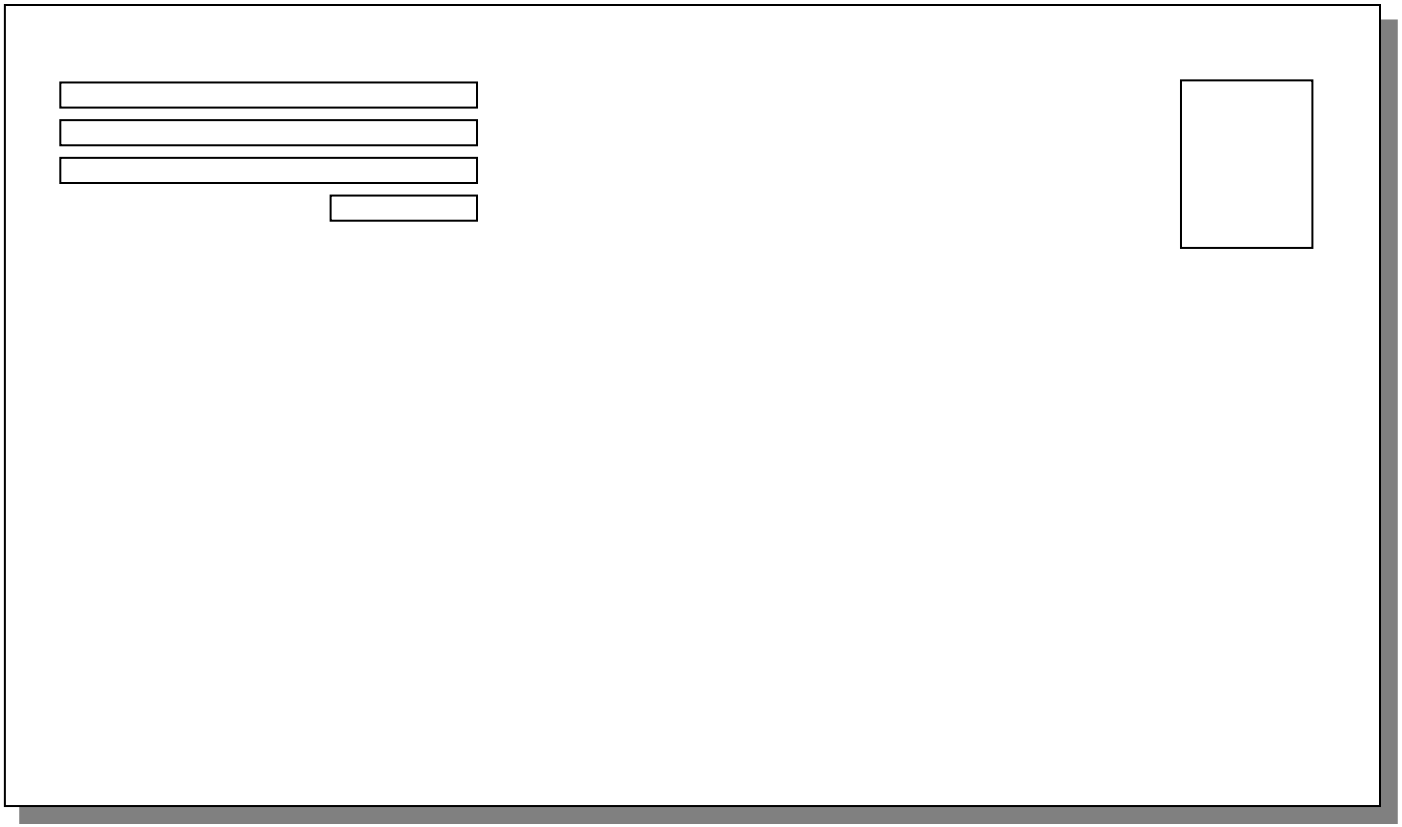
What Color?



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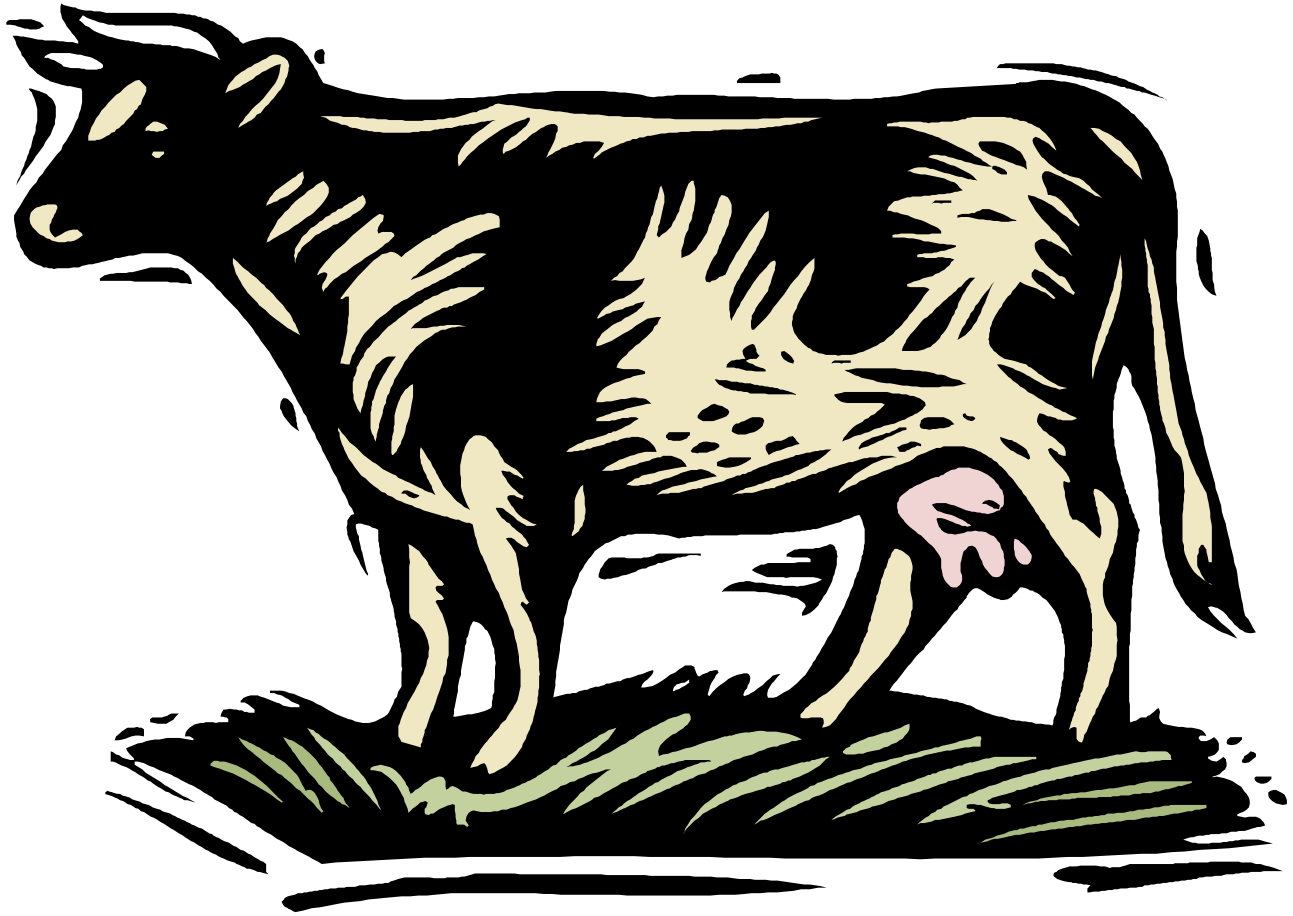
What Do Cows Drink?



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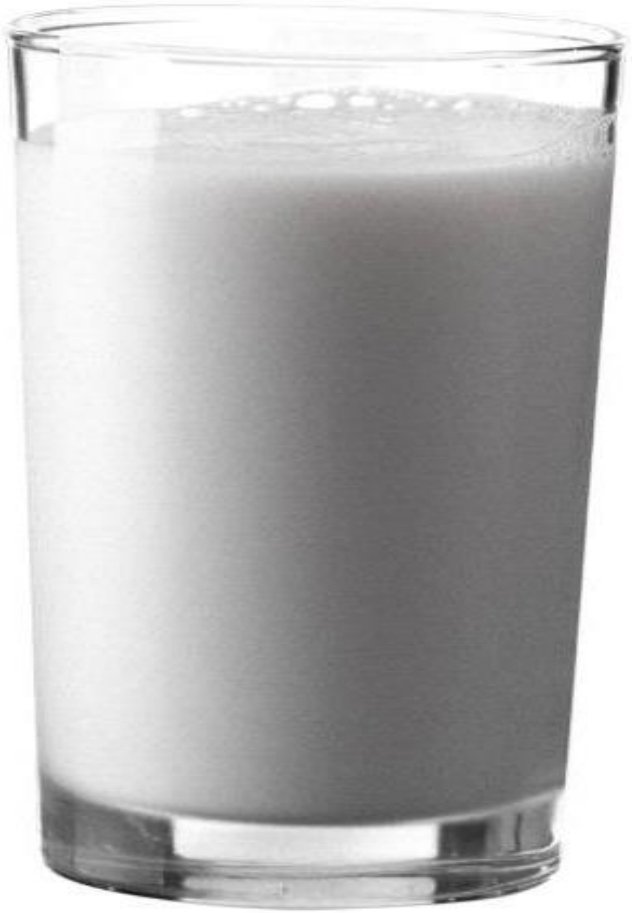
An Important Brain Rule...

Associations in the brain are real, physical brain structures.

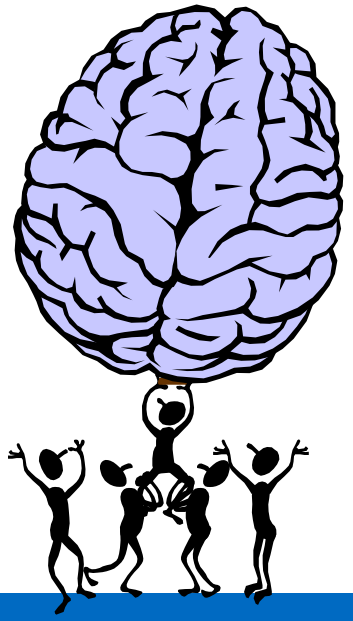
It is much more difficult for our brains to **unlearn** something than to learn something new.

Associations between stimuli and addictive behavior create powerful brain pathways.



Today's Itinerary

1. ***Let's Meet the Uniquely Unique Adolescent Brain***



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Pop Quiz!

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Whip Around Rules

- You'll need a partner (look for someone who looks really smart!)
- *Sit back-to-back so you can see the screen*
- Also: Stand back-to-back
- *"True" is a "T" and "False" is crossed wrists*
- Then (wait for it) "Whip Around!"

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Whip Around Rules

- Quickly (but without hurrying), explain to your partner the “Whip Around” Rules.
- ***Any questions?***

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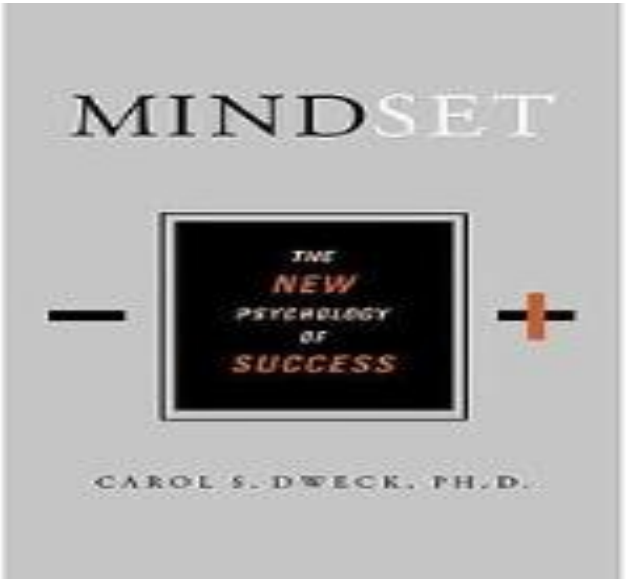
Facts and Myths About Adolescence

1. T F Telling teens that they are "smart" or "talented" may negatively impact academic performance.

Facts and Myths About Adolescence

1. T F Telling teens that they are "smart" or "talented" may negatively impact academic performance.

TRUE! Teachers, Coaches and Mentors should focus praise on strategy selection, perseverance and effort.



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Facts and Myths About Adolescence

2. T F The developing brain is more vulnerable to stress during the 14-18 year-old period than at any other time in childhood.

Facts and Myths About Adolescence

2. T F The developing brain is more vulnerable to stress during the 14-18 year-old period than at any other time in childhood.

TRUE! Because of the biological process known as "blossoming," teen brains are highly sensitive to the impact of stress.

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Facts and Myths About Adolescence

3. T **F** Most of the content that teens learn in school is directly relevant to their daily life outside the school walls.

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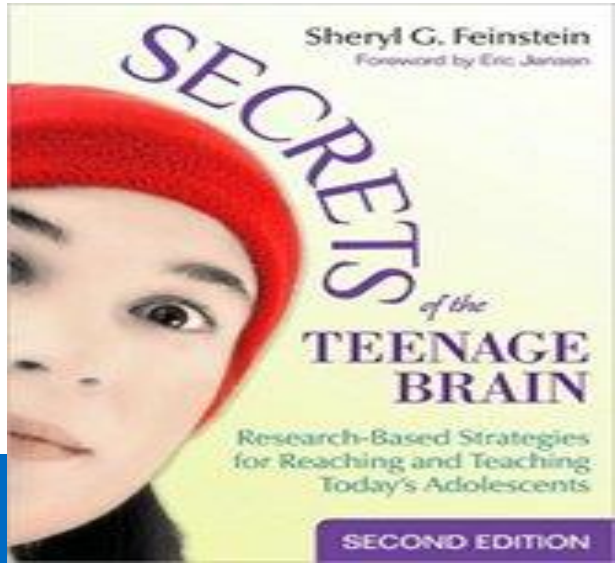
Facts and Myths About Adolescence

3. T **F** Most of the content that teens learn in school is directly relevant to their daily life outside the school walls.

- **FALSE!** *Teens often have difficulty finding*
- *relevance to daily life in their coursework.*



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Facts and Myths About Adolescence

4. T F The adolescent brain is like an adult brain but with several years less experience.

Facts and Myths About Adolescence

4. T **F** The adolescent brain is like an adult brain but with several years less experience.

The teen brain is different in <u>many</u> ways.

(Gied et al. 2006)

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Facts and Myths About Adolescence

5. T F The start time of a teen's school can have a significant impact on his/her academic performance.

Facts and Myths About Adolescence

5. T F The start time of a teen's school can have a significant impact on his/her academic performance.

YES! Teens typically experience sleep deprivation resulting in perception and memory problems. (Carskadon et al. 2008)

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Facts/Myths Answers

1. **T** F Telling teens that they are “smart” may negatively impact academic performance.
Teachers should focus praise instead on strategy and effort.

2. T **F** Adolescent lying is a direct result of bad morals, lack of ethics, poor parenting or all of thee above.
Often it’s a typical teen brain struggling to make decisions.

3. T **F** Most of the content that teens learn in school is directly relevant to their life outside the school walls.
Teens often have difficulty finding relevance to daily life in their coursework.

4. T **F** The adolescent brain is like an adult brain but with several years less experience.
The teen brain is different in <u>many</u> ways.

5. **T** F The start time of a teen’s school can have a significant impact on his/her academic performance.
YES! Teens typically experience sleep deprivation resulting in perception and memory problems.

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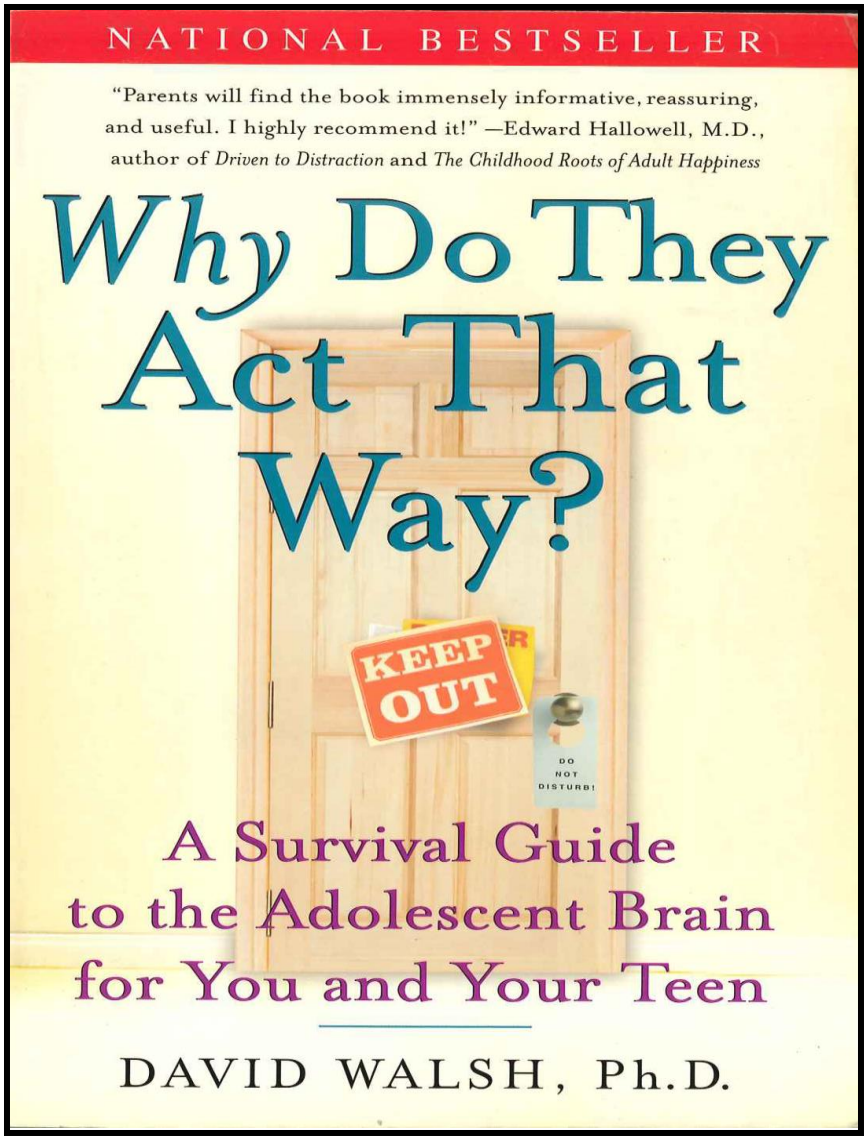

What is Adolescence?

It's not childhood.

It's not adulthood.

It's in between.

It's getting longer.

Puberty
(10-13 yrs.)

Adulthood
(24-26 yrs.)

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Four "Secrets" of the Teenage Brain

1. Blossoming
2. Pruning
3. Myelination
4. Hormones

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1. Blossoming

- To understand and appreciate the impact of “blossoming,” we need to understand the basic functions of neurons (brain cells).

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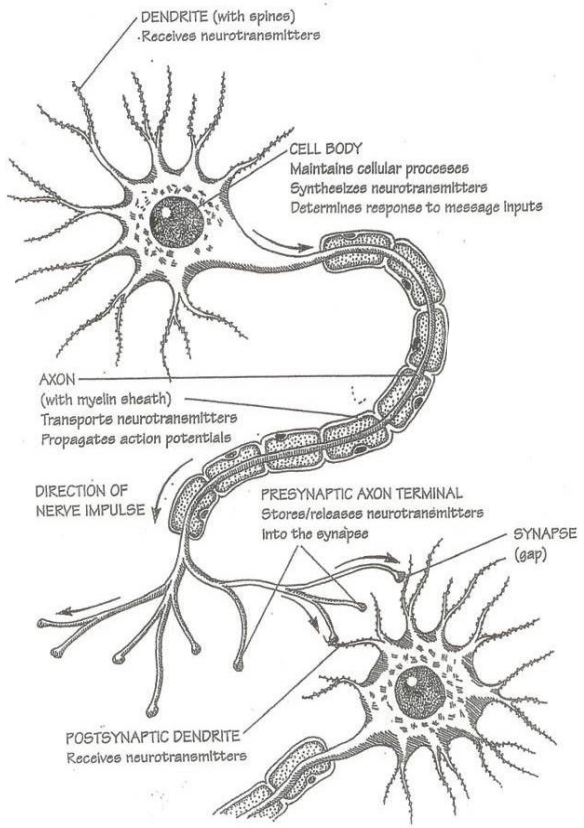
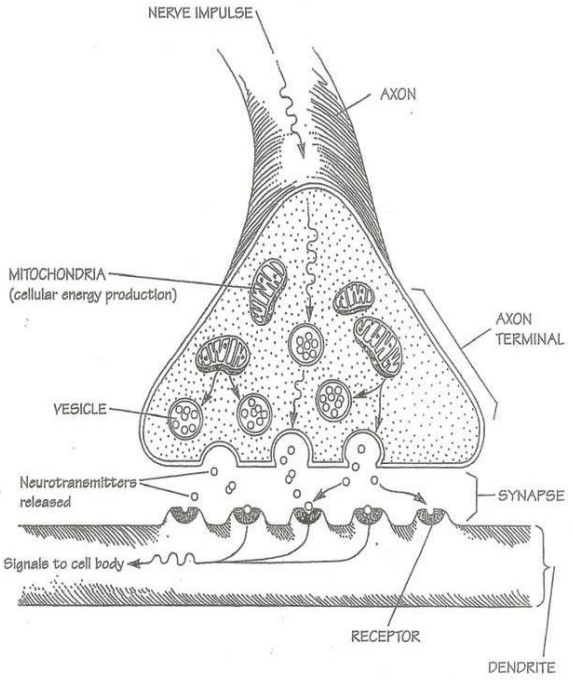
Functional Model of a Neuron



Synaptic Area



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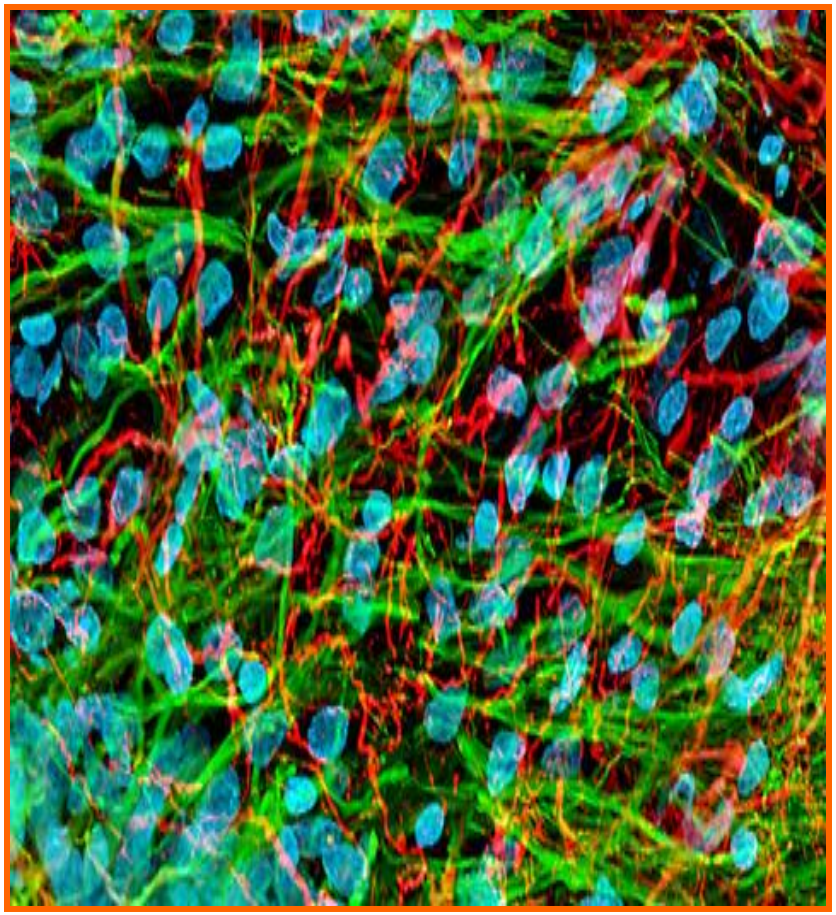
Four "Secrets" of the Teenage Brain



1. Blossoming

- The over-production of dendrites on neurons (10x)
- Last "push" to sculpt our first adult brain

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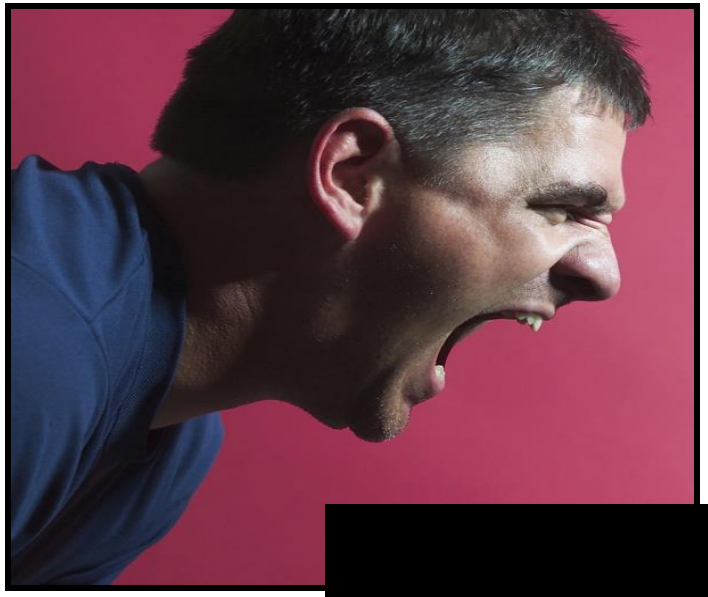
Blossoming

The reduction in processing time—the need for more time to think through circumstances in order to make good decisions—has resulted in this ages-old question adults have asked adolescents……



"What ***were*** you thinking?"

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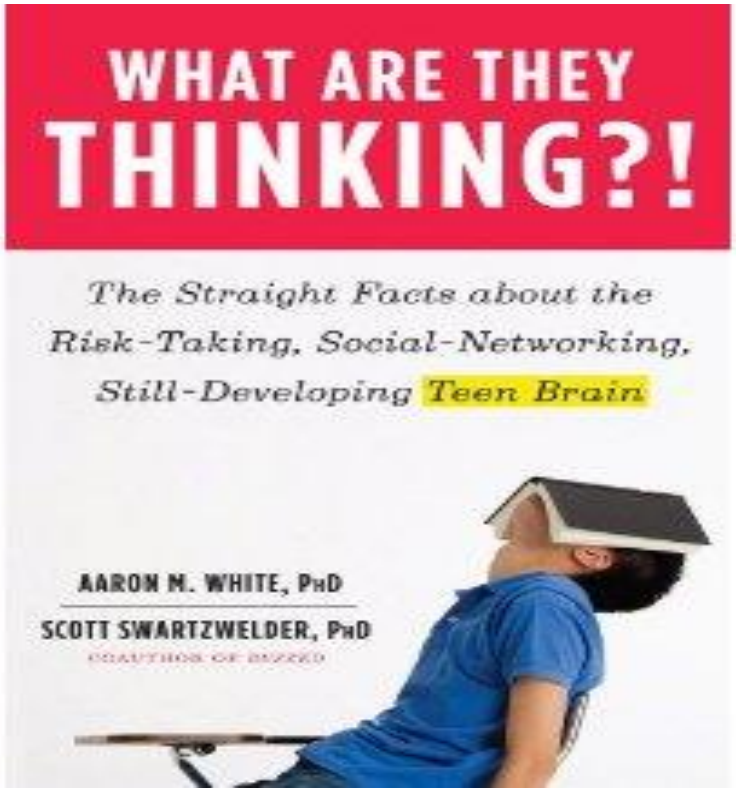
The Question is Still Being Asked…



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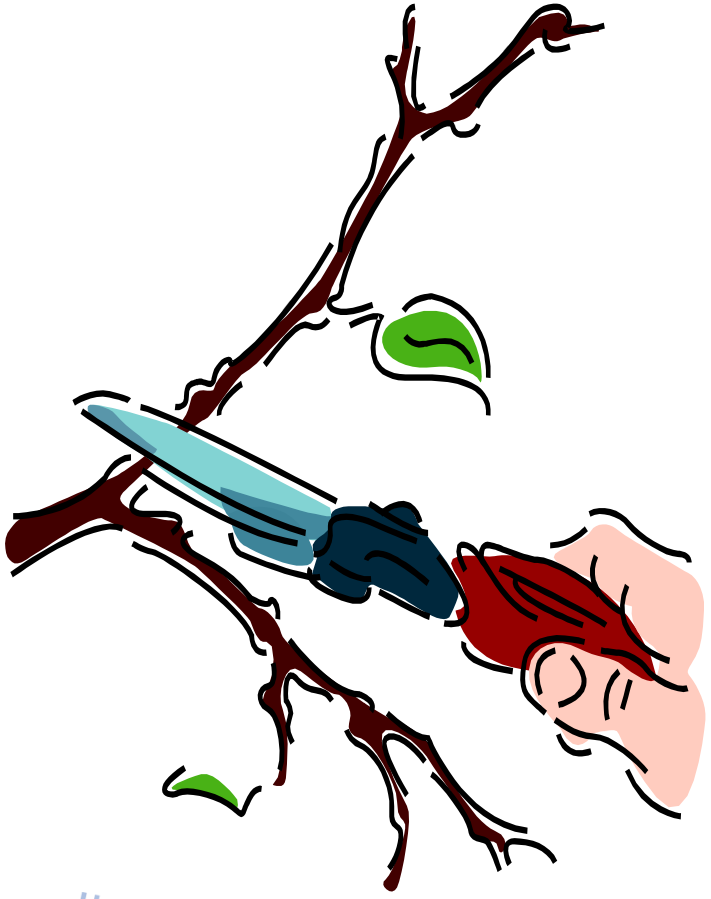
Four "Secrets" of the Teenage Brain



2. Pruning

- Reduction or "stripping" of dendrites to adult numbers
- *"Use it or lose it."*
- Windows of Opportunity
- Windows of Sensitivity
- The Brain is Neutral

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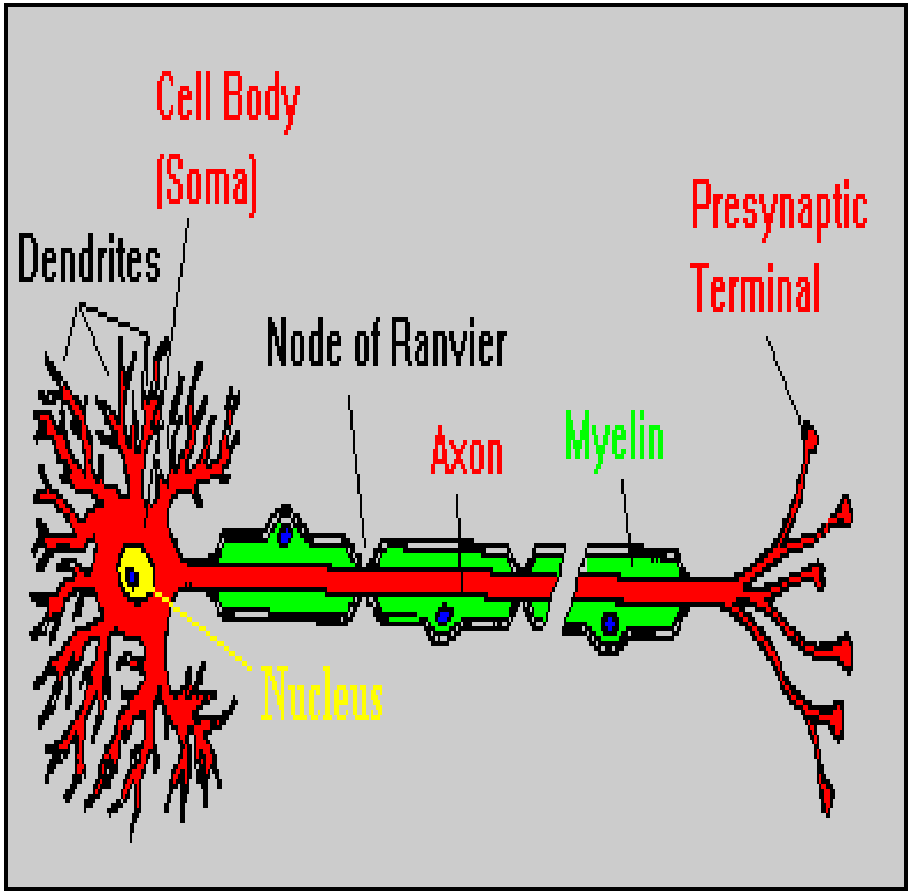
Four "Secrets" of the Teenage Brain



3. Myelination

- Physical reinforcement of often-used learning connections (white matter)
- *"The neurons that fire together, wire together."*
- *Once completed, difficult to undo…*

Once Something is Learned, the Brain Gets Faster at It

Advantage =

Conservation of Energy, "Automatic" or "Routine" thinking and behavior

Disadvantage =

The Brain is Neutral

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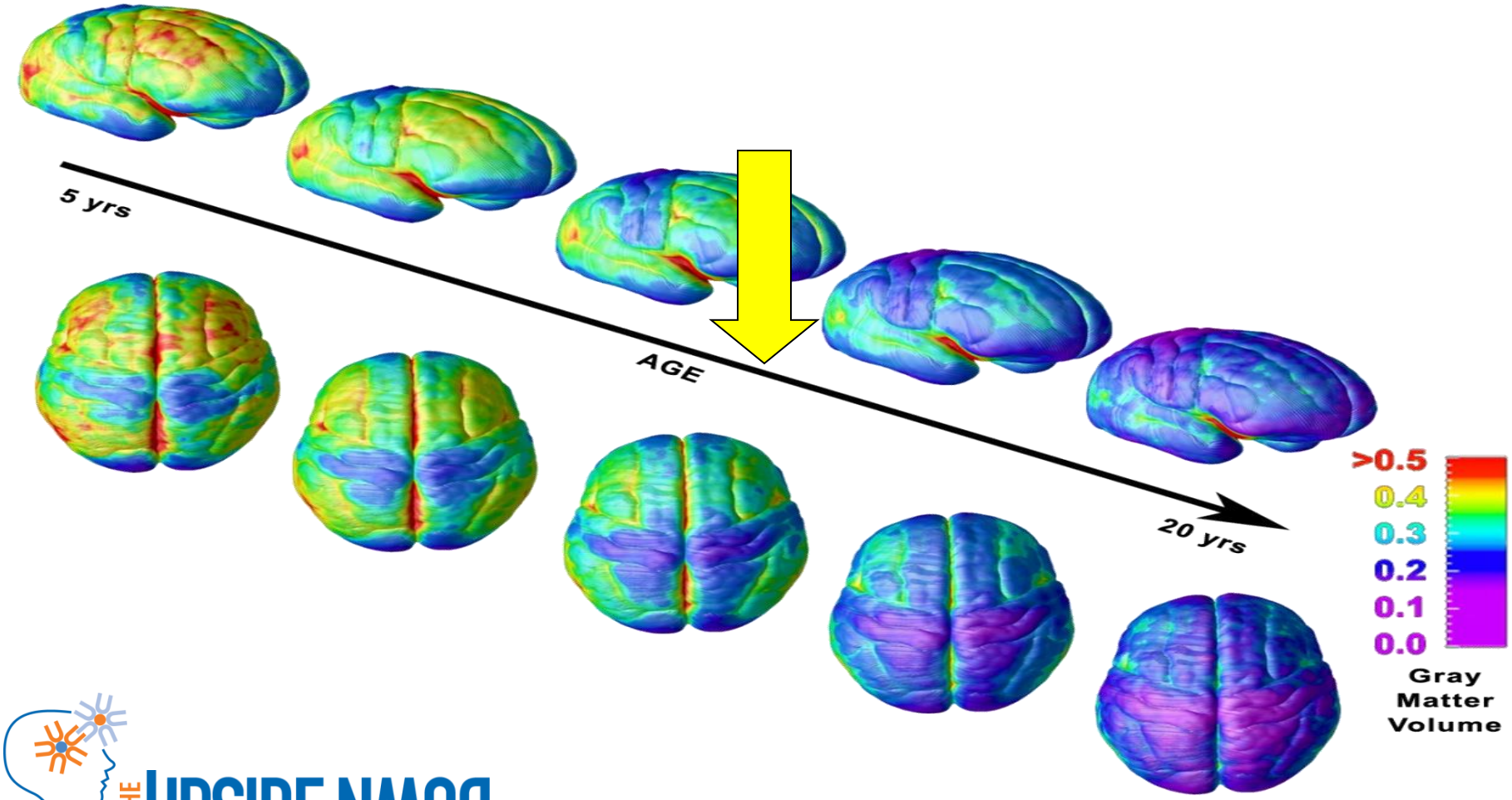
Increasing Blue/Purple Areas Show Greater Myelination



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Which Brain Do You Want?

Dendrites Survive…

Myelination Occurs

Dendrites Also Survive…

Myelination Also Occurs

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Upside Down Idea

- *What brains do and think about when they are 12-18 years-old may matter more than what they do and think about at any other time of life…*

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Four "Secrets" of the Teenage Brain

Isn't it all about the hormones?

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Quick Brain Chemistry

- ***Cortisol* - UH-OH"**
- ***Adrenaline* - "YIKES!"**

vs.

- Serotonin – "AHH.."
- Dopamine – "YAHOO!"

These pairs do not play well together…

Boys and Girls are Different…

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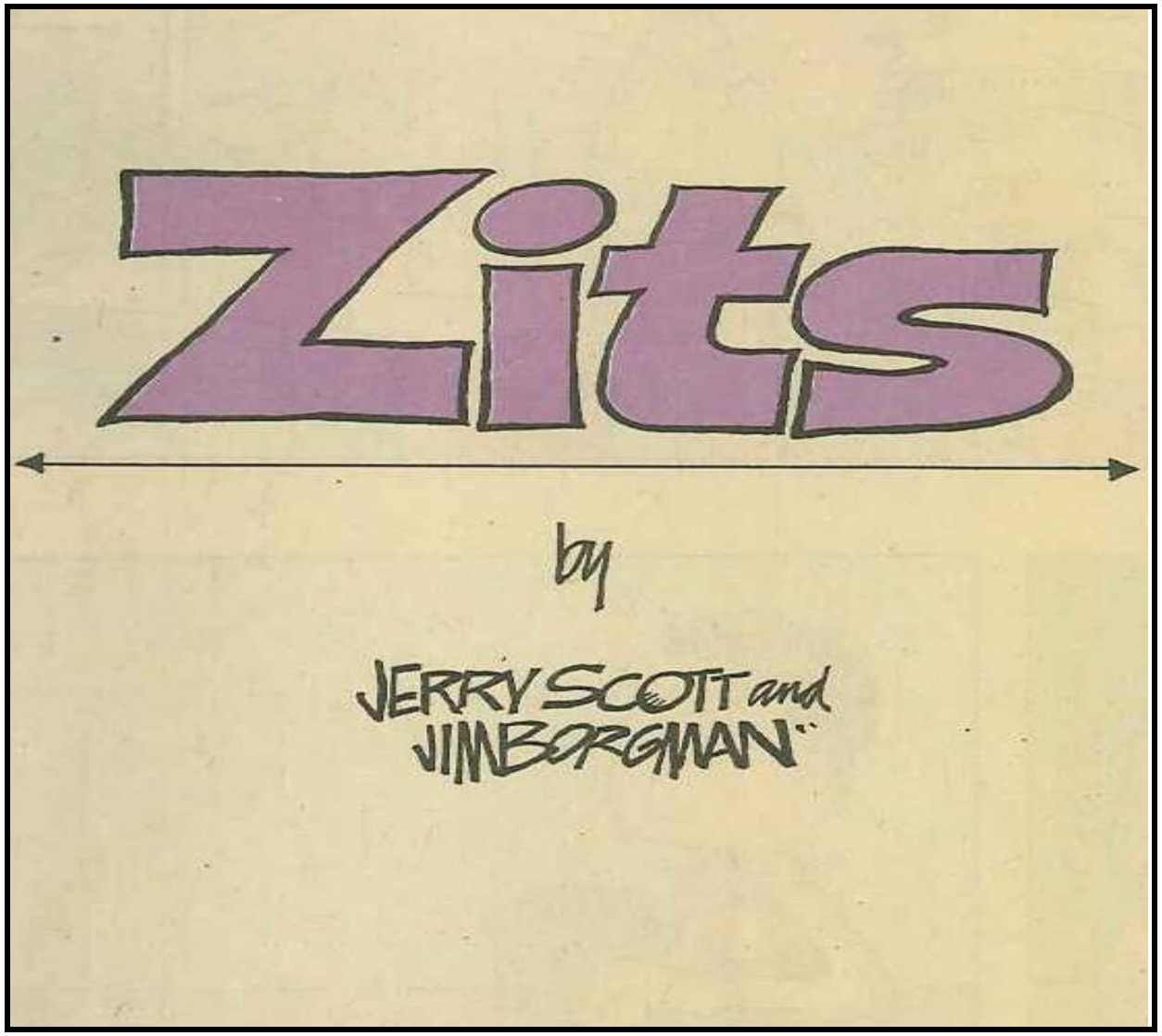
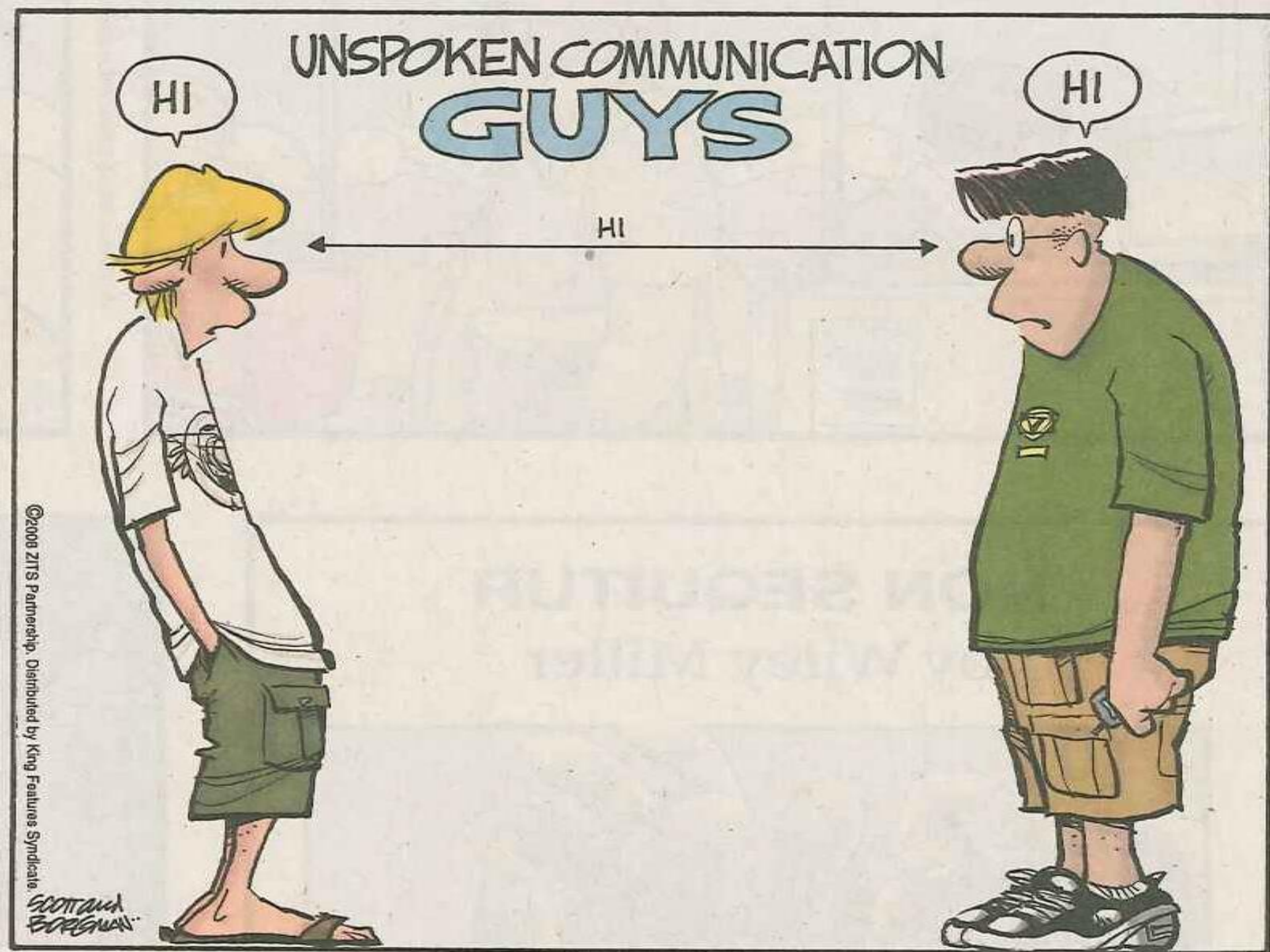
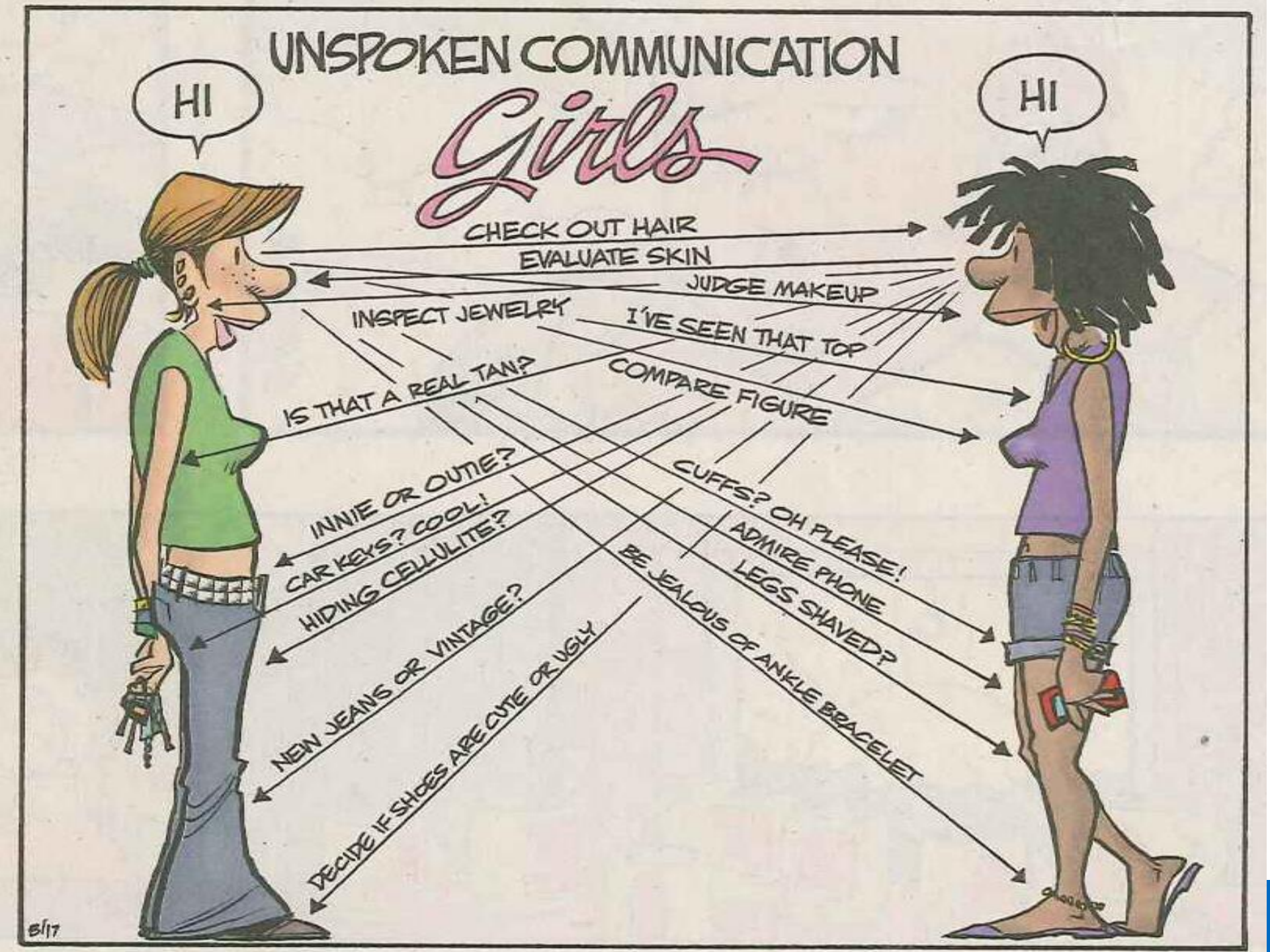


UNSPOKEN COMMUNICATION

GUYS




UNSPOKEN COMMUNICATION
Girls
HI
HI
CHECK OUT HAIR
EVALUATE SKIN
JUDGE MAKEUP
INSPECT JEWELRY
I'VE SEEN THAT TOP
IS THAT A REAL TAN?
COMPARE FIGURE
INNIE OR OUTIE?
CUFFS? OH PLEASE!
CAR KEYS? COOL!
ADMIRE PHONE
HIDING CELLULITE?
LEGS SHAVED?
NEW JEANS OR VINTAGE?
BE JEALOUS OF ANKLE BRACELET
DECIDE IF SHOES ARE CUTE OR UGLY
8/17

Boys and Hormones

- **Testosterone** (1000x)
- **Over-stimulates the Amygdala**
(Impulsive, emotional center, stress system)
- ***Changes Neurotransmitter Levels***
Lower Serotonin
Very Low Dopamine
- **Aggression, Depression, Risk Taking**
- ***Territoriality, Dominance, Poor Impulse Control***
- **Increased Sex Drive**

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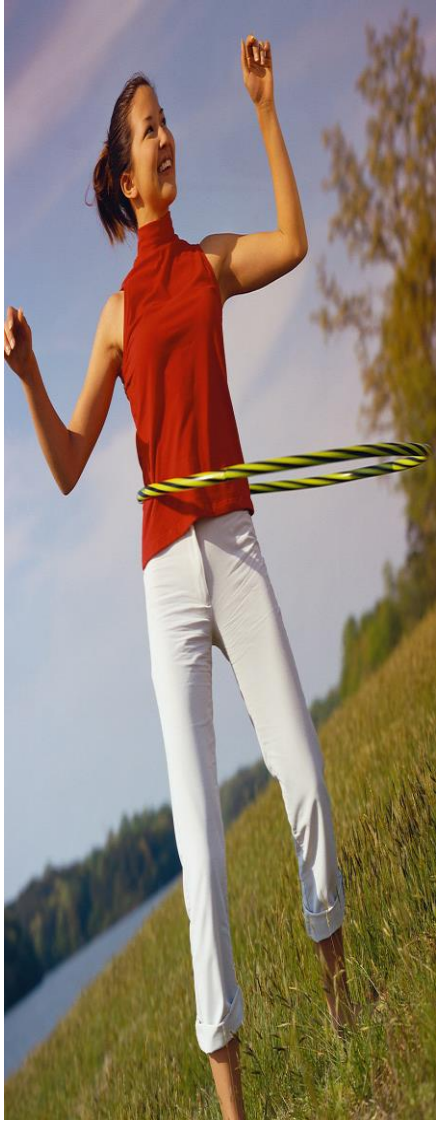
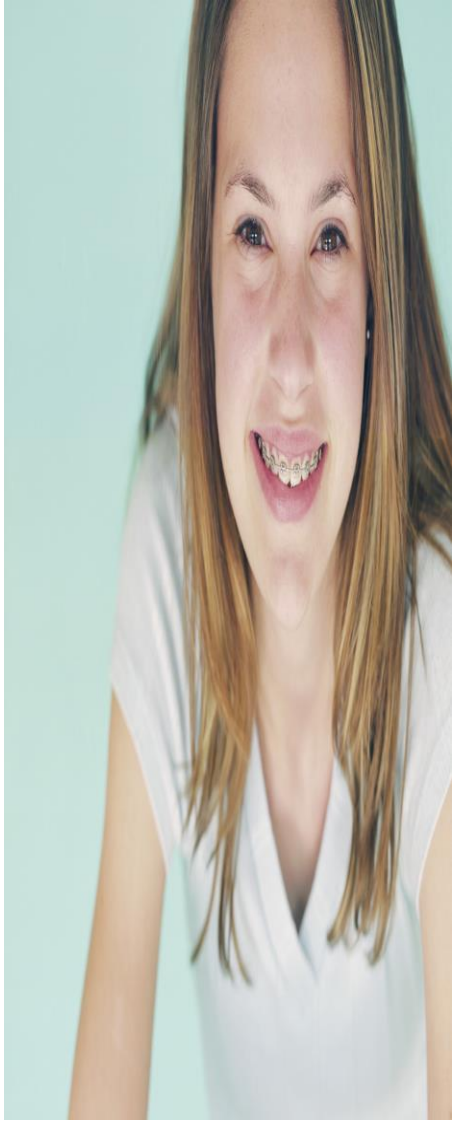


Girls and Hormones

- **Estrogen /Progesterone**
- **Destabilizes the Amygdala**

(Think: inconsistent emotional response)

- ***Changes Neurotransmitter Levels***
  - ***Lower Dopamine***
  - ***Very Low Serotonin***
- **Amplification of Emotions,**
  - **Depression, Anxiety**
- ***Increased Stress and Appetite***
- **Increased Sex Drive**



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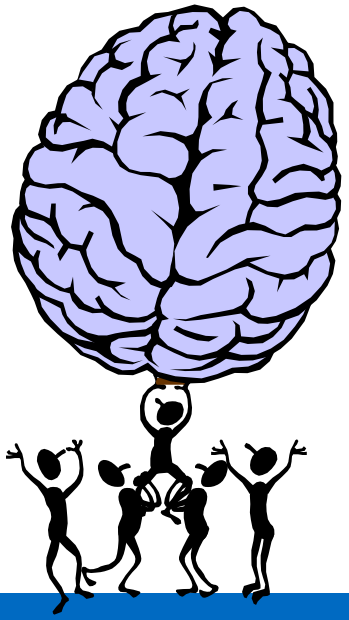
Today's Itinerary

2. Cortisol: The Mysterious Motivator Known as "Stress"



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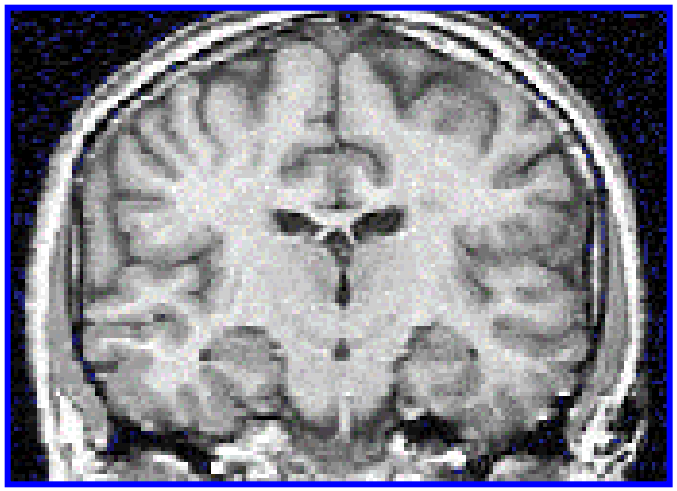
What is Stress?

Stress is a *physiological* response to a perception of a lack of control over an aversive situation, person or event.

What is Stress?

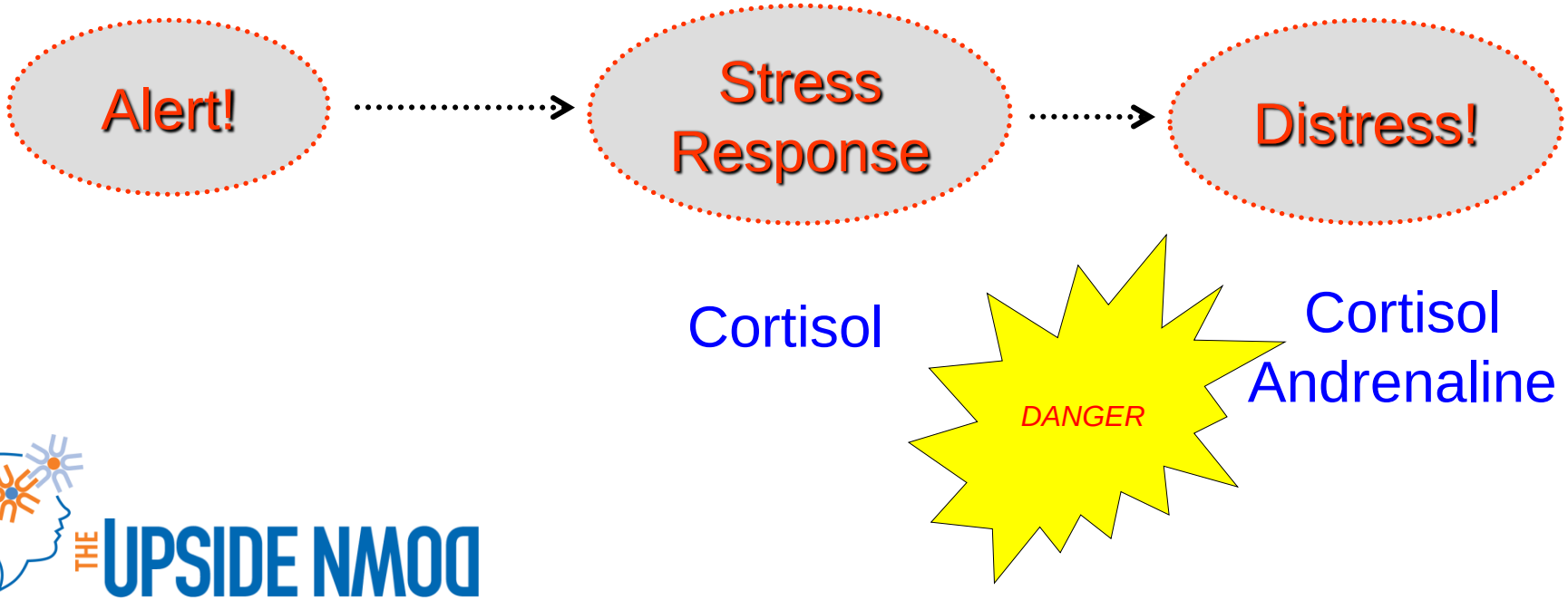
While we often think of stress as psychological, our human stress system is made-up of a sequence of biological processes.



3 Stages of the Stress Response
(Amygdala Driven)

Amygdala compels you to:

1. ***Solve the problem causing stress.***
2. ***Escape from the problem.***
3. ***Cope with the problem.***
4. ***Defend yourself the best you can.***
5. ***At any cost, survive.***



Is All Stress Bad for Us?

No. We need the stress response for survival and ***motivation***. Only when stress reaches an unusually high threshold (Distress) is it bad for us.

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Big Idea

*But while we need stress to survive and thrive--stress can be very uncomfortable—**motivating** us to develop behaviors to reduce our stress, especially when it is chronic or severe. For some, including adolescents, these stress-relieving behaviors can be addictive.*

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Plus…

Adolescents Have Greater Vulnerability to the Impact of Stress…

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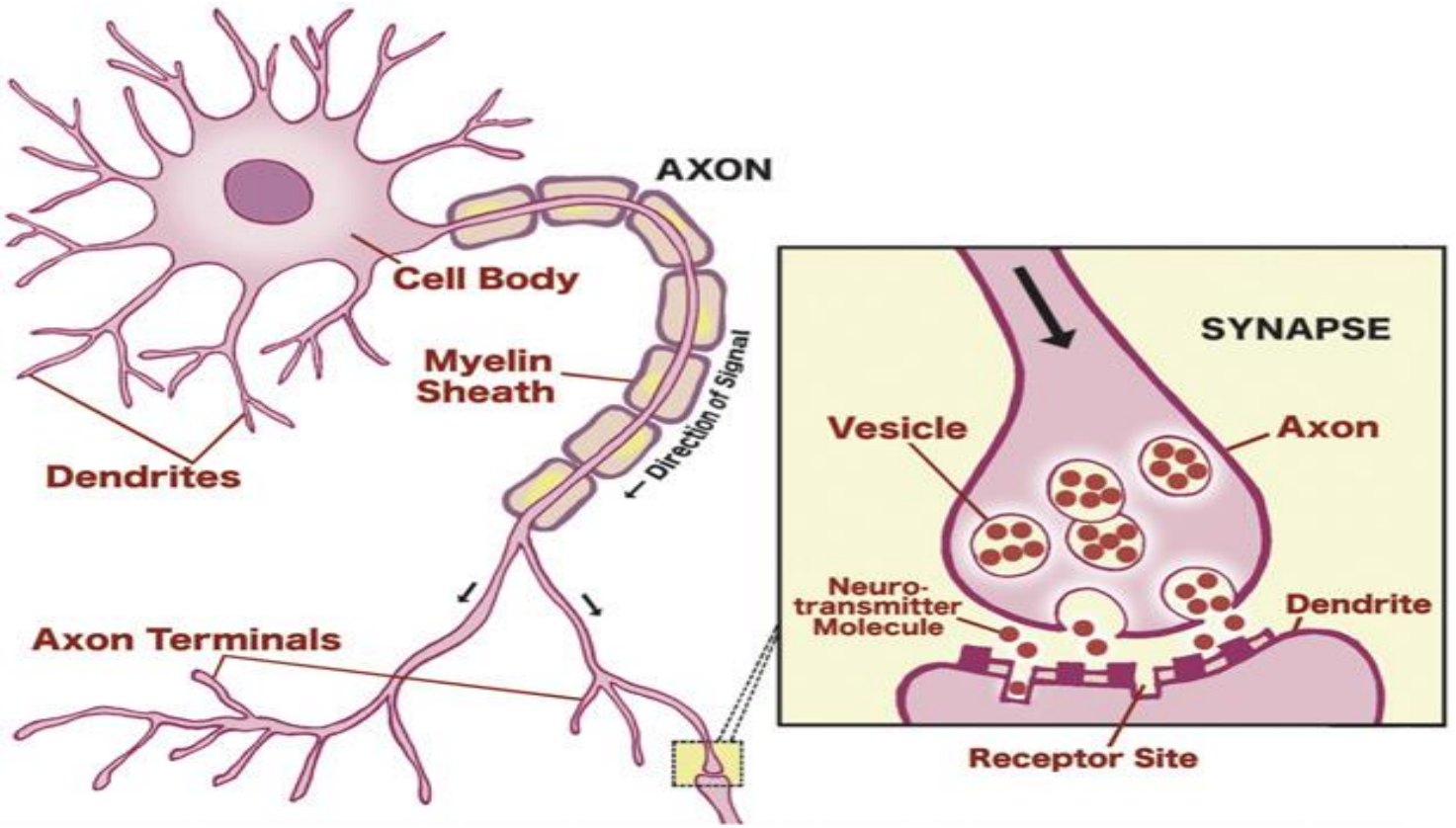
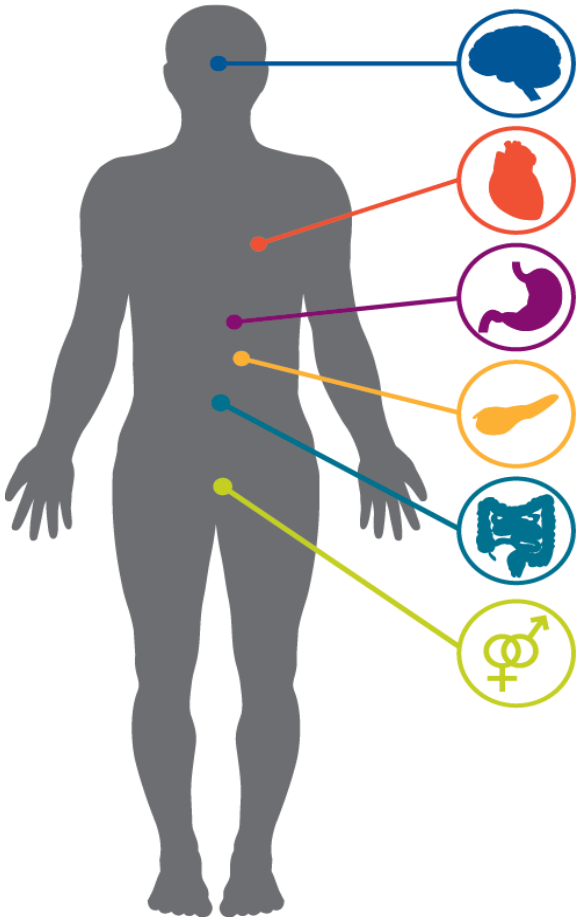
Do You Remember Why?



Stress is Uncomfortable



Effects of Stress on the Body

Brain and Nerves: Headaches, feelings of despair, lack of energy, sadness, nervousness, anger, irritability, trouble concentrating, memory problems, difficulty sleeping, mental health disorders (anxiety, panic attacks, depression, etc.)

Heart: Faster heartbeat or palpitations, rise in blood pressure, increased risk of high cholesterol and heart attack

Stomach: Nausea, stomach ache, heartburn, weight gain, increased or decreased appetite

Pancreas: Increased risk of diabetes

Intestines: Diarrhea, constipation and other digestive problems

Reproductive Organs: For women- irregular or painful periods, reduced sexual desire. For men-impotence, low sperm production, reduced sexual desire

Other: Acne and other skin problems, muscle aches and tension, increased risk for low bone density and weakened immune system (making it harder to fight off or recover from illnesses)

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The Paradox of Cortisol

Too Little

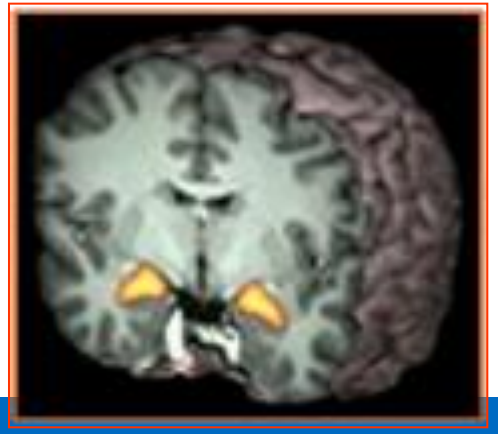
- Weak memory formation (encoding)

Too Much

- Strong encoding for emotion
- Weak encoding for detail
- Poor recall
- In extreme, cell death

Just Right

- Moderate cortisol improves the formation of detailed memory for facts and events
- Low cortisol promotes efficient and effective recall



Effects of Too Much Cortisol

- Brain Damage
- Poor Social Skills
- Low Verbal Skills
- Memory Impairment
- Aggression
- Impulsiveness
- Anxiety
- Dissociation

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Distress Impact on Neurons

Dendrites taken from rat PFC show effects of distress.

How much (time) exposure to distress would you predict it would take for neurons to wither as shown?

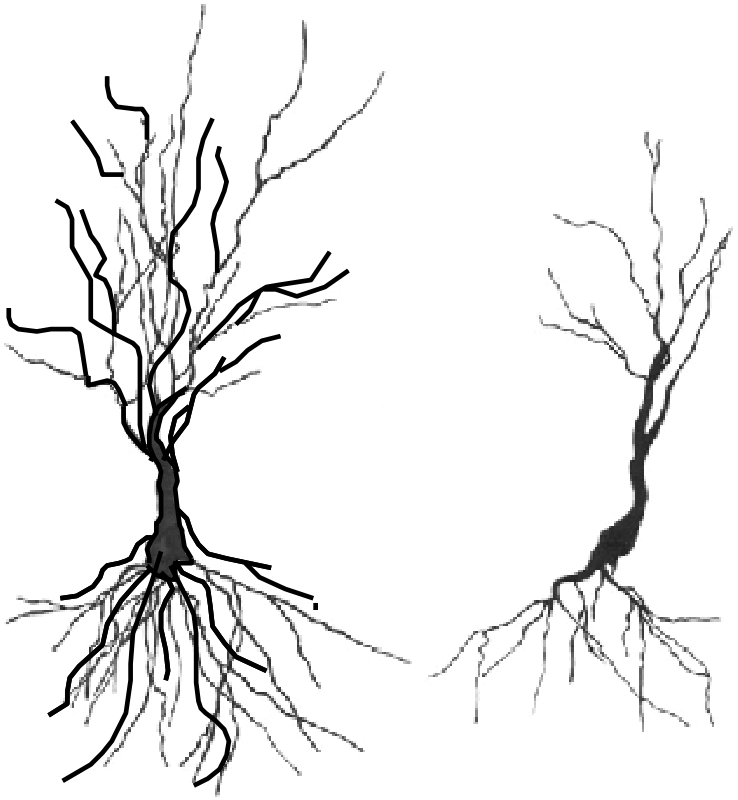
a.) 2 hrs./day for 2 months

b.) 30 min./day for 7 wks

c.) 1 hr./day for 10 weeks

d.) 10 min./day for 5 days

(Brown et al. 2005)



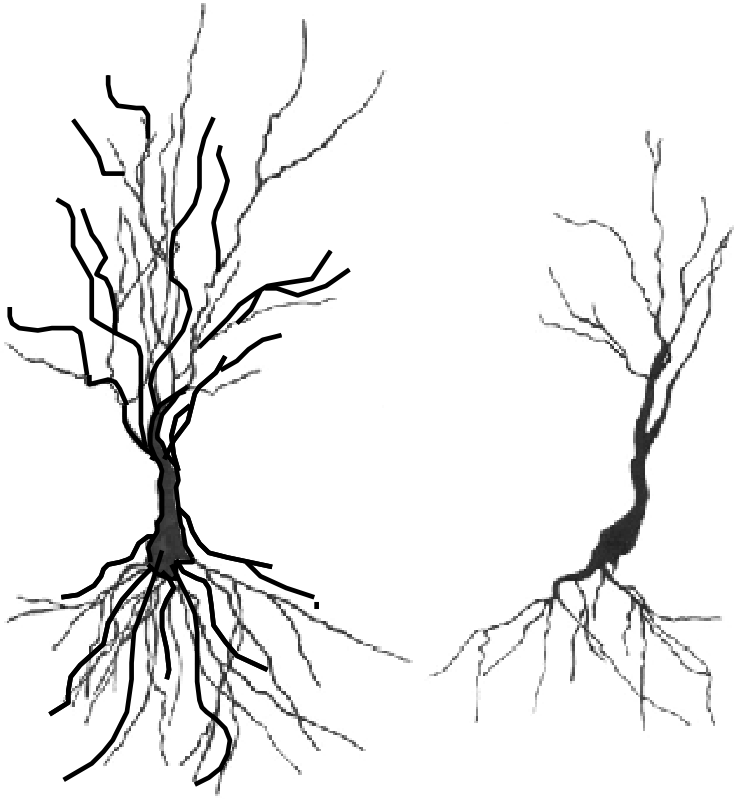
Control Stressed

Distress Affects Neurons

There is strong evidence of withering and retraction of dendritic branching within …

a.)
b.)
c.)
d.) 10 min./day for 5 days!

(Brown et al. 2005)



Control Stressed

Let's Think About Memory...

All Learning =

Making a Memory

- Slumber
- Siesta
- Doze
- Nap
- Deep
- Nightlight
- Snooze
- Wake
- Rest
- Night
- Sound
- Tired
- Snore
- Dream
- Yawn
- Bed

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- Slumber
- Siesta
- Doze
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- Wake

- Rest
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- Sound
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- Snore
- Dream
- Yawn
- Bed

"SLEEP" IS NOT ON THE LIST

Most Everyone Has Had a Memory Lapse

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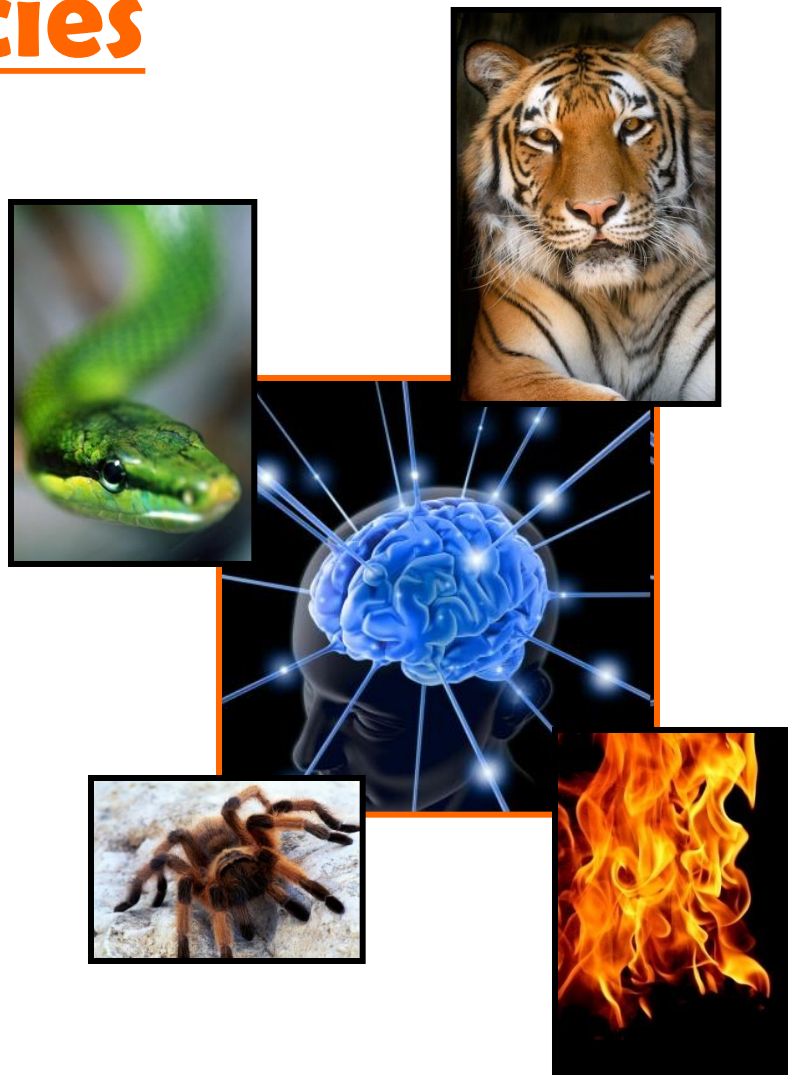
Stress Response is Designed for Emergencies

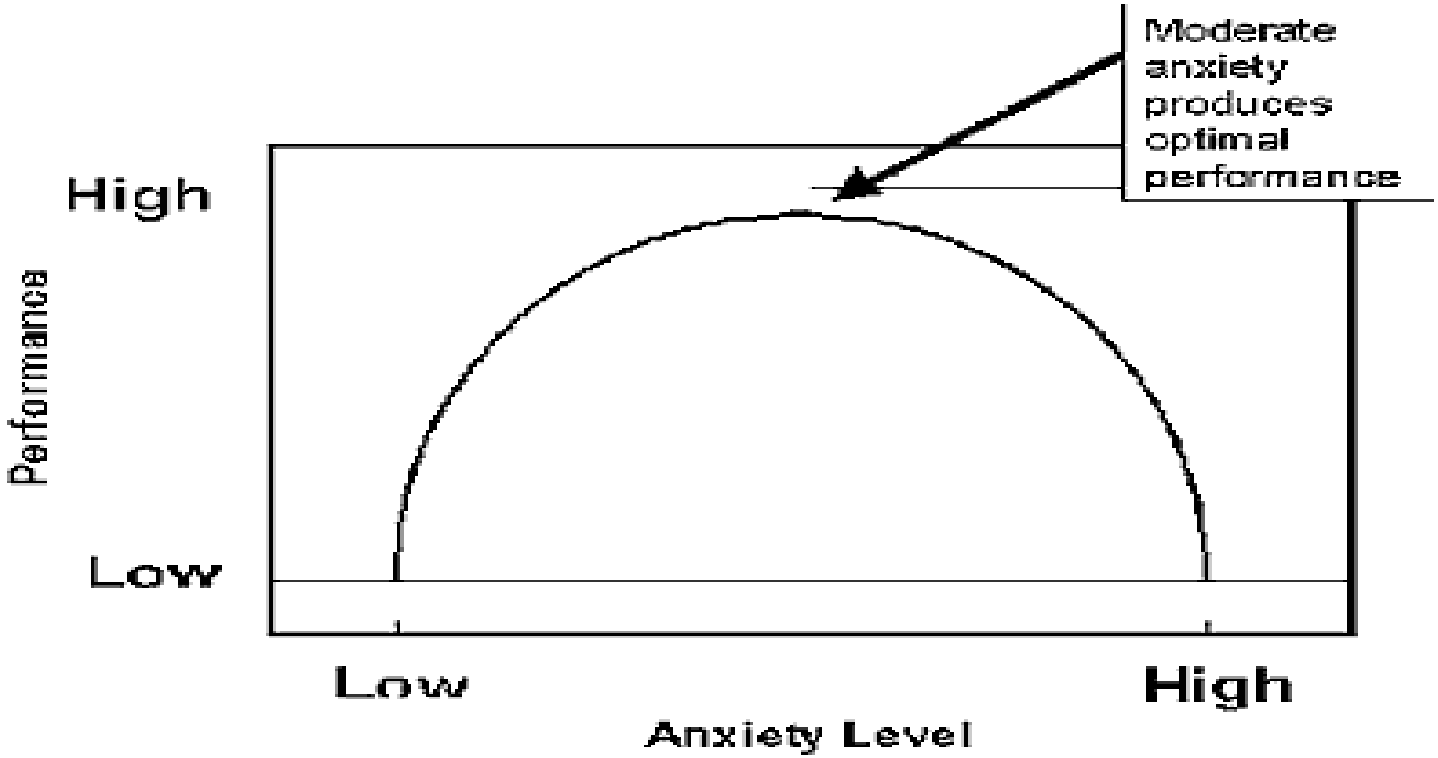
- When stressed, the brain causes a cascade of hormones to flow, most notably **cortisol**.
- The stress response compels us to act by having major impact on all bodily functions.



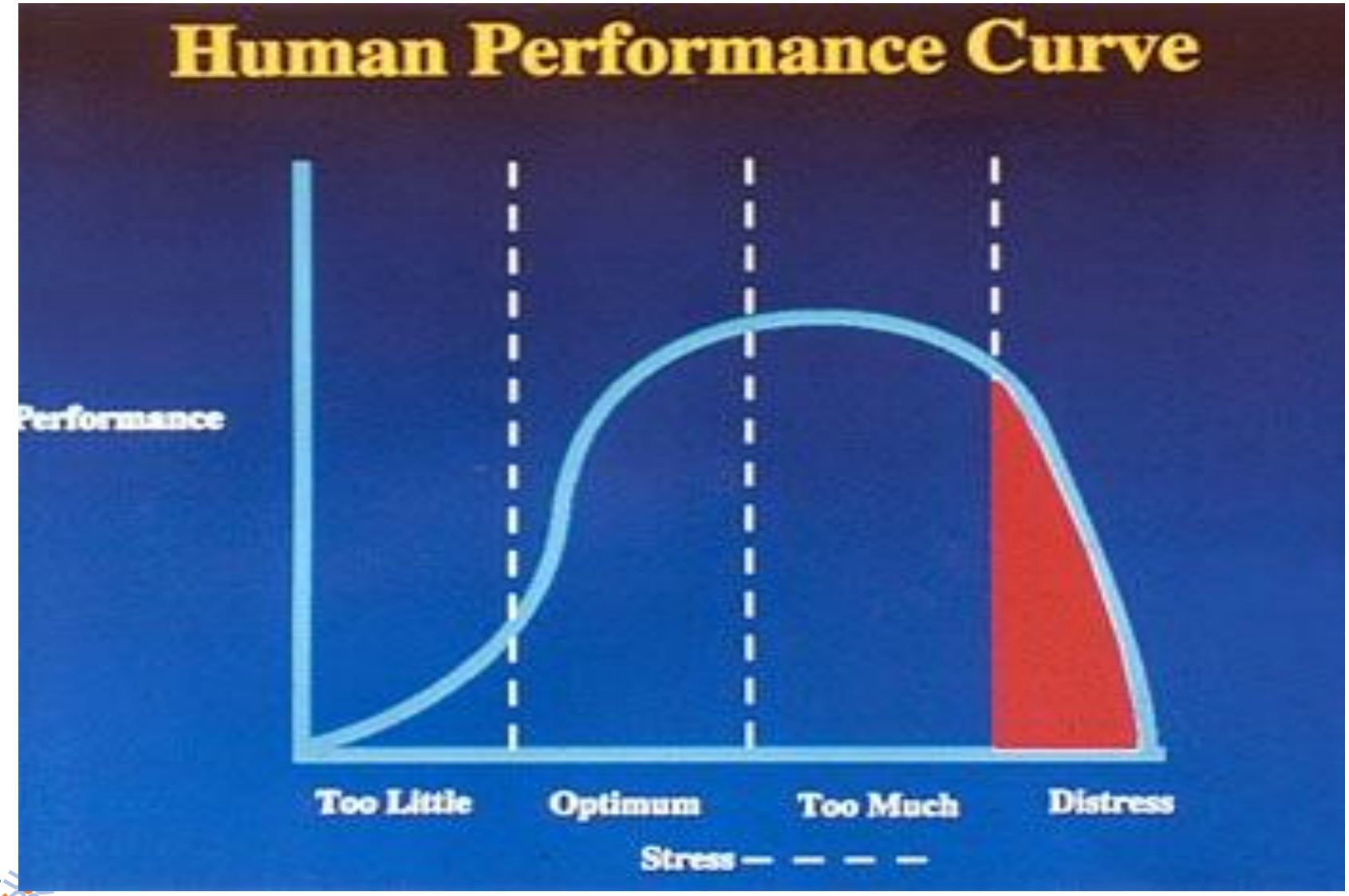
The Stress Response - Overview

- Find Energy
- Get it to Where it is Needed
- Shut-off Long-Term Projects
- Suppresses Digestion, Immune Response, Growth and Reproduction
- Sharpens Cognition, Alertness and May Increase Pleasure **BUT**…Short-Term Only
- May Release Dopamine (Horror Movies, Roller Coaster)

Yerkes-Dodson Law



As stress increases, performance initially rises, and then declines.



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The Stress Response on the Brain

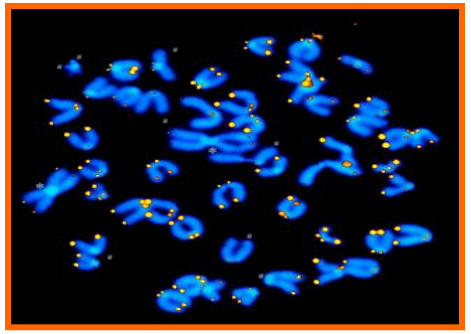
Hippocampus	Amygdala	Frontal Cortex
Memory Center Most Stress HormoneReceptors	Center of Uncertainty Emotional Regulation	Executive System Planning, Judgment, Problem Solving, Impulse Control
Decreased Function Less Communication Between Neurons Lower Neurogenesis Dead Neurons	More Anxiety “Faster” Fear More Excitatory Neurons Depletion of Dopamine	Reorganizes Neuronal Connections Poor Decision Making “Fuzzy” Thinking

Chronic Stress Effects on Humans

Two groups of moms ages 20-50, (n = 58)

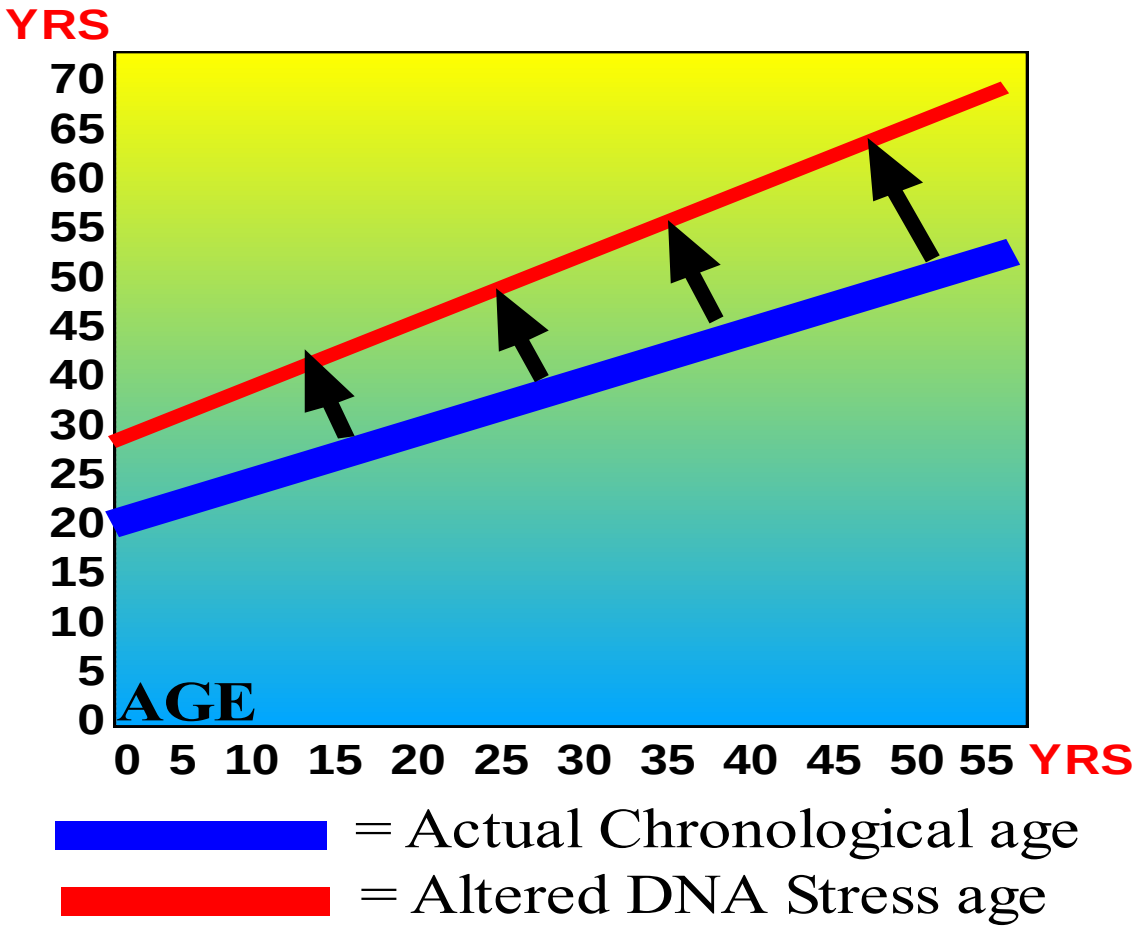
- One group had a healthy child (control group)
- The other group (stressed) had a chronically ill child.
- How much faster did the DNA age in the stressed women?

a) 6 months
b) 12 months
c) 1-3 years
d) 3-10 years
e) 9-17 years



One way to measure aging is to examine DNA. Each time it copies, it loses telomeres. This becomes a marker for aging.

Chronic stress aged women **9-17** *years faster* than their counterparts with a healthy lifestyle.
(Epel, et al. 2004)



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What Do You Do to Manage Your Cortisol?

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Another "Big Idea"

Addictive behaviors can provide significant stress relief. There may be other consequences, but the "high" can temporarily decrease high levels of cortisol.

Stress Motivates!

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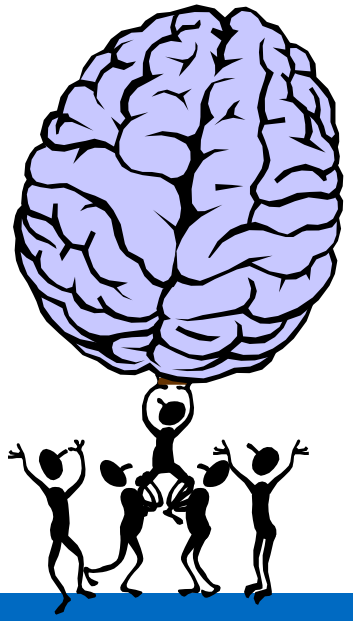
Today's Itinerary

3. Addiction in the Brain: The 4 "Whats"



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The 4 "Whats" of Addiction

1. **What's** the Brain Got to Do With It?
2. **What** Happens in the Brain When Someone is "Getting High?"
3. **What** is Addiction in the Brain?
4. So **What?**

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The 4 "Whats?"

1. What's the Brain Got to Do With It?

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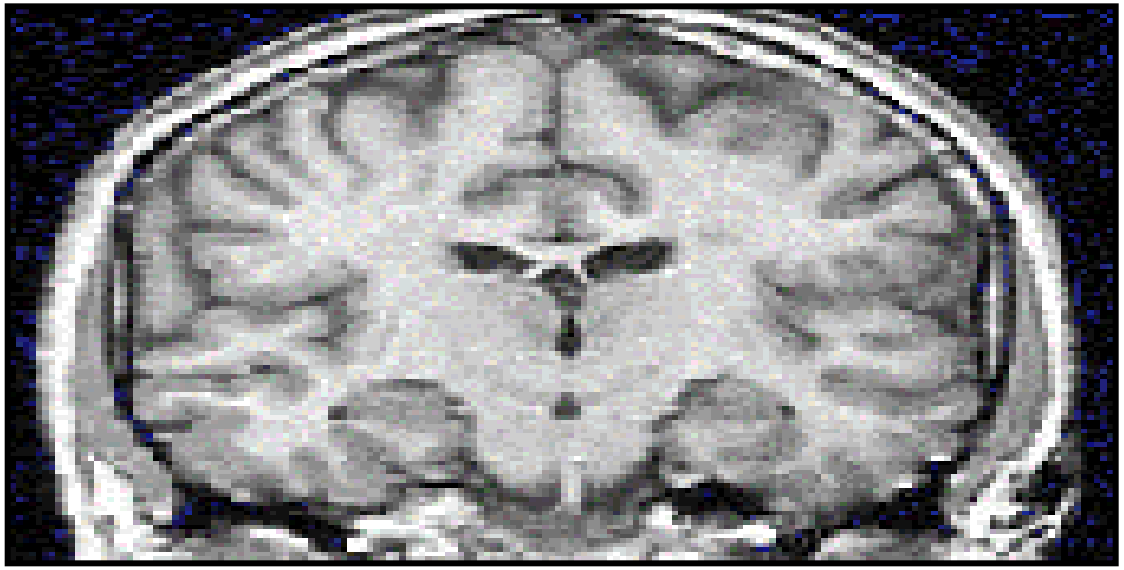
Why the Brain? Reason #1

Because the brain is involved in **EVERYTHING** humans do!



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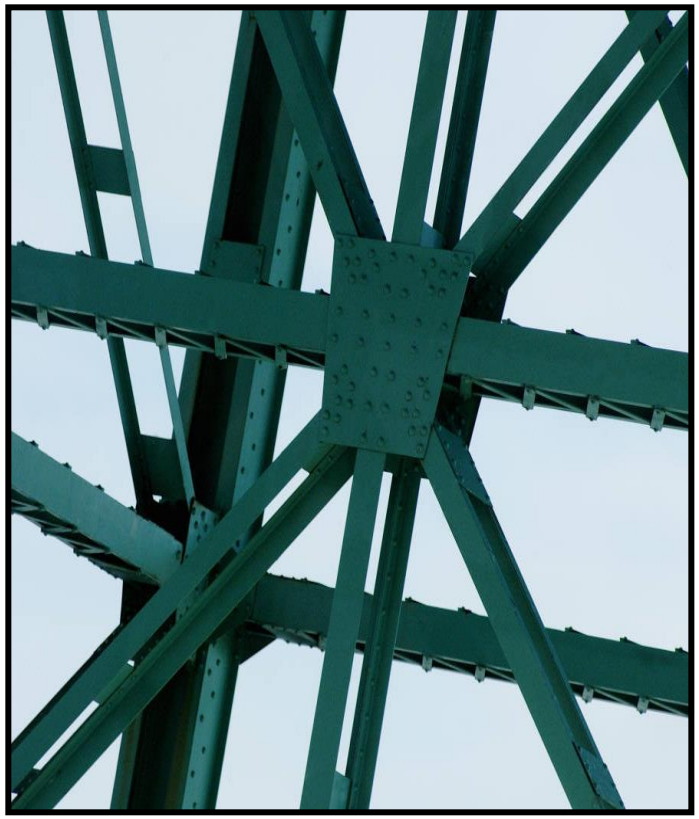
Brain Science Can (and Has)...

- Provided a new, researched-based perspective on chronic human problems.
- **Reinforced** the reasons many traditional practices work.



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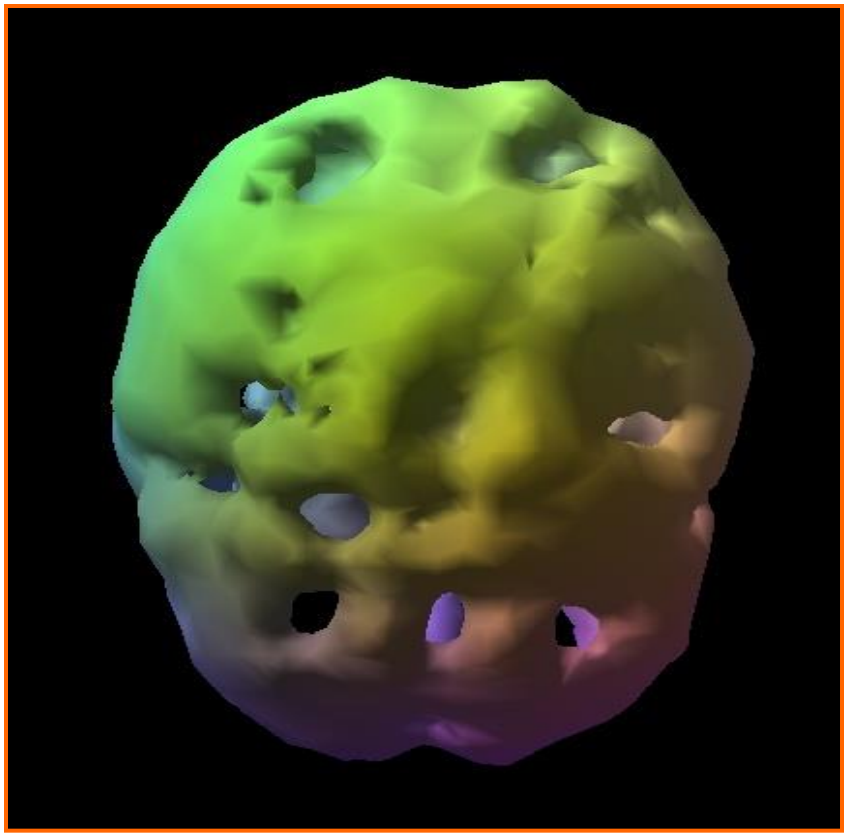
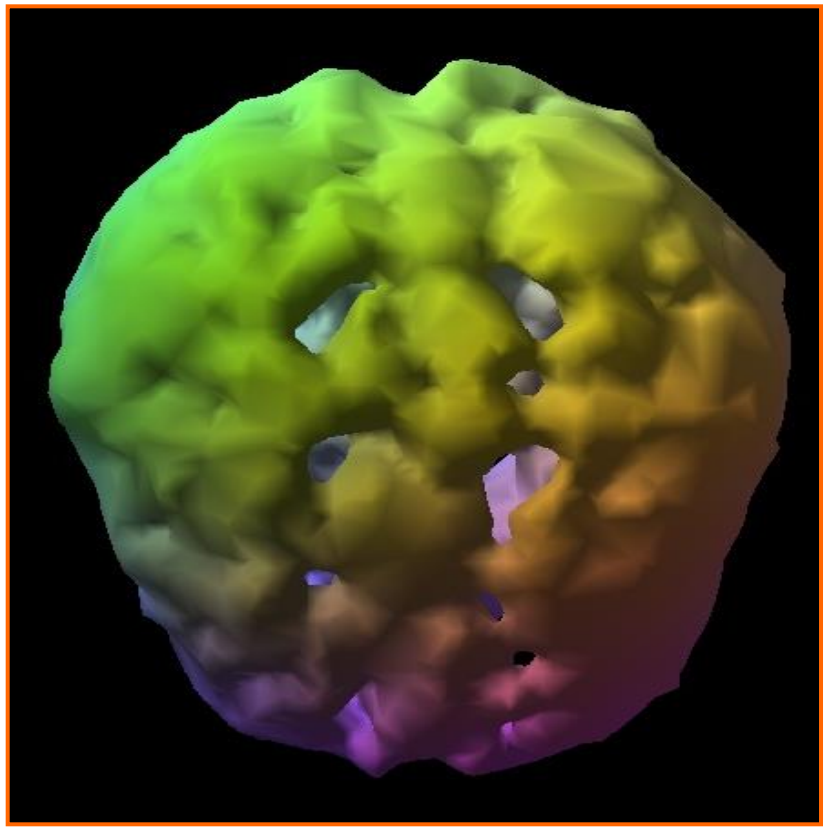
A New View of Drug Abuse



Cocaine



Methamphetamine

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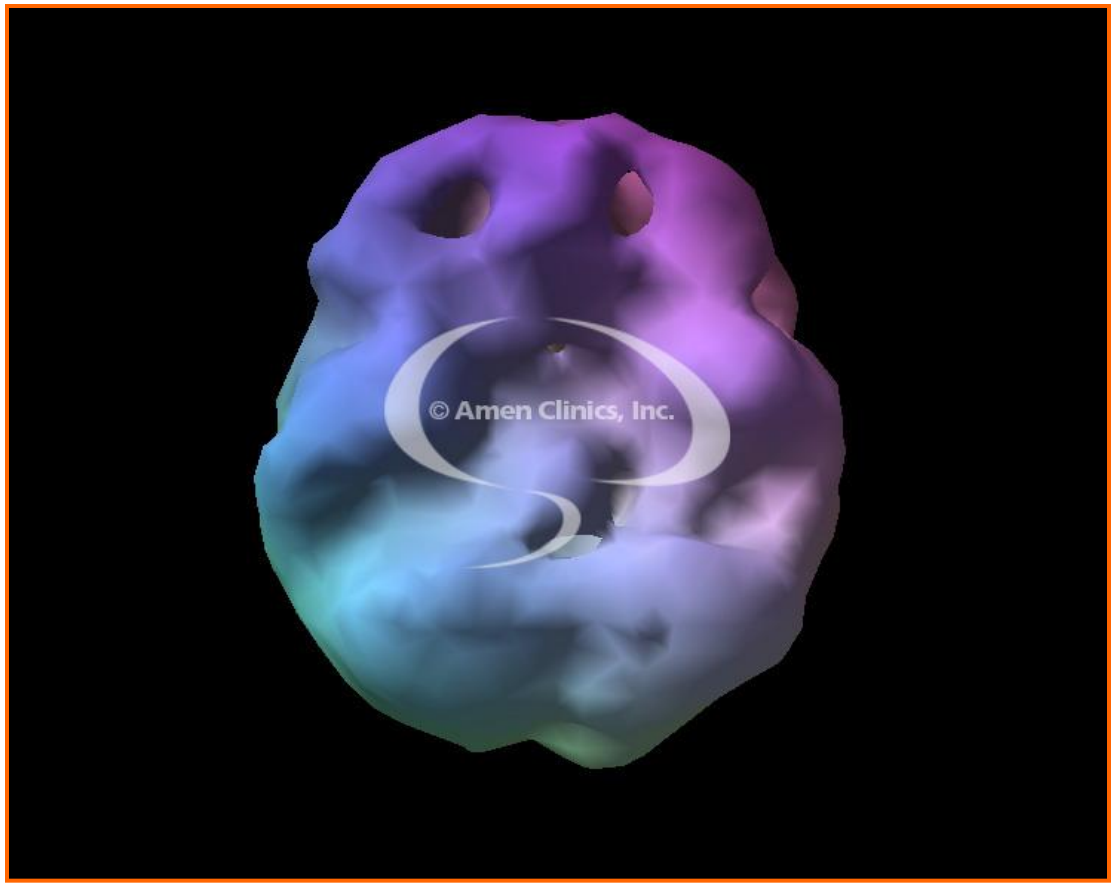
ADHD Brain at Rest



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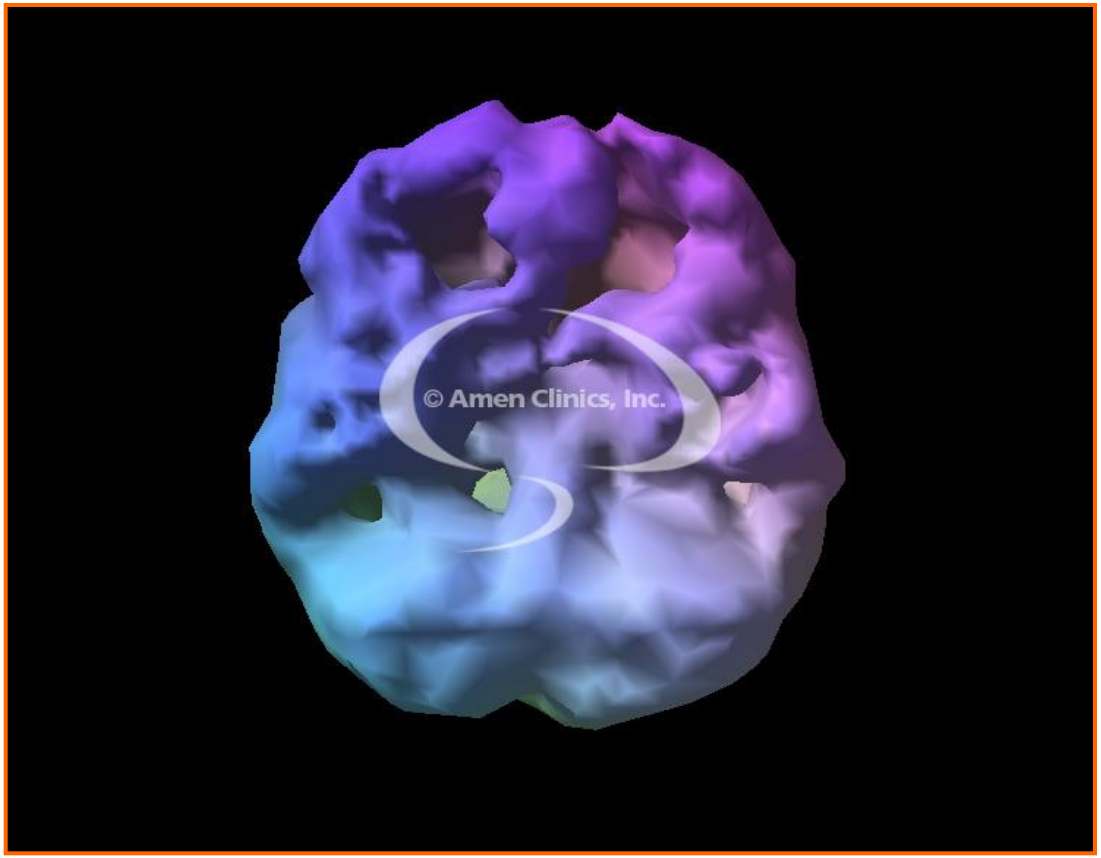
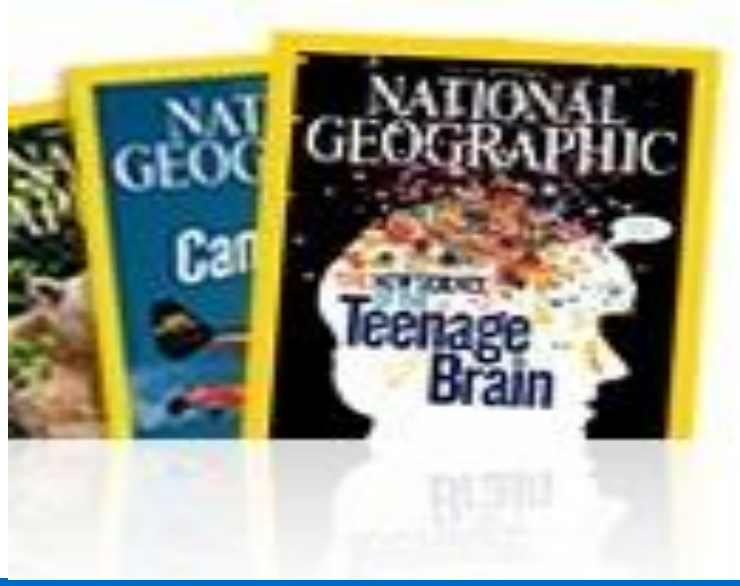
ADHD Brain: Concentration Under Stress/Threat



Why the Brain? Reason #2

Because knowledge about the brain is **EVERYWHERE** these days…



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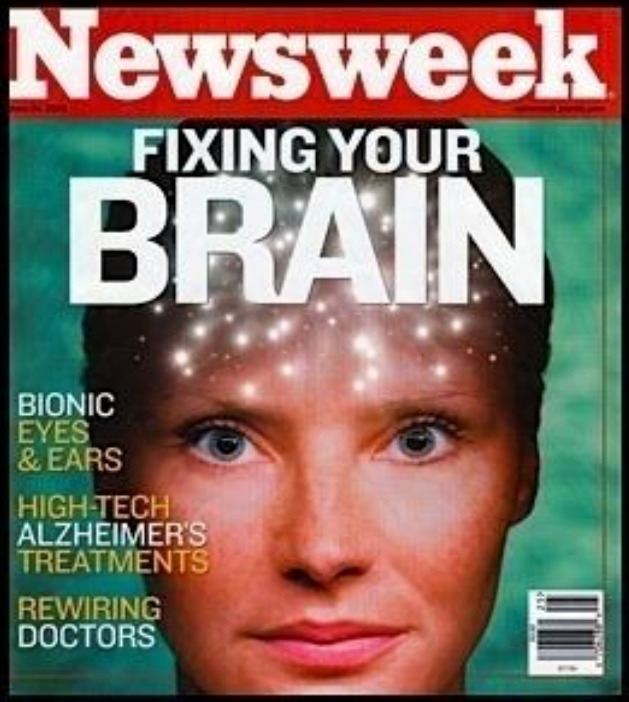
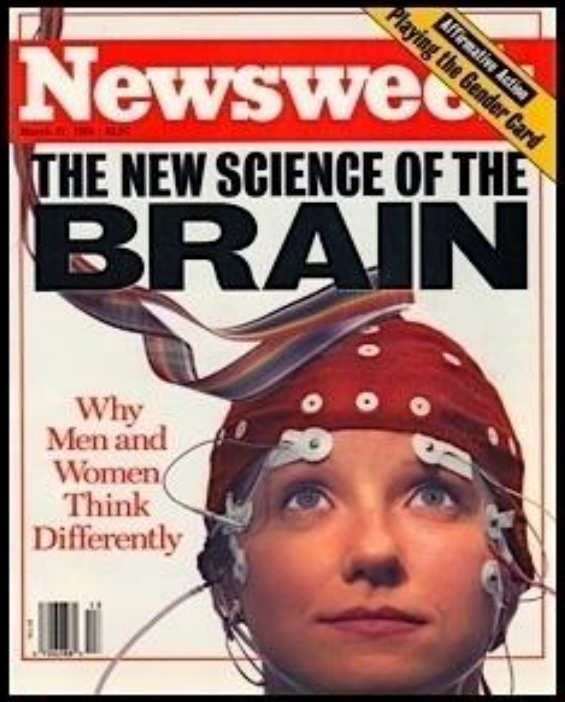
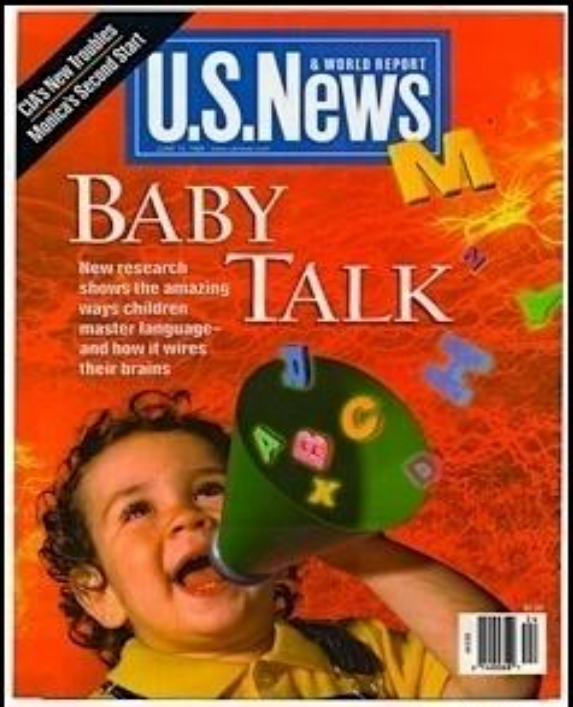
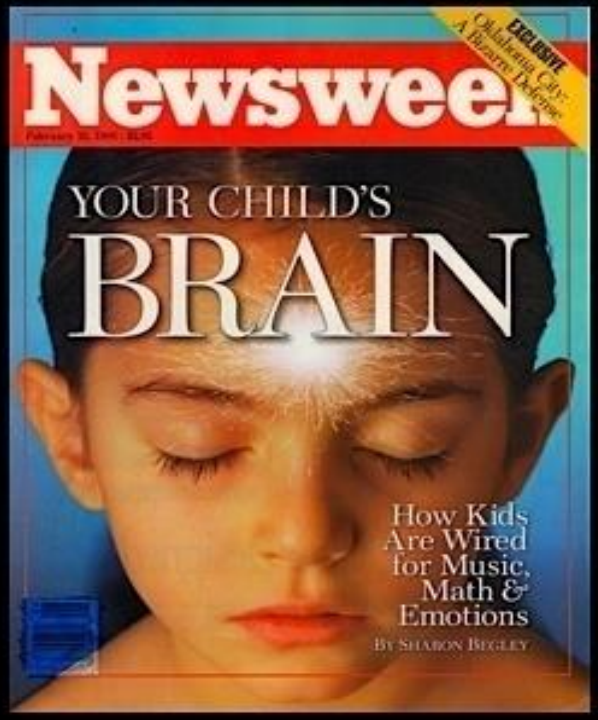
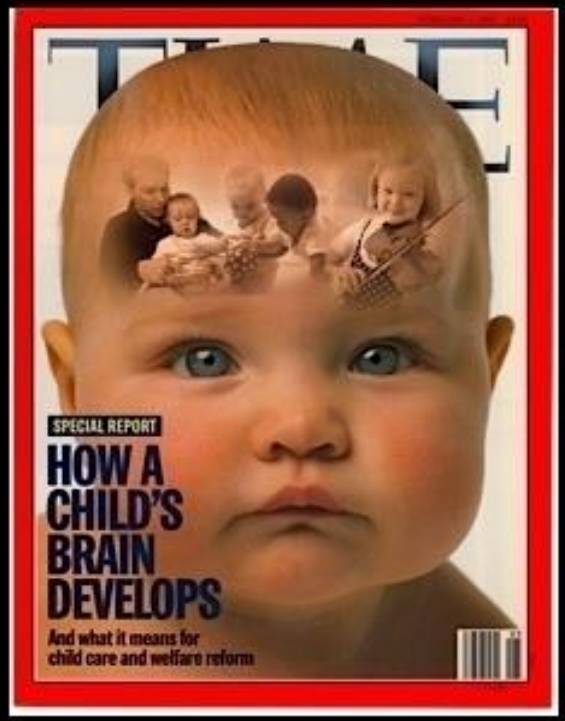
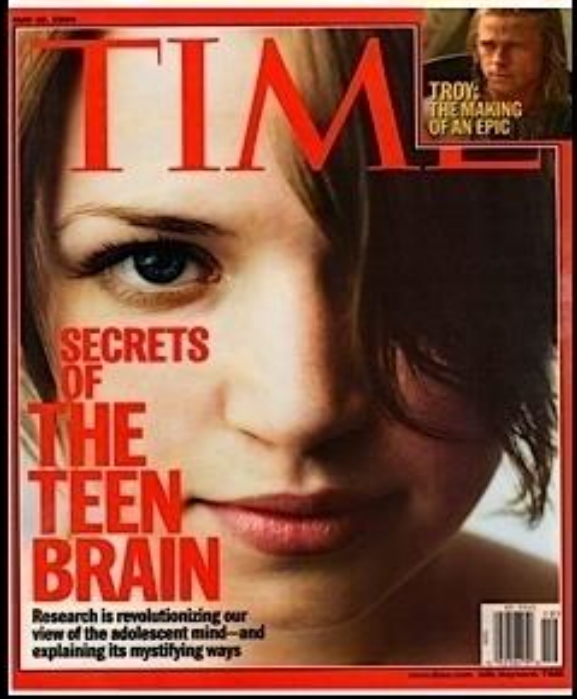

Newsweek
FIXING YOUR
BRAIN
BIONIC
EYES
& EARS
HIGH-TECH
ALZHEIMER'S
TREATMENTS
REWIRING
DOCTORS


Newsweek
Affirmative Action
Playing the Gender Card
THE NEW SCIENCE OF THE
BRAIN
Why
Men and
Women
Think
Differently

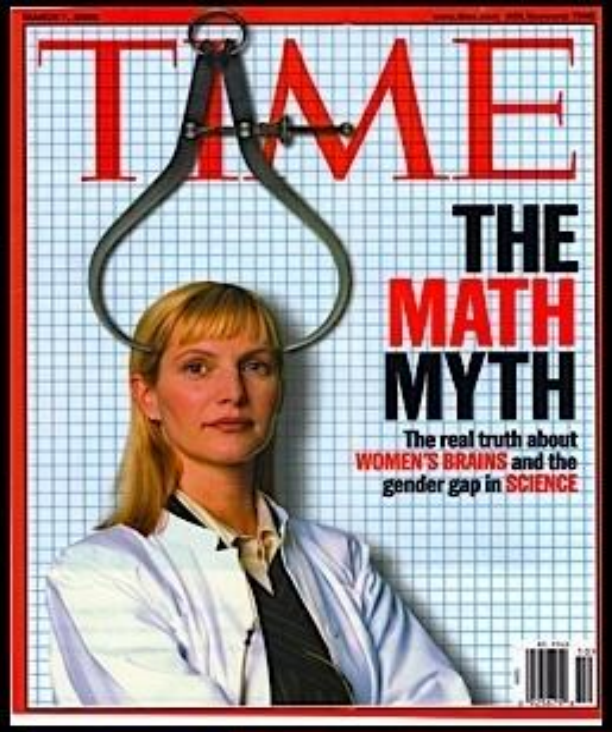

U.S.News
& WORLD REPORT
CIA's New Troubles
Monica's Second Start
BABY
TALK
New research
shows the amazing
ways children
master language—
and how it wires
their brains

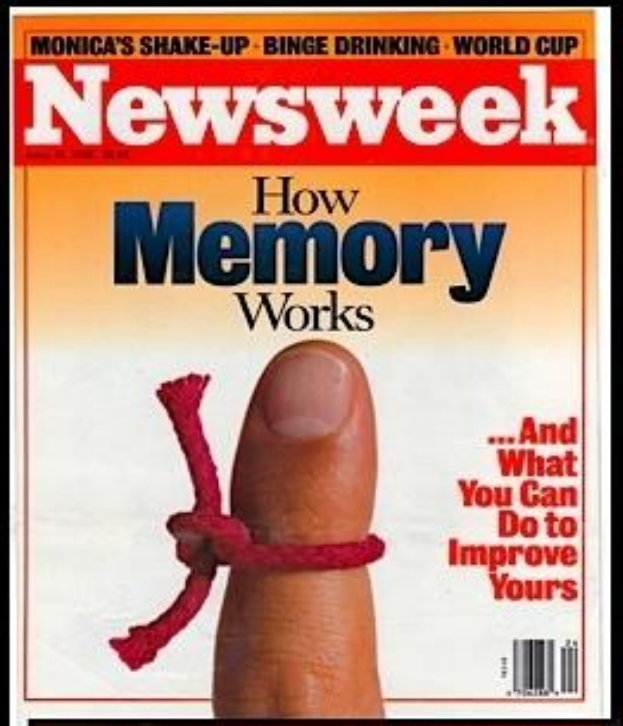

Newsweek
EXCLUSIVE
Oklahoma City:
A Bizarre Defense
YOUR CHILD'S
BRAIN
How Kids
Are Wired
for Music,
Math &
Emotions
By Sharon Begley


SPECIAL REPORT
HOW A
CHILD'S
BRAIN
DEVELOPS
And what it means for
child care and welfare reform

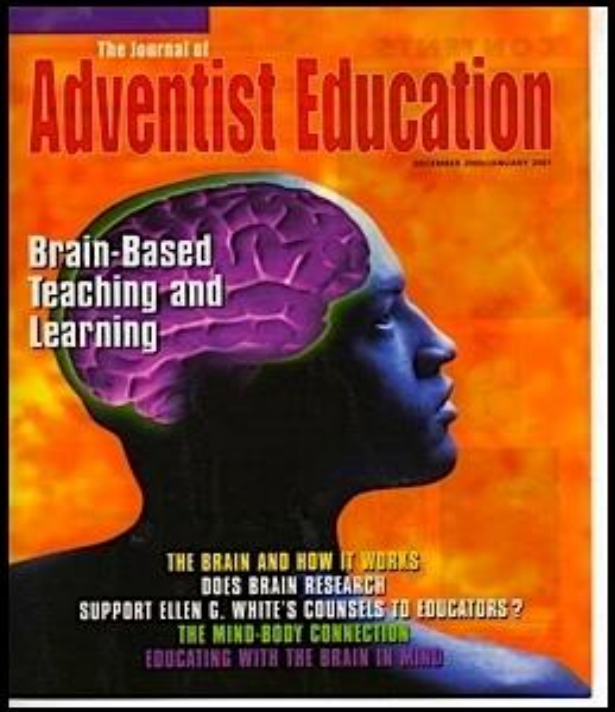

TIME
TROY:
THE MAKING
OF AN EPIC
SECRETS
OF
THE
TEEN
BRAIN
Research is revolutionizing our
view of the adolescent mind—and
explaining its mystifying ways


KILLER TRUCKS: THE DANGER TO MOTORISTS
U.S.News
& WORLD REPORT
How Kids Learn
Faster than you think— but don't push too hard


TIME
THE MATH MYTH
The real truth about WOMEN'S BRAINS and the gender gap in SCIENCE


MONICA'S SHAKE-UP · BINGE DRINKING · WORLD CUP
Newsweek
How Memory Works
...And What You Can Do to Improve Yours


MIND & BODY SPECIAL ISSUE
TIME
THE BRAIN
A USER'S GUIDE


The Journal of
Adventist Education
Brain-Based Teaching and Learning
THE BRAIN AND HOW IT WORKS
DOES BRAIN RESEARCH SUPPORT ELLEN G. WHITE'S COUNSELS TO EDUCATORS?
THE MIND-BODY CONNECTION
EDUCATING WITH THE BRAIN IN MIND


WWII'S FORGOTTEN FRONT • THE STONES OPEN UP
Newsweek
Your Baby's Brain
NEW RESEARCH
From Jealousy To Joy: How Science Is Unlocking the Inner Lives Of Infants

One of My Favorites!

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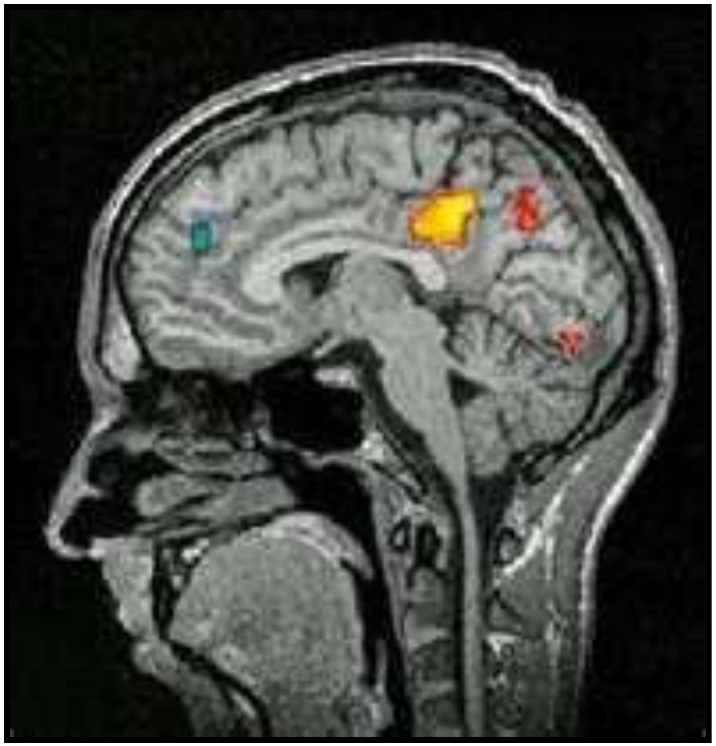
Knowledge About the Brain

- **Knowledge** impacts our **Thinking** (Our beliefs about how things work)
- **Thinking** determines our **Behavior**
- ***We Each Become What We Think About***



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Knowledge About the Brain

- Knowledge about the brain can impact how we think about the brains we serve and, directly and indirectly, how we behave toward them.
- Our focus today**: How and Why Addiction Happens in the Brain.**

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Why the Brain? Reason #3

Because the brain is where addiction does its insidious work…

Both the "High" and the "Addiction Response" Happen Here!

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Why the Brain?

1. It is *where* addiction works its potent power.
2. If you know what happens in the brain, then you will understand why addiction makes you/them *feel and behave* the way you/they do.
3. You can judge whether you/they are in *control* or whether the addiction is in control.
4. If you know the physiological actions of addiction, you can *strategize how to fight back* when your/their brain craves more, even when you/they want less.

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The 4 "Whats?"

2. What Happens in the Brain When Someone is Getting High?

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Natural Highs

Voluntary behavior in animals (including humans) is motivated by the avoidance of pain and the *pursuit of pleasure.*

Higgins, E. and George, M., The Neuroscience of Clinical Psychiatry (2007) Lippincott, Williams & Wilkins, Philadelphia

The Pursuit of Pleasure

The motivation to pursue a beneficial act to enhance survival is driven in part the brain giving a brief squirt of ***euphoria*** — the reward system.

The Pursuit of Pleasure

This euphoric feeling is caused by the secretion of endorphins in the brain. The most important of which is the neurotransmitter ***dopamine.***

The Pursuit of Pleasure

This reward system has evolved over thousands of years to enable the brain to sort through the variety of stimuli that bombard the senses and choose the ones that enhance survival (i.e., eating, sex, social interaction). ***When these stimuli are encountered, the brain secretes dopamine.***

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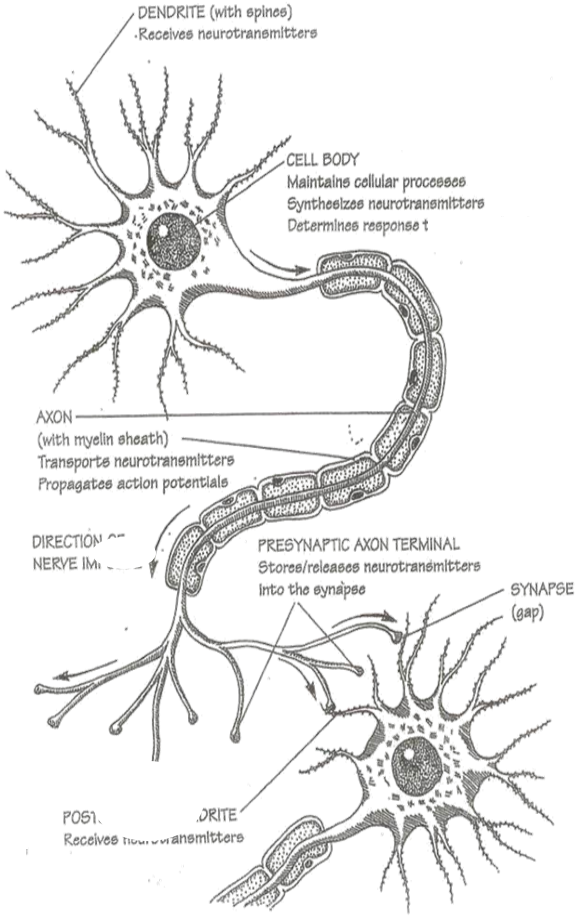
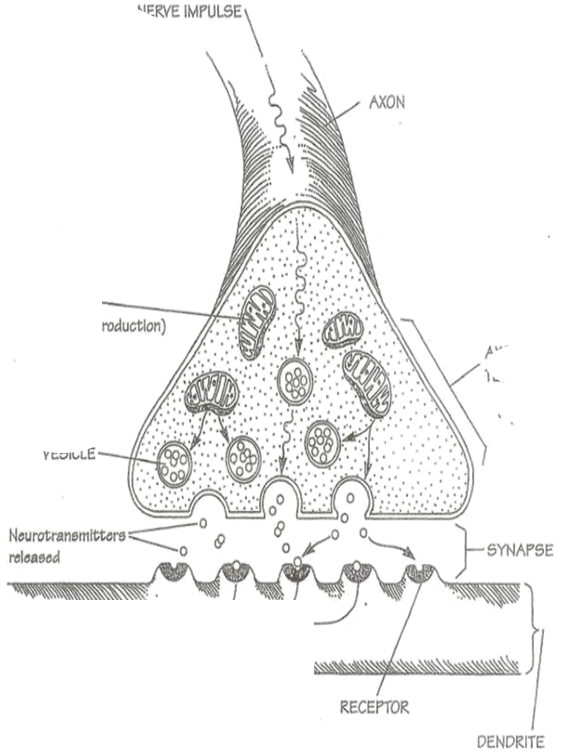
Functional Model of a Neuron



Synaptic Area



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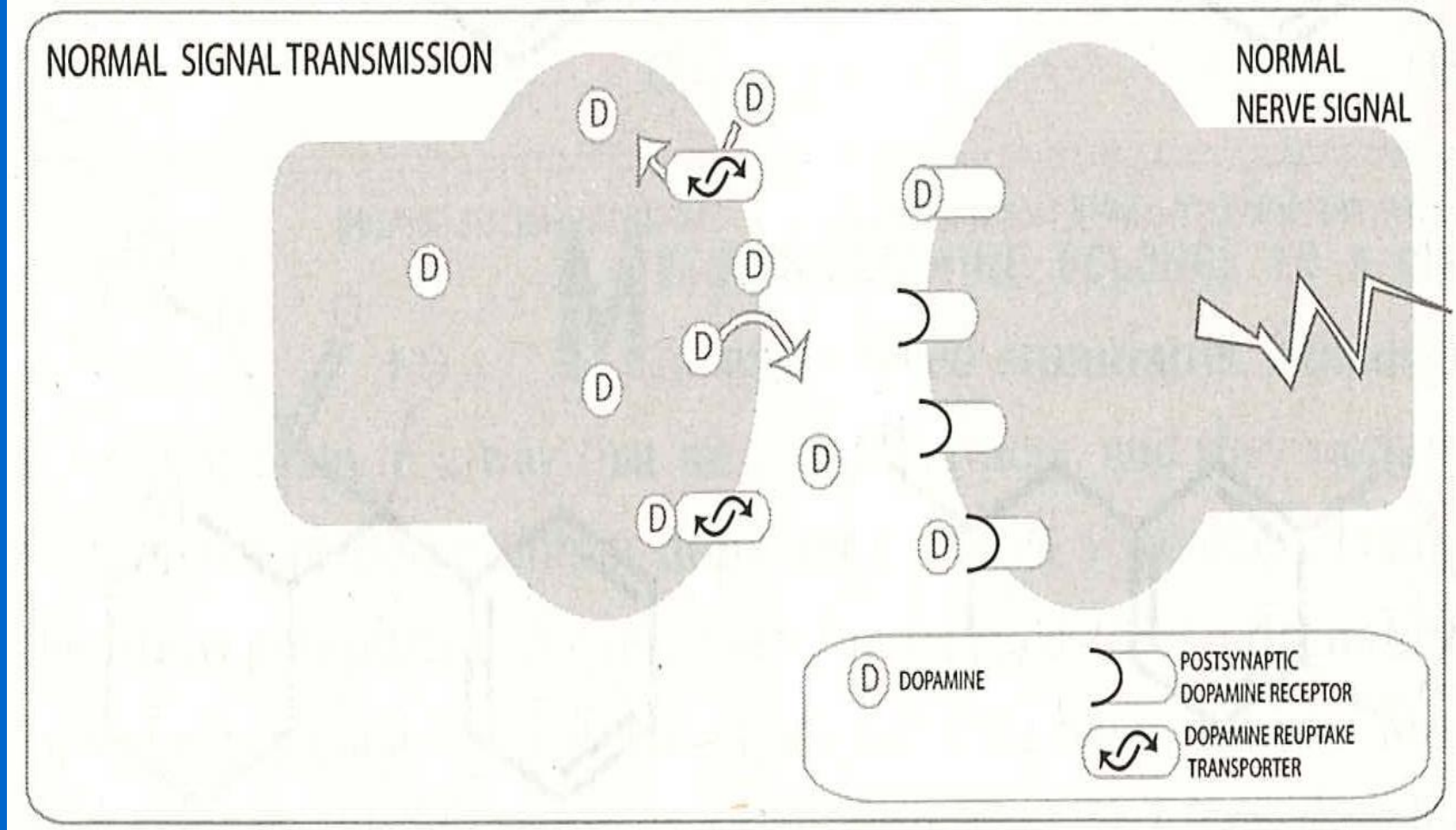

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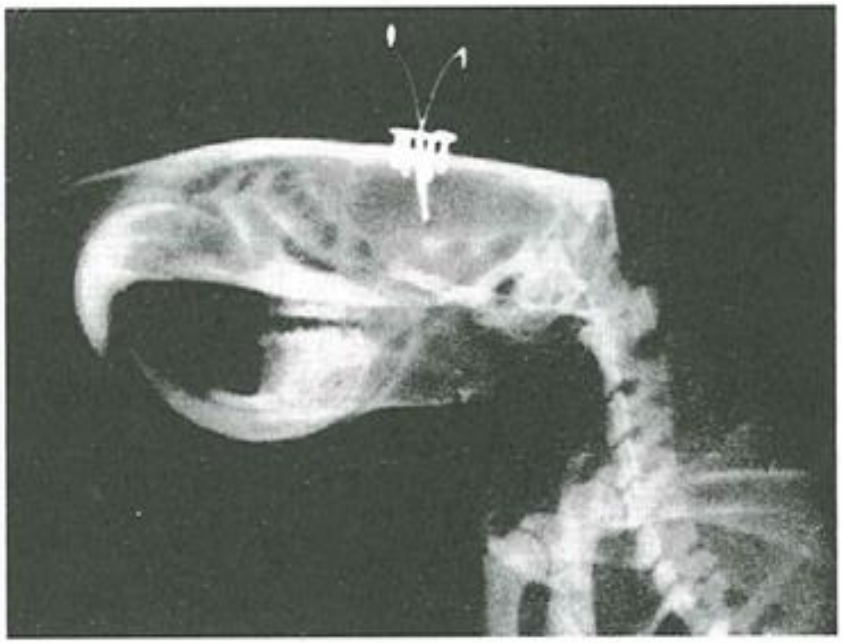
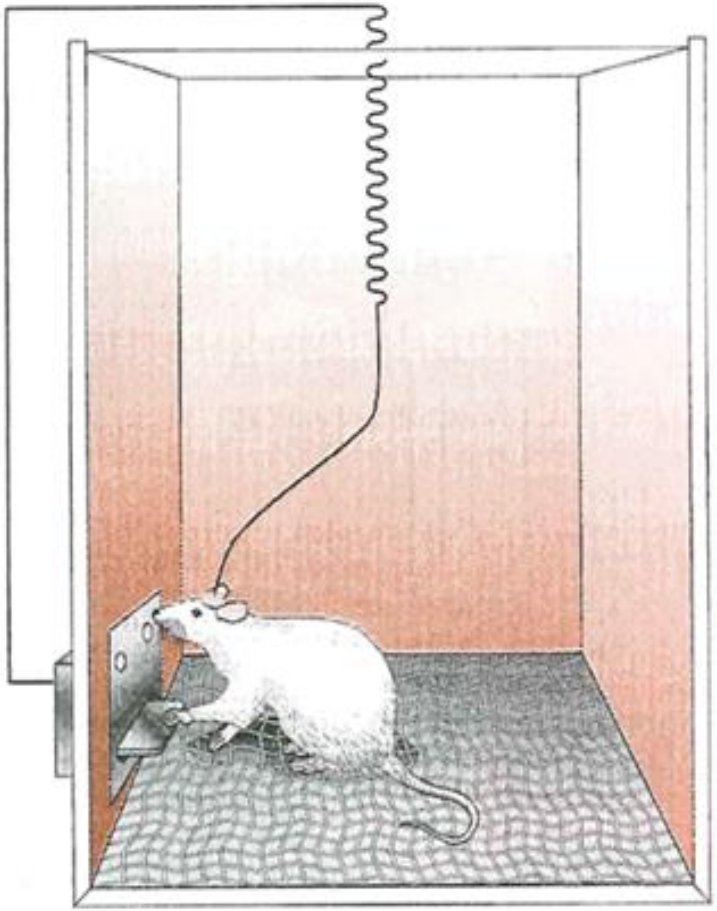
The Power of Reward

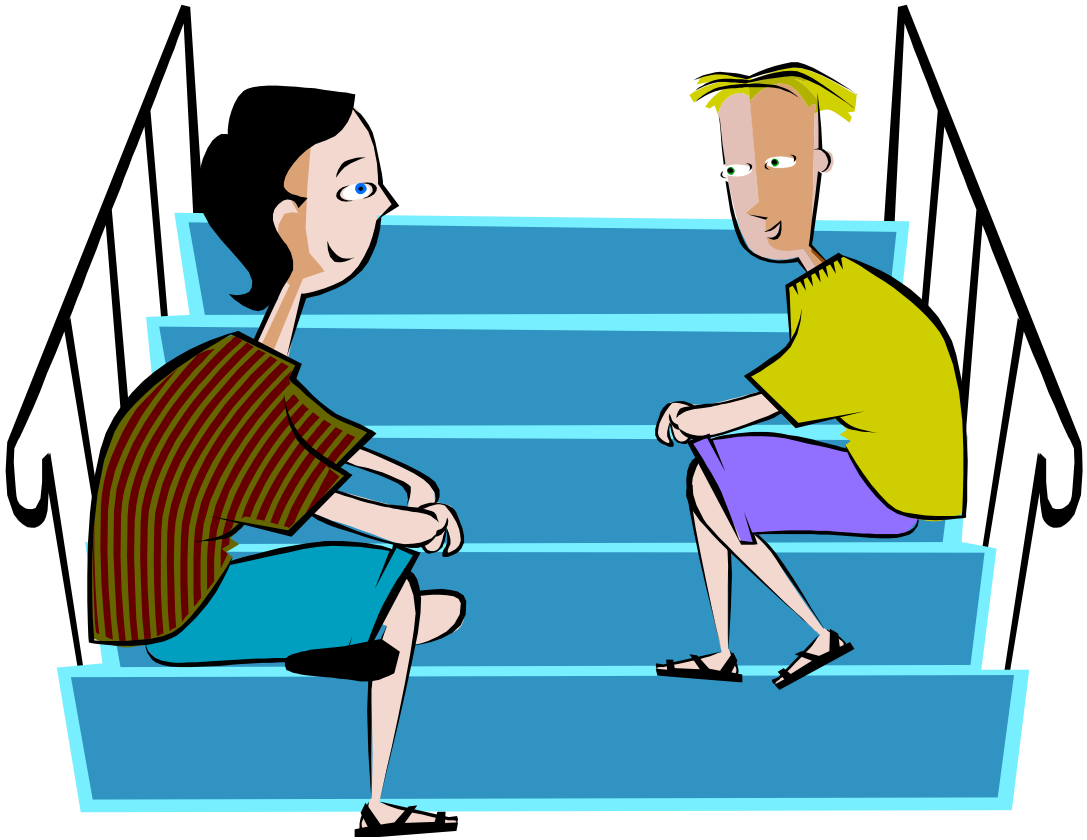
- The first clues about the power of pleasure were discovered by accident in the 1950's.
- In an experiment on surgical techniques, an electrode placed in rat's brain provided pleasurable stimulus when rat pressed a lever. ***In other words, the rat could get a secretion of dopamine whenever it wanted it.***

The Power of Reward





Nudge a Neighbor Time!



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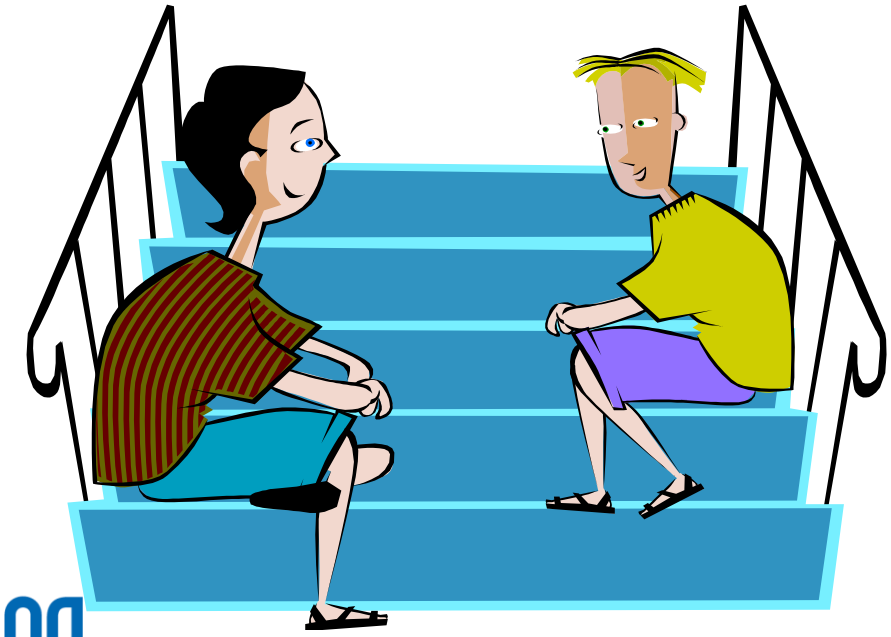
Nudge a Neighbor Time!

1. *How many times did the rat hit the lever?*
2. *What made it stop?*



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The Power of Reward

Results –

Rat would:

- Press the lever up to 5,000 an hour.
- Choose dopamine experience over food (even when starving).
- Cross an electrified grid (painful!) for a chance to press the lever.

Olds, J.; Pleasure Centers in the Brain. Sci Am. 1956; 195: 105-112.

Only ***death***
stopped the rat
from pressing the
lever.

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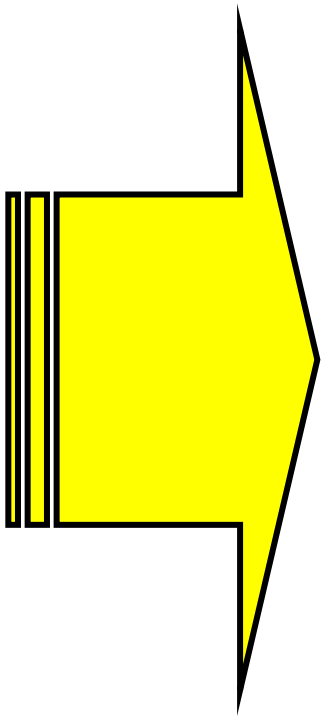

What activities result in enhanced dopamine levels in our society?

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What activities result in enhanced dopamine levels in our society?

- Romantic Love
- Sexual Orgasm
- Music
- Humor
- ***Expectation of $***

- Inflicting punishment on a known enemy
- Looking at beautiful faces
- Social cooperation

**** Obviously, a partial list!***

Take Home Messages

- Dopamine feels good! (It is supposed to feel good).
- This is the brain's normal system of reward.
- The brain is stingy with dopamine because the euphoria is a powerful motivator.
- **Many activities naturally give us dopamine.**

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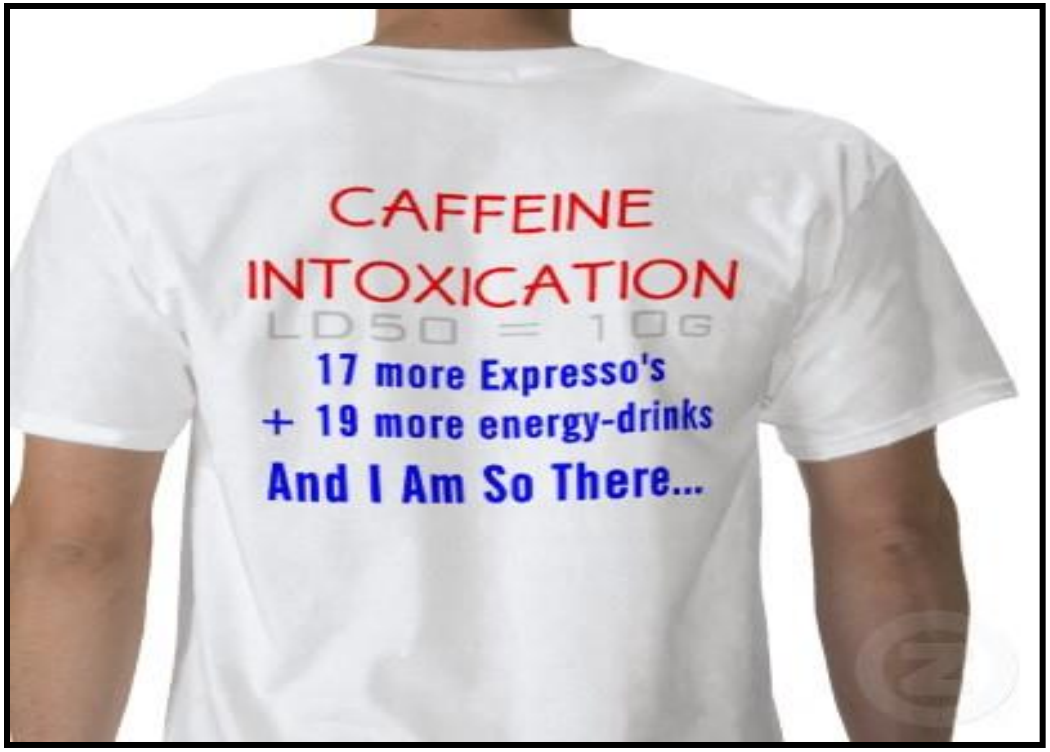
Chemically-Induced Highs



What *chemicals* result in enhanced dopamine levels in our society?

- Chocolate
- Cocaine
- Alcohol
- Amphetamines
- Nicotine
- Methylphenidate

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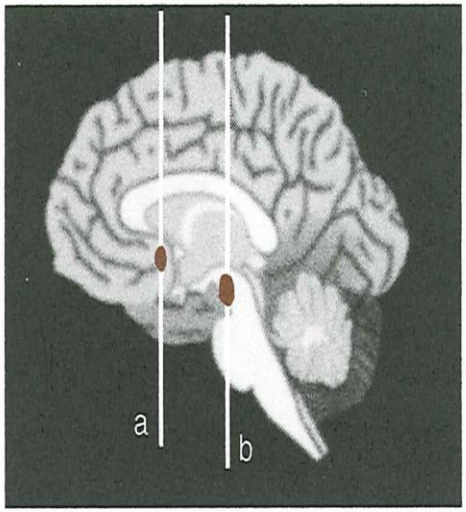
Drugs

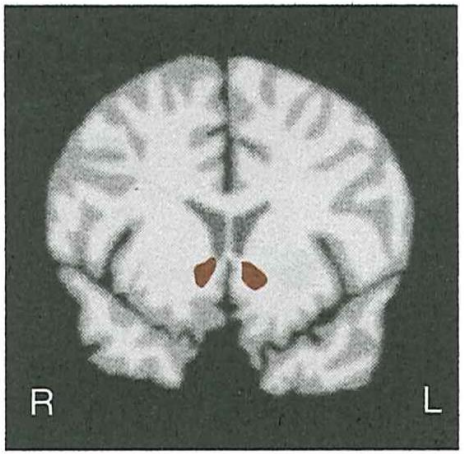
1. Cocaine
2. Alcohol
3. Amphetamines
4. Methylphenidate
5. Nicotine



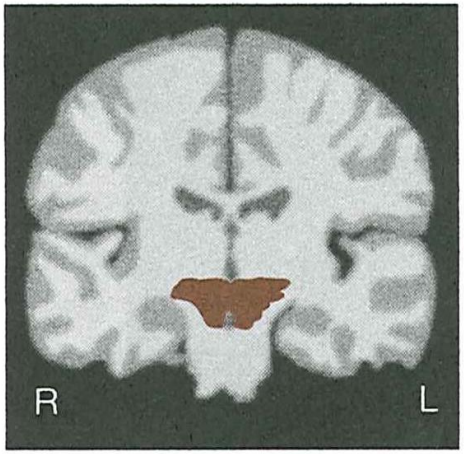
Feelings

6. Romantic love
7. Listening to music
8. Humor
9. Expectation of $$$
10. Inflicting punishment
11. Looking at beautiful faces
12. Social co-operation
13. Eating chocolate

a. Nucleus accumbens

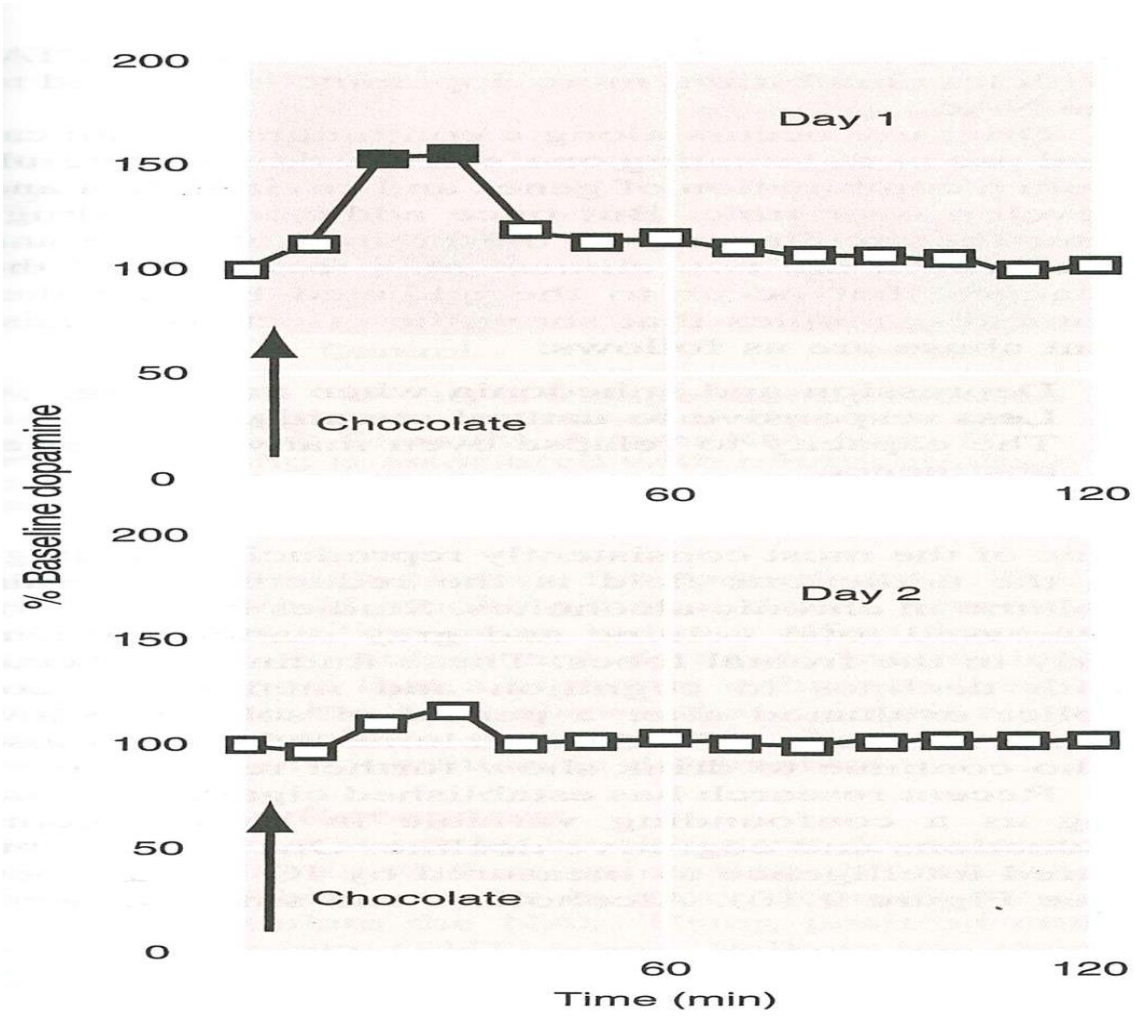


b. Ventral tegmental area



Boosting Dopamine Levels

- Chocolate
  - 150% boost in dopamine levels at MAc over baseline of first administration.
  - On second administration, boost in dopamine level is no longer significant.

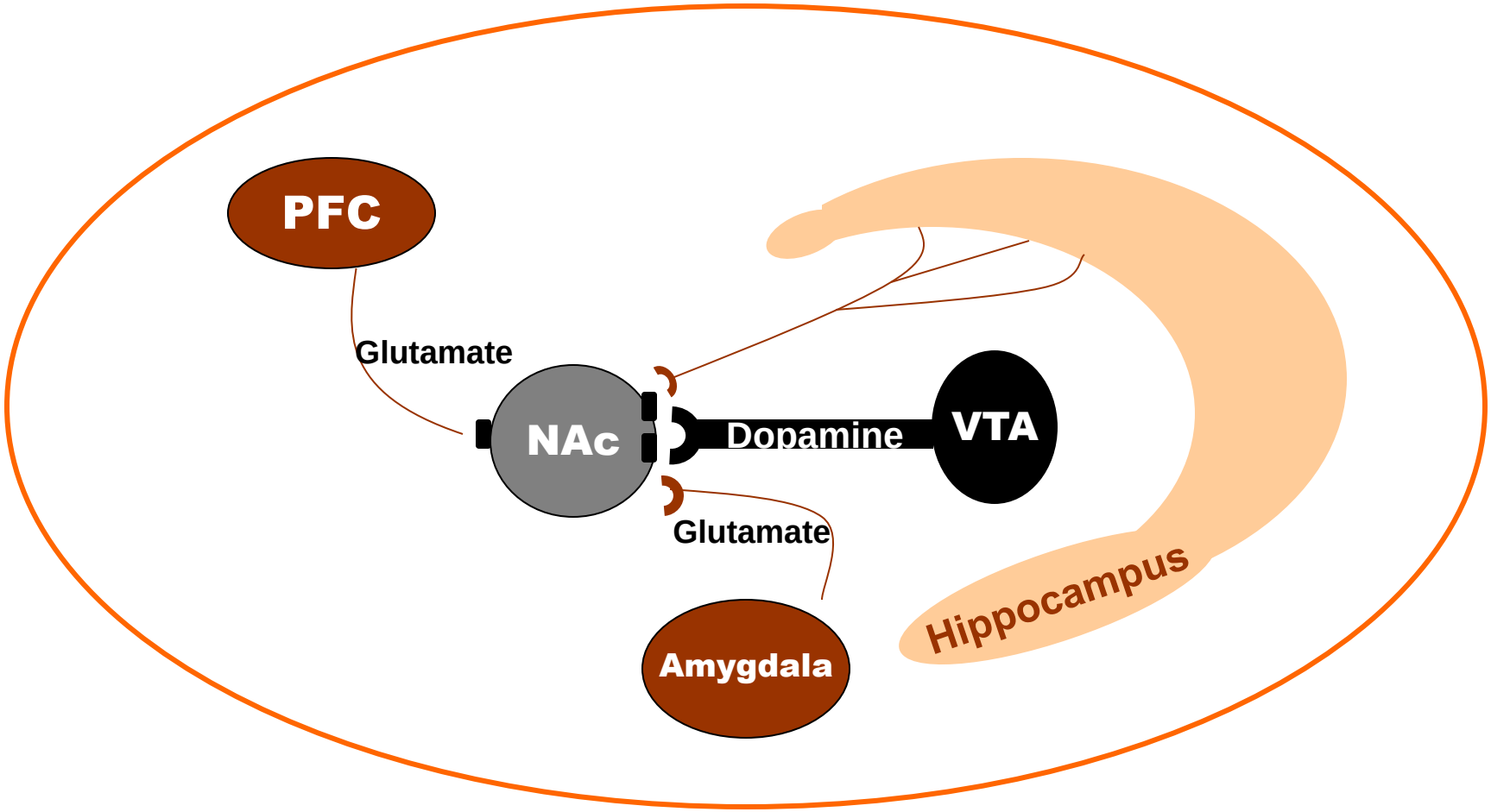


Boosting Dopamine Levels

- Cocaine
  - 400% boost in dopamine levels over baseline at first administration.

Boosting the Messenger

- METH
  - 1500% boost in dopamine levels at NAc over baseline at first administration.



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The 4 "Whats?"

3. What is Addiction in the Brain?

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Addictions Change the Brain

For much of human history, most of the pleasurable activities that we are wired to pursue occur in nature in limited supply, making it hard to overindulge.

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Addictions Change the Brain

But modern life provides a smorgasbord of temptations that activate the reward system.

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Addictions Change the Brain

Drugs of abuse and gambling behavior can overwhelm and fundamentally alter the neurons that were never intended to experience such supra-physiological levels of neurotransmitters (dopamine).

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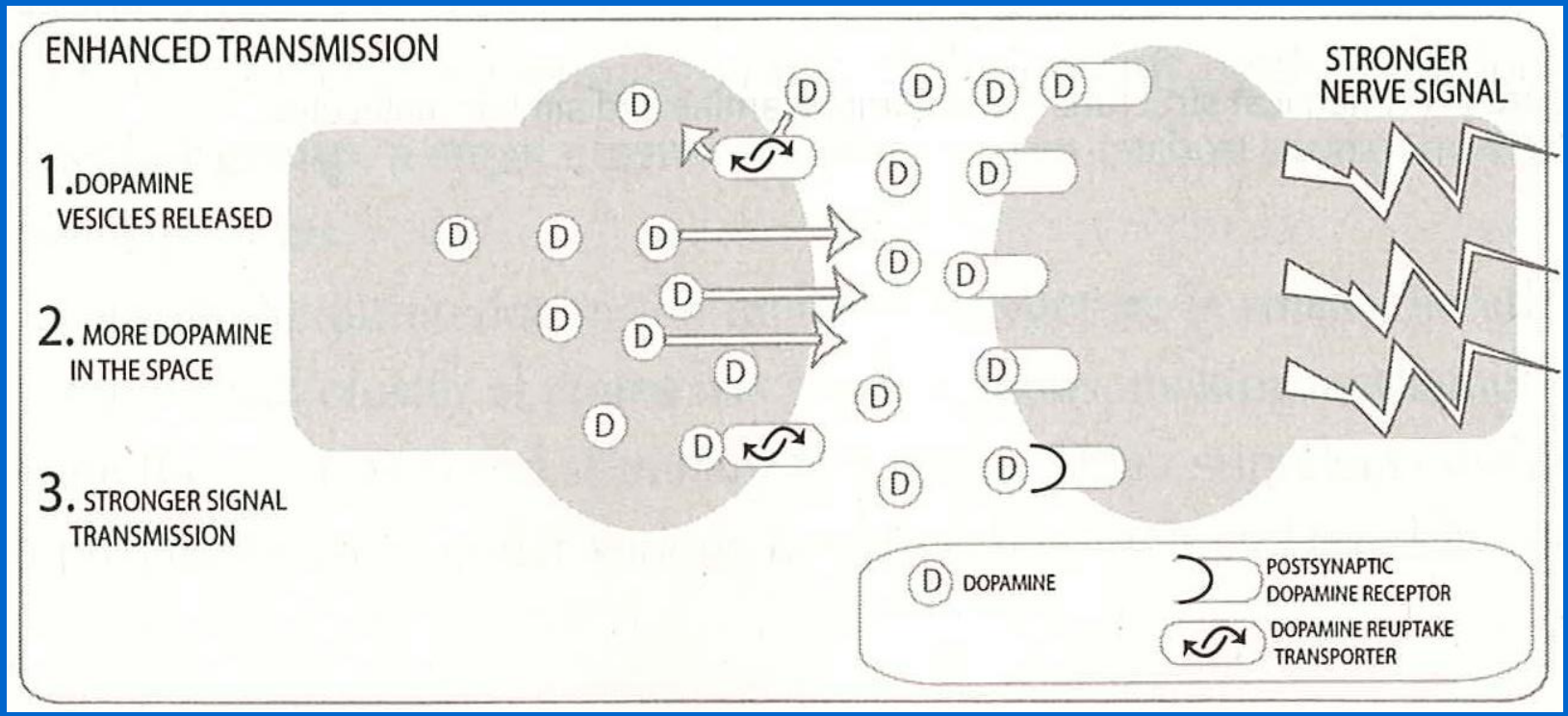
Addictions Change the Brain

Some drugs have direct effects on the dopamine pathways while others work indirectly.

Addictions Change the Brain

Stimulants and Nicotine and METH
Dramatically increase dopamine levels
— DIRECT IMPACT!



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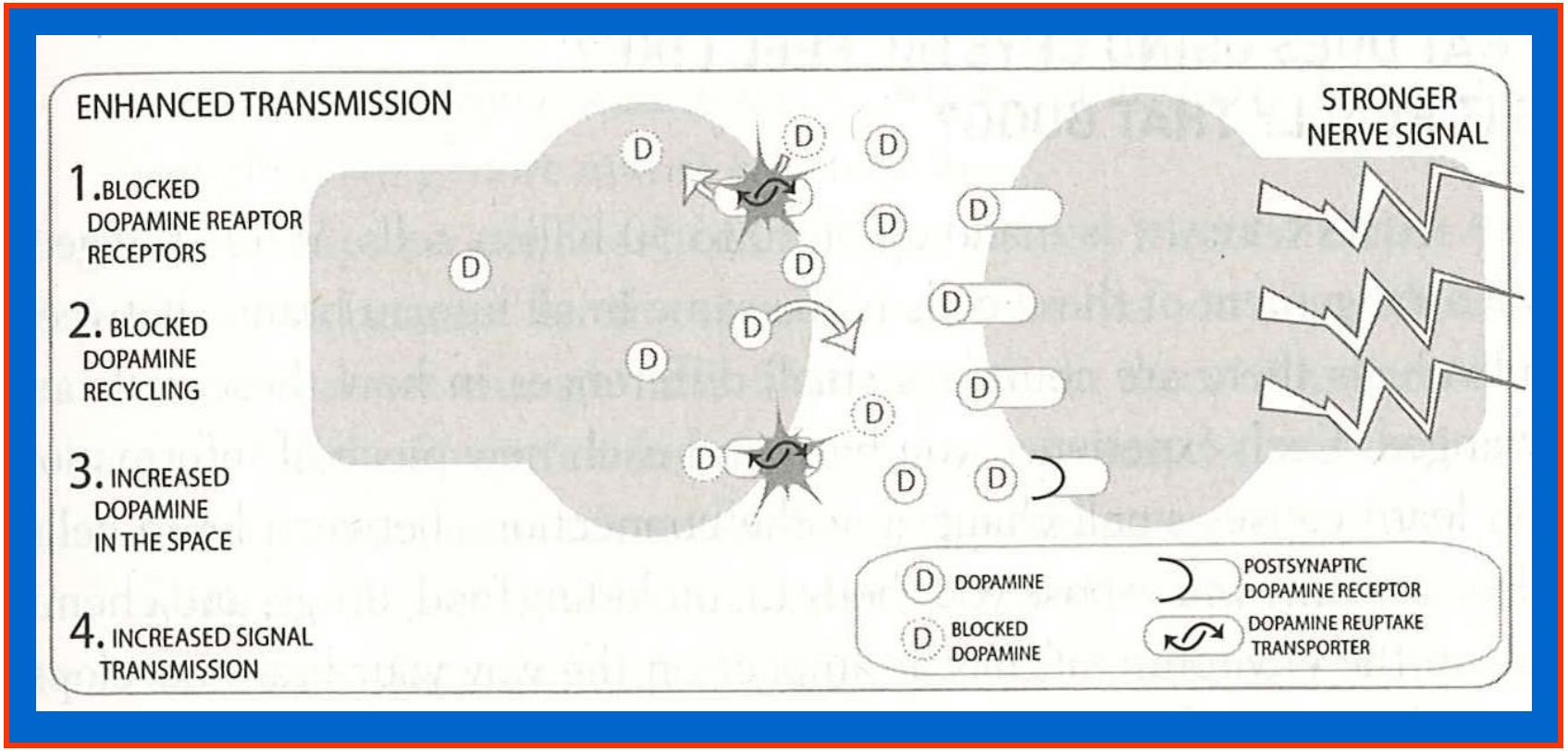
Addictions Change the Brain

Opiods, Alcohol and METH
suppress the inhibitory neurons that modulate (limit the amount of dopamine metabolized). With less inhibition, more dopamine is available —

INDIRECT IMPACT!



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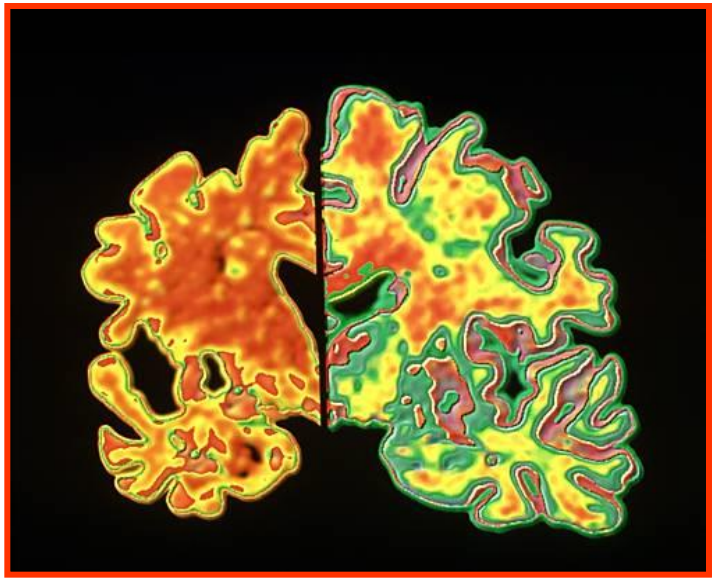
Addictions Change the Brain

METH presents a “double-whammy” to the natural reward system. The amount of dopamine secreted is increased AND the dopamine modulators are prevented from working. ***This could be the most explosively powerful reward response that currently exists.***

Addiction Changes the Brain

Damage to Dopamine Receptors

Excessive use of hedonic substances results in a decrease (shut down) of dopamine receptors.



Addiction Changes the Brain

Damage to Dopamine Receptors

With fewer dopamine receptors, the addicted brain:

1. Will develop **tolerance** and the need to take more;
2. Will have difficulty experiencing **pleasure** with natural reinforcers.

Addiction Changes the Brain

Genetic Protection

Genetic expression is also stimulated to produce substances (gaba) and activate glial cells (remove glutamate) that further dampen the reward circuitry and induce tolerance. Addiction changes genes!

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"Life of the Party"

vs.

"The Wet Blanket"

- **Glutamate =** Neurotransmitter that creates cellular excitement! "The Life of the Party." When glutamate is present, cells pay attention!

- **Gaba =** Neurotransmitter that dampens cellular excitement and moderates cell excitement. A real wet blanket!

Take Home Messages: Addiction

- Never underestimate the high.
- Addiction is the brain's physiological response to too much dopamine.
- Dopamine receptors close and genes crank-up to dampen the reward system.
- If the abuse continues, permanent damage can occur.

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The 4 "Whats?"

4. So What?

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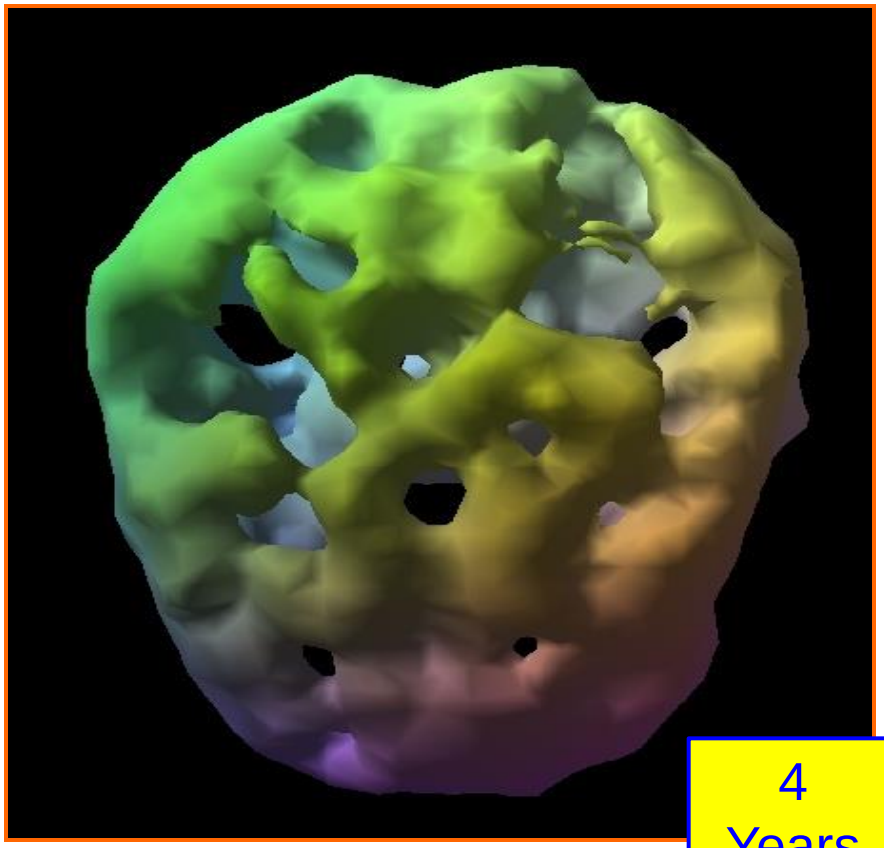
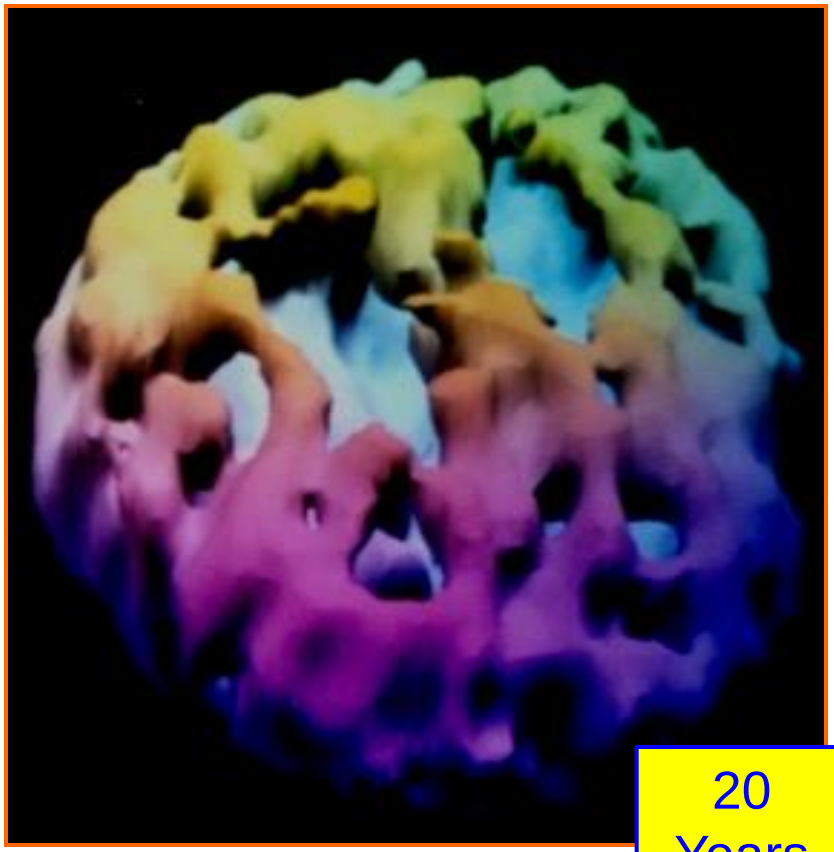
Addiction Treatment Implications

1. Delayed Experimentation (Montana Meth Project).
2. Early Intervention. Damage happens faster in younger brains.
3. Abstinence (w/motivation) will heal many brains.
4. Medications are the future. (Ironic, isn't it?)
5. **Identify and reinforce healthy activities that stimulate the reward system.**

Alcohol Abuse



4
Years



20
Years

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Take Home Messages: Addiction

Help everyone you know find healthy ways to produce dopamine!

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Healthy Dopamine Squirts

- Positive Relationships
- Vigorous Physical Play
- Goal Achievement
- The Arts
- Helping Others

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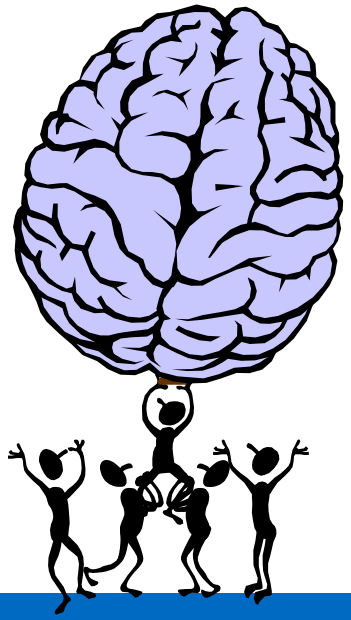
Today's Itinerary

4. *Gambling, Addiction and the Teen Brain*



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Gambling Addiction

- Gambling is a $100 billion industry
- 65% of American adults gamble
- Up to 5% of gamblers develop an addiction to the activity

Gambling and Neuroscience

"Understanding that addiction is, at its core, a *consequence of fundamental changes in brain function* means that a major goal of treatment must be either to reverse or to compensate for those brain changes."

--Dr. Alan Leshner, National Institute on Drug Abuse

Gambling and the Brain

"People diagnosed with pathological gambling experience *negative biological consequences similar to those of substance abusers*, namely tolerance and withdrawal."

Dr. Jon Grant

9 Ways Gambling Addiction and Substance Addiction are Similar

1. Repetitive/feeling while compulsive behavior despite *negative* consequences.
2. *Diminished* control over the problematic behavior.
3. A state of anticipated *pleasure* prior to engaging in the problematic behavior.
4. A *positive*, satisfying feeling while engaging in the problematic behavior.

9 Ways Gambling Addiction and Substance Addiction are Similar

5. *Tolerance* toward the activity increases over time.
6. Occurrence of *withdrawal* symptoms.
7. Attempts to cut-back or stop are often repetitive and *unsuccessful.*
8. *Higher* usage rates during adolescence and young adulthood.

9 Ways Gambling Addiction and Substance Addiction are Similar

9. *Rapid* rate of progression to problematic behavior in women compared to men.

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Gambling and the Brain

" A complex system of neurotransmitters, such as serotonin, dopamine, endogenous opioids and hormones, are responsible for what we feel, how we think and what we do. Imbalances within this system have been shown to influence both behavioral and substance addictions."

Grant, J.E., et al., (2006). "The neurobiology of substance and behavioral addictions," CNS Spectrums, 11(12), 924-930

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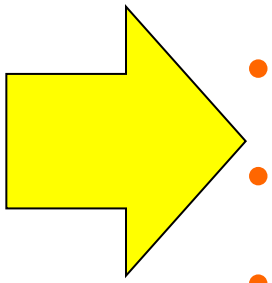
Neurotransmitter Imbalance

1. Serotonin = *"Ahhh"*
2. Dopamine = *"Yahoo!"*
3. Endogenous Opioids = *Naturally occurring opiate-like substances*
4. Cortisol = *"Uh-oh" impairs thinking*

1. Short on Serotonin

- Impacts mood, emotion, cognition (thinking) and impulse control
- Common in pathological gamblers
- Increased motivation to satisfy urges, lessened ability to inhibit behavior, impairment in reward/risk processing

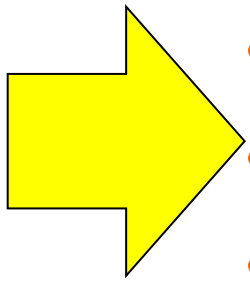


Serotonin Boosters:

- *Physical Activity*
- *Meditation*
- *Martial Arts*
- *Stress Management Skills/Outlets*
- *SSRIs*

2. Bad Dopamine Sources

- Alterations within the dopaminergic pathways result in the pursuit of activities (gambling) that trigger dopamine release.
- "Reward Deficiency Syndrome" causes a craving for environmental stimuli to compensate for the dopamine imbalance—regardless of the consequences.



Alternative Dopamine Sources:

- *Physical Activity*
- *Relationships*
- *Achievement*
- *Adventure*
- *Arts*
- *Sex*

3. Endogenous Opioids

- Altered opiodergic systems result in difficulty controlling desires to continue an addictive behavior due to intense euphoric feelings experiences when engaging in that behavior.
- This euphoric experience is “on top of” or in addition to the “Yahoo!” of dopamine.

Drugs vs. Drugs:

Clinical studies have demonstrated treatment success with opioid antagonists Naltrexone and nalmefene.

European College of Neuropsychopharmacology. "Pathological gambling is associated with altered opioid system in the brain." ScienceDaily. ScienceDaily, 18 October 2014. <www.sciencedaily.com/releases/2014/10/141018205407.htm>.

4. Teaching Better Thinking

- In pathological gamblers, there is decreased activation in the frontal lobes, the "thinking" part of our brains.
- The frontal lobes play a criitical role in the processing of risk and decision making.
- This lower activity is found in both behavior addictions and substance addictions. Potenza, 2006)

Let's Talk:

Therapies with evidence-based support:

- *Cognitive Behavioral Therapy*
- *Motivational Interviewing*
- *Relapse Prevention*

Shah, et al., (2004)

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5. Stress Relief and Social Supports

- In pathological gamblers, mood –including stress— plays a major factor in motivating gambling behavior.
- In addition, for many problem gamblers, gambling is the only social activity in which they participate.
- Providing stress relief and social supports may help.

Healthy Stress Relief:

Mindfulness

Yoga

Exercise

Extreme Sports

Talk Therapy

Medication

Treatment of Comorbid Conditions

University of Cambridge. "Part of brain linked to gambling addiction identified by researchers." ScienceDaily. ScienceDaily, 7 April 2014. <www.sciencedaily.com/releases/2014/04/140407153915.htm>.

Putting it All Together

1. Adolescent Brain
2. Stress
3. Addiction
4. Gambling Behavior

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