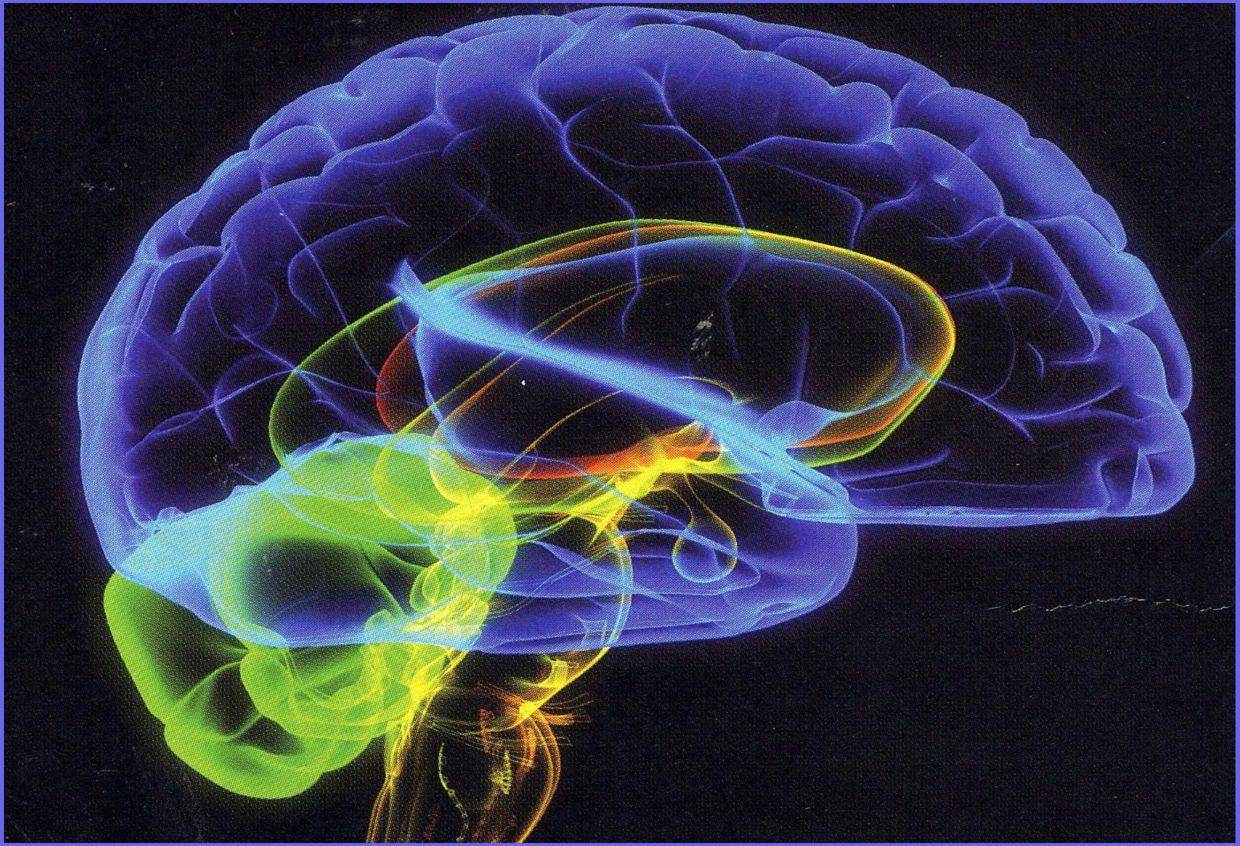
Trauma and Development

Lifelong consequences and how to overcome them



John B. Arden, PhD, ABPP

The ACE Study

- Examined the health effects of ACE's throughout the lifespan among 17, 421 members of Kaiser Permanente in San Diego county
- What are Adverse Childhood Experience?
  - Childhood abuse and neglect
  - Growing up with domestic violence, substance abuse, parental discord, crime, or mental illness in the home

Categories of Adverse Childhood Experiences

Abuse, by Category	Category Prevalence (%)
• Psychological (by parents)	11%
• Physical (by parents)	11%
• Sexual (anyone)	22%
Household Dysfunction, by Category	
• Substance Abuse in family	26%
• Mental Illness in family	19%
• Domestic Violence	13%
• Imprisoned Household Member	3%
• Loss of parent	23%

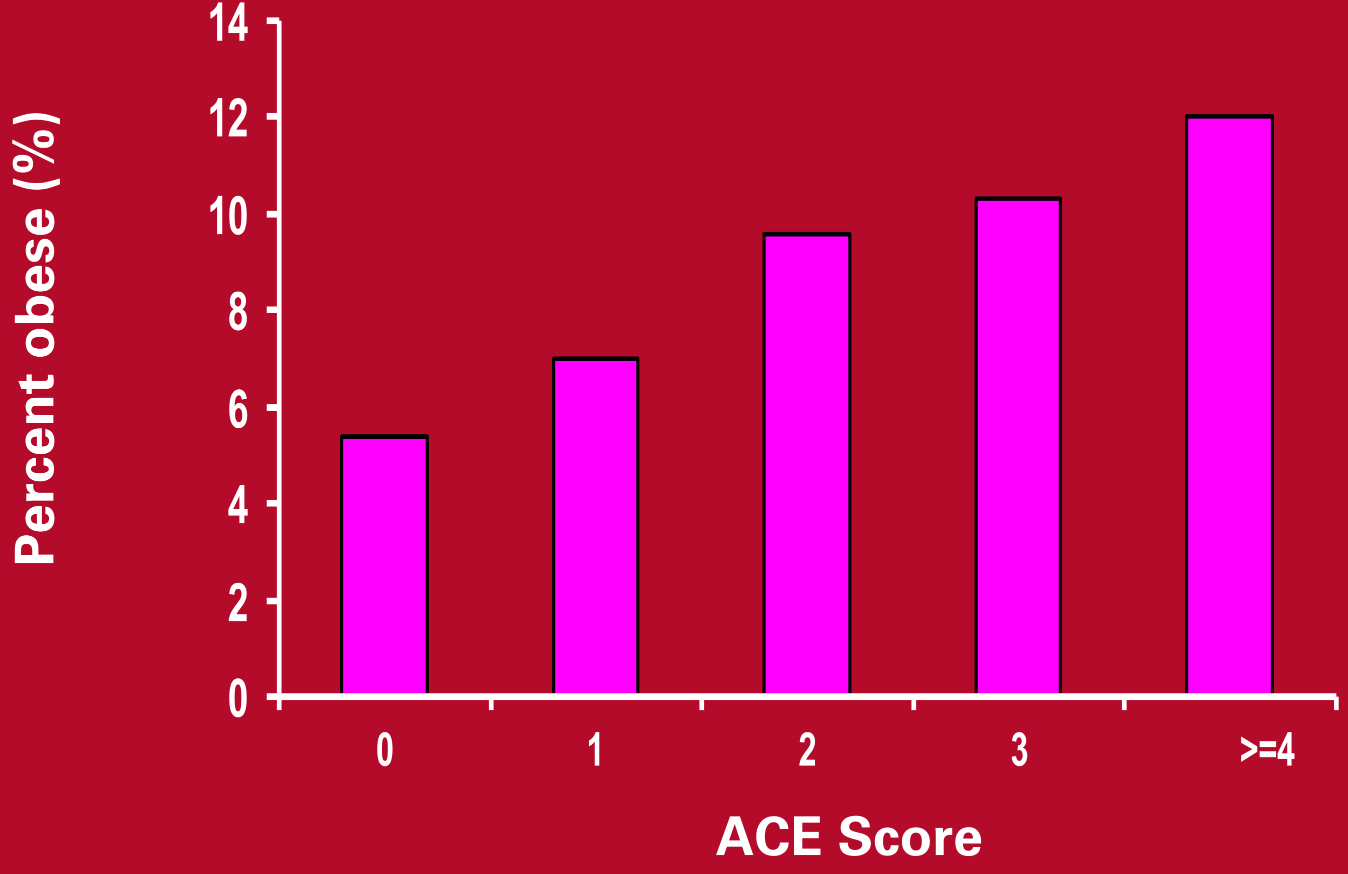
ACEs score percentages

Number of categories of childhood experiences are summed

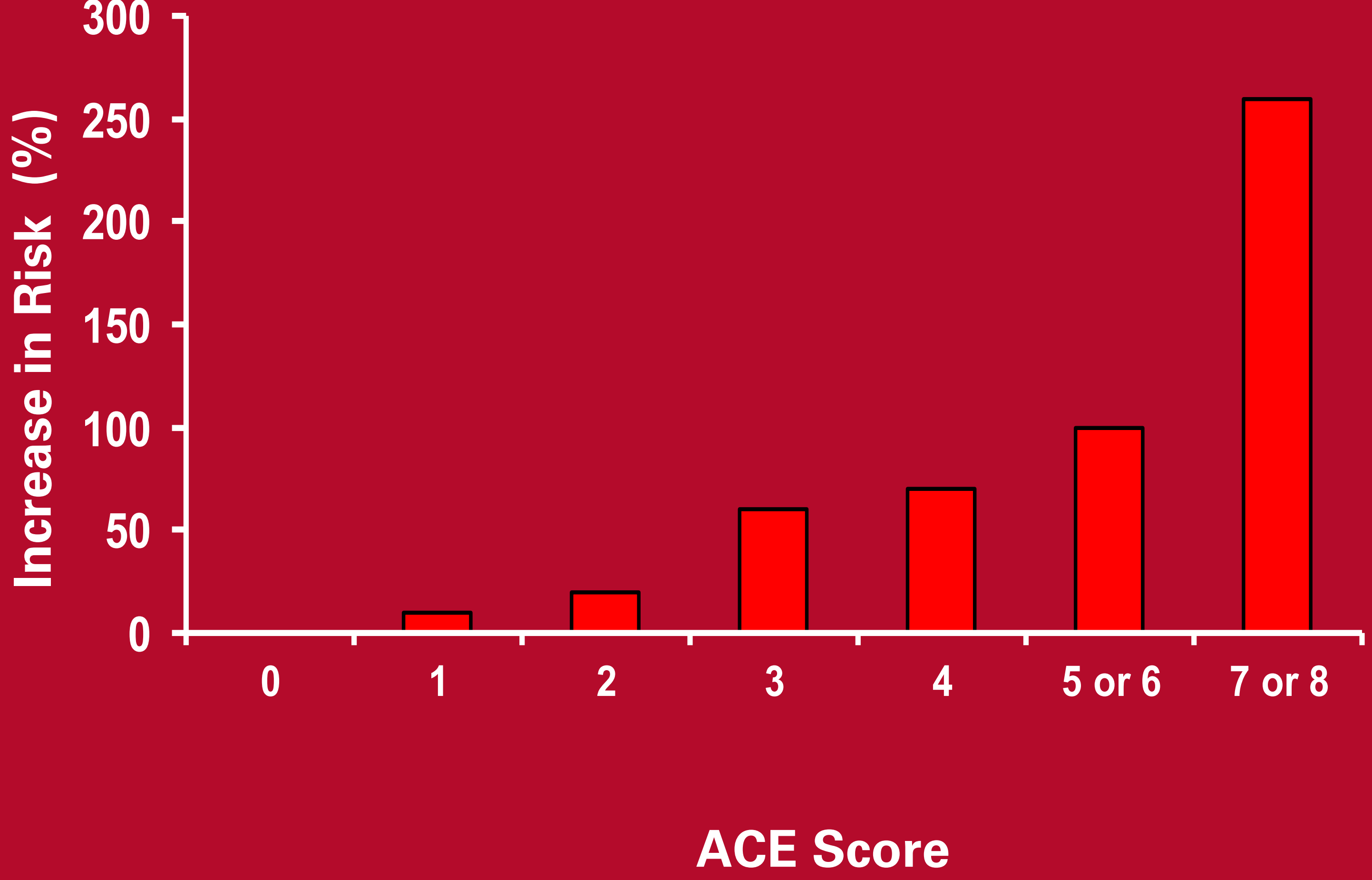
ACE Score	***Prevalence***
0	**48%**
1	**25%**
2	**13%**
3	**7%**
4	**7%**

- More than *half have at least one ACE*
- Slightly more than one quarter have experienced 2 – 4 ACE categories

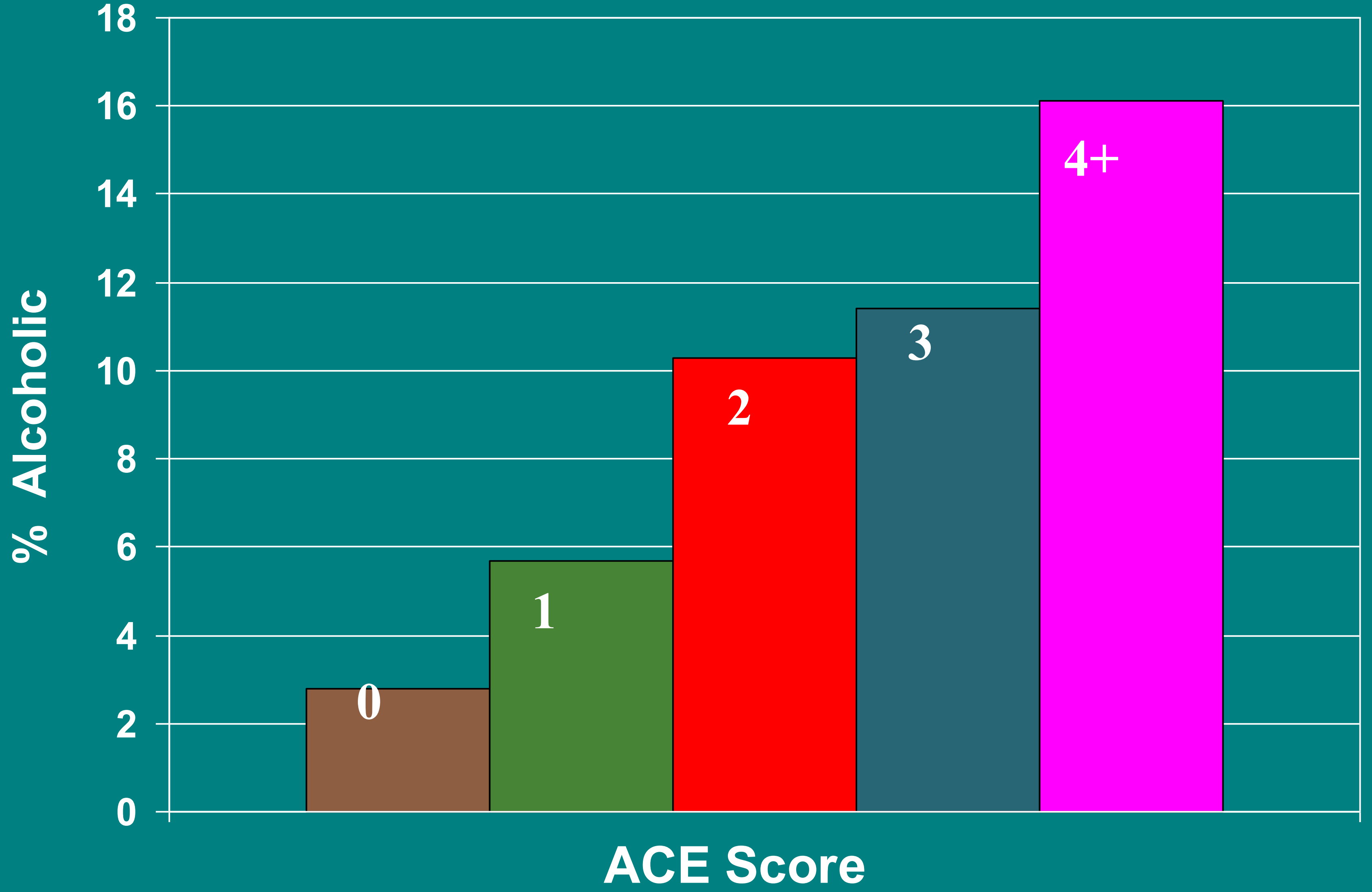
The ACE Score and the Prevalence of Severe Obesity (BMI>35)



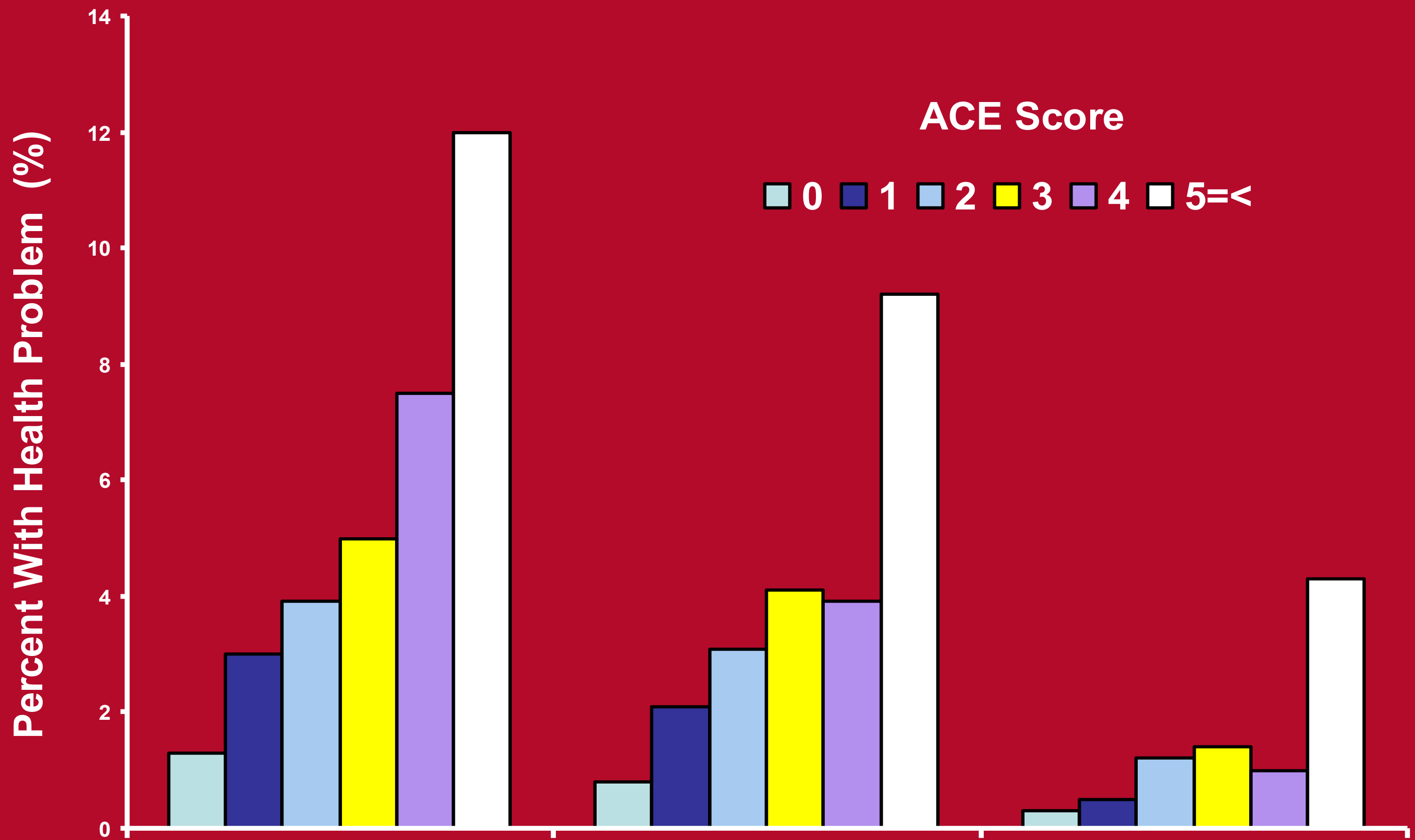
The ACE Score and the Risk of Coronary Heart Disease



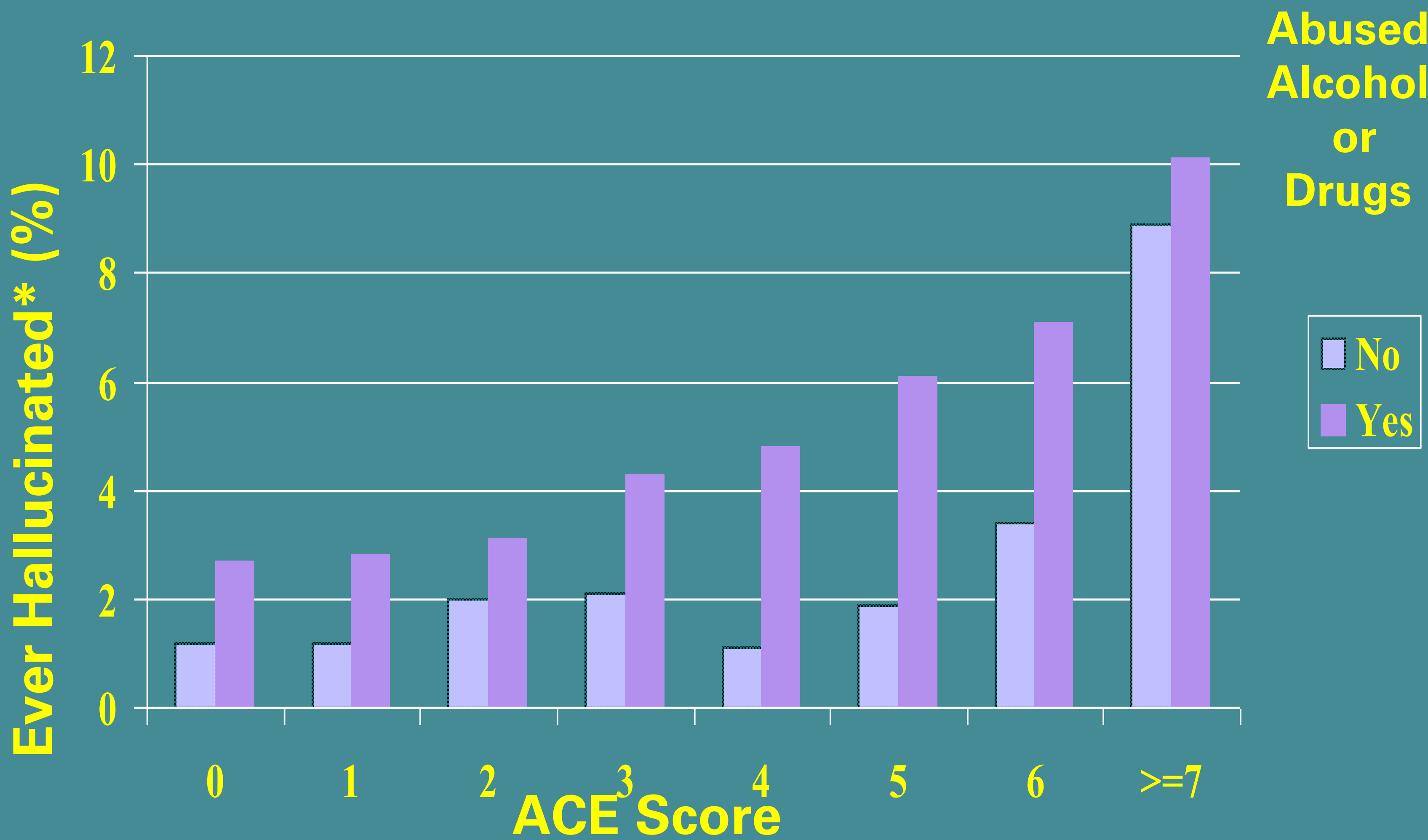
ACE Score and Adult Alcoholism



The ACE Score and Drug Addiction

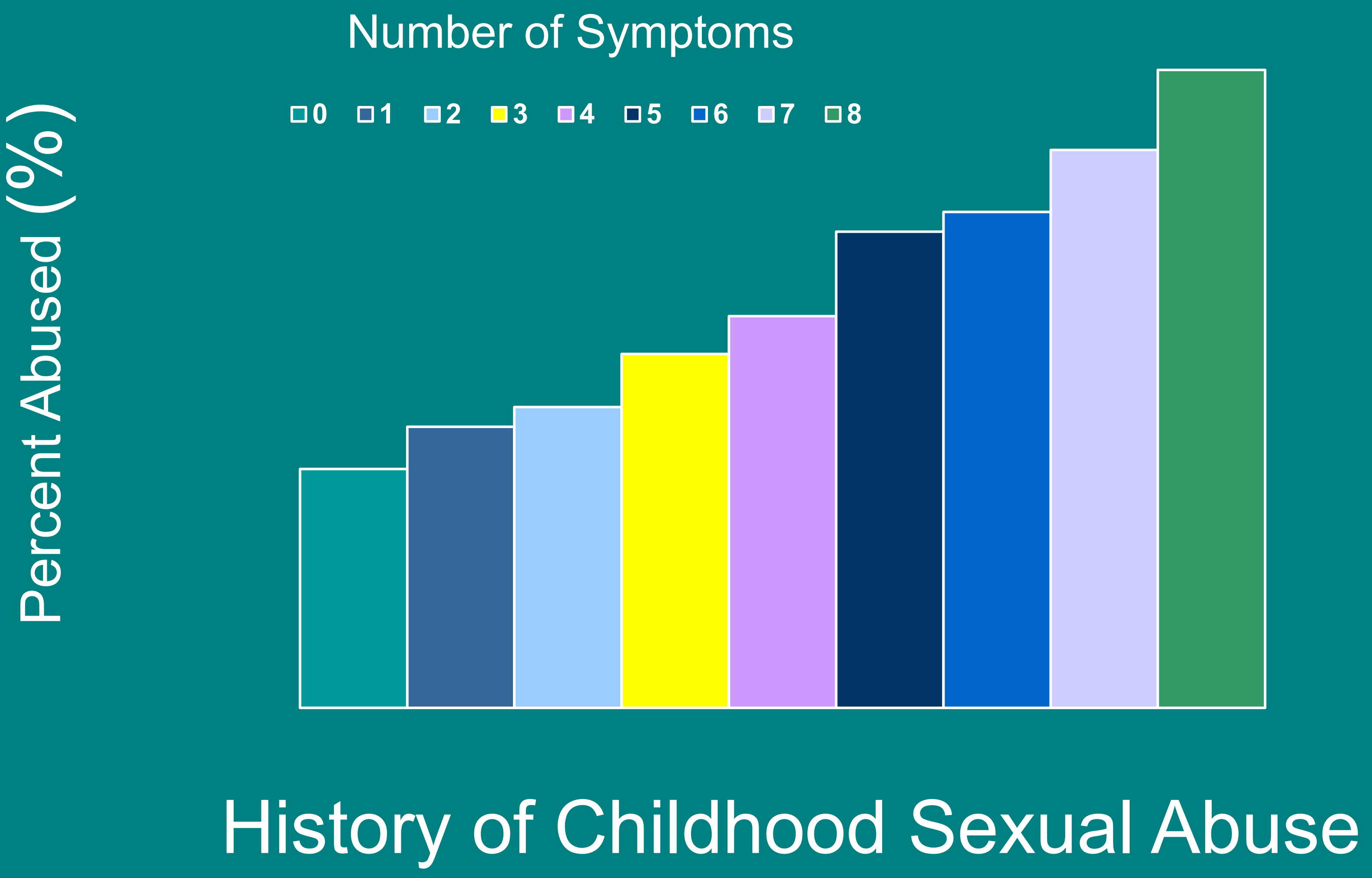


ACE Score and Hallucinations

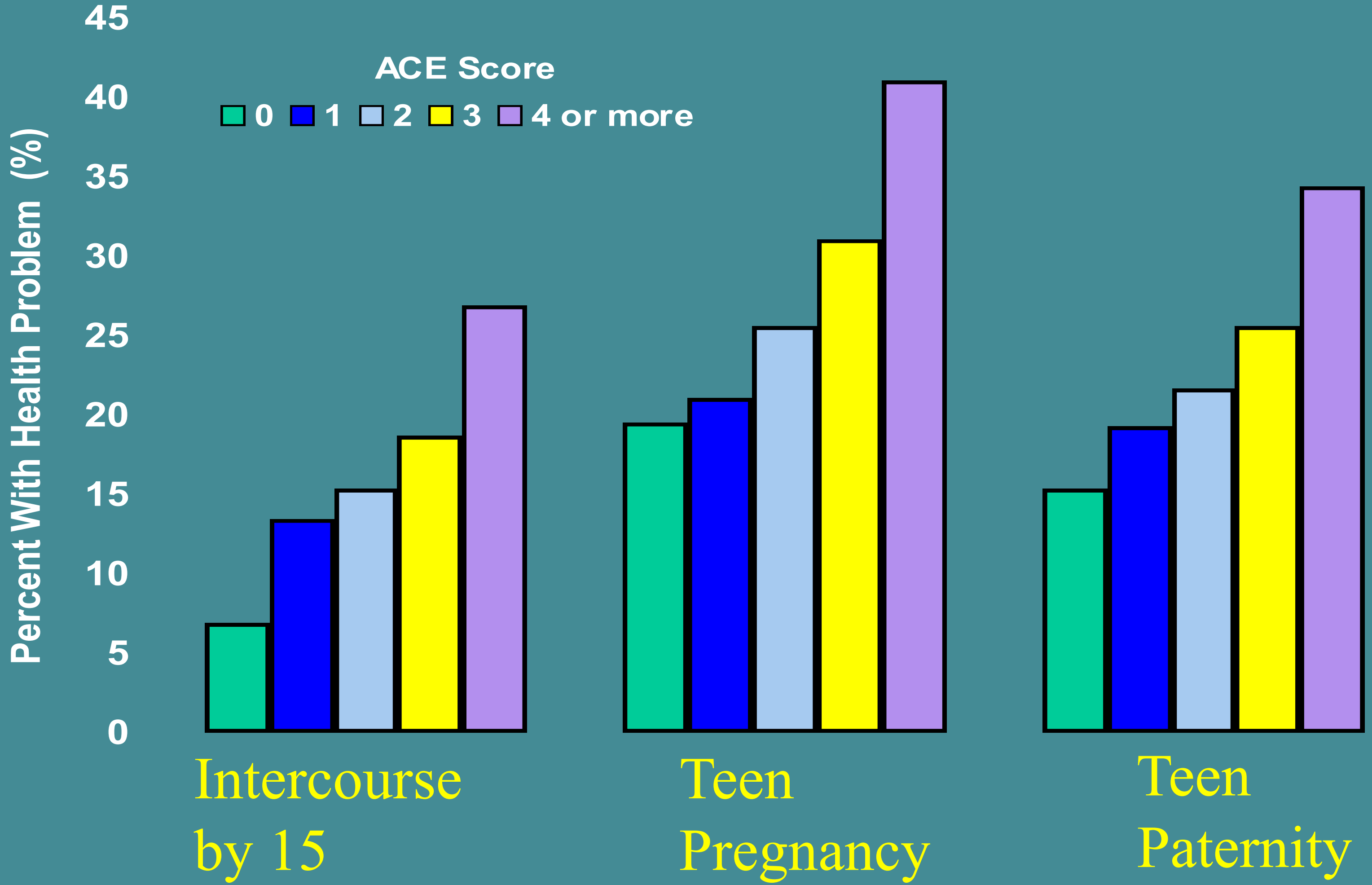


*Adjusted for age, sex, race, and education.

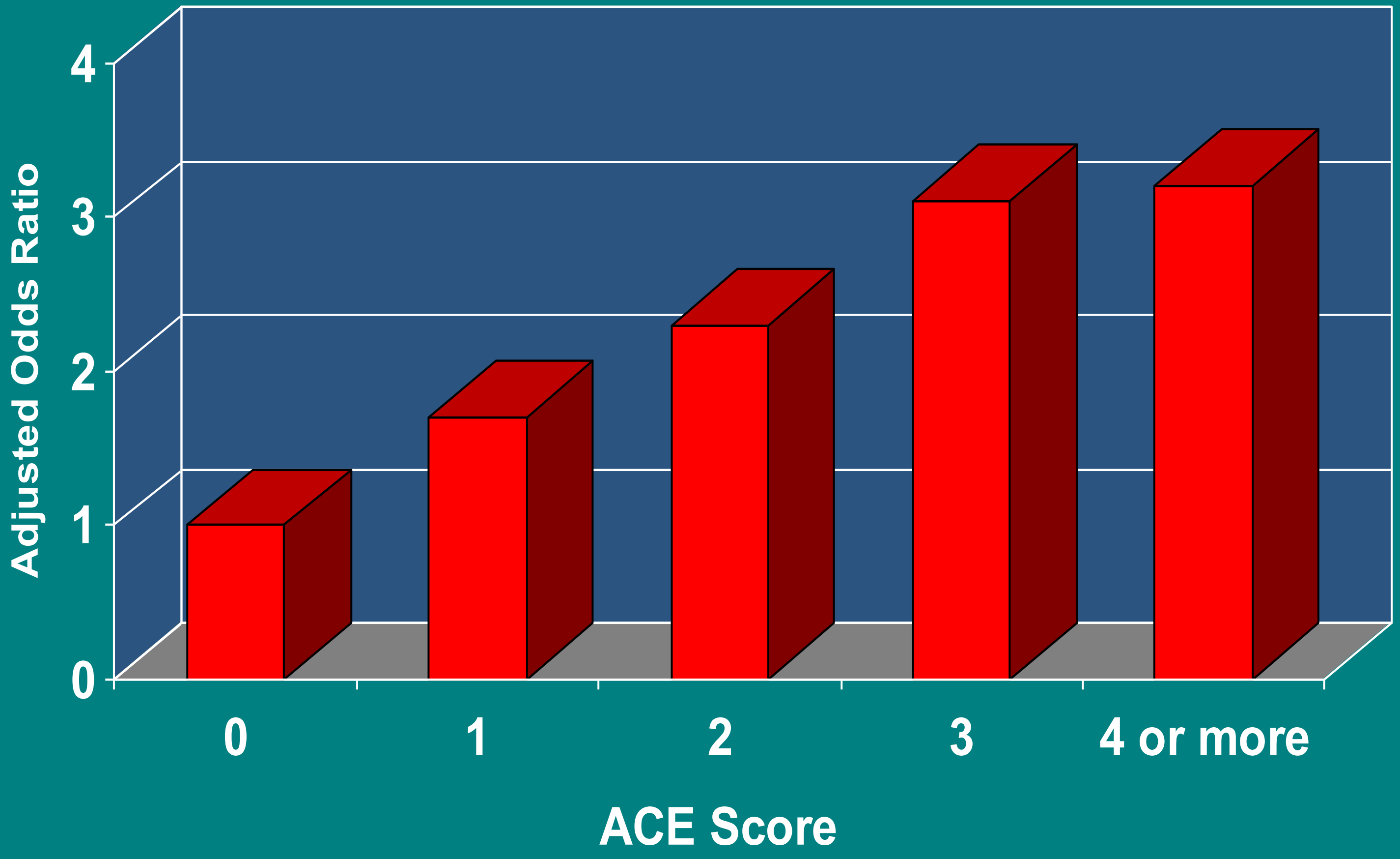
Childhood Sexual Abuse and the Number of Unexplained Symptoms



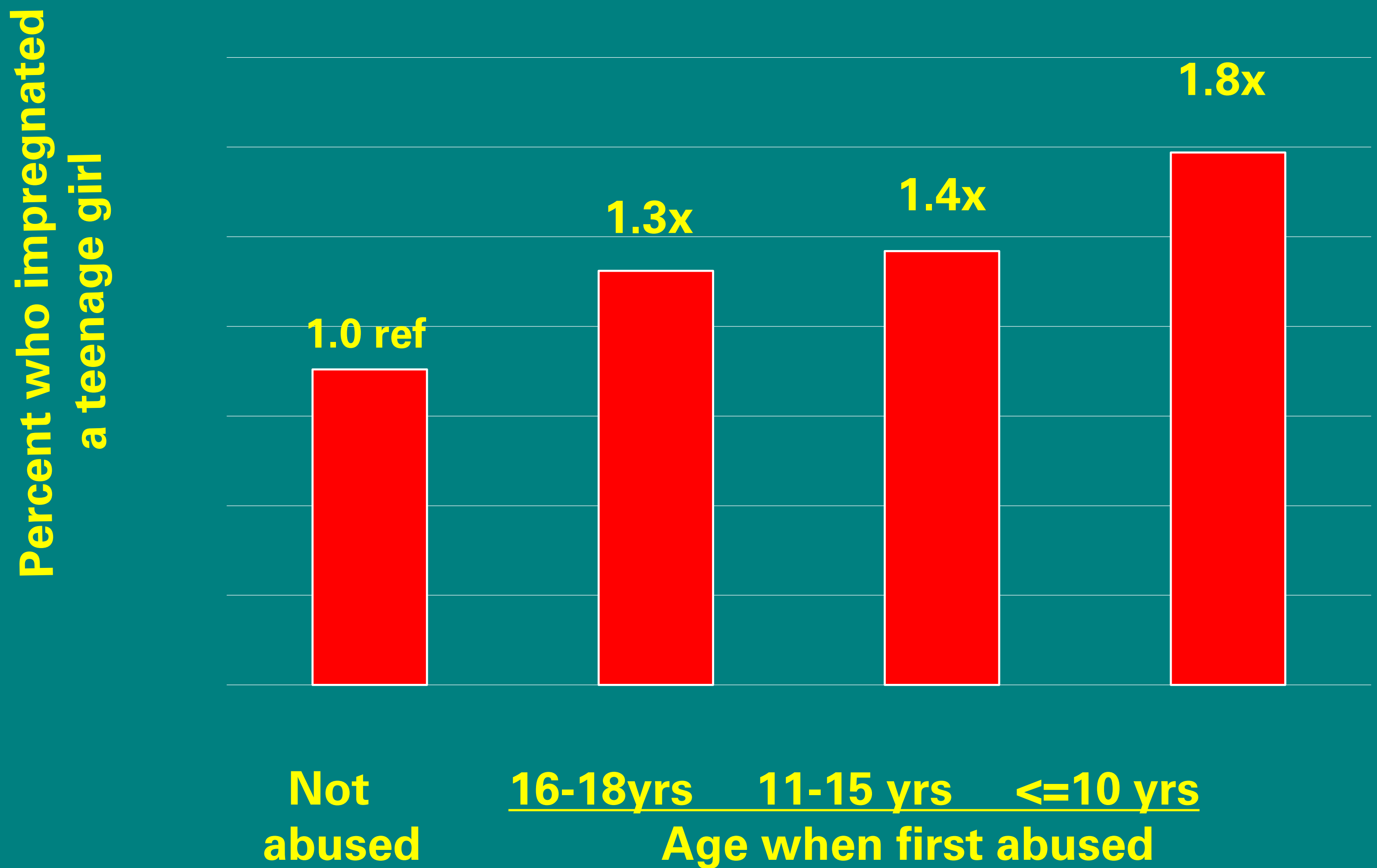
ACE Score and Teen Sexual Behaviors



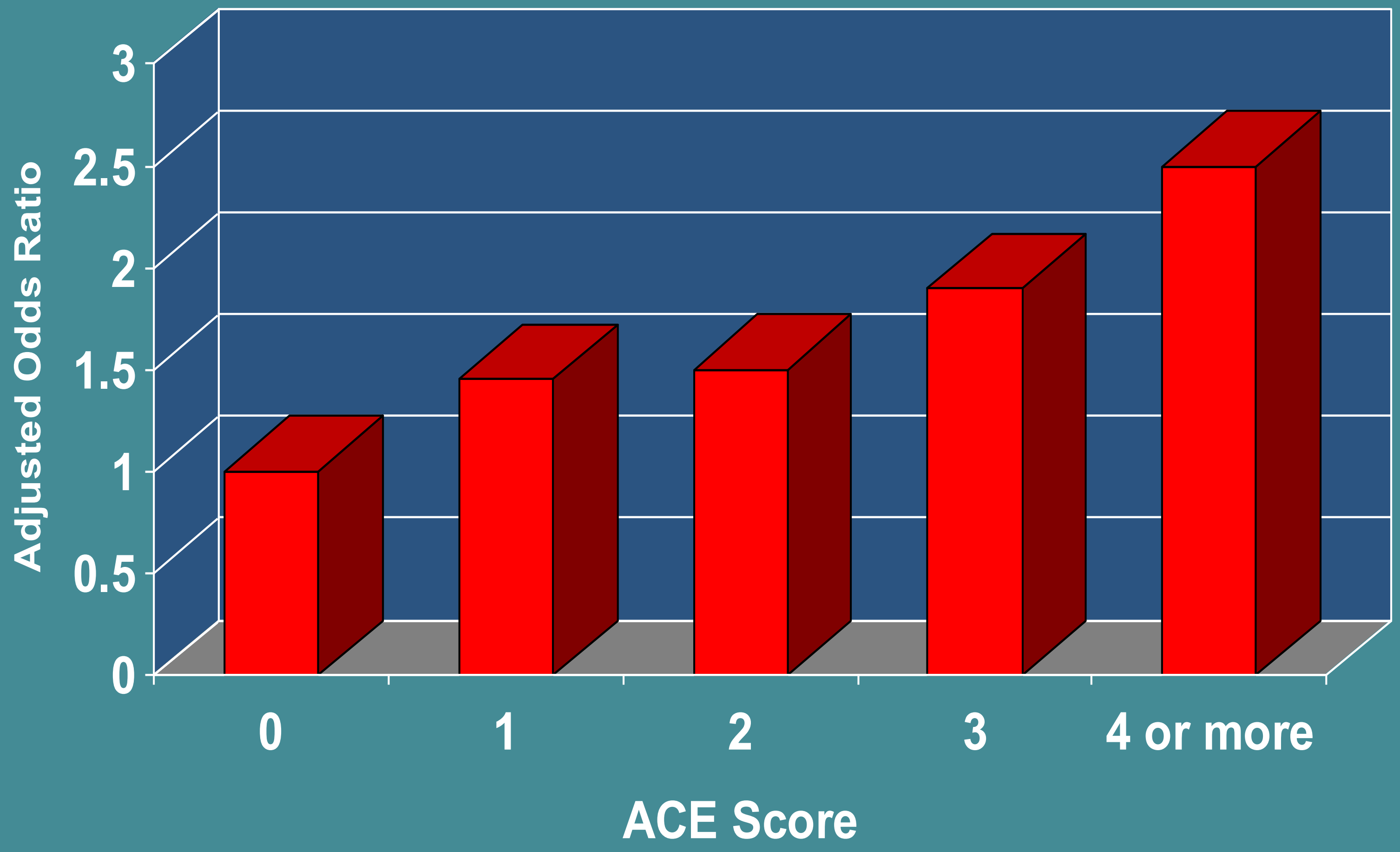
ACE Scores and Likelihood of > 50 Sexual Partners



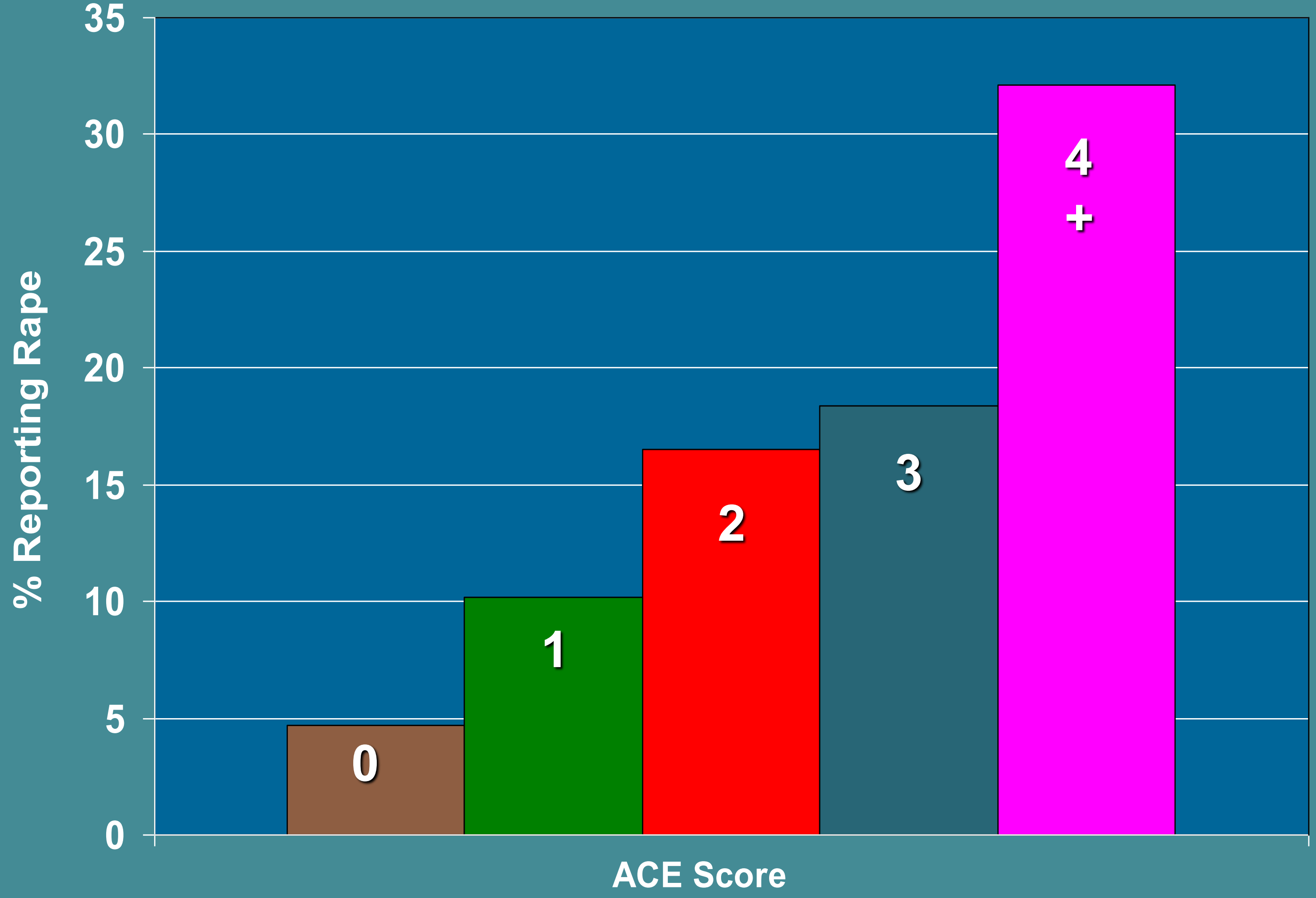
Sexual Abuse of Male Children and Their Likelihood of Impregnating a Teenage Girl



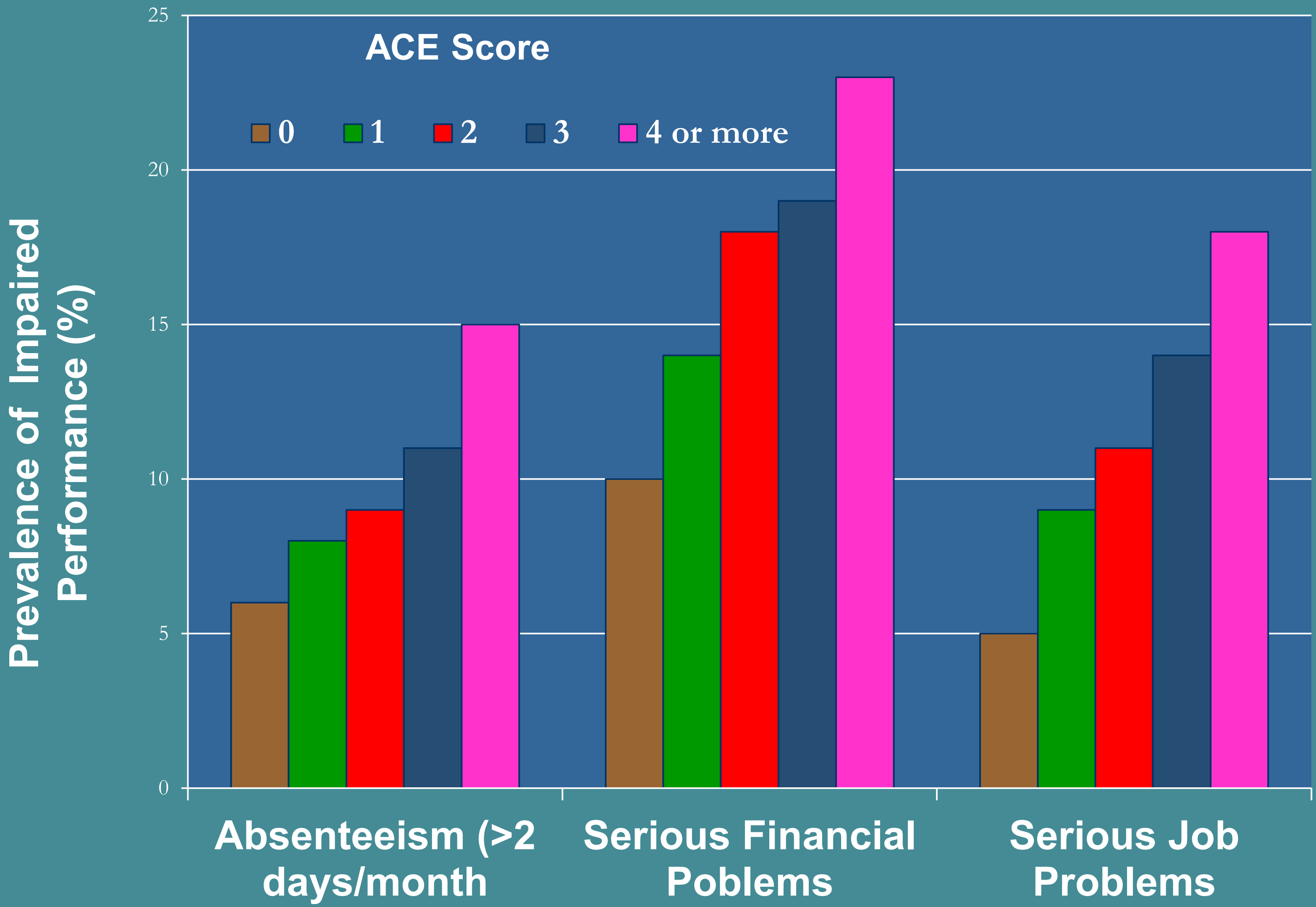
ACE Scores and History of STDs



Childhood Experiences Underlie Later Being Raped

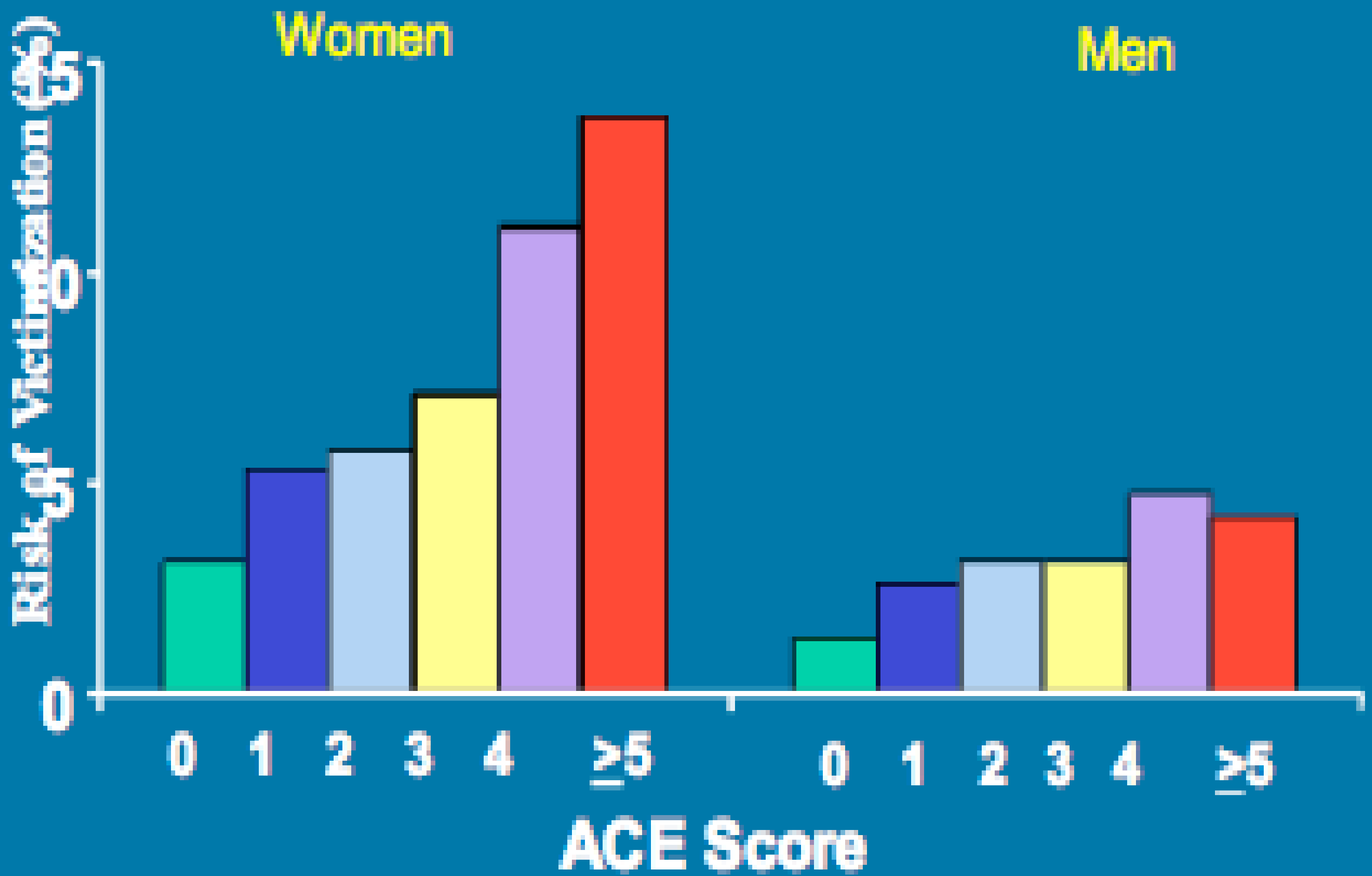


ACE Score and Indicators of Impaired Worker Performance



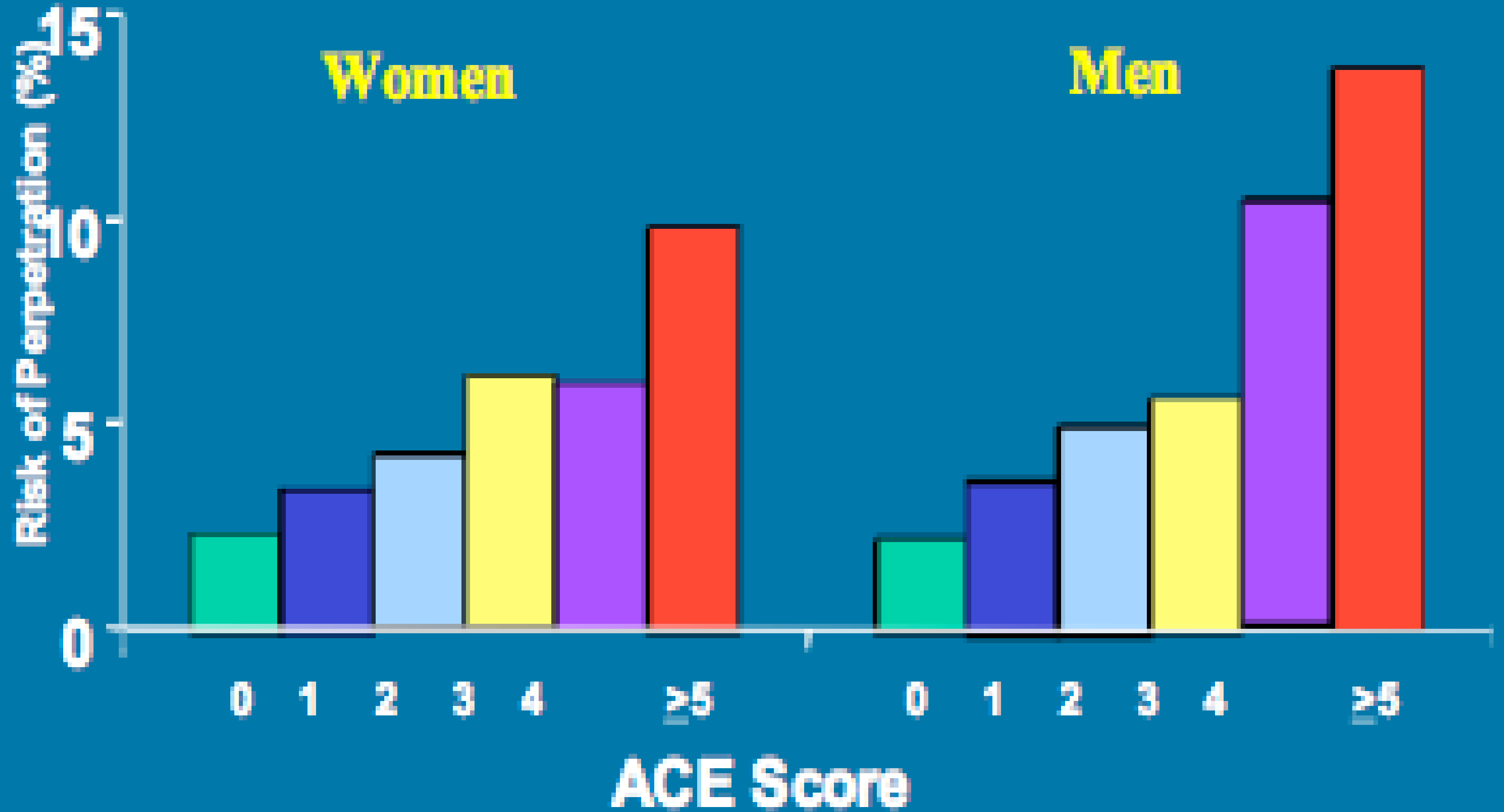
Well-being

ACE Score and the Risk of Being a Victim of Domestic Violence

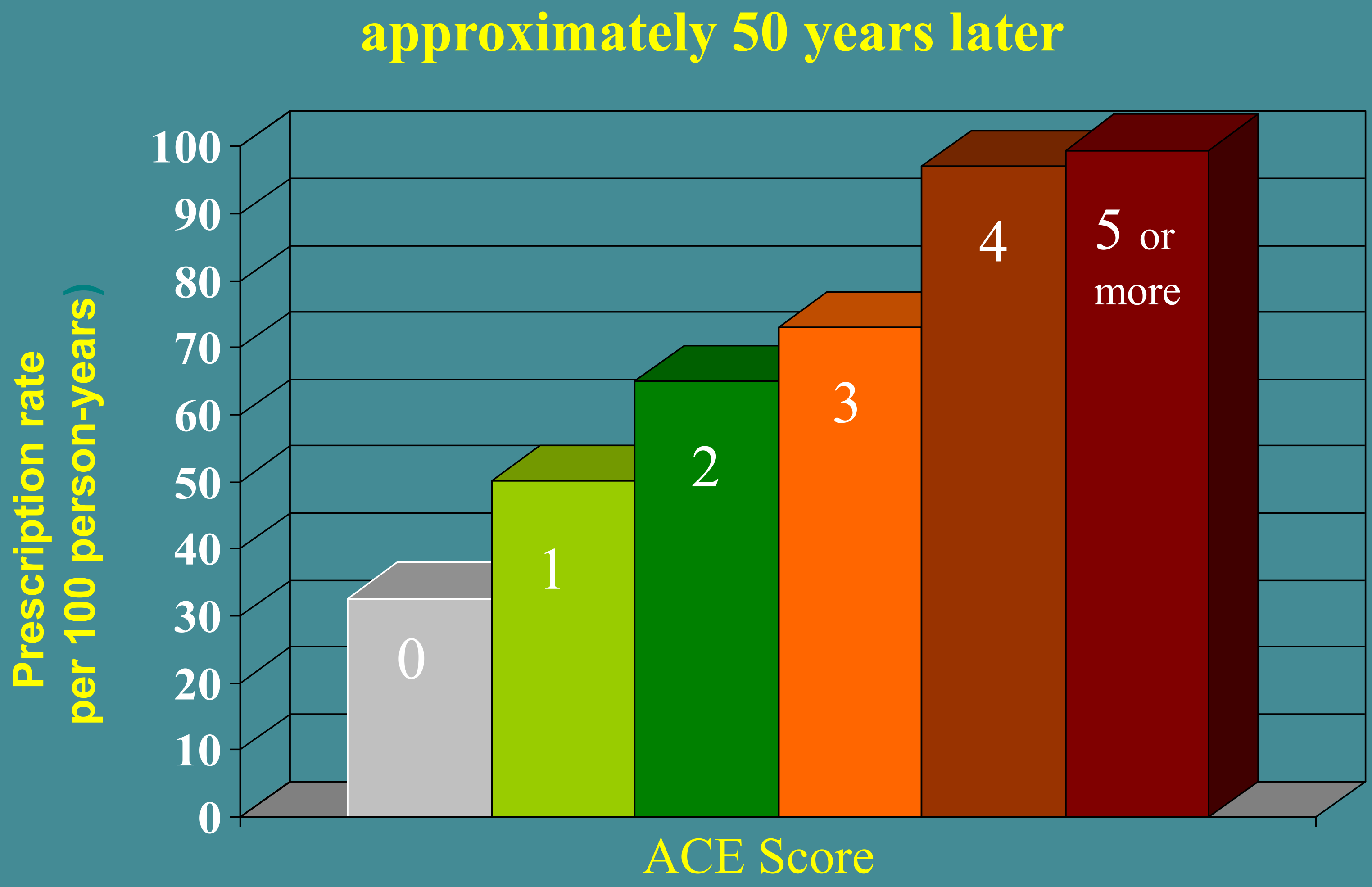


Well-being

ACE Score and the Risk of Perpetrating Domestic Violence



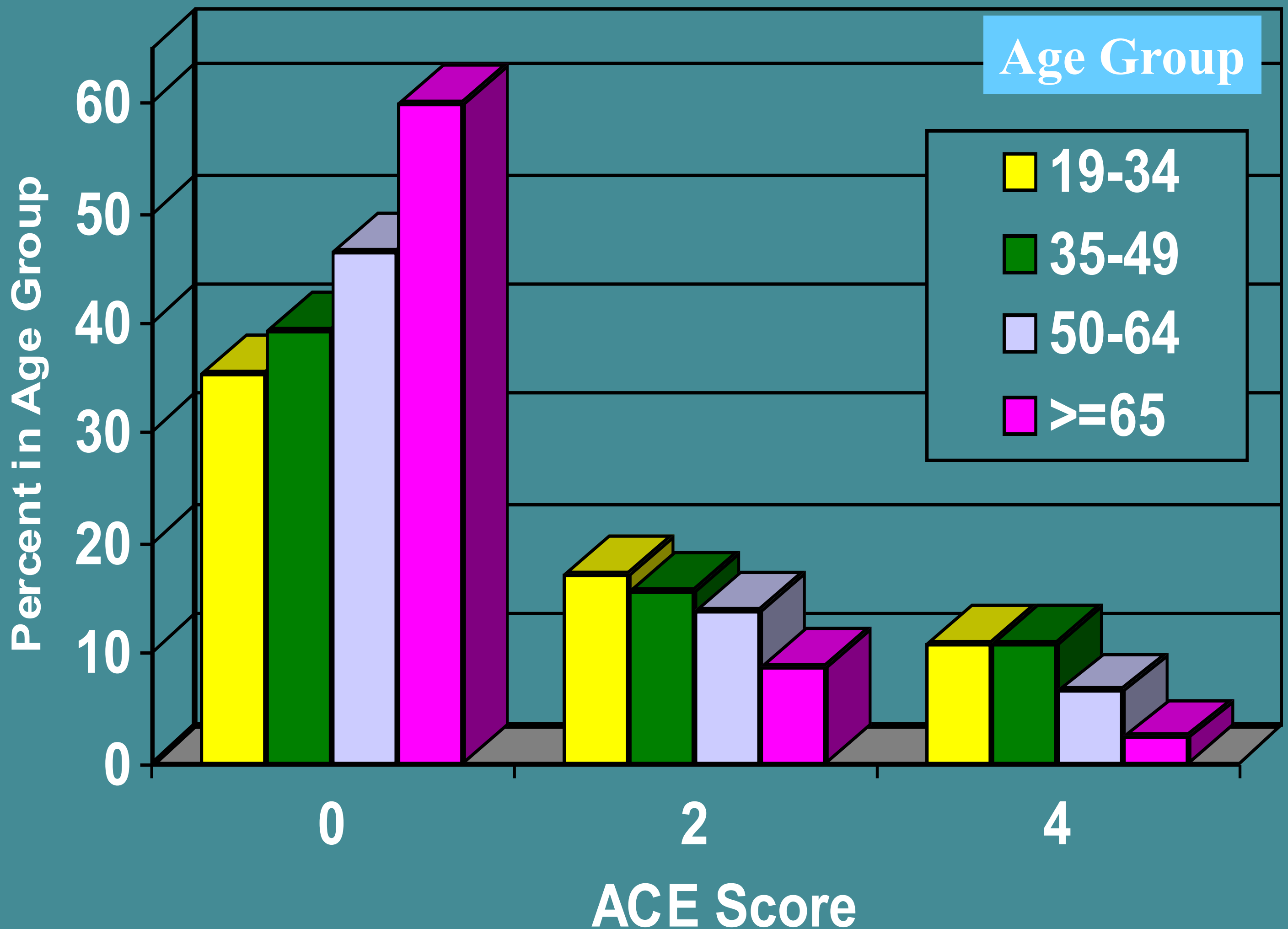
ACE Score and Rates of Antidepressant Prescriptions

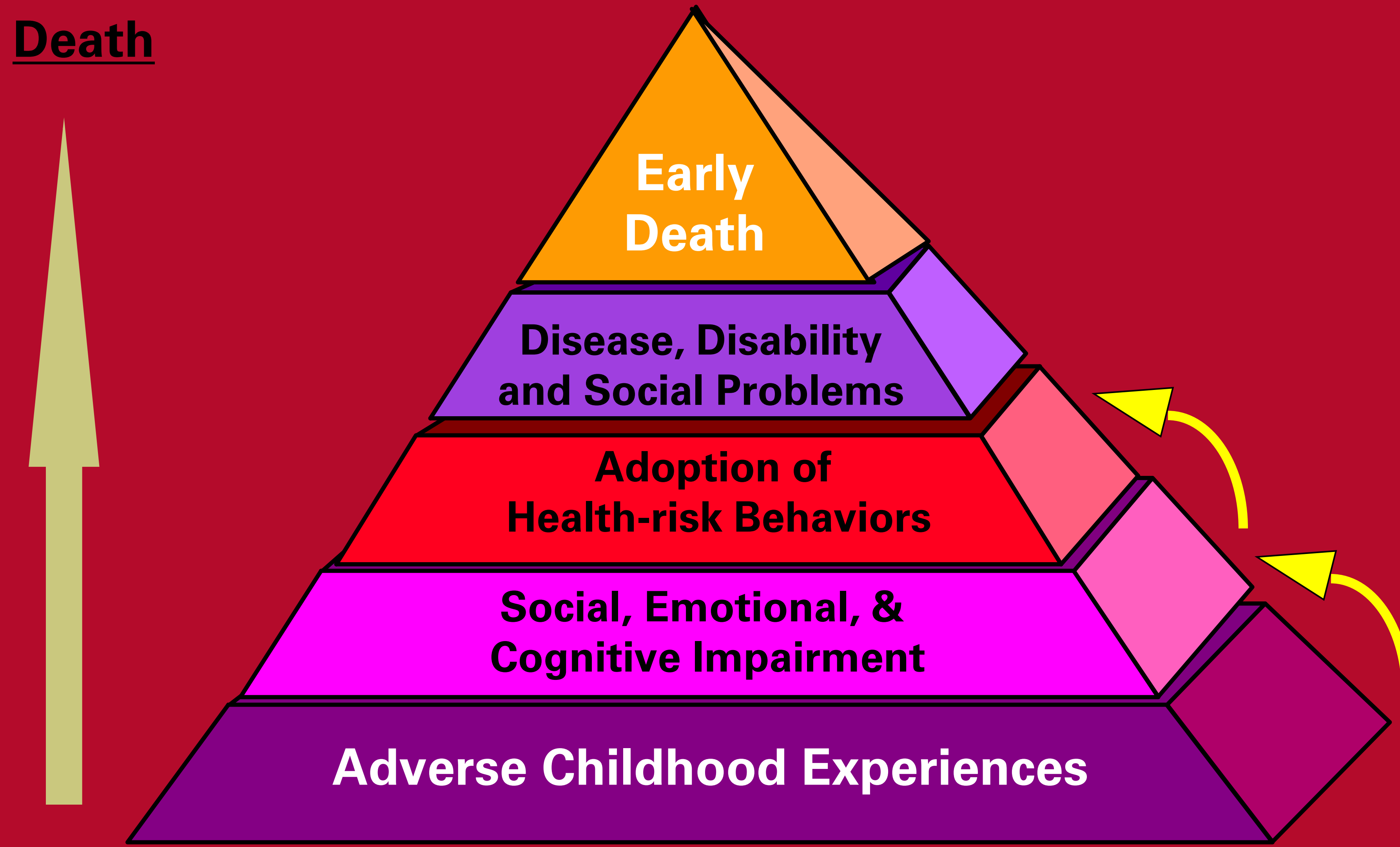


A Connection with Homelessness

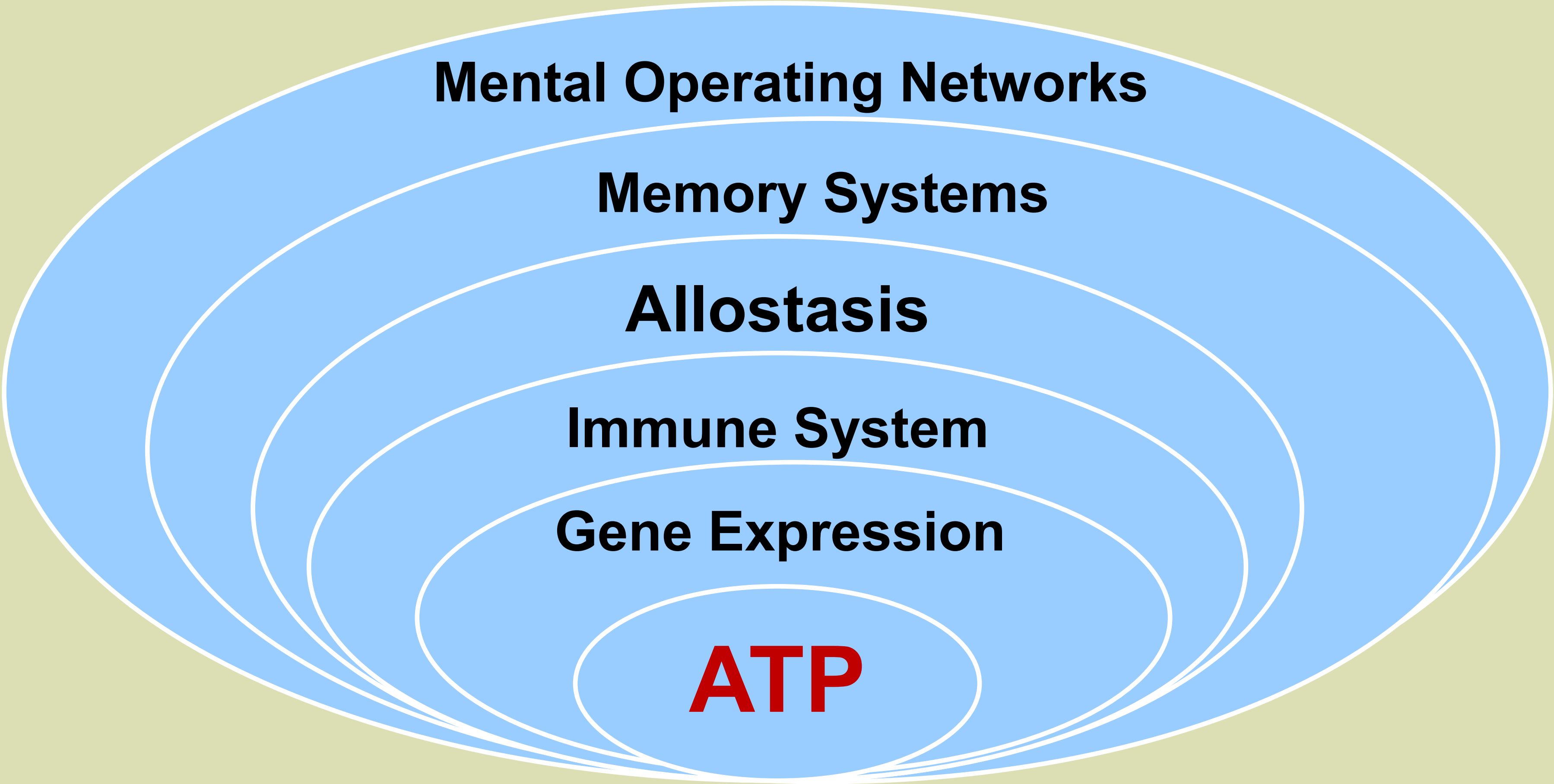
- Mental illness and substance abuse problems are more common among homeless people
- ACEs connection to substance abuse and mental illness
- Even non-homeless people with either substance abuse problems or mental illness are less likely to hold a job
- More than half of sample with ACE Score of 4 or higher

Effect of ACEs on Death Rate

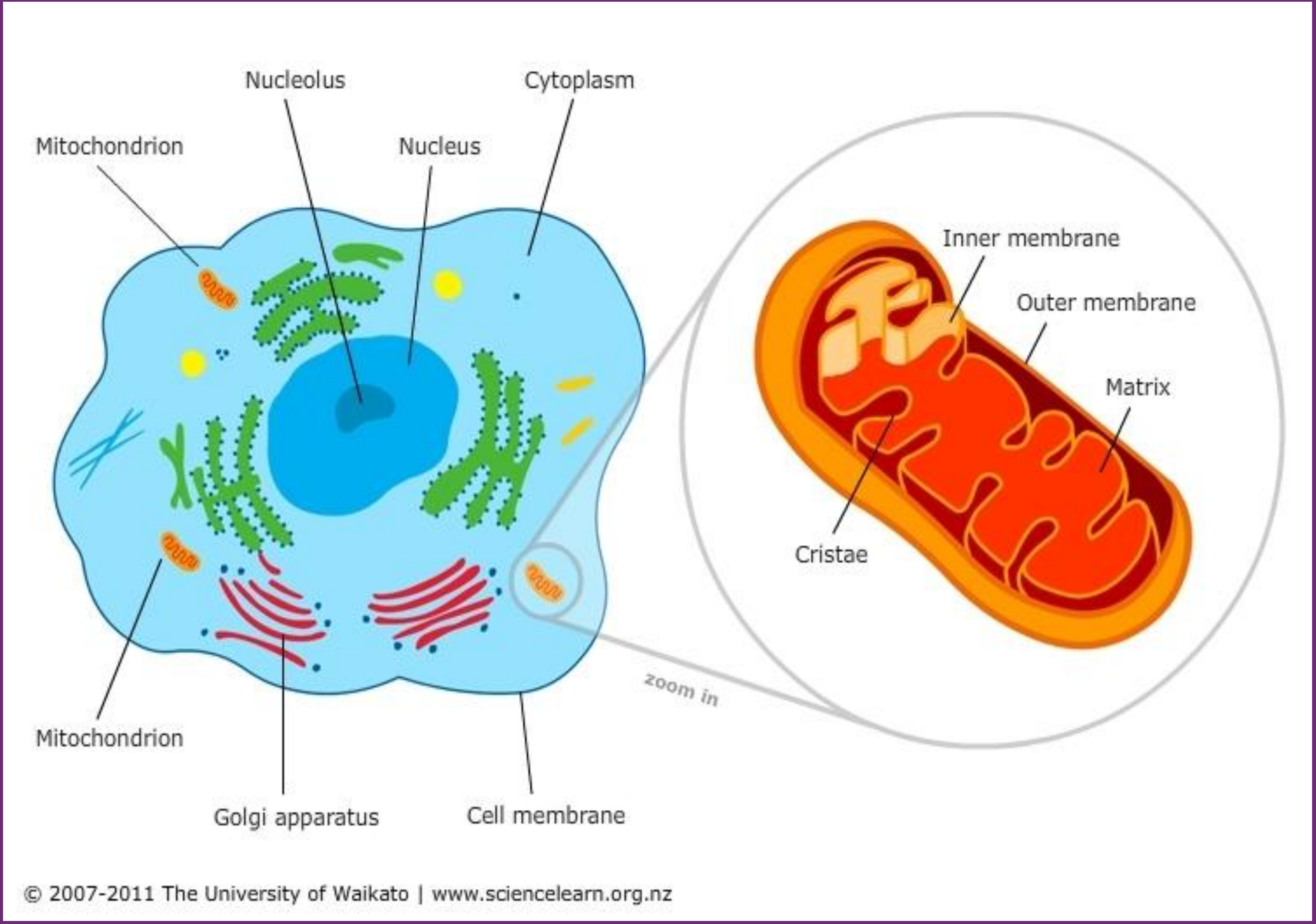



Death
Early Death
Disease, Disability and Social Problems
Adoption of Health-risk Behaviors
Social, Emotional, & Cognitive Impairment
Adverse Childhood Experiences

"Self"-Organization



Cells and Their Energy Factories



Energy Production

- ↑ food intake + Oxygen = ATP (energy)
- But with ↓ exercise --no demand for ATP
  ↑ free radicals
- When not enough antioxidants available:
  - Oxidation of lipids
  - Electron flow stops
  - More free radicals attack mtDNA
  - Cells fail to produce ATP and die

Numbers of Mitochondria

- On average each of our cells host 500 mitos.
  - Roughly 10 percent of our total body weight.
- Energy needs: our heart and brain cells contain the greatest number of number of mitos.
  - There are approximately 10 million billion mitos in an adult human brain.

The Energy Generating Metaphor

Mitochondria, just like a dam, uses pressure in each step so that energy is released from electrons within the pump.

The biochemical reactions culminate with the final product, the synthesis of ***adenosine triphosphate*** *(ATP).*

Metabolic Energy = Life

- Energy production and use is called ***metabolism:***
  - Everyday a person's metabolism makes two hundred trillion trillion ATP molecules.

  - The rate at which the total number of ATPs are produced is a measure of your ***metabolic rate***.

The Life Cycle of Mitochondria

- Mitos shelf life -- few days to a few weeks.
- They are recycled so that weak mitos are disposed of to insure quality of those that remain.
  - Removed by ***"mitophagy"*** ---killing off damaged mitos by mild ROS.
- Clears the way for mito ***"biogenesis."***

Client Education

Because your energy generators are mighty: Call them ***Mitos***

They produce your principal energy: ATP for: ***All That Power***

Free Radicals

- Highly reactive molecules that contribute to oxidative stress
- They lost an electron and are on the prowl to steal one from neighboring molecules.
  - Cells malfunction
  - Cells age (zombie cells)
  - Cells are more vulnerable to disease
  - DNA and mDNA more vulnerable to inaccurate gene expression

Client Education

- Use it or lose it:
  - No exercise and overeating:
  - the dam leaks
  - ↑ flood of free radicals

Mobile Mitos

- Brain uses 20% of our body's energy, and our synapses use of 80% of that energy.
  - But, mitos at the synapses can only tolerate 25% drop in ATP before cognitive, emotional, and movement deficits.
- The energy fuels neuroplasticity by:
  - Mitos traveling on microtubules within our neurons to the synapses.

Mitochondria Burnout

- Mitos can burn out if the input and output is not balanced
  - Oxidative damage to:
    - Proteins
    - Lipids
    - mDNA
    - mito dysfunction.

Exercise and Biogenesis

- Aerobic exercise increases mitos in muscle cells by to 50% in 6 weeks.
  - ↑ ATP and ↓ ROS.
- ↑ biogenesis when ATP used up,
  - Number and size of healthy mitos increase to enhance energy production.

Diabetes of the Brain” - “Type 3 Diabetes.”

- Insulin resistance and type 2 diabetes increase the risk of Alzheimer’s Disease.
  - “Insulin resistance in the brain leads to neurogenerative impairments.
    - increases in free radicals, low energy (ATP),
    - inflammation,
    - cell death,
    - neurotransmitter dysregulations.

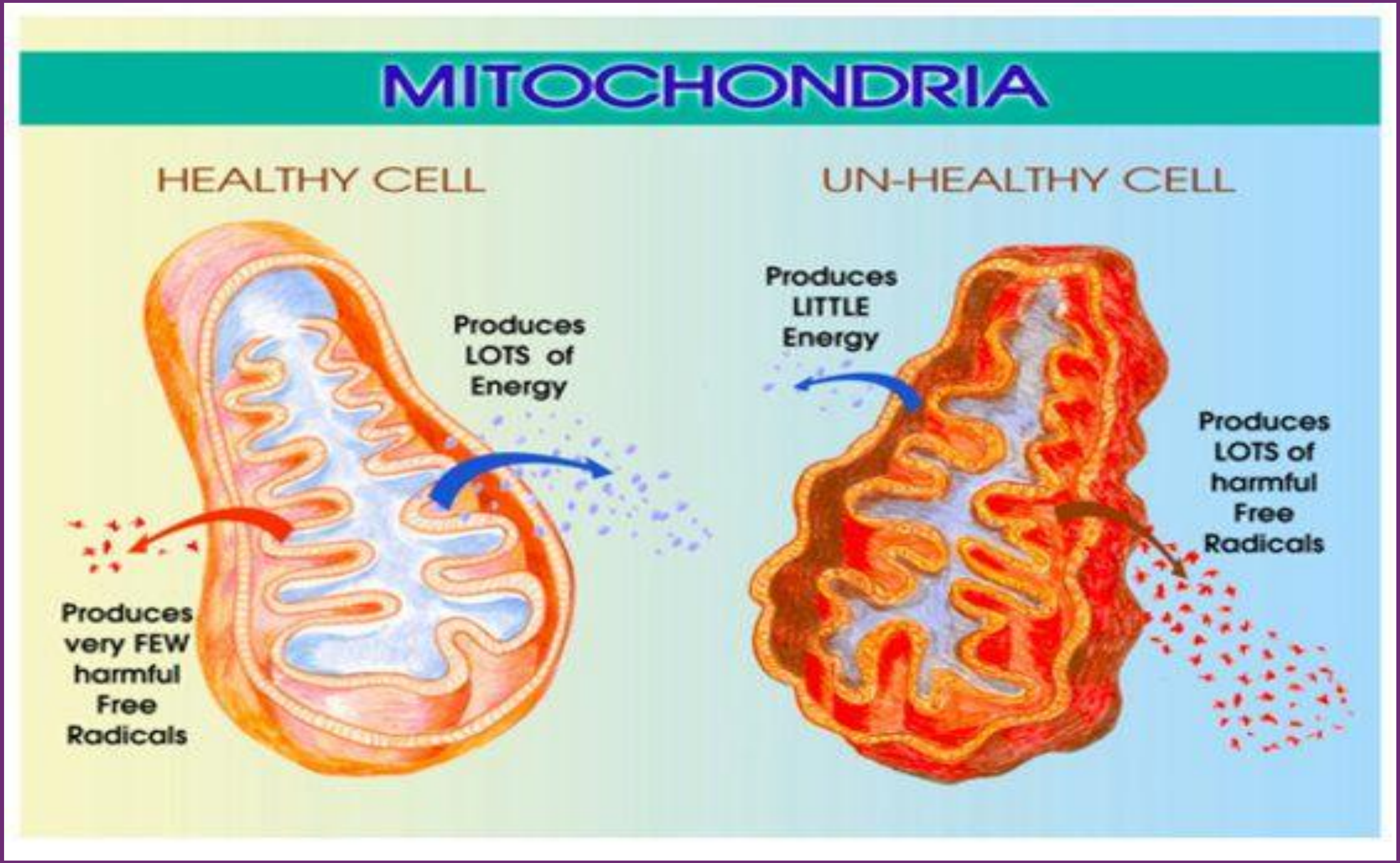
Client Education

- Don’t assume that consuming more empty calories will give you energy
  - The reverse is true.
    - Consuming the wrong calories *decreases* energy.

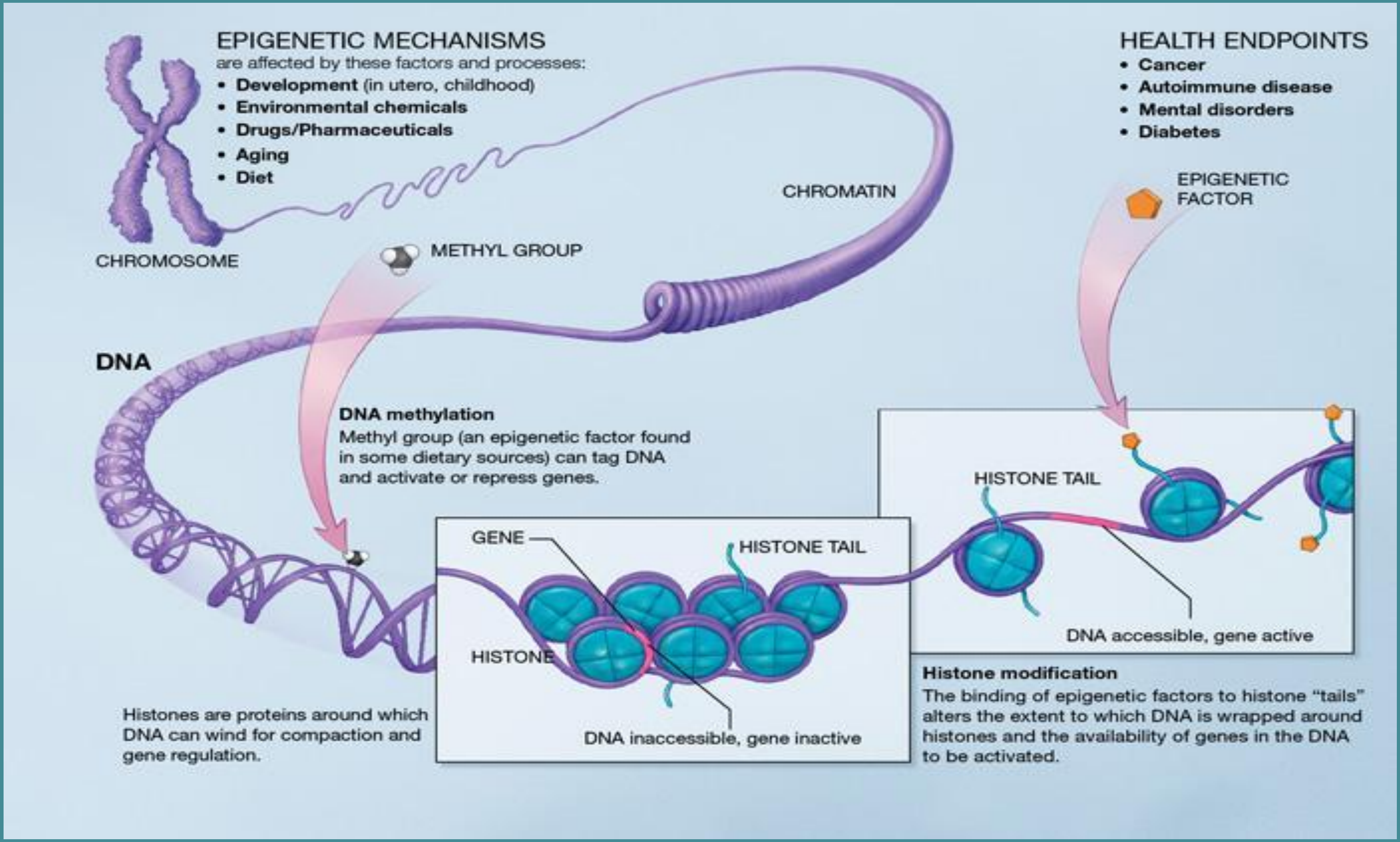
Free Radicals

- Highly reactive molecules that contribute to oxidative stress
- They lost an electron and are on the prowl to steal one from neighboring molecules.
  - Cells malfunction
  - Cells age
  - Cells are more vulnerable to disease
  - DNA more vulnerable to inaccurate gene expression

Free Radical Damage



Epigenetics



Epigenetics in Gene Expression

- Histones are proteins wrapped tightly into ball like shapes with floppy tails
- Acetylation of histones allows transcription—unwrapping genes for expression
- Methylation of histones keeps them in place—suppressing gene expression

Epigenetics and Neuroscience of Early Experience

- Early secure attachment experiences regulate the opioid and GABA systems to generate feelings of comfort and buffer stress. (Curley, 2011).
  - Feeling soothed with less pain occurs through opioid release into the anterior cingulate cortex.
  - Increased GABA receptors dampen anxiety
- • Maternal nurturance stimulates the expansion of BDNF.
  - BDNF and NMDA expression as well as increased cholinergic innervation of the hippocampus enhance cognition (Liu et al., 2002).
  - BDNF buffers cortisol in the hippocampus from stress and promotes ongoing plasticity (Redicki et al., 2005).
  - The brains of suicide victims --lower mRNA levels of the genes for BDNF and receptor tyrosine kinase B (Dwivedi et al., 2003).

Epigentics and parenting

- Good parenting produces kids with less methylation of the cortisol receptor gene
- The kids have a better thermostat for cortisol and can turn of the stress response system more easily

Cortisol level

Infant experiences nurturing

- Her serotonin levels increase:
  - signals her hippocampus to increase the production of an enzyme called acetylates histones.
  - This enzyme binds to the cortisol receptor gene and adds acetyl groups to histone proteins.
- The histone acetylation creates a more relaxed environment so that DNA methylation is removed.
  - leads to higher expression of the cortisol receptor gene and consequently better ability to turn off the HPA axis— the stress response system.

SEVERE NEGLECT:
Persistent Neurobiological Changes

- **Decreased serotonin**

  irritability; reduced emotional control

- **Increased CRF:** ↓ deep sleep;

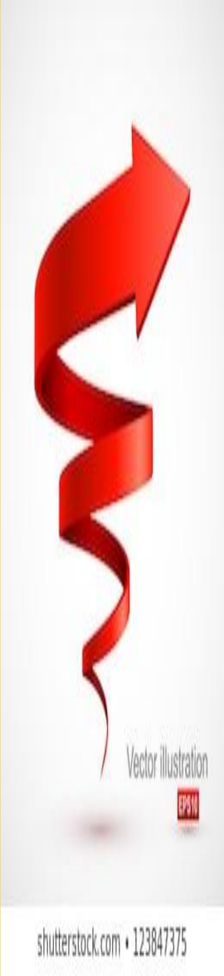
  agitated depression; anxiety

- **Decreased Oxytocin:** attachment problems

Epigenetics and Increased Stress

- With methylation of the cortisol receptor gene, fewer cortisol receptors
  - it is difficult to turn off the stress response.

- Increased methylation levels of cortisol receptor gene:
  - In suicide victims with a family history of abuse and/or neglect
  - In preemies:



Epigenetics and Increased Stress

- Maternal separation;
  - leads to decreased DNA methylation of the arginine vaseopressin and CRH genes.

  - This results in the increased production of arginine vaseopressin and CRH, which stimulates the HPA axis— the stress response system.

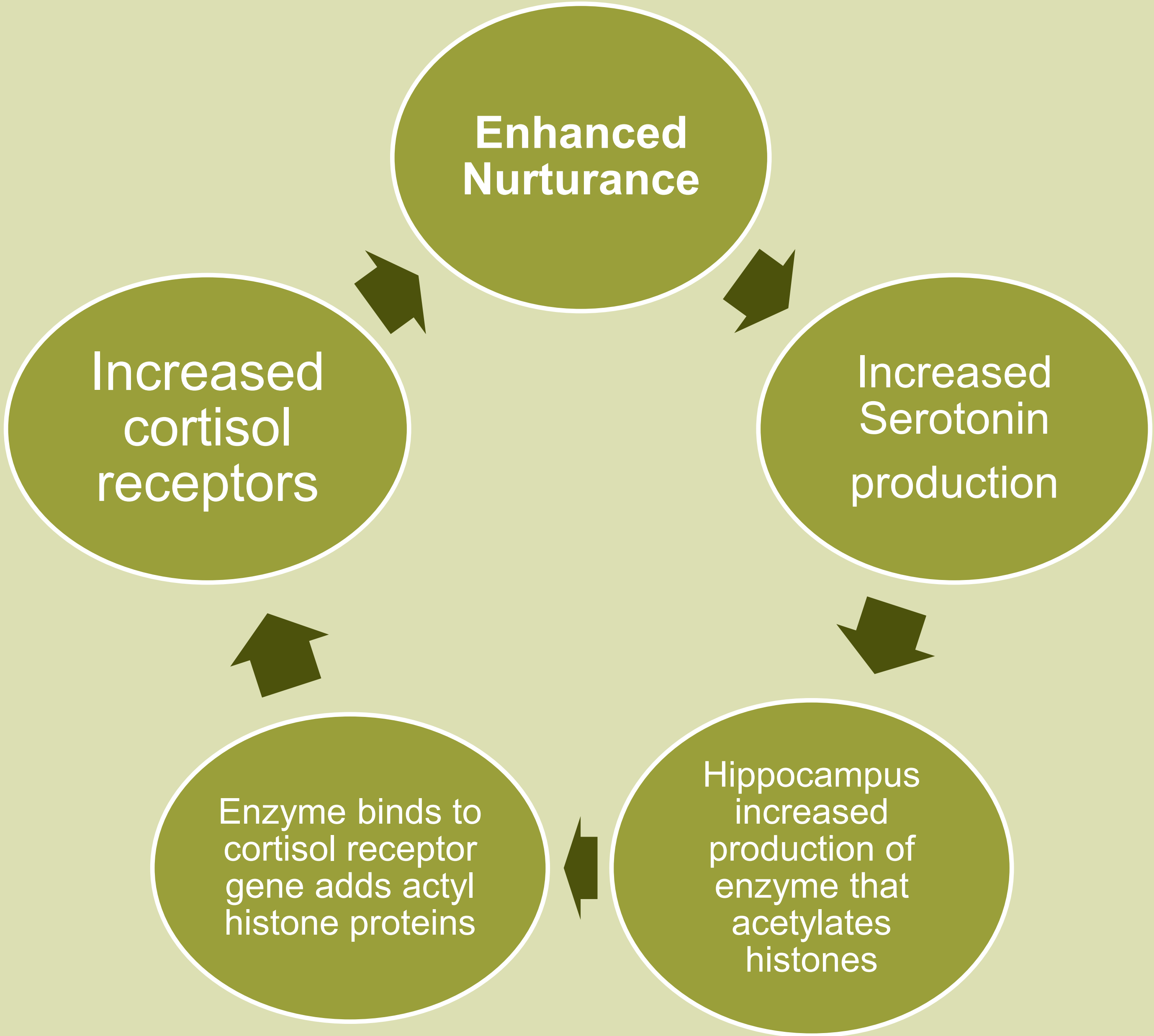
Epigenetics and Increased Stress

- Increased methylation levels of cortisol receptor gene:
  - In suicide victims with a family history of abuse and/or neglect
  - Also in preemies:
  - Can’t easily turn off the stress response
- Decreased methylation of the arginine vasopressin gene
  - If stressed early in life:
    - Resulting in increased vasopressin and stimulating the stress response

Epigenetics and Decreased Stress

- Decreased methylation levels of cortisol receptor gene:
  - In offspring who had good nurturing produces more cortisol receptors on the hippocampus
    - Lower levels of CRH, ACTH, and cortisol
    - More 5-HT
    - Stress tolerance (Good thermostat)

Epigenetics of Stress Tolerance



Epigenetics: For Better or Worse

- The serotonin- transporter gene differentiates those people with the “short version” from the “long version” (eg S/S, L/S, or L/L).
  - Short version - mistaken for the “depression gene.”
  - Yes, carriers of the short version may become depressed if they experienced ACEs, **but** those with supportive early environment and positive experiences can have the fewest symptoms.
- The genetic polymorphism BDNF alone does not operate as a plasticity factor, but the environment and multigene interactions together do.

Epigenetics: For Better or Worse

- Infants with a variant of the dopamine receptor gene (DRD4) have been linked to lower receptor efficiency and greater risk for disorganization and externalizing behaviors if exposed to maternal loss or trauma.

- Yet, when children with this supposed “vulnerability gene” were raised by mothers who had no unresolved loss they displayed significantly less disorganization. With nurturing mothers, they show the lowest levels of externalizing problem behavior.

- This variant of the DRD4 gene can afford the carrier to benefit disproportionally from supportive environments.

Epigenetics: For Better or Worse

- Carriers of a specific mutation of the catechol-O-methyltransferase (COMT) gene, --who use of cannabis during adolescence -- more likely to develop psychotic symptoms
- The COMT gene protein is of particular importance in regions such as the PFC, which is typically dysregulated in schizophrenia.
- The COMT gene is NOT a “schizophrenia gene” but is an enzyme that breaks down dopamine, norepinephrine, and epinephrine.

Epigentics and parenting

- Good parenting produces kids with less methylation of the cortisol receptor gene
- The kids have a better thermostat for cortisol and can turn of the stress response system more easily

Cell Aging: Telomeres Length

- “Psychobiomarker”: Linked to social status, perceived stress, depression, predictive of mortality and genetic impairment (Epel, 2009, Current Directions)
- •Telomeres: non-coding sequences (AKA “junk DNA”) capping ends, serving as a
- “senescence clock” (Blackburn, 1978)
- •Telomerase: enzyme that prevents telomere shortening, promotes cell resilience.

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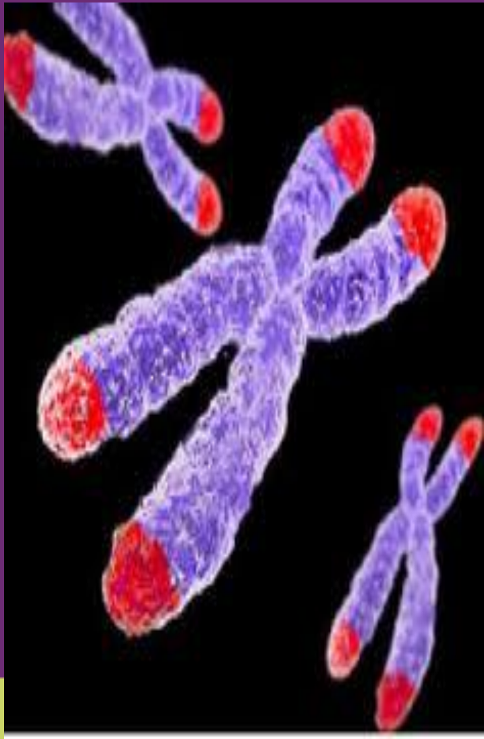

- Psychobiomarker”: Linked to social status, perceived stress,
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Factors that Shorten Telemeres

- Aging
- Cardiovascular disease
- Smoking
- Obesity (more than smoking!)
- Type 2 Diabetes
- Social isolation
- Poor diet
- No exercise
- Poor sleep
- Alcohol and other drugs
    - **All rendering DNA vulnerable to damage**

Telomerase

An enzyme that adds nucleotides to protects telomeres:

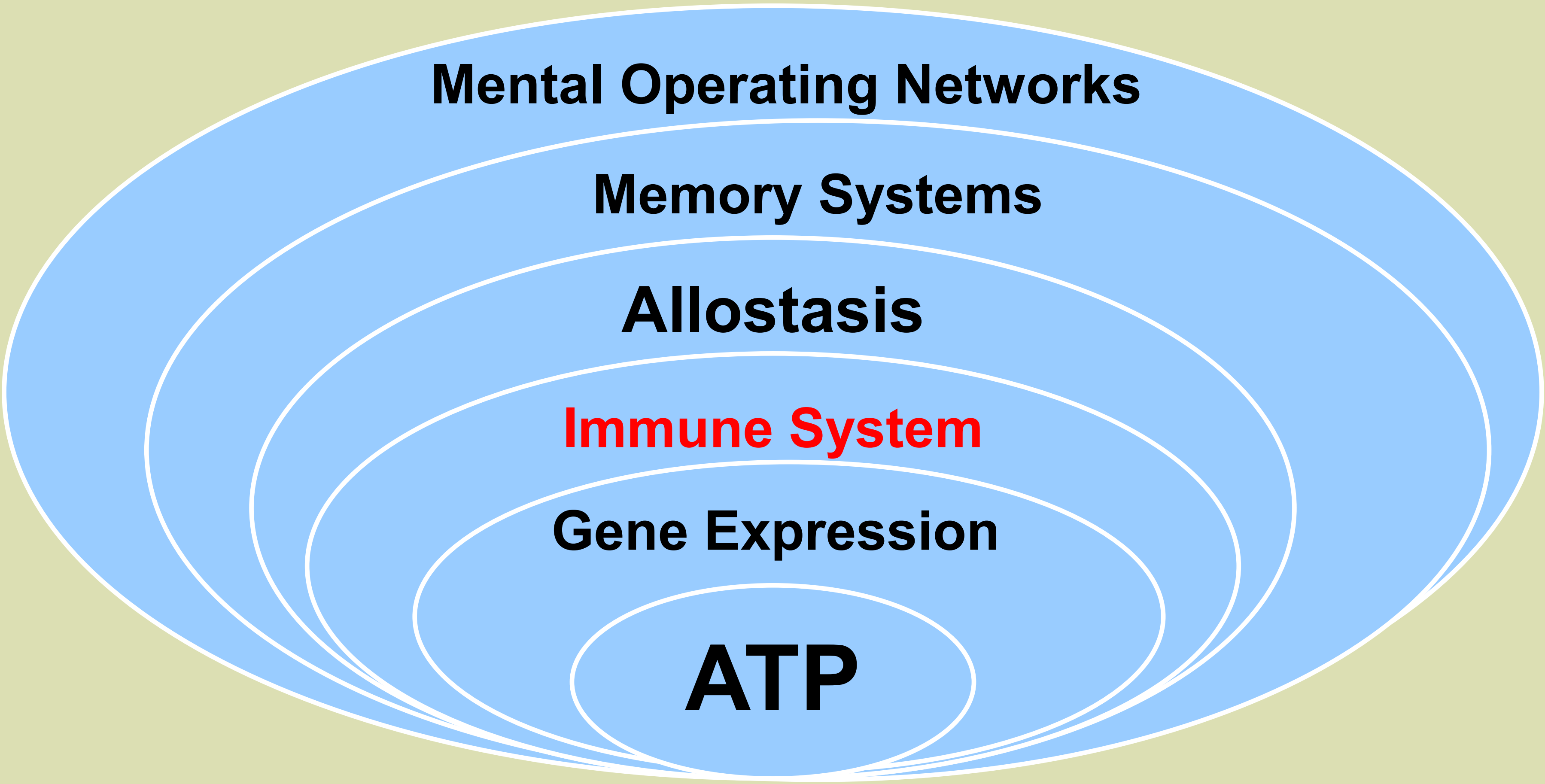
Insulin, IGF-1, VEGF, EGF upregulate telomerase activity.

All increased by aerobic exercise

Developmental Programming of stress responses

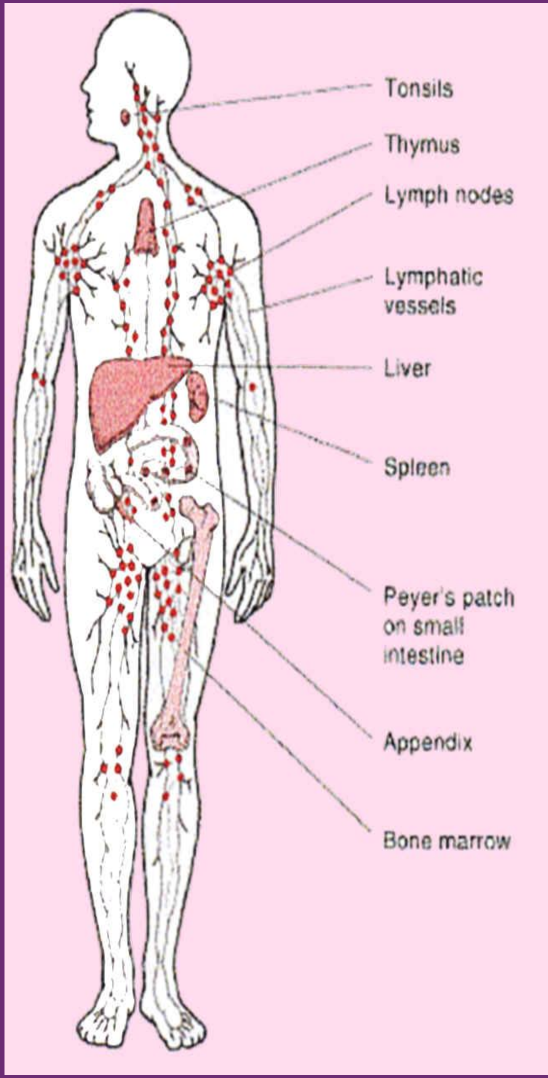
- Experiencing trauma or stress in infancy or childhood leads to:
  - Impaired regulation of HPA axis
  - Epigenetic changes to genes involved in inflammation
    - Elevated inflammation, especially in gut
    - Increased incidence of pain conditions including fibromyalgia & irritable bowel syndrome

“Self”-Organization

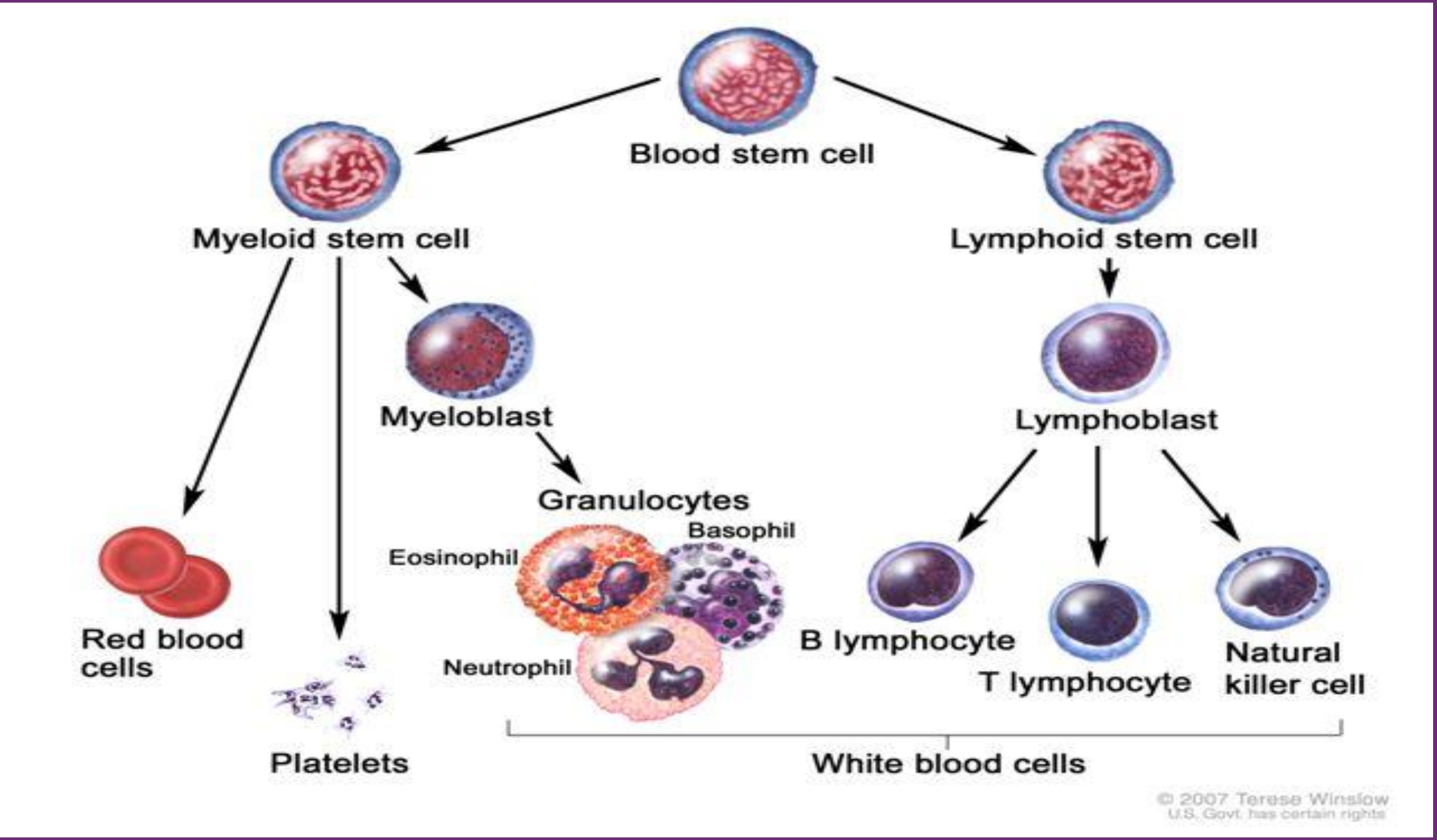


Components of the Immune System

- Lymph vessels and lymph nodes — filtering system for the lymph. WBCs lie in wait for foreign substance to destroy
- Bone marrow — origin of WBCs
- Thymus — where T cells differentiate into functioning cells from precursors
- Spleen — filtering system for the blood
- Other organs — gastrointestinal tract has Peyer's patches with high density of WBCs, respiratory tract has tonsils, skin, etc.



Me not Me Detection System



B and T “true” memory cells

Short Term Stress Can Suppress Immune System

Increased stress: (Kiecolt-Glaser/Glaser):

- Suppress T cell function
- Suppress natural killer cell function
- Suppress lymphocyte proliferation
- Reactivate latent viruses (herpes simplex virus; Epstein Barr virus)
- decreased ability of cell to repair broken DNA.
- Lower antibody response when vaccinated.

T cells attack a virus

*effects also seen in bereavement, divorce, and other stressors

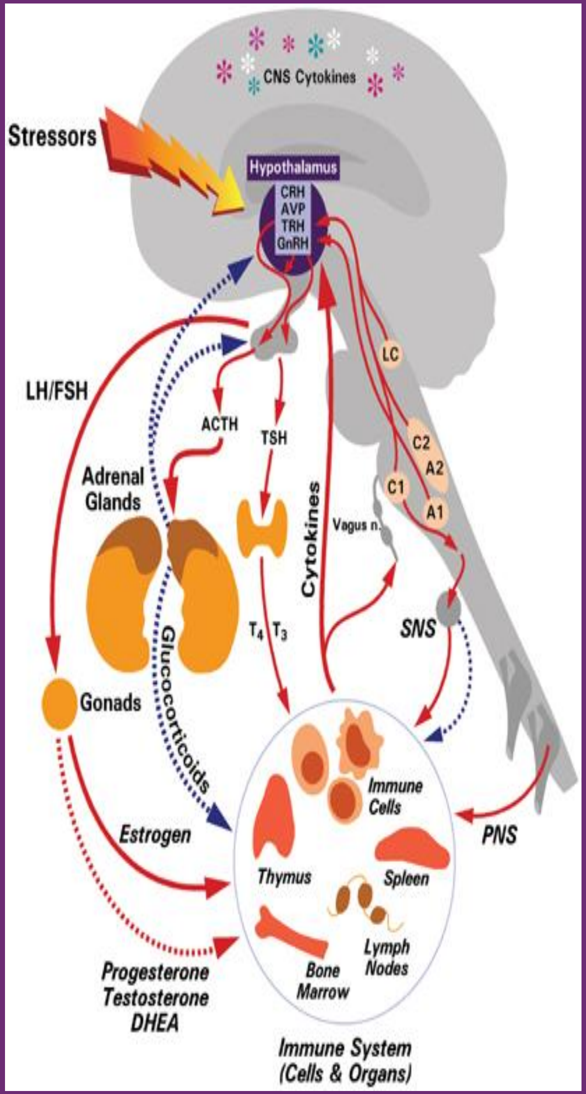
The Brain Controls the Stress Pathways

Distress, via the cortex and amygdala signal to the hypothalamus.

The hippocampus (memory) also has inputs to the hypothalamus.

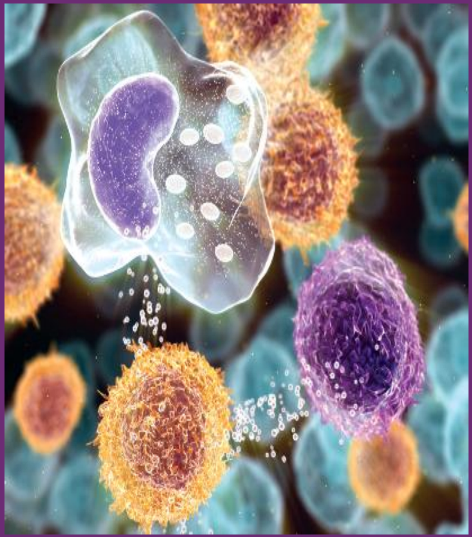
The hypothalamus maintains homeostasis by regulating visceral activities: heart rate, blood pressure, body temperature, thirst, hunger, weight, sleep/wakefulness.

The hypothalamus also controls HPA stress response system



Communication in the immune system happens via chemicals

- *Cytokines:* Proteins released by immune cells that act on target cells to regulate immunity, and signal the brain
- *Proinflammatory cytokines:* coordinate inflammatory responses in the body; in response to microbes; mediates acute inflammation (e.g. IL-1, TNFa, IL-6)
- *Anti-inflammatory cytokines*: controls the pro-inflammatory response (e.g. IL-10)
- *Chemokines*: recruit cells to affected tissues
- *Prostaglandins:* recruit immune cells, and *signal the brain*



Stress

Activation of corticotropin releasing hormone (CRH):

- Contributes to delayed gastric emptying
- Increased colonic activity
- Functional bowel disease (IBS)
- Increase in gut permeability
- Leaky gut – antigens leaking out
- Toxic liver overload
- Systemic disease

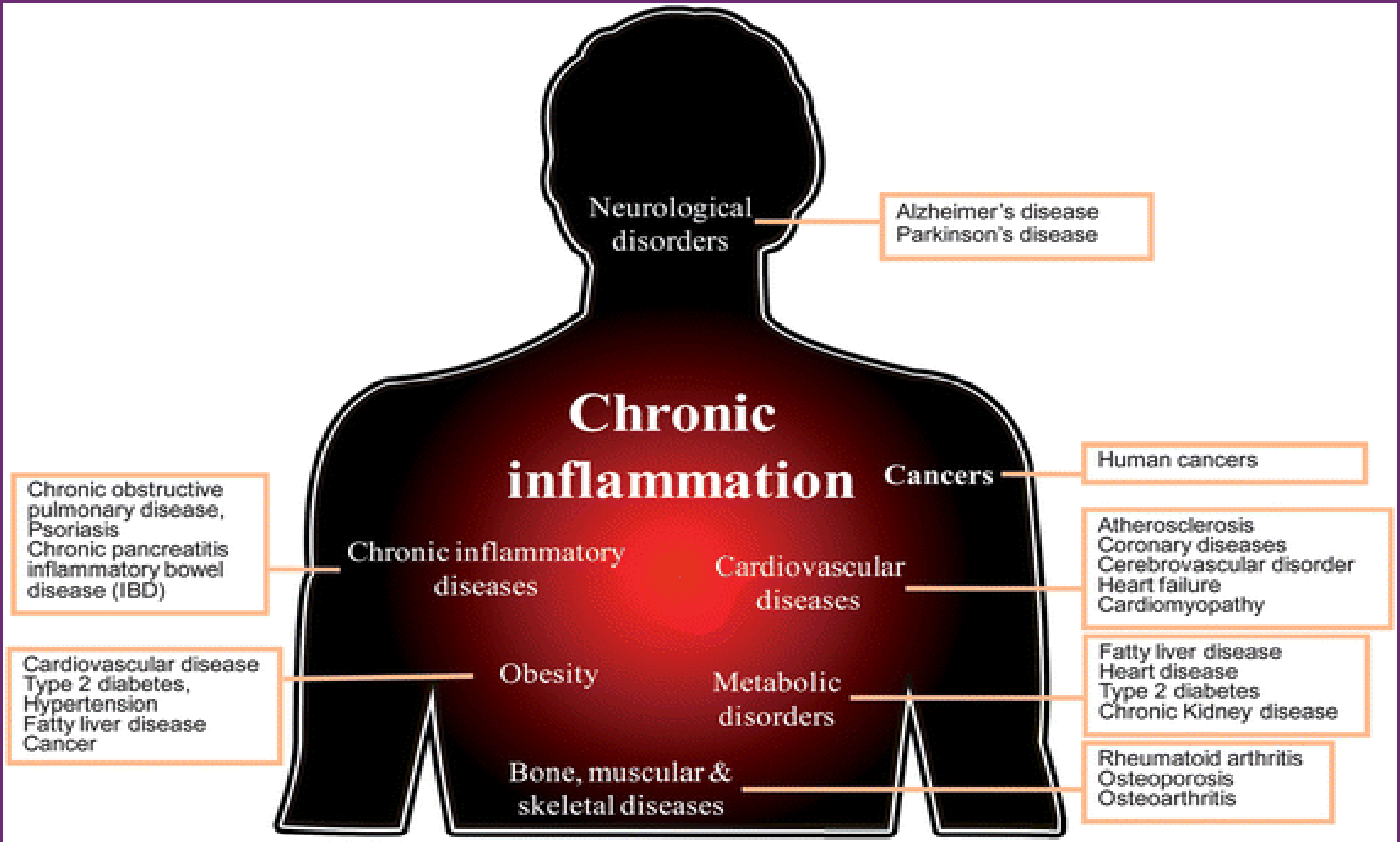
The Immune System Can Affect Your Emotions:

- PICs contributes to depression as underlying inflammatory conditions
- Stressors may contribute to depression or exacerbate it via PICs
- Depression linked to medical conditions-- involves PICs
- Strong link between depression and vulnerability to medical diseases (CVD, autoimmune)

Inflammatory pathways in the brain adversely affect memory and mood.

- PICs cause cognitive deficits that disturb synaptic strength.
  - High concentrations of receptors for PICs in the PFC and hippocampus, potentiating cognitive impairments,-- i.e. working memory, episodic memory, and executive functions
  - IL- 1 in the hippocampus impairs memory by interfering with BDNF, which is involved in neural plasticity, neurogenesis, memory, energy balance, and mood.

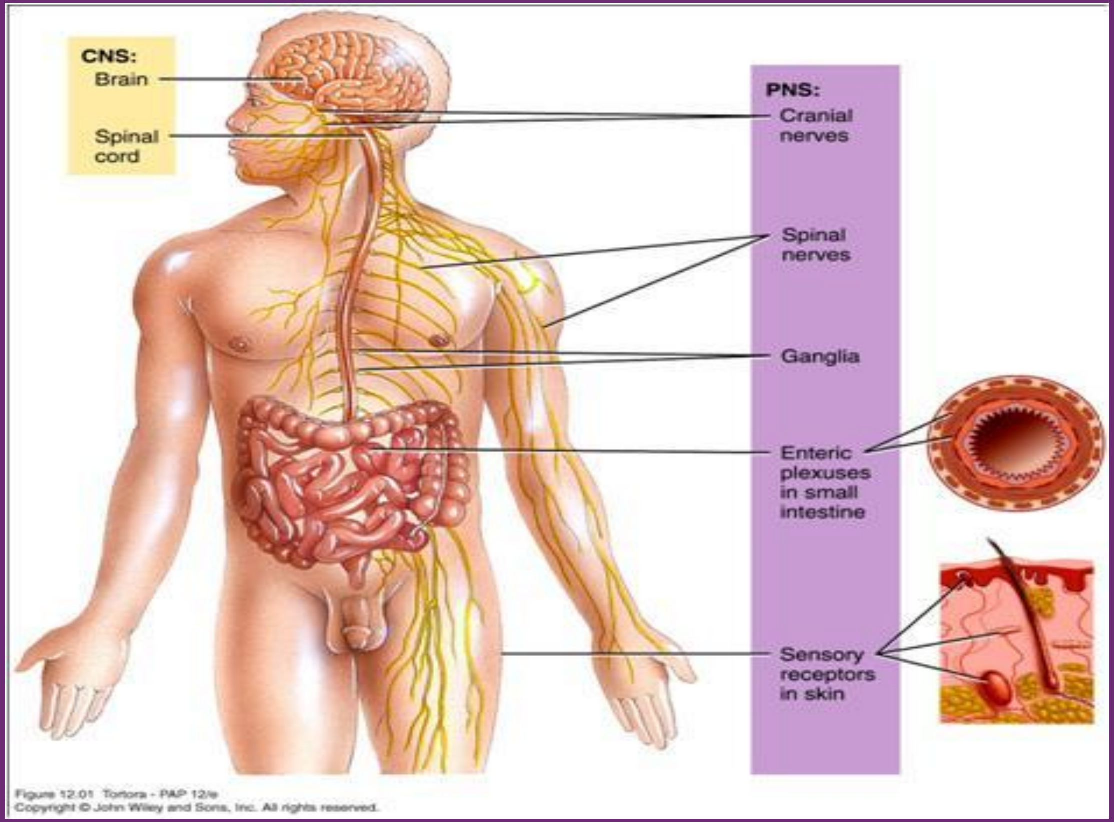
Inflammation in the Mainstream



Neurological disorders
Alzheimer's disease
Parkinson's disease
Chronic inflammation
Cancers
Human cancers
Chronic obstructive pulmonary disease,
Psoriasis
Chronic pancreatitis
inflammatory bowel disease (IBD)
Chronic inflammatory diseases
Cardiovascular diseases
Atherosclerosis
Coronary diseases
Cerebrovascular disorder
Heart failure
Cardiomyopathy
Cardiovascular disease
Type 2 diabetes,
Hypertension
Fatty liver disease
Cancer
Obesity
Metabolic disorders
Fatty liver disease
Heart disease
Type 2 diabetes
Chronic Kidney disease
Bone, muscular & skeletal diseases
Rheumatoid arthritis
Osteoporosis
Osteoarthritis

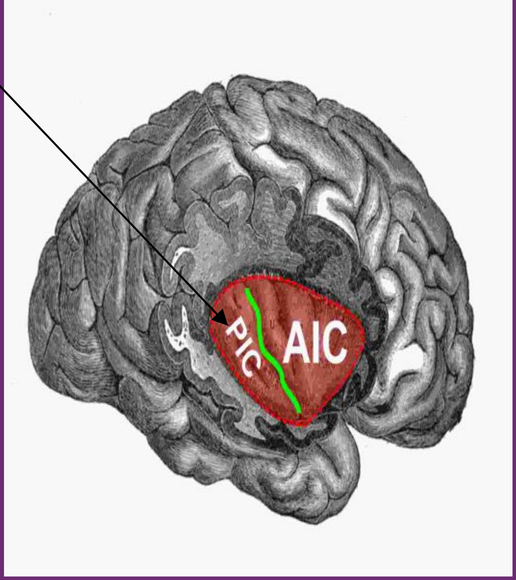
Enteric Nervous System

- ***Enteric*** **– meshwork of nerve fibers that innervate the viscera (gastrointestinal tract, pancreas, gall bladder)**

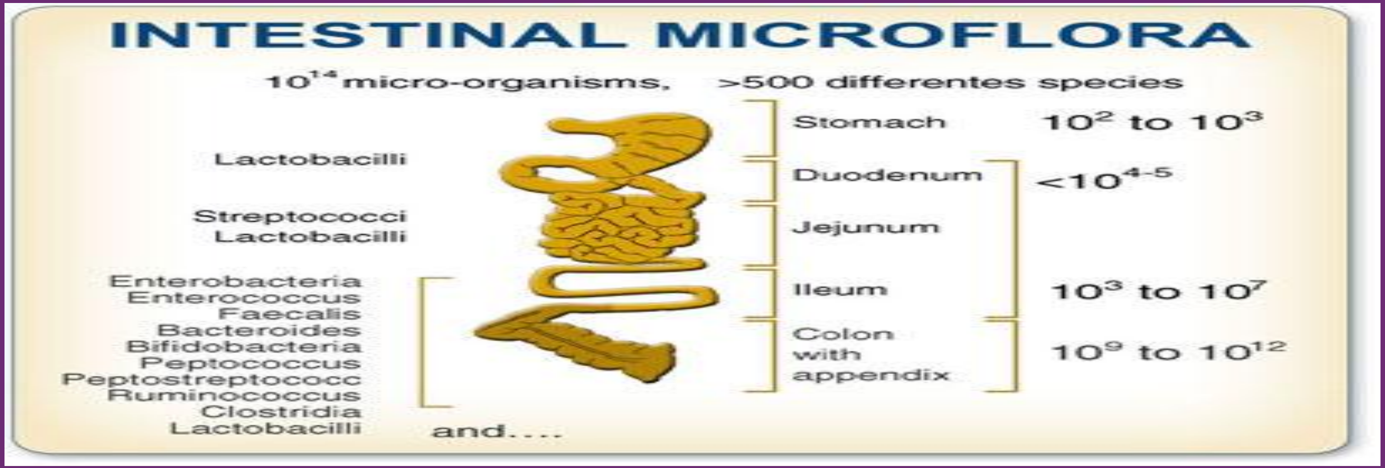


Language of Gut

- **Visceral sensations include:**
  nausea, bloating
- **All arrive at Insular Cortex in brain**
  - **Part of the Salience Network**
- **Plays role in emotions & body homeostasis**
- **Regulates the immune system**
- **Conscious desires – food, drugs**



Microbiome



- The GOOD: helps digest certain foods the stomach/small intestine doesn't, can combat invading microorganisms. Microbes generally do not cause disease unless they grow abnormally; they exist in harmony with us.
- The BAD: may have a role in auto-immune diseases (e.g., diabetes, rheumatoid arthritis, multiple sclerosis, fibromyalgia) and possibly some cancers. A poor mix of microbes in the gut may also aggravate obesity.

Our microbes are like an organ

- Control each other's behavior
- Collaborate with our immune system in host defense
- Program phenotypes/activity states of immune cells
- Diet influence our microbial populations
- Link of inflammation and disease
- Influence brain development
- Influence our behavior

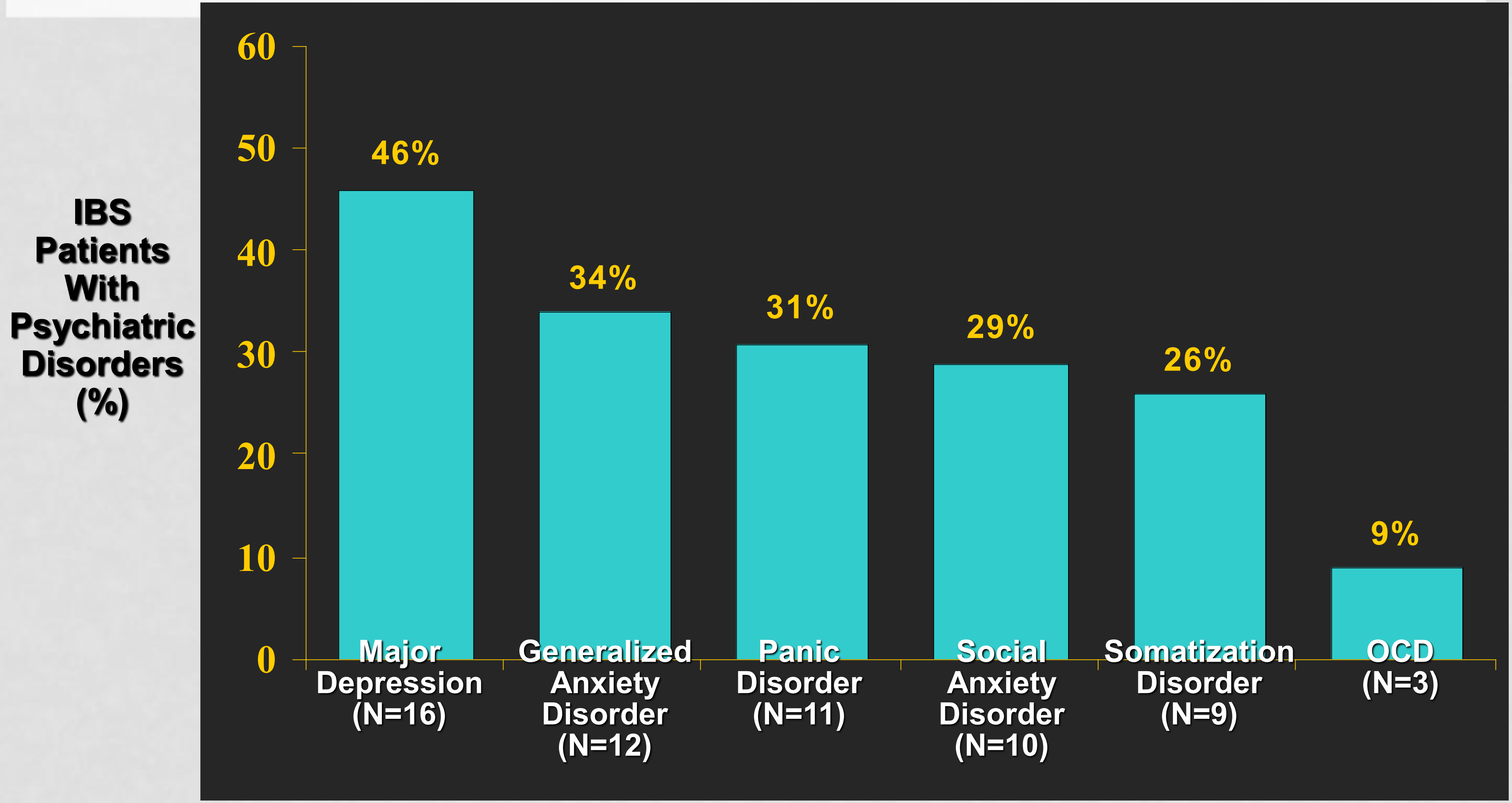
Gut bacteria

- Play a key role in nutrition
- Production of neurotransmitters
- Synthesize: vitamins such as thiamine (B1), folic acid (B9), pyridoxine (B6), and vitamin K
- Produce digestive enzymes to absorption calcium, magnesium, and iron.

Gut Bacteria

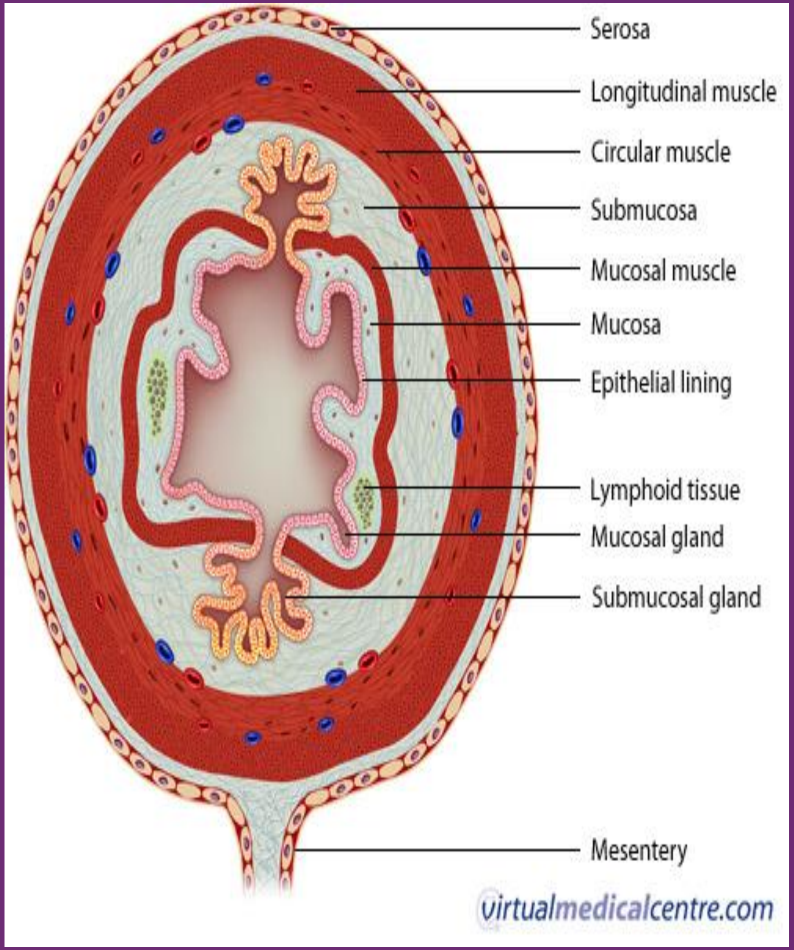
- 90% of bacteria in the colon   F/B ratio:
- Firmicutes
  - Fat loving—increases fat absorption
  - Efficient at extracting calories from carbs
  - Turns on genes that increase the risk for obesity, diabetes, and CVD
- Bacteroidetes
  - More dominant in lean people

LIFETIME PSYCHIATRIC DISORDERS IN PATIENTS WITH IBS



"Leaky gut": the consequences of stress and inflammation and link between diet and health

- AKA "increased intestinal permeability"
- Is associated with many disorders (diabetes, metabolic syndrome allergies, neurological etc.)
- Allows more absorption of toxins and lets fluid out e.g. during inflammation and infection (diarrhea)
- Many factor regulate this: immune cells and molecules, microbes, stress

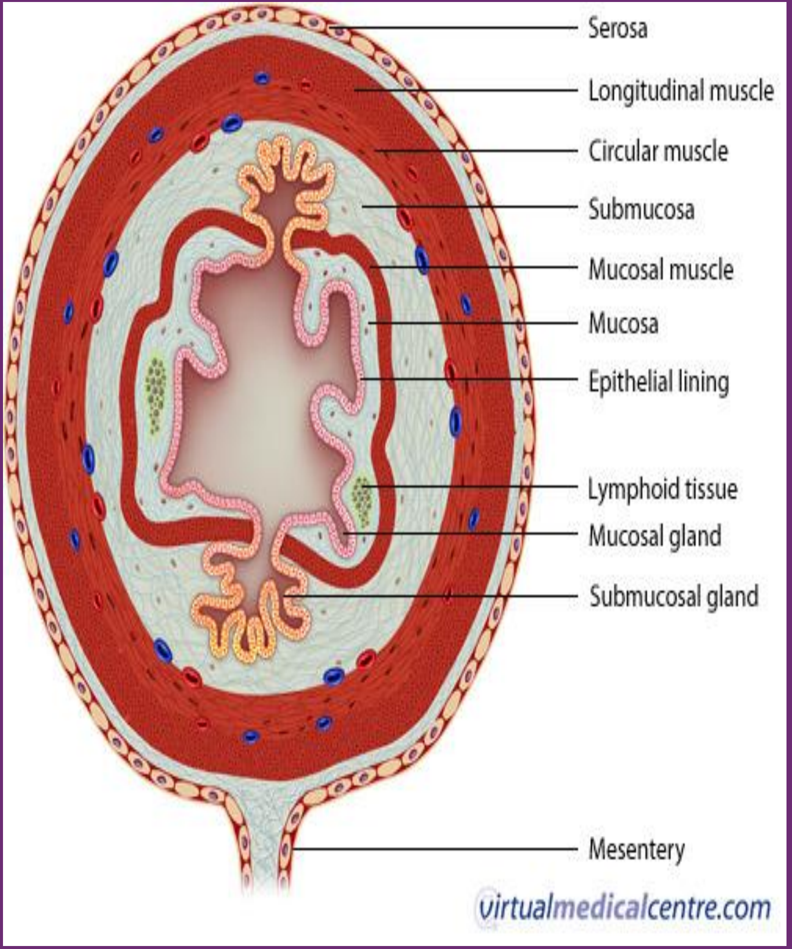


"Leaky gut": the consequences of stress and inflammation and link between diet and health

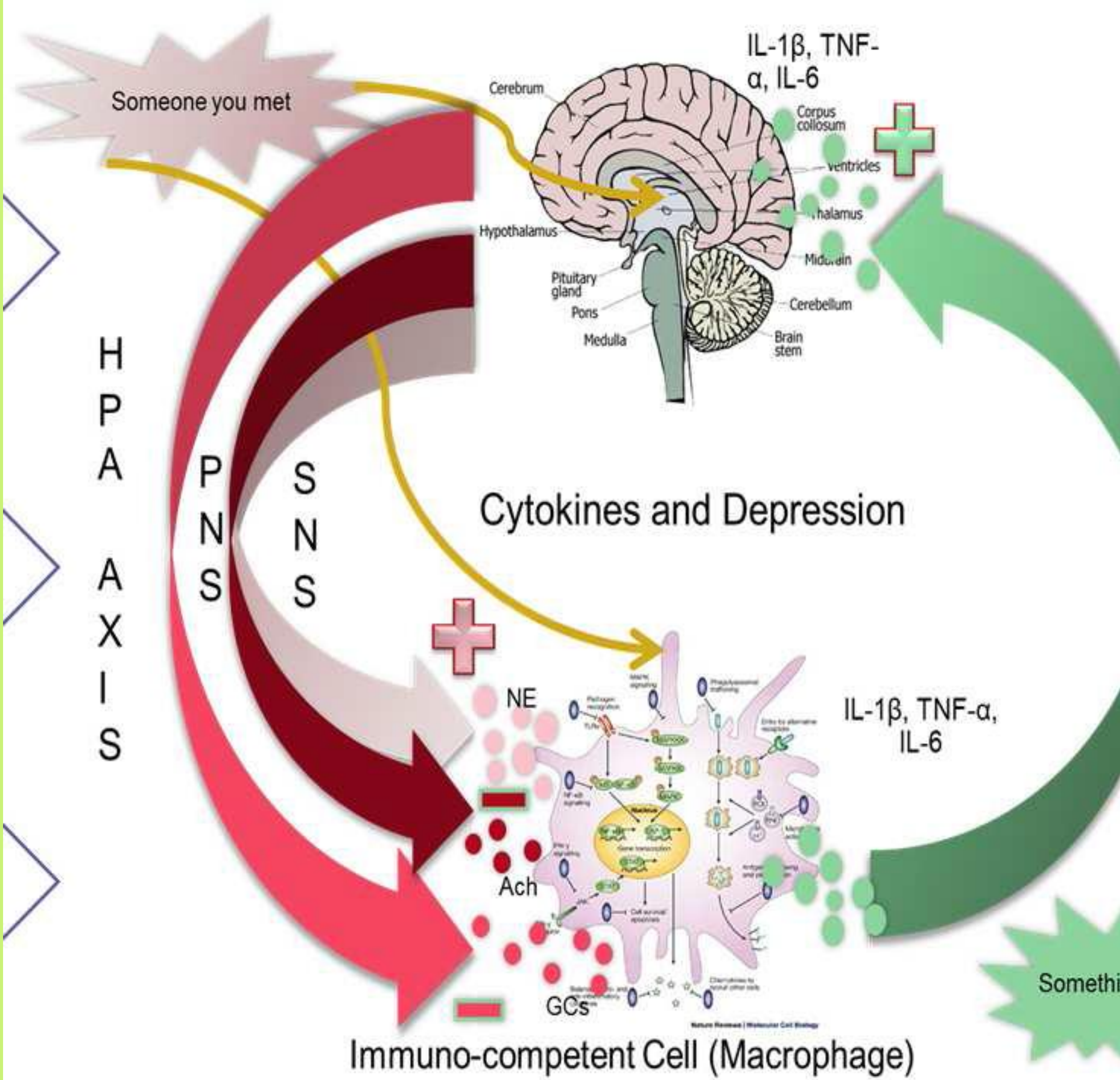
- **intestinal permeability**

- **Firmacutes + LPS**

- Lipopolysaccharide (LPS), a cell wall component of Gram-negative bacteria, induces neuronal death, decreases neurogenesis, and impairs synaptic plasticity and memory,



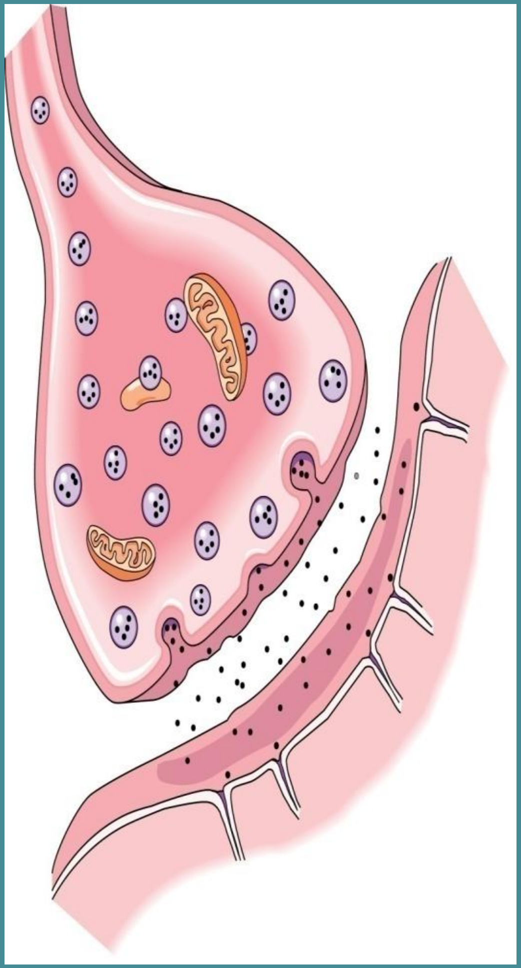
- Bad Diet
  - Simple carbs
  - Transfatty acids
  - Saturated fats
  - Food allergies
  - Bad oils
  - High dairy
  - High gluten
- No exercise
- Chronic illnesses
- Autoimmune disorders
- Chronic pain
- Chronic stress
- Being overweight
  - Apple shape
- Leaky gut



Hunter-gatherer Adaptation Boosted the Social Brain

The Developing Brain

- Born with twice as many neurons as mother (for redundancy) allowing for experience dependent learning during sensitive periods
- Apoptosis (programmed cell death).
  - 50 percent of the neurons die --use it or lose it
- More granular cells in the dentate gyrus of the hippocampus (Kemperman, et al. 1997).
  - As much as 85% of the dentate gyrus neurons are generated postnatally.



Regulatory Networks of the Social Brain

- Bonding/Attachment
- Cognitive capacity
- Affect Regulation
- Safety
- Mental and physical health

The Effects of Social Medicine

- Cardiovascular reactivity (Lepore, et al, 1993)
- Blood pressure (Spitzer, et al, 1992)
- Cortisol levels (Kiecolt-Glaser, et al, 1984)
- Serum cholesterol (Thomes, et al, 1985)
- Vulnerability to catching a cold (Cohen, et al, 2003)
- Depression (Russell & Cutrona, 1991)
- Anxiety (Cohen, 2004)
- Natural killer cells (Kiecolt-Glaser, et al, 1984)
- Slows cognitive decline (Bassuk, et al 1999)
- Improves sleep (Cohen, 2004)

Hungry Social Networks

- Brain development involves many forms:
  - the establishment of synaptic connections
  - the pruning of others
  - changes to the behavior of a single ion channel
  - dendritic outgrowth
  - changes to the shape and number of sprouting new axons
  - modifying their dendritic surfaces

(Kolb & Gibb, 2001)

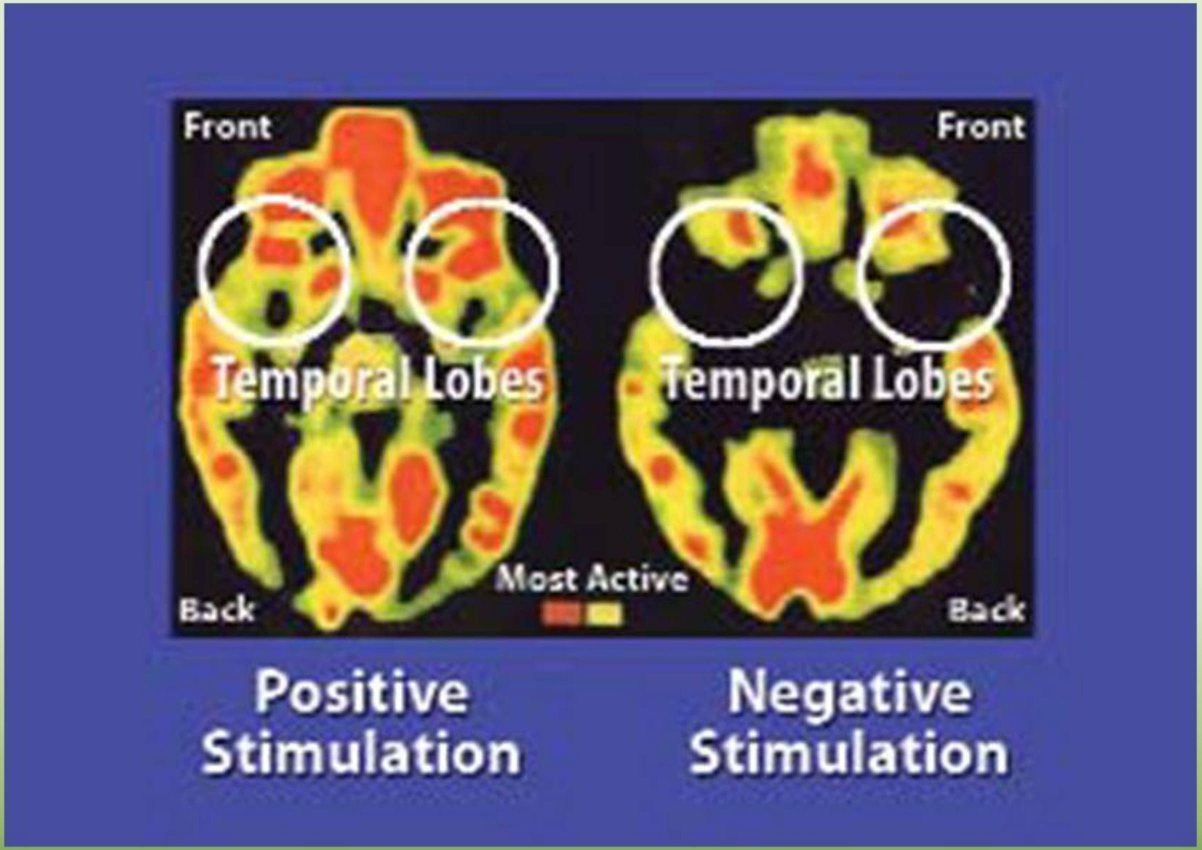
Deprived Social Brain Networks

- 150,000 children found languishing in Romanian orphanages. They were emotionally neglected.
- They missed human contact during critical periods (Kuhn & Schanberg, 1998).

Sustained impairment if over one year

- Increased Cortisol
  - Impaired OFC
  - Cognitive impairments (i.e. ADD)

“Normal” vs Neglected Brains

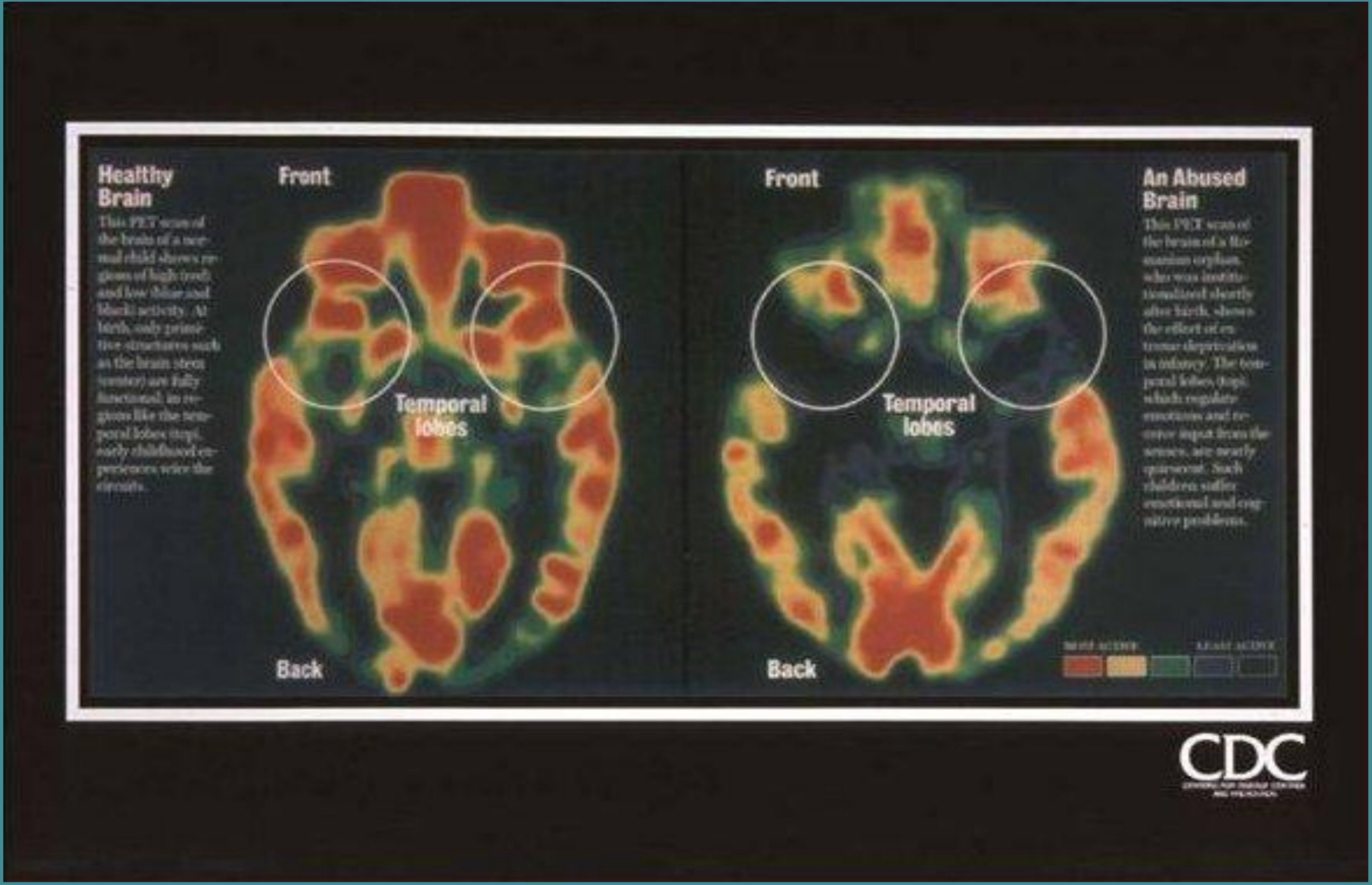


Brain activity of a normal five-year-old child (left)
and a five-year-old institutionalized orphan neglected in infancy (right).

Child Abuse and Neuropathology

- **Diminished left hemisphere and left hippocampal volume** (Bremner et al., 1997).
- **Accelerated loss of neurons** (Simantov, et. al., 1996)
- **Delays myelination** (Dunlap, et. al., 1997)
- **Abnormalities in developmentally appropriate pruning** (Todd, 1992)
- **Inhibition of neurogenesis** (Gould, et. al., 1997)
- **Adults who were physically or sexually abused as children – high IL-6 & CRP**
  - **diminished left hippocampal development** (Howe, Roth, & Cicchetti, 2006).

“Normal” vs Abused Brains



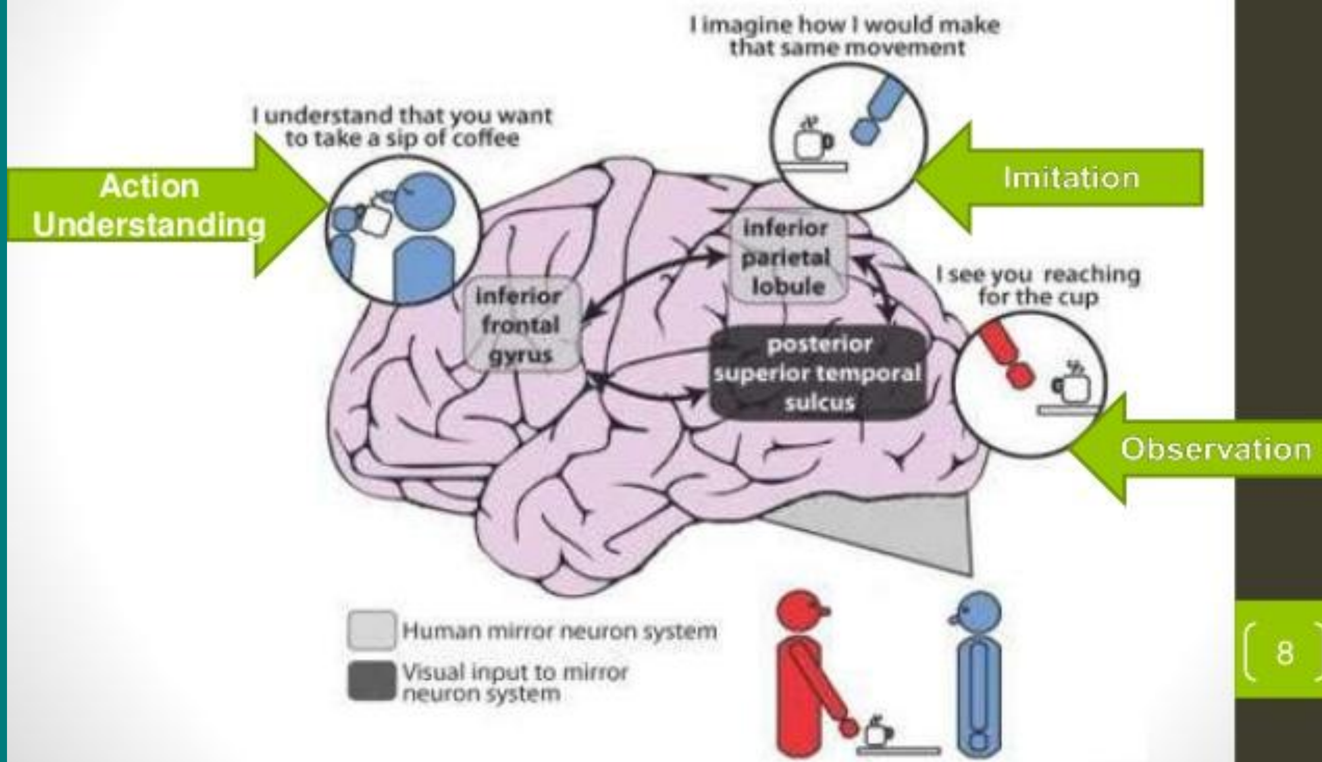
Intergenerational Transmission

Infants of depressed mothers have:

- **Over-active right frontal lobes**
- **Under-active left frontal lobes**
- **Lower levels of DA and 5-HT**
- **Higher levels of stress hormones** (Field et al., 1998)

- **Treating the mother's depression contributes to the child's improvement**

Role of Mirror Neurons



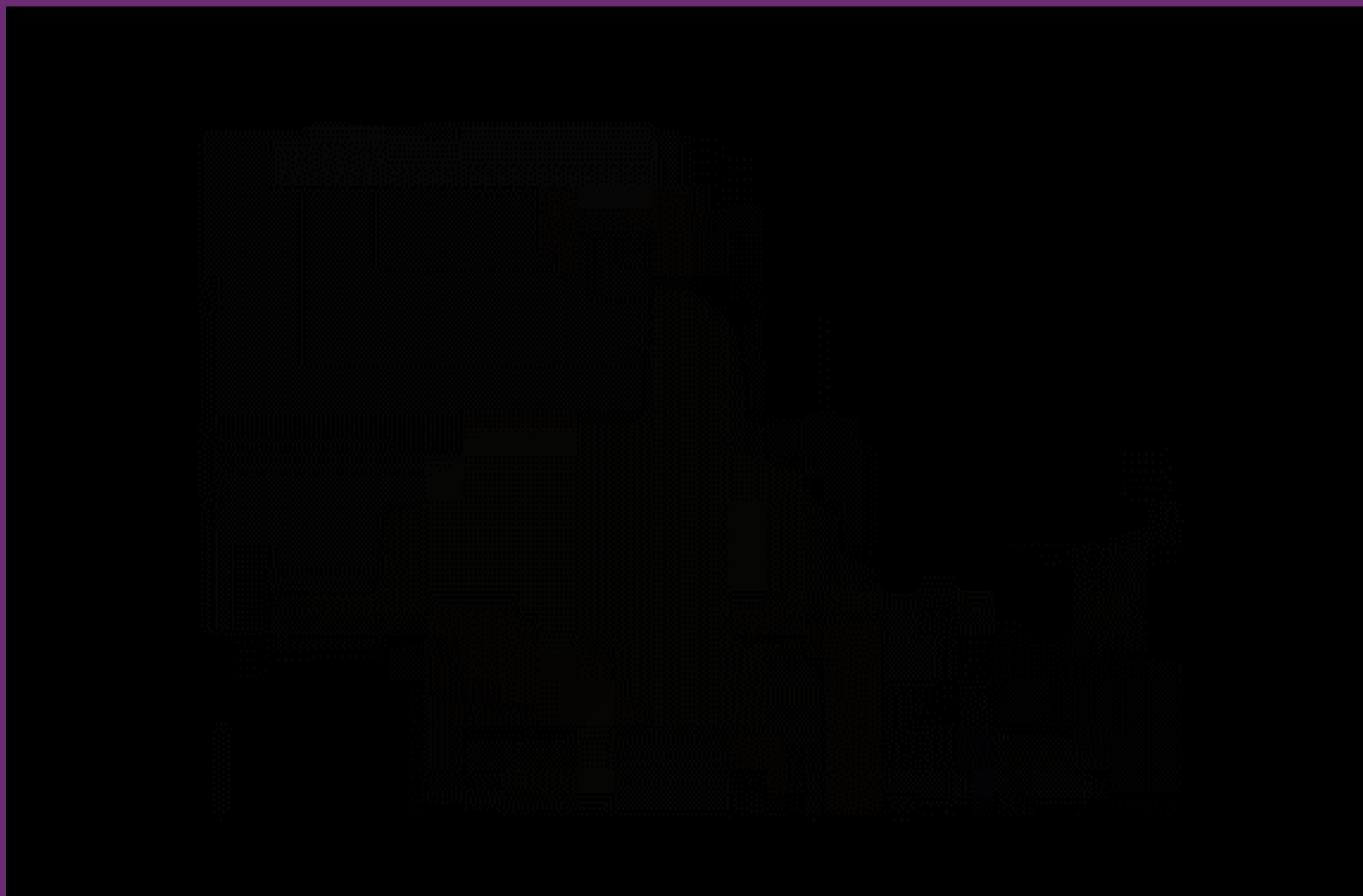
Mirror Neurons

- Originally found in monkeys (Rizzolati & Arbib, 1998)
- Critical for evolutionary development of social skills
  - Associated with anticipating goal-directed behavior
- Associated with empathy (Iacobini; Miller, 2005)
- Found in PFC, posterior parietal lobe, superior temporal sulcus, insula, and cingulate cortex

Mirror Neurons?

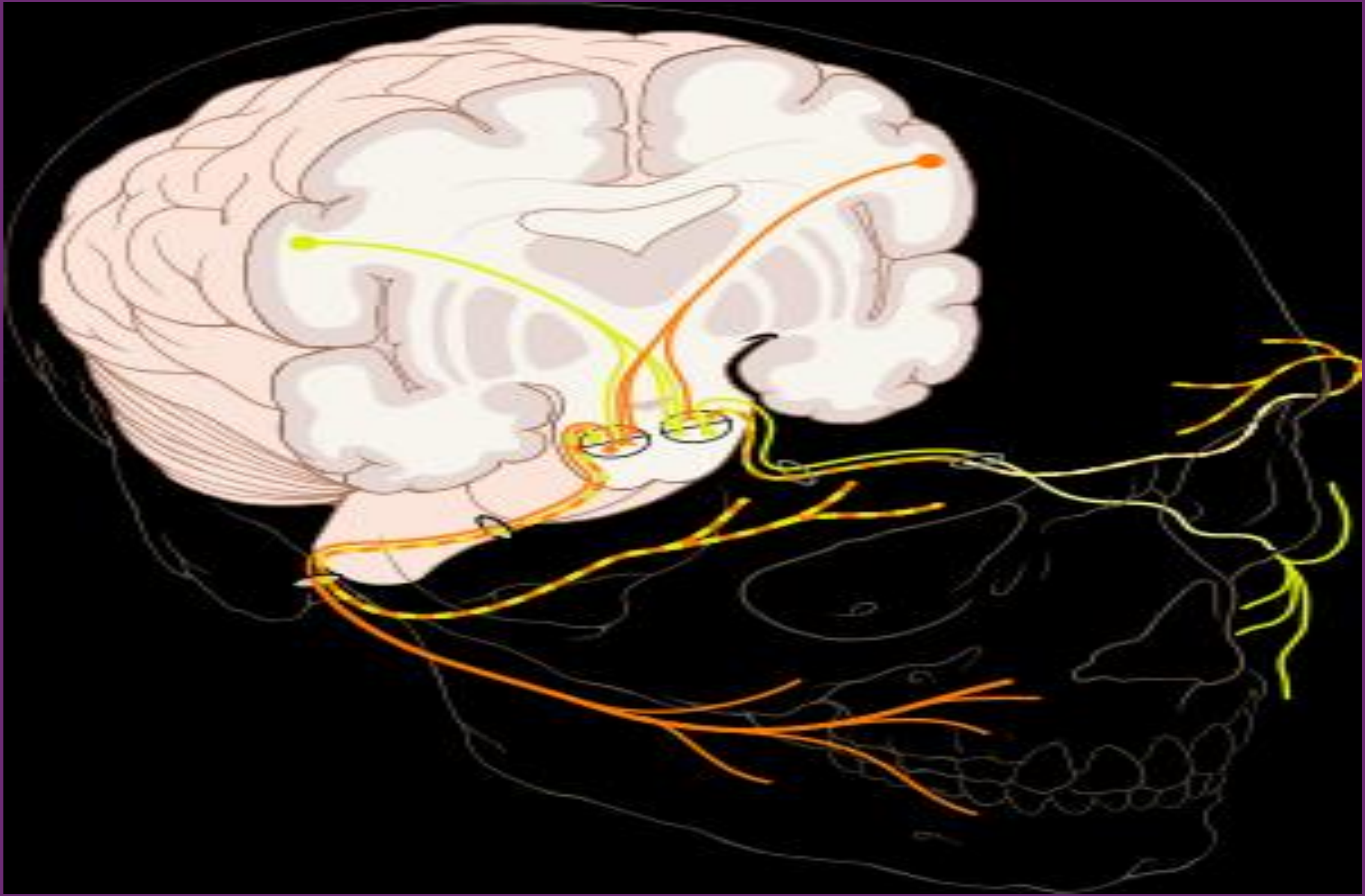
Mirroring Human to chimp ?

Mirror Neurons



Modeling

Contralateral
Facial Muscles and Nerves



Facial Expressions

Left Hemisphere	Right Hemisphere
Controls expression on the lower right side of face	Controls expression on the lower left side of face
• Is NOT adept at reading facial emotion expression (e.g. alexithymics)	• Is adept at reading facial emotion expression

Maternal separation leads to the following:

- ↓ development of inhibitory neurons and changes in the connections of serotonin and dopamine neurons in the mPFC
- Downregulation of gene expression for GABA receptors in the locus ceruleus, resulting in more norepinephrine
- Upregulation of gene regulating glutamate receptors, which contributes to anxiety and depression.
- Abnormally programmed gene expression in the amygdala, hippocampus, and PFC, priming the stress system
- Plasticity between the PFC and amygdala skewing toward the amygdala and the rest of the stress system

Epigenetic changes to the developing child's stress response system

Still Face and Visual Cliff

- Visual Cliff paradigm (Source, 1985)
  - –Mother shows fear – child won't cross
  - –Mother smiles 80% will cross
- Still Face paradigm (Tronick, Cohn, Field)
  - –9 months old no longer approach novel toys—imagination shuts down
  - –s/he becomes agitated and distressed

Still Face

Amygdala activation adults vs. children

- The amygdala involved in disambiguation of social situation—helps an individual disregard irrelevant information
- Fearful faces provoke more amygdala activity in adults than children
- Neutral faces (ie. Still Face Paradigm) provoke more amygdala activity in children than adults
- (Tottenham, et. al., 2009 for review)
- With maturation: neutral faces and ambiguity are tolerated due to increased cortical processing

(Casey, et. al., 2005)

Gender Differences

- Boys more likely to likely to orient towards mothers' facial expression of joy, vocalizations, and gestures
- Girls more object oriented with sustained attention
  - Girls show more self-regulatory behaviors
  - Greater PFC—amygdala development
- The slower development of boys makes them more reliant on caregivers for help with their emotional regulation.
  - More at risk for suffering from abuse and neglect
  - More reactive to maternal emotions
  - More hostile attribution bias to ambiguous social situations

Client Education

- Though the stress thermostat function in your brain is not working, we will work <u>together</u> to rebuild it so that you will no longer react to normal situations as if they are dangerous.

D.W. Winnicott

- **Analysand of Melanie Klein**
- ***Good-enough parenting***
- **The *holding environment***
- ***Impingements mirroring***
- ***transitional object***

“Good Enough” Parents

- Perfect *isn’t* good enough
- High levels of affective matching correlate with insecure attachment
- Low levels also correlate with insecurity
- Moderate matching is optimum

Good-enough parenting and frustration tolerance

- **If the baby is matched by instantaneous soothing s/he will not develop the PNS and the brakes to the SNS and HPA axis**
- **Good enough parenting factors in time before the baby is soothed**
  - **To anticipate being soothed and activate the parasympathetic nervous system**
  - **builds in frustration tolerance**

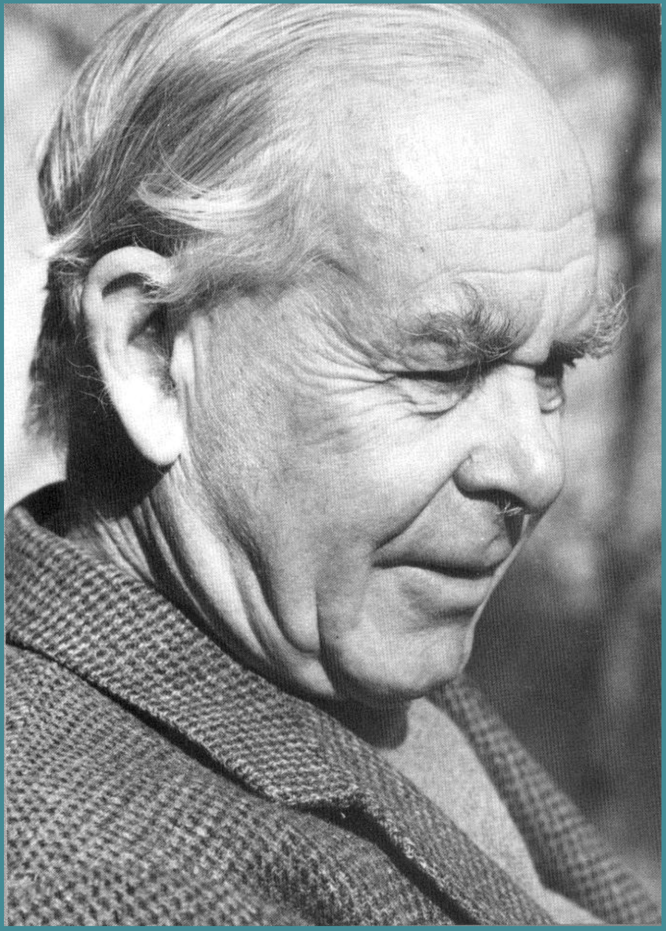
Hyperatunement

John Bowlby (1907 – 1990)

- ***Supervised by M. Klein***
- ***Safe haven***
- ***Attachment figures***
- ***Proximity seeking***

– infants seek proximity to the attachment figure for safety.

"Like a thermostat"



Client Education

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ISS/ Maternal Behaviors

Child Categorization	*Maternal Behavior*
(Secure)	emotionally available, perceptive & effective
(Avoidant)	distant & rejecting
(Anxious/Ambivalent)	inconsistent availability
(Disorganized)	conflictual behavior

The Neuroscience of Attachment

- Balance Between the two branches of the Autonomic Nervous System
- Endorphin & Benzodiazepine receptors
- Cortisol Regulation
- Positive Immunological Functioning
- Neural Growth and Plasticity

Thermostat of Attachment

- Secure attachment limits elevations of cortisol in stressful situations because the parent perceives and responds to the inner state of the child (Fonagy & Target, 1997).
- Early positive maternal care protects the hippocampus from high levels of cortisol (Meaney et al., 1989).
- Insecurely attached toddlers in the face of stranger and separation situations show elevated cortisol levels (Nachmia, et al, 1996).

Ethnic Attachment Styles

- **Northern Germany-- a preponderance of *Avoidant* patterns of attachment. It is not uncommon for parents to leave their babies unattended or outside of supermarkets.** (Grossman, et al., 1981)
- **In Japan – a preponderance of *Ambivalent* and hard to sooth infants. Mothers and babies are rarely separated. Babysitting is rare and when it occurs is generally with grandparents** (Miyake, et al,1985).
- **Among Kibbutzim in Israel babies have been reported to become *anxious* by the entry of strangers in attachment testing situations. Strangers, therefore, are distrusted.** (Saarni, et al, 1998).

Insecure Attachment Longitudinally

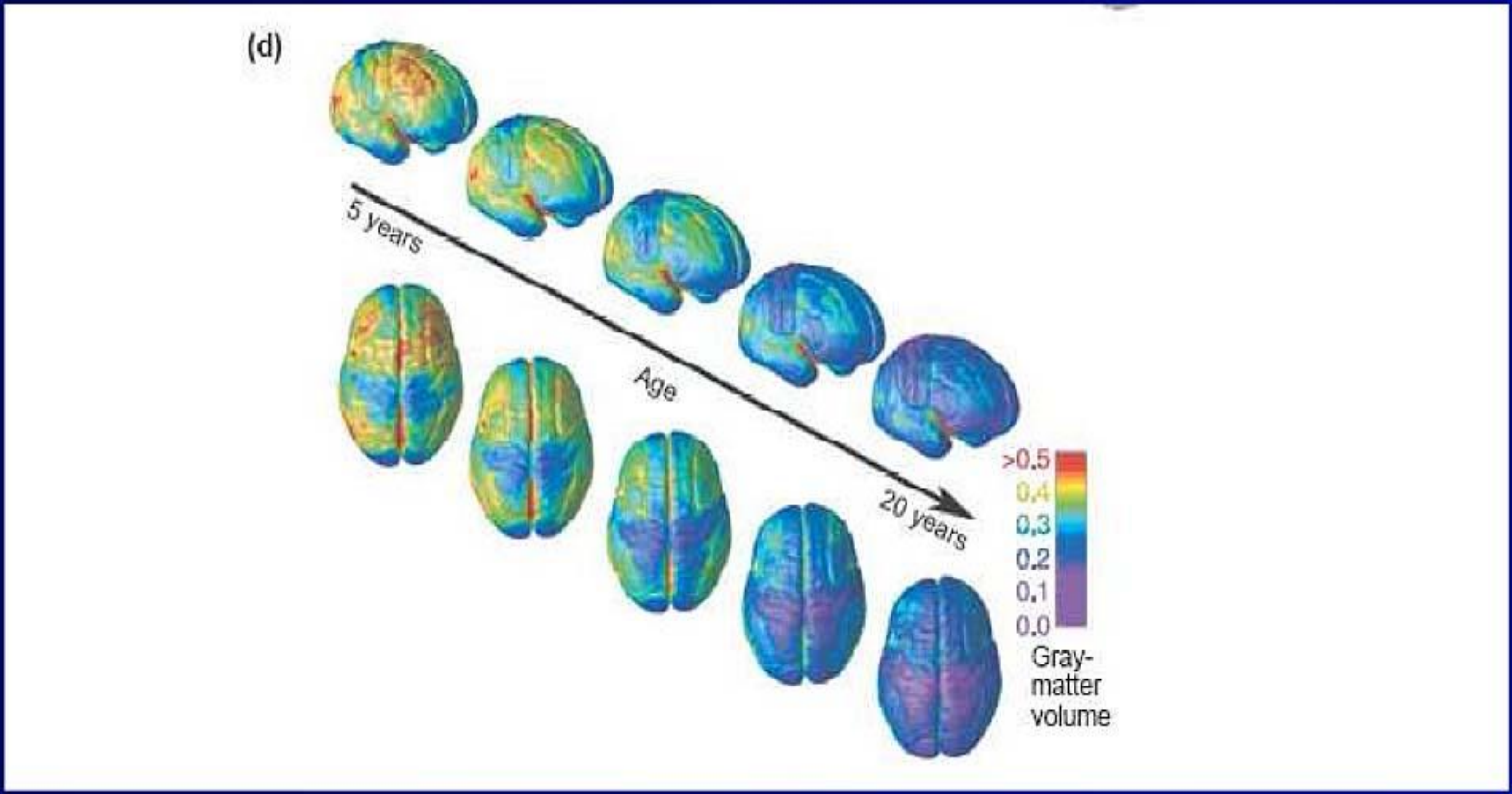
- Anxious/ambivalent and avoidant attachment styles associated with the development of depression.
  - Avoidant style leads to depression based on a sense of alienation
  - Anxious /ambivalent style leads to depression based on an internalized sense of helplessness and self-doubt.

Sibling Relationships

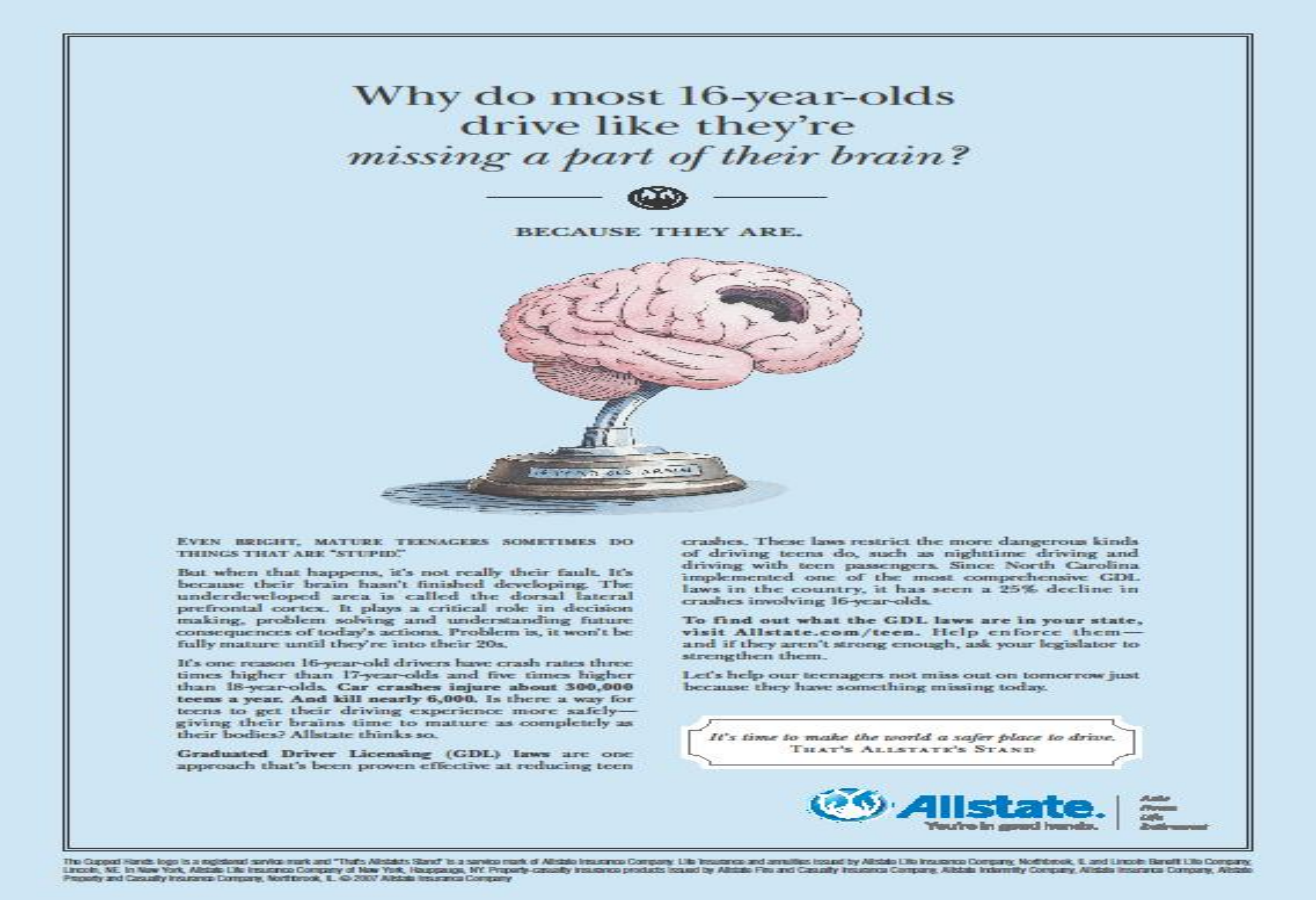
The Adolescent Brain

- Relative to adults:
  - Heavy reliance on the amygdala
  - While relatively less reliance on PFC
  - Less activity in the nucleus accumbens
  - Less DA
  - More oxytocin
- As a result they feel that they need to:
  - Seek excitement to get enjoyment
  - Seek affiliation and the feeling of belonging

The Adolescent Brain Changes



The Cost of Adolescence



Adolescent Brain Changes

- Between ages 10-12 frontal lobes go through a growth spurt with new connections and branching.
- Major synaptic pruning (loss of 50% of synaptic connections)
- Increased myelination (15x faster)
  - Mid 20s myelination of the PFC (especially the DLPFC)

The Adolescent Brain

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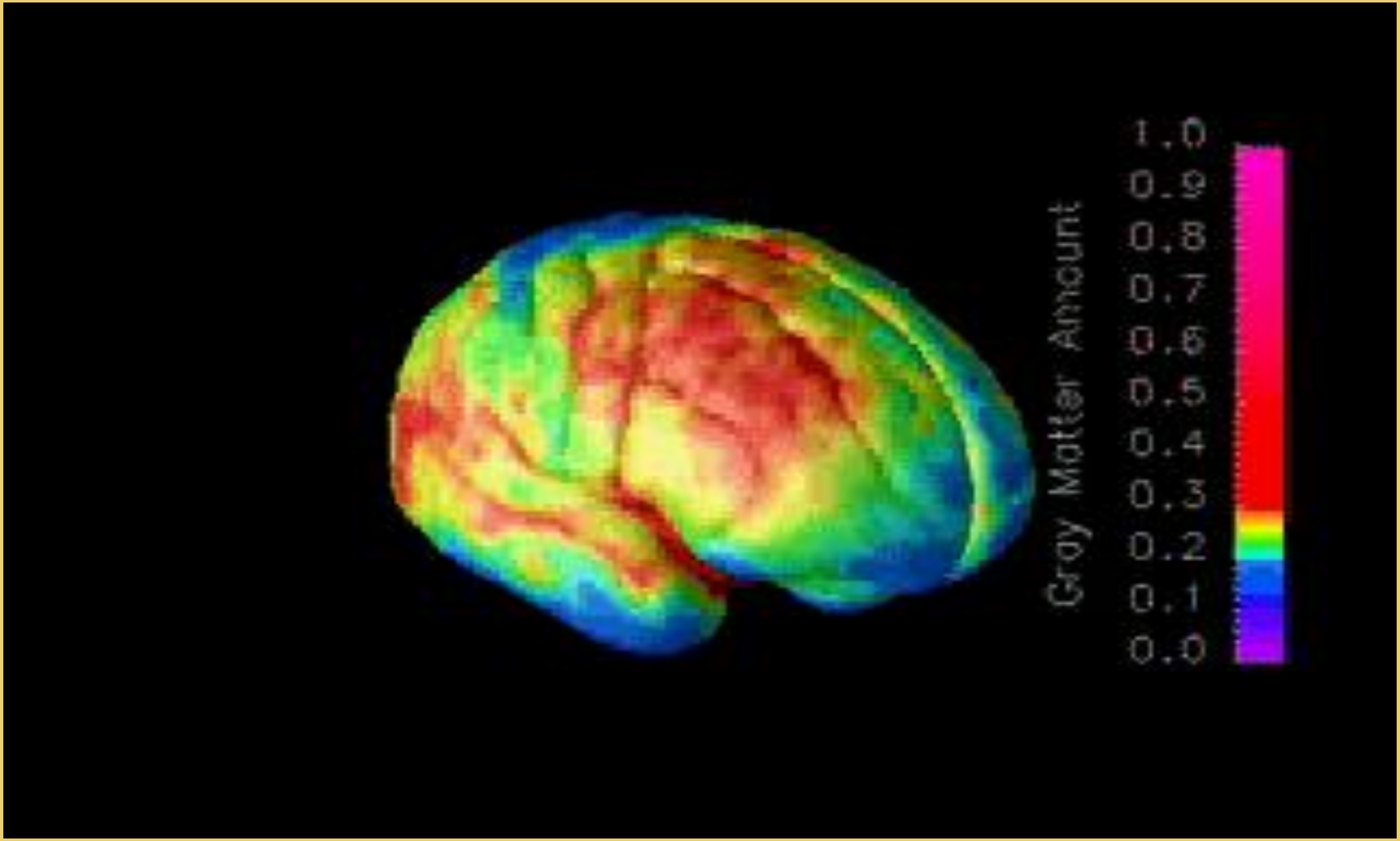
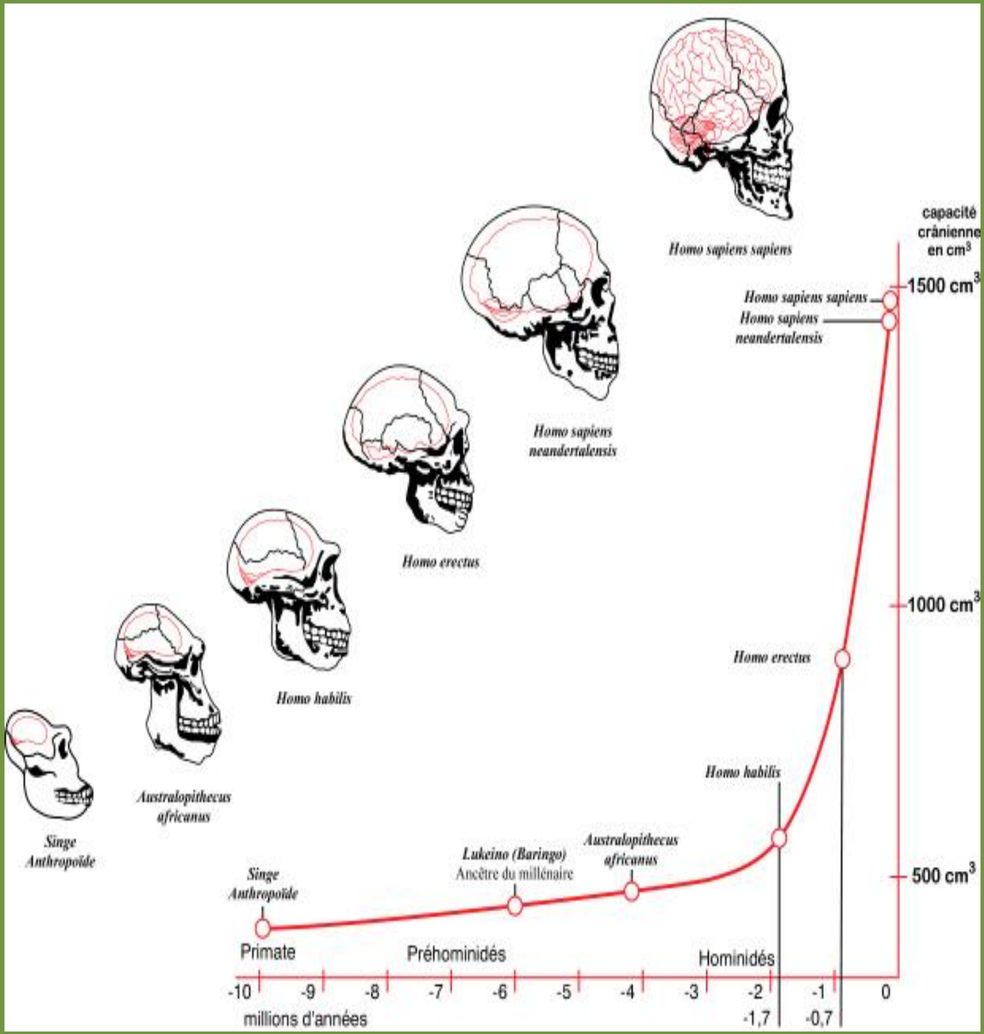
The Adolescent Brain Changes



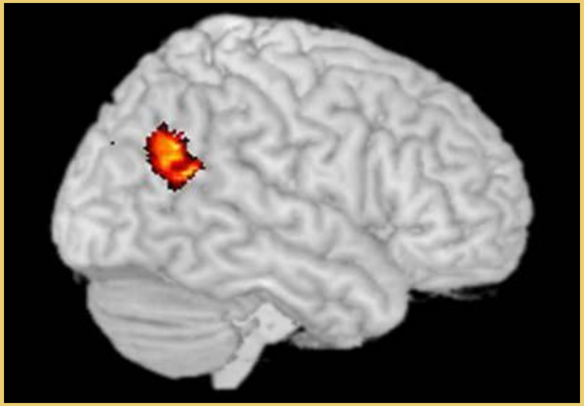
Brain Evolution

- Human evolution is the story of growth & increased complexity of the cortex

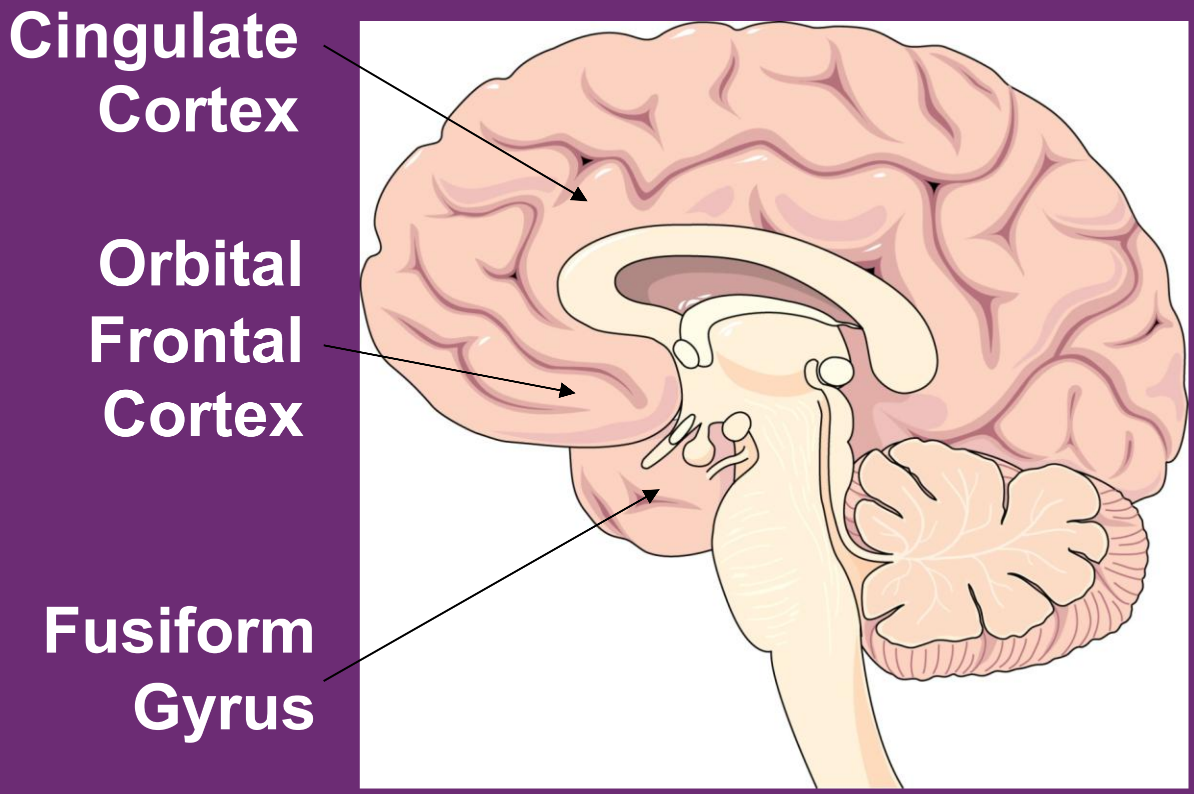
- PFC- 20% of the human brain is comprised of the frontal lobes
(FYI - 3.5% of the cat's brain is in the frontal lobe)



Theory of Mind



- Amygdala
- Insula
- Right TPJ
- Anterior cingulate (Siegal & Varley, 2002)
- The R-OFC -- decoding mental states
- The L-OFC -- reasoning about those states (Sabbagh, 2004).
- There may be major nodes:
  - the medial prefrontal cortex for self-related mental states;
  - the superior temporal sulcus for goals and outcomes

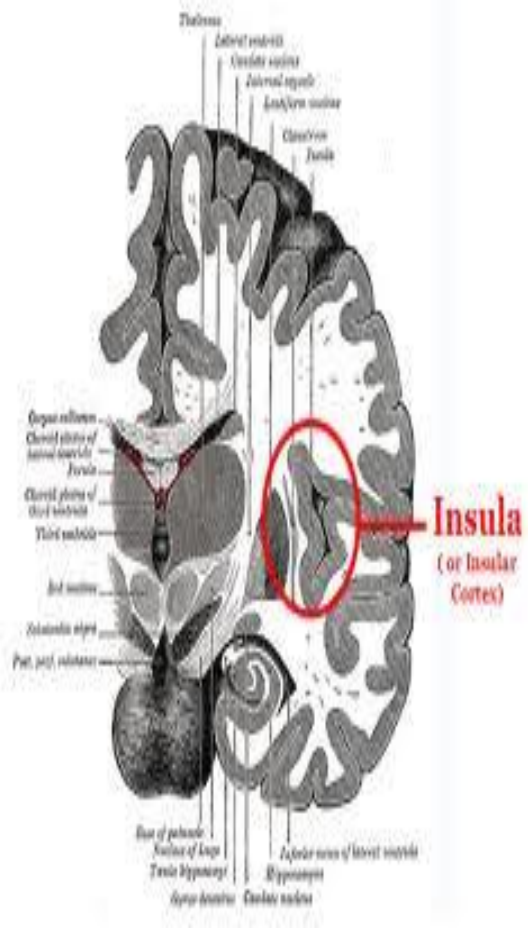

Cingulate Cortex
Orbital Frontal Cortex
Fusiform Gyrus

Anterior Cingulate Cortex

- ACC integrates cognitive and emotional information (Bush, et al, 2000)
- Active when detecting emotional signals from self and others (Critchley, et al., 2004)
  - The ACC is involved in both physical pain and social rejection (Eisenberger & Lieberman, 2005)
  - The dorsal ACC activates when fear of rejection occurs (Lieberman, 2005)
  - Activated when someone we love experiences pain or social ridicule (Botvinick, et al, 2005)
- Part of neural basis for cooperation (Pilling, et al, 2002)
- Damage results in reduced empathy and/or maternal behavior (Brothers, et al., 1996)

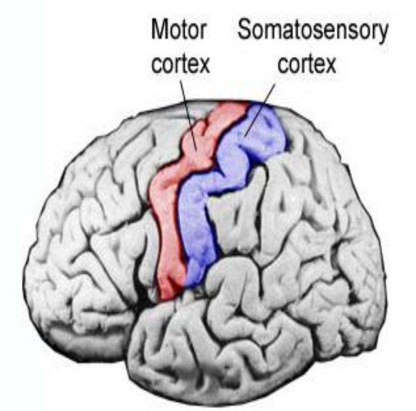
Insula and Empathy

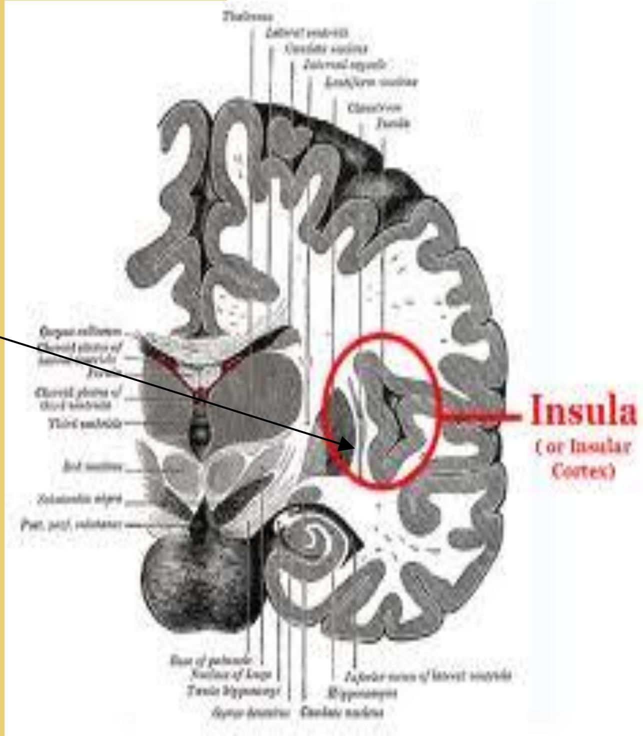
- Conduit between subcortical areas and cortex
- Draws on information from body areas, and input from amygdala and hippocampus
- Works with medial PFC to interpret and regulate emotional experiences
- Links mirror neuron systems with body states “Insula Hypothesis of empathy (Carr, et al, 2003)



Insula and Touch

- Soft touch: C—Tactile fibers (CT)
  - Unmyelinated—thus slower, tracks to the:
    - **insula** (part of the Salience Network
    - Emotional touch
    - Oxytocin
    - Impaired in people struggling with forming relationships





VENs--Spindle Cells

- Found in abundance in the OFC, AIC, and ACC---transmitting salience info
- Four times larger than other neurons, with a long extension
- At birth humans have approximately 28,000 spindle cells,
  - growing to 184,000 by age four,
  - 193,000 by adulthood.
- By comparison an adult ape has 7,000.

VENs-- Spindle Cells

- Respond extremely quickly— “Behavioral Flexibility”
- Involved in making snap judgments, but also in solving complex problems in emotionally stirring situations
- Rich receptors of dopamine, serotonin, and vasopressin, important for generating mood and bonding
- Vulnerable to neglect, abuse, and trauma

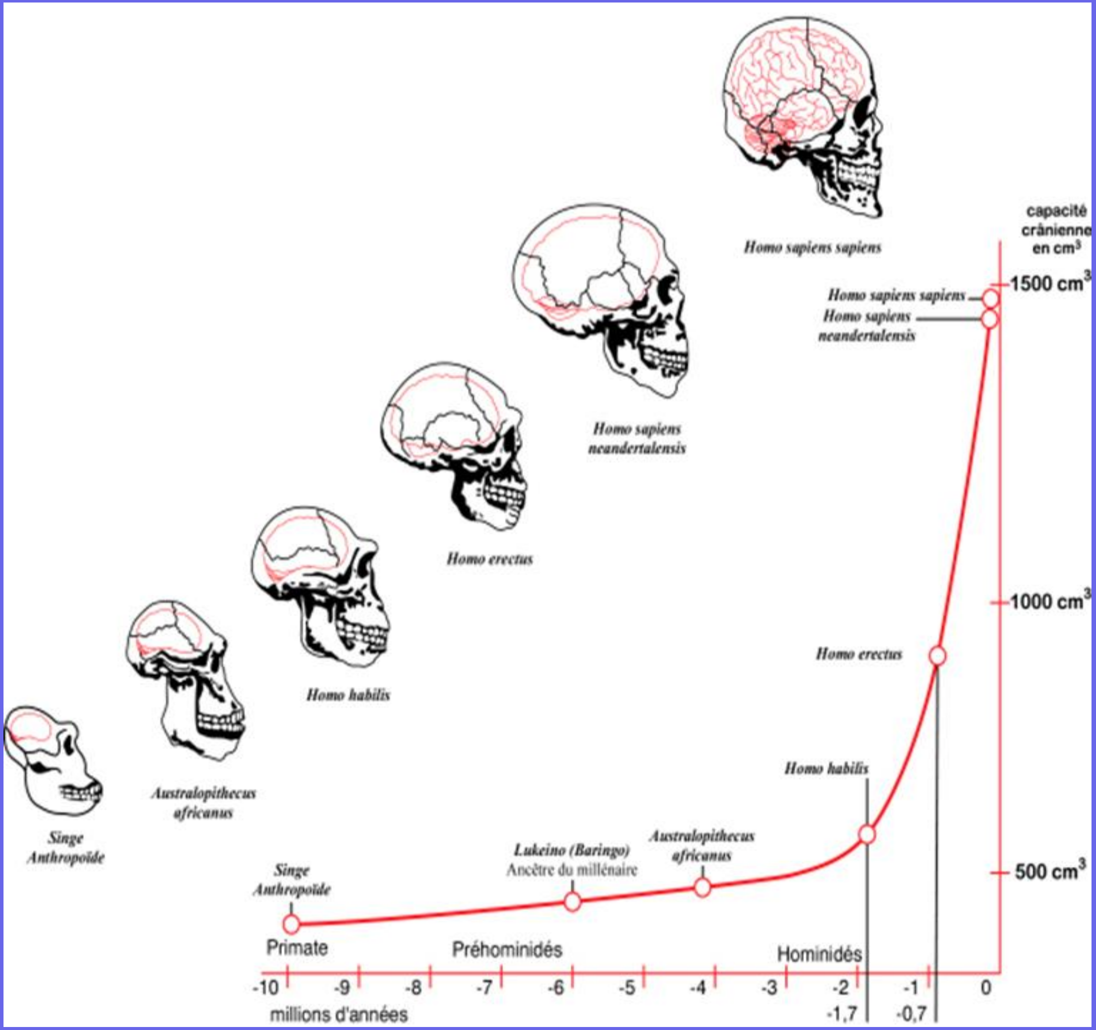
Correspondence between Child & Adult Attachment Categories

Child (ISS)	*Adult (AAI)*
- secure	- free/autonomous
- avoidant	- dismissing
- ambivalent	- preoccupied
- disorganized	- unresolved

Frontal Lobes: & Brain Evolution

•Human evolution is the story of growth & increased complexity of the cortex and PFC

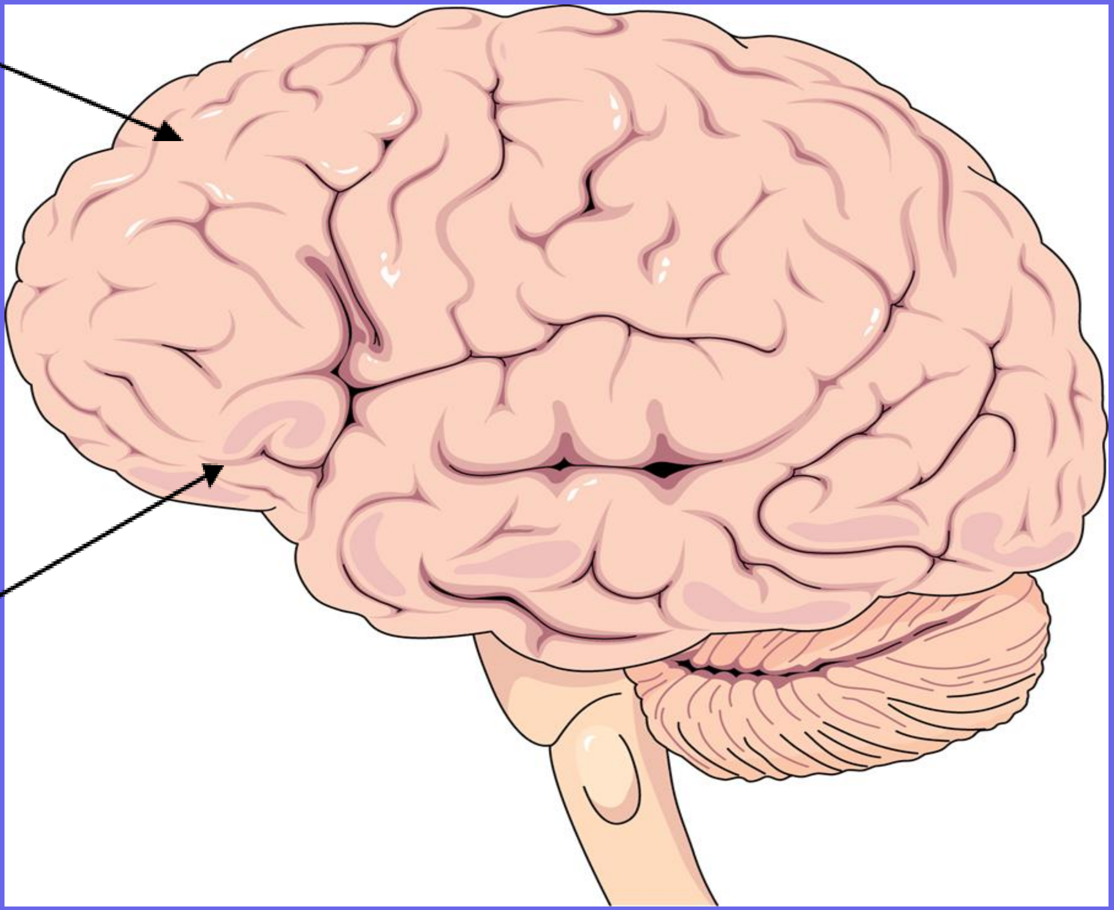
- Humans: 30%
- Chimps: 12%
- Dogs 6%
- Cats 3%



DLPFC and the OFC

Dorsolateral Prefrontal Cortex

Orbital Prefrontal Cortex



Pre-Frontal Cortex

- Dorsolateral pre-frontal cortex (DLPFC)---working memory: 7, plus or minus 2, ……….or 20-30 seconds of information
- Orbital frontal cortex (OFC)
  - Social brain
  - Affect regulator
  - Empathy
  - Attachment, warmth, and love
  - Connections with limbic area, i.e., amygdala
  - Phineas Gage

Phineas was no longer Phineas

The OFC and Serotonin

- Large numbers of 5-HT receptors in the OFC
- ↓ 5-HT in OFC ↓ inhibition of the amygdala
- Tryptophan depletion impairs reverse learning tasks (Robbins & Everitt, 1995)
  - Ability to evaluate, integrate, and act on environmental cues
  - To stop responding to something when it becomes unhealthy and shift back to something healthier

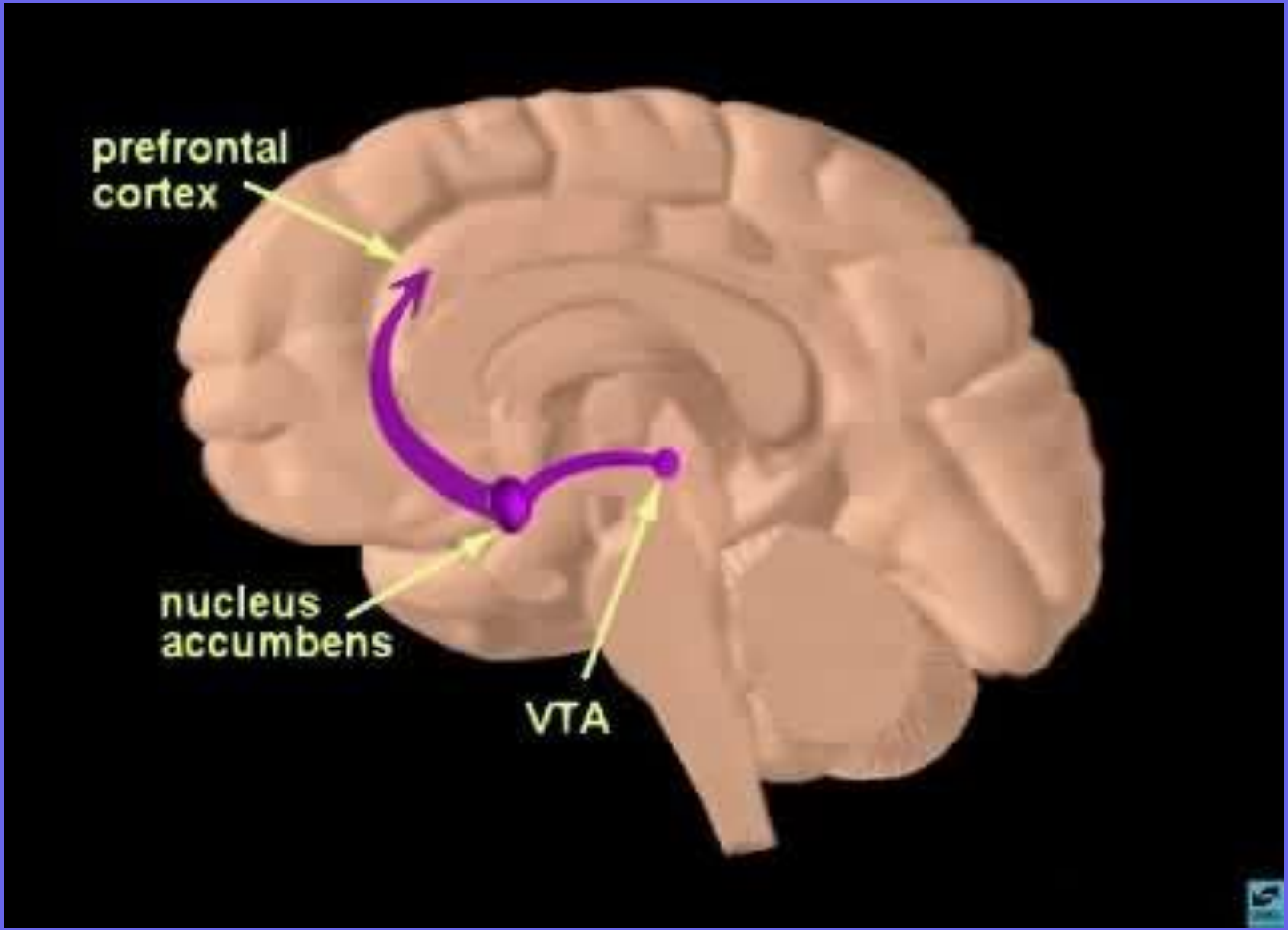
Deficits in OFC and DLPFC

- OFC deficits
  - emotionally disinhibited
  - insensitive to ambiguity
- DLPFC deficits
  - ”pseudodepression”
  - aspontaneity and a <u>lack</u> of affect—rather then negative affect

PFC—ADD vs ADHD

- OFC impairment—ADHD
  - Difficulty with affect regulation
- DLPFC impairment—ADD
  - Difficulty maintaining attention
  - Working memory

Pleasure and Addiction



Dopamine

- Most widely studied chemical in addiction
- Implicated in many mood-altering substances
- Dopamine hypothesis - drugs of abuse release dopamine in the mesolimbic dopamine system
- At heart of all reinforcing behaviors (“currency of reward”)

Glutamate

- Associated with learning, memory, and motivation
- Relates to brain's ability to adapt to the environment (neuroadaptation)
- Involved in projections to orbitofrontal cortex
- Sustaining addiction (to cocaine) relies on dopamine AND glutamate
- Related to drug seeking (motivation) and drug memories
  - Implicated in relapse?

Effects of Acute Alcohol on Other Neural Circuits

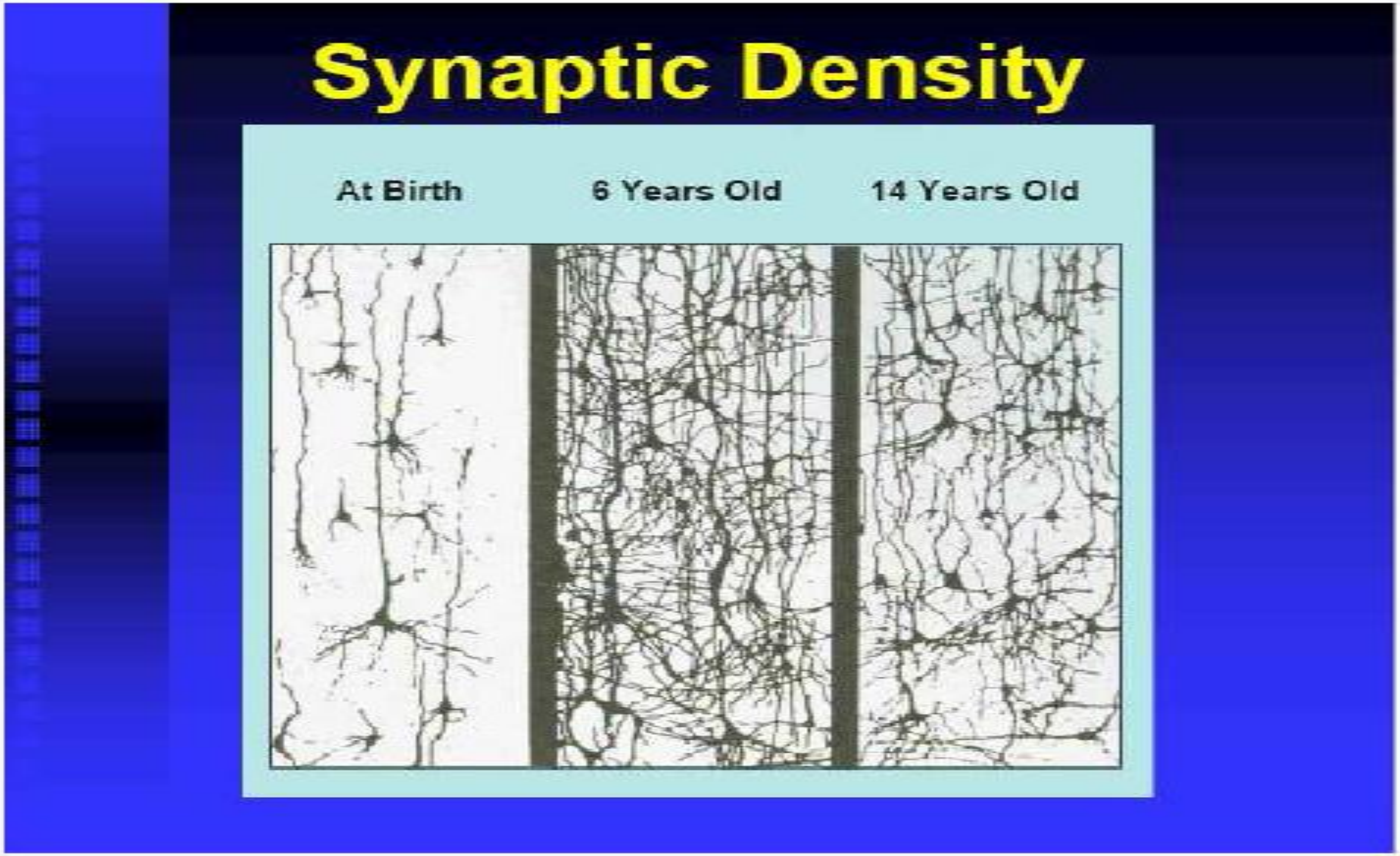
GABA and Glutamate Systems

- Increases the effects of GABA, the major inhibitory neurotransmitter in the brain
- Inhibits the effects of glutamate, the major excitatory neurotransmitter in the brain
- Contributes to decreased anxiety and increased sedation during acute alcohol intake

GABA = gamma-aminobutyric acid.

Source: Littleton J. *Alcohol Health Res World*. 1998;22:13-24.

Alcohol damages dendrites and white matter, reducing message traffic between neurons and transmission speed.

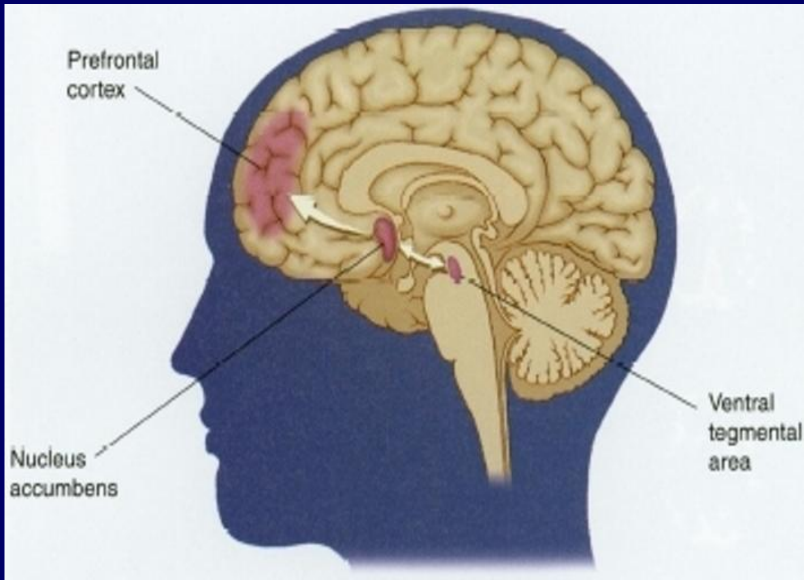


Marijuana

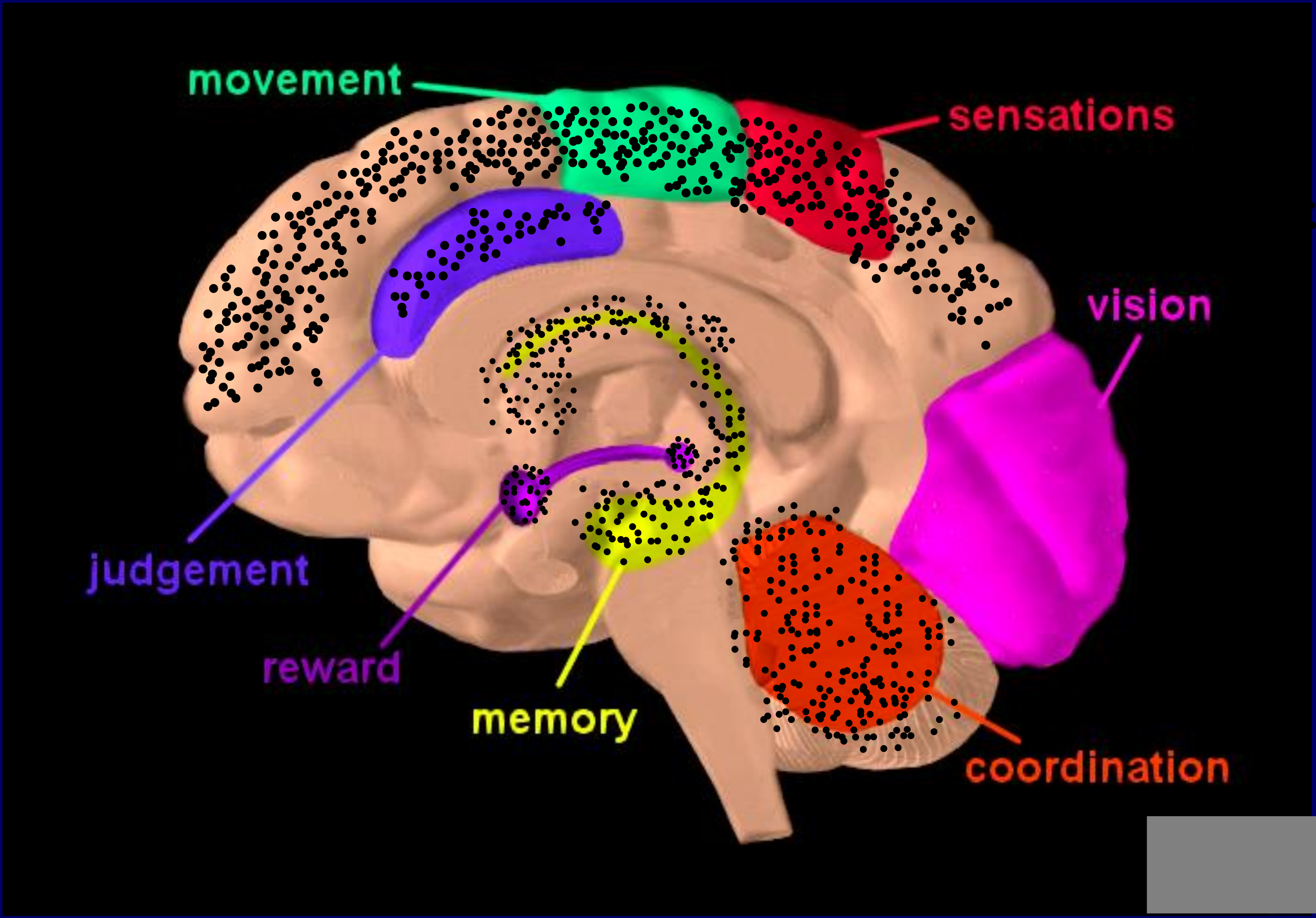
- 2 endogenous cannabinoid (CB) receptors:
  - Anadamide (Sanskrit for bliss)
  - 2-archidonyl-glycerol (2-AG)
- Anadamide inhibits the release of glutamate and acetycholine within the cortex and the hippocampus
  - Impairing the formation of memory
- The CB receptors enhance the release of DA
- Stimulation of the CB receptors in the hypothalamus underlies the “munchies”

THC: Reward, Pleasure & Addiction

- **Nucleus Accumbens:**
- **Increases dopamine (DA) like other drugs of abuse.**
- **Thinking about MJ causes a release of DA.**



THC Landing (Receptor) Sites



The Downside:

- Tolerance: Receptor Site Degradation
- Receptor sites immediately dwindle.
- Overstimulation: suck receptor sites into the cell.
- Cont’d use: receptor sites dismantled
- Can reduce 90 % of receptor sites.
- Life gets more boring
- Don’t learn as much from negative experiences.

Long-Term use of Marijuana

On 9 standard neuropsychological tests that assessed attention, memory, and executive functioning

- Impaired Learning
- Impaired Retention
- Impaired Retrieval

Impairments endure beyond the period of intoxication and are worse with increasing years of regular cannabis use

Solowij et al., *JAMA*, Vol. 287, No. 9, pp. 1123-31, Mar 6, 2002

MJ: Addiction & Withdrawal Sx**

- Peak Symptoms 2 – 6 days into withdrawal. Duration for most symptoms is 5 – 21 days.

- Craving
- Anger/Irritability/Aggression
- Sleep Disturbances
- Increased dream sleep including "strange dreams"
- Nervousness/anxiety
- Decreased appetite or weight loss
- Concentration Problems
- Restlessness
- Aches, Pains and Chills
- Sweating

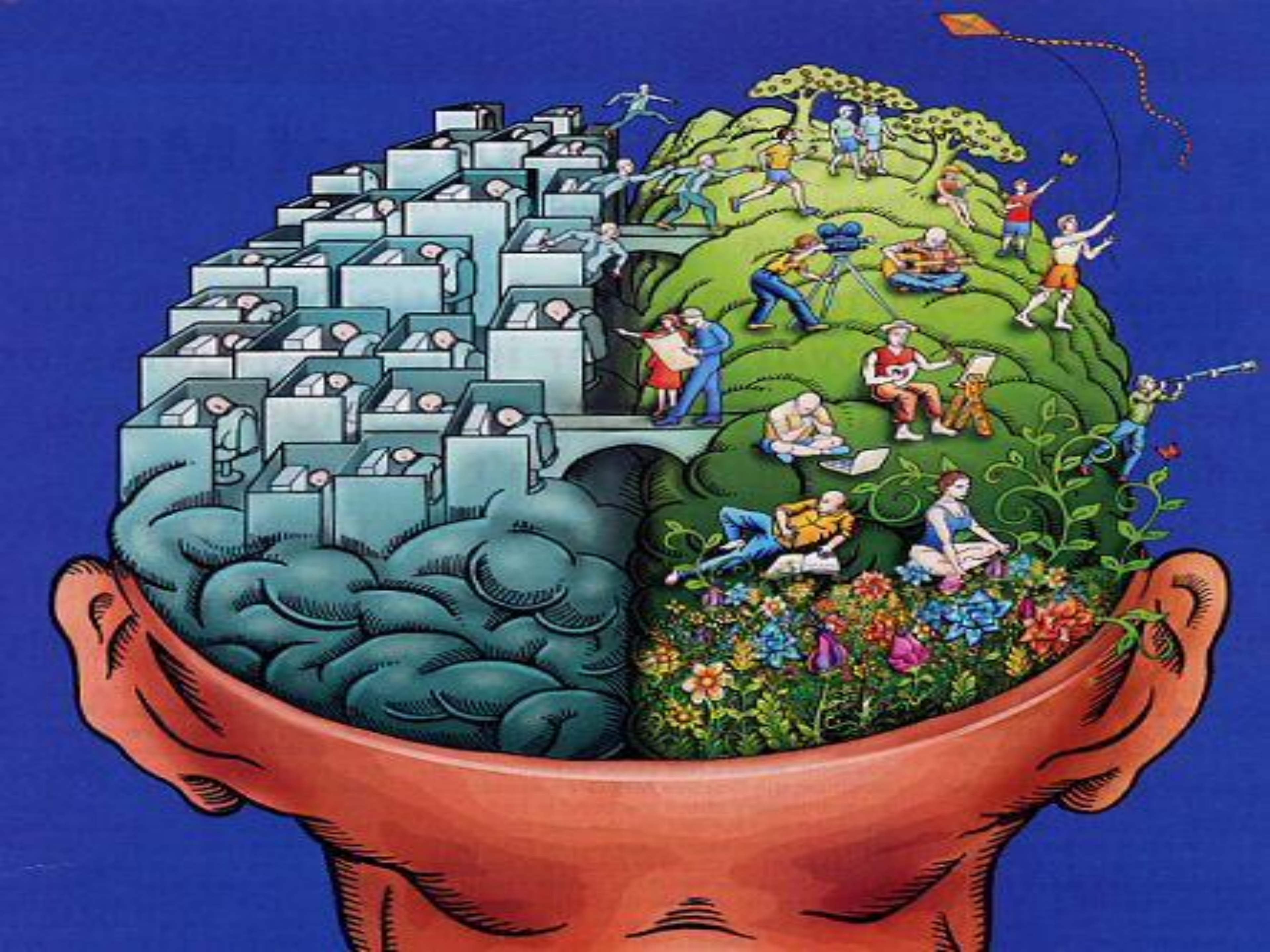
**Withdrawal from heavy marijuana use (25 days/month) is about as harsh as withdrawal from nicotine addiction (10 cigarettes daily) A within-subject comparison of withdrawal symptoms during abstinence from cannabis, tobacco, and both substances Drug and Alcohol Dependence Volume 92, Issues 1-3, 1 January 2008, 48-54 ,

6 Executive Functions impaired withADD

1. Activation—organizing, prioritizing, and activating to work (vs. impulsive or procrastinating)
2. Focus—Sustaining and shifting attention to tasks (Jame’s spotlight)
3. Regulating alertness--sustaining effort, and processing speed (vs. drossiness and running out of energy)

6 Executive Functions impaired with ADD

4. Managing frustration—affect regulation and modulating emotions (vs. affective liability)
5. Memory—utilizing working memory and accessing recall
6. Action—monitoring and self regulating action (acting w/o sufficient forethought



Affect Asymmetry
Set points

LEFT FRONTAL LOBE

- Positive emotions
- Approach behaviors
- Labeling thoughts and feelings and
- Developing new narratives (helps to alleviate anxiety and depression)

RIGHT FRONTAL LOBE

- Negative emotions
- Withdrawal behaviors
- Feeling overwhelmed

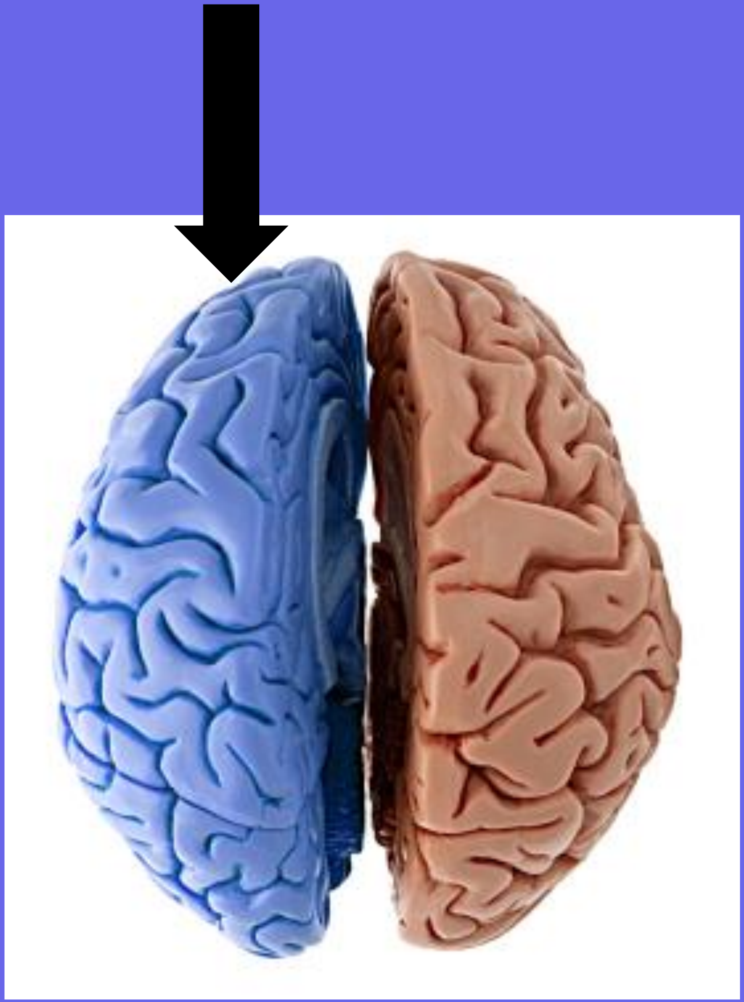
Alexithymic pts. have smaller right ACCs

larger right ACCs--more fearfulness and worry (Gandell, et al, 2004)

Left PFC:

Suppressing Sadness

Activating Positive Emotions

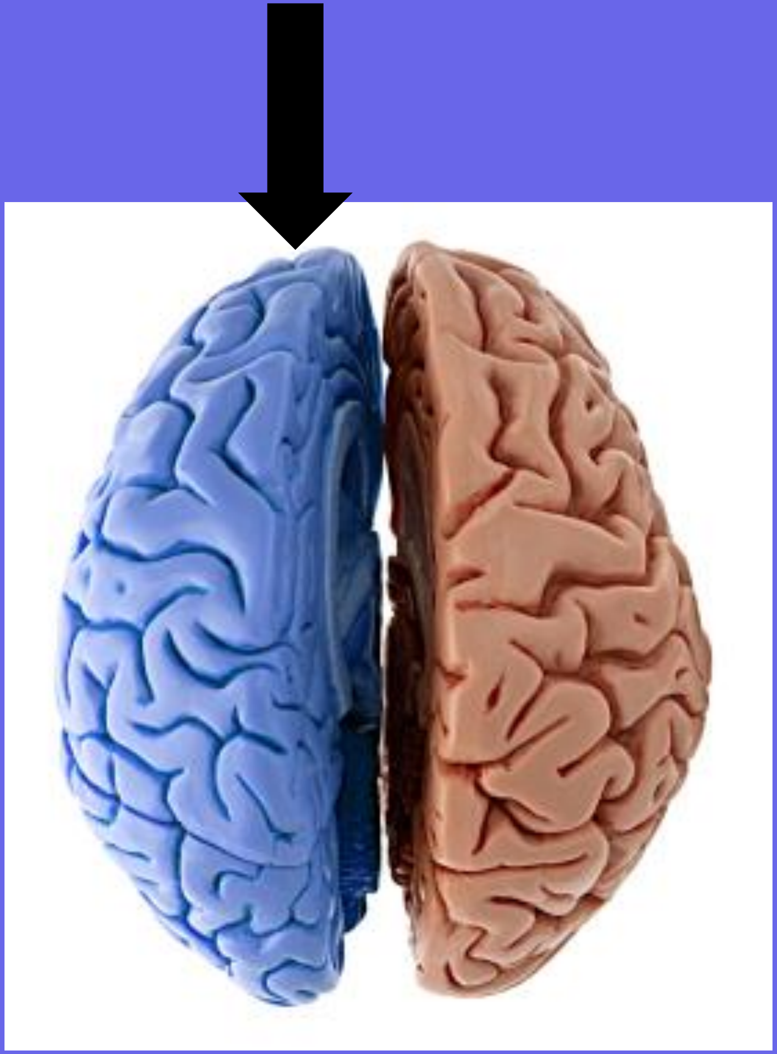


Client Education

- When you are overwhelmed with anxiety or depression it is best to shift from the big picture to the small, and do something that approaches a goal in a piecemeal, incremental manner.

Left PFC:

Activation
&
Approach
Behaviors
(curiosity; assertion)



Right PFC:

Activating Behavioral Inhibition

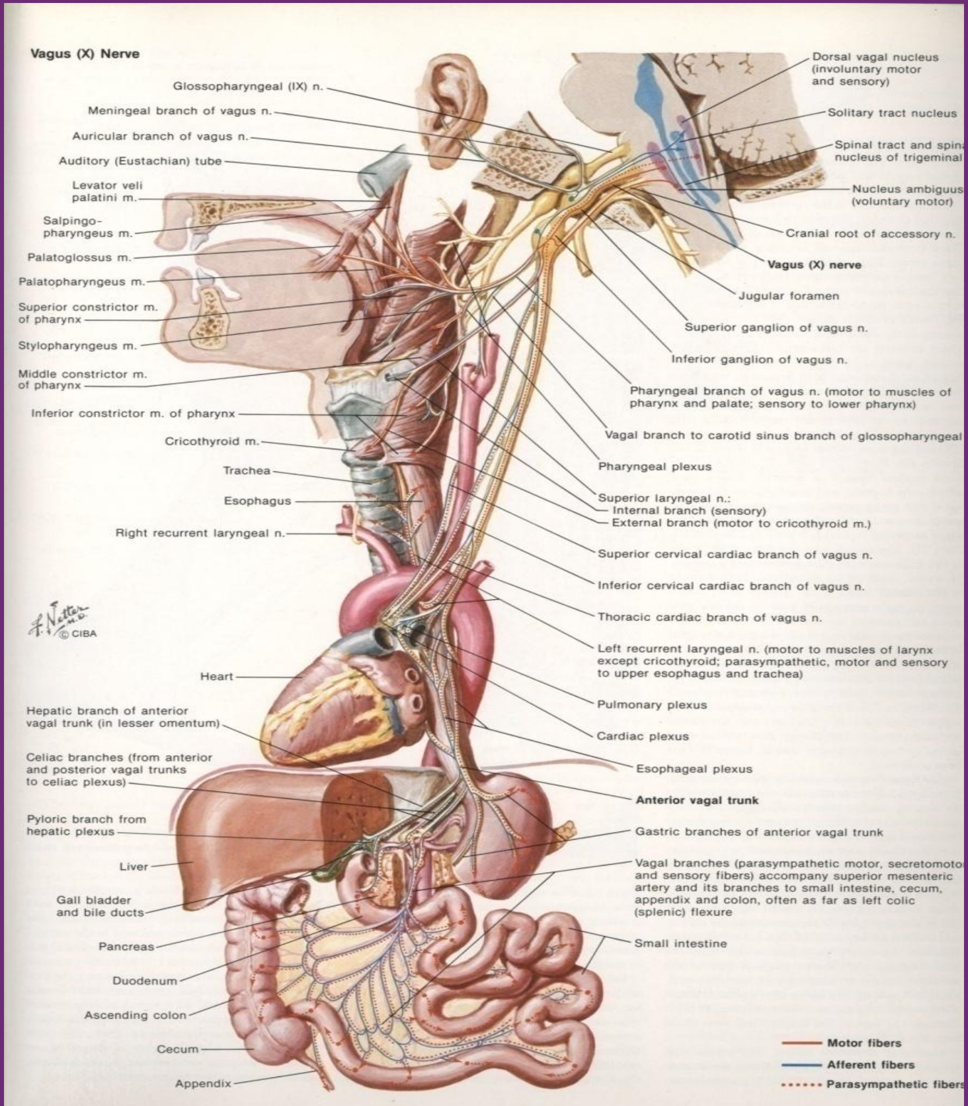
Associated With negative Emotions

The Vagus Nerve System

- Tenth Cranial Nerve --a complex of sensory and motor nerve fibers.

- *Vagal tone*- the ability to modulate target organs without sympathetic arousal

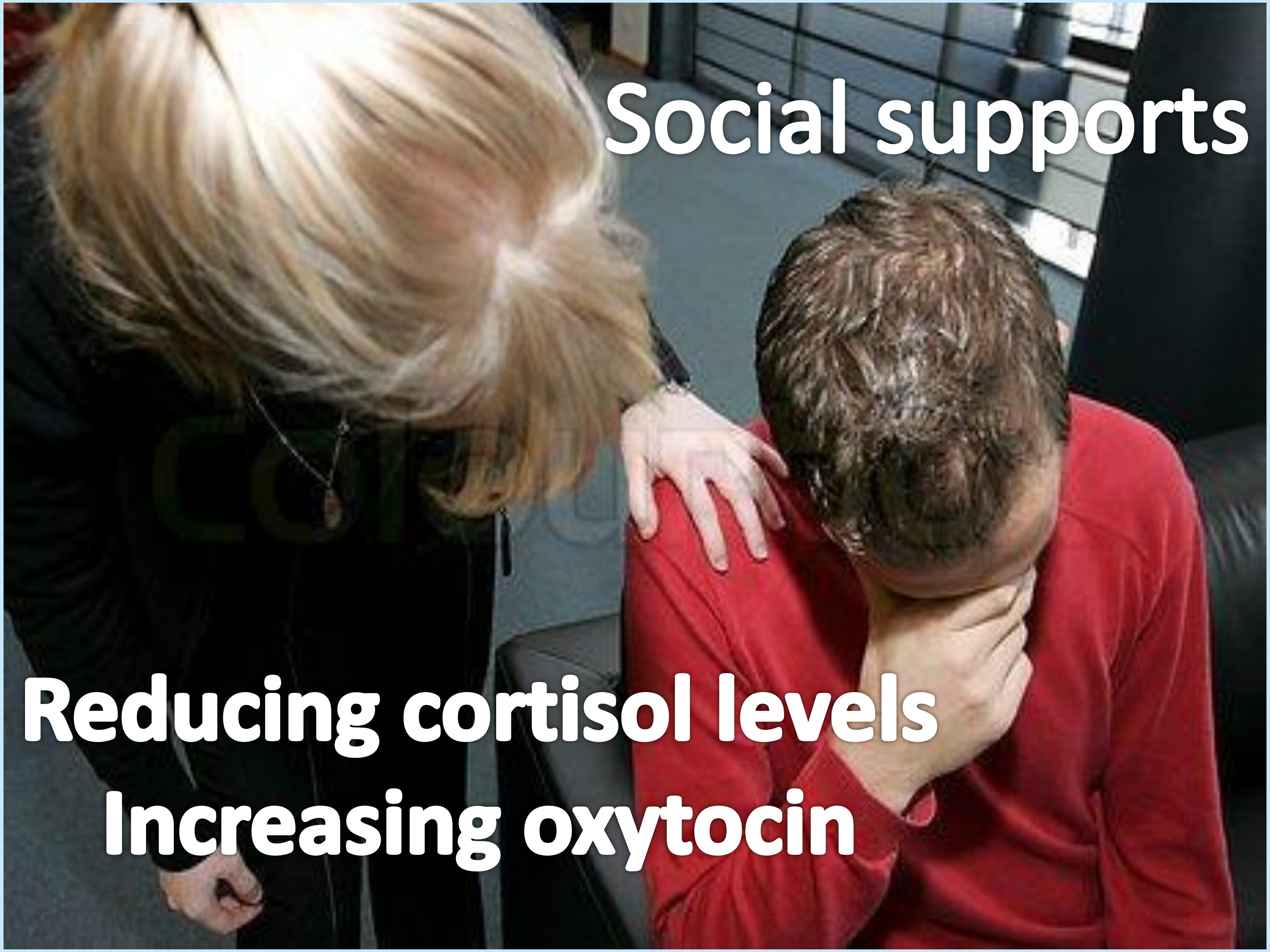
- allows attachment and sustained relationships.



Vagal Brake (Porges)

- *Higher vagal tone* correlates with:
  – Self-Soothing capacity
  – Quality of caretaking and attachment
  – More reliable autonomic responses
  – The range and control of emotional states
- *Lower vagal tone* correlates with:
  -- Anxiety
  – Impulse Control problems
  – Hyperactivity, Attention deficit and distractibility
  – Avoidant & Disorganized Attachment
  – Irritability

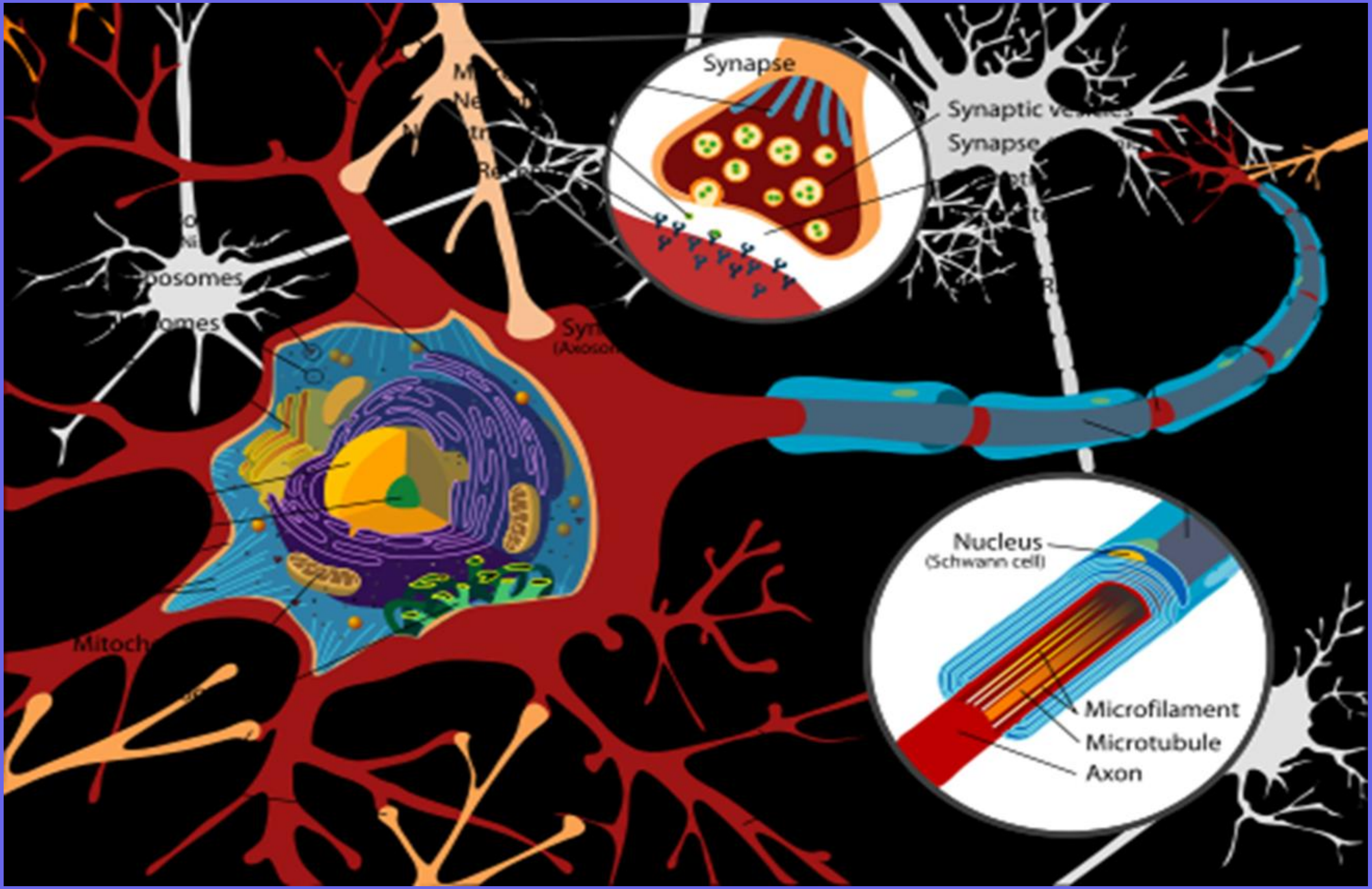
On the market


Social supports
Reducing cortisol levels
Increasing oxytocin

Neuroplasticity

- *Neuroplasticity* is a general term that describes changes in the brain as you experience and learn (Buonomano & Merzenich, 1998)
- Neuroplasticity involves many changes to the brain including:
  – New synaptic connections
  – Strengthening of connections through LTP
  – The growth of new dendrites (dendritogenesis)
  – Neurogenesis (the growth of new neurons)

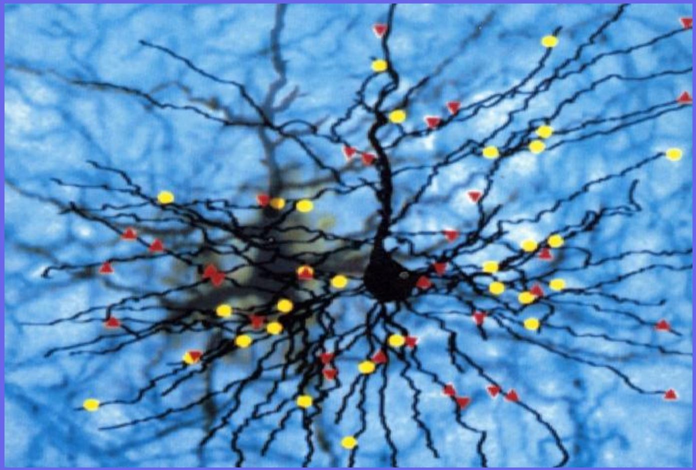
100 Billion Neurons with 10,000 Synaptic Connections



Synapses

Neuroplasticity

- Increases in:
  - synaptic efficacy
  - receptor density

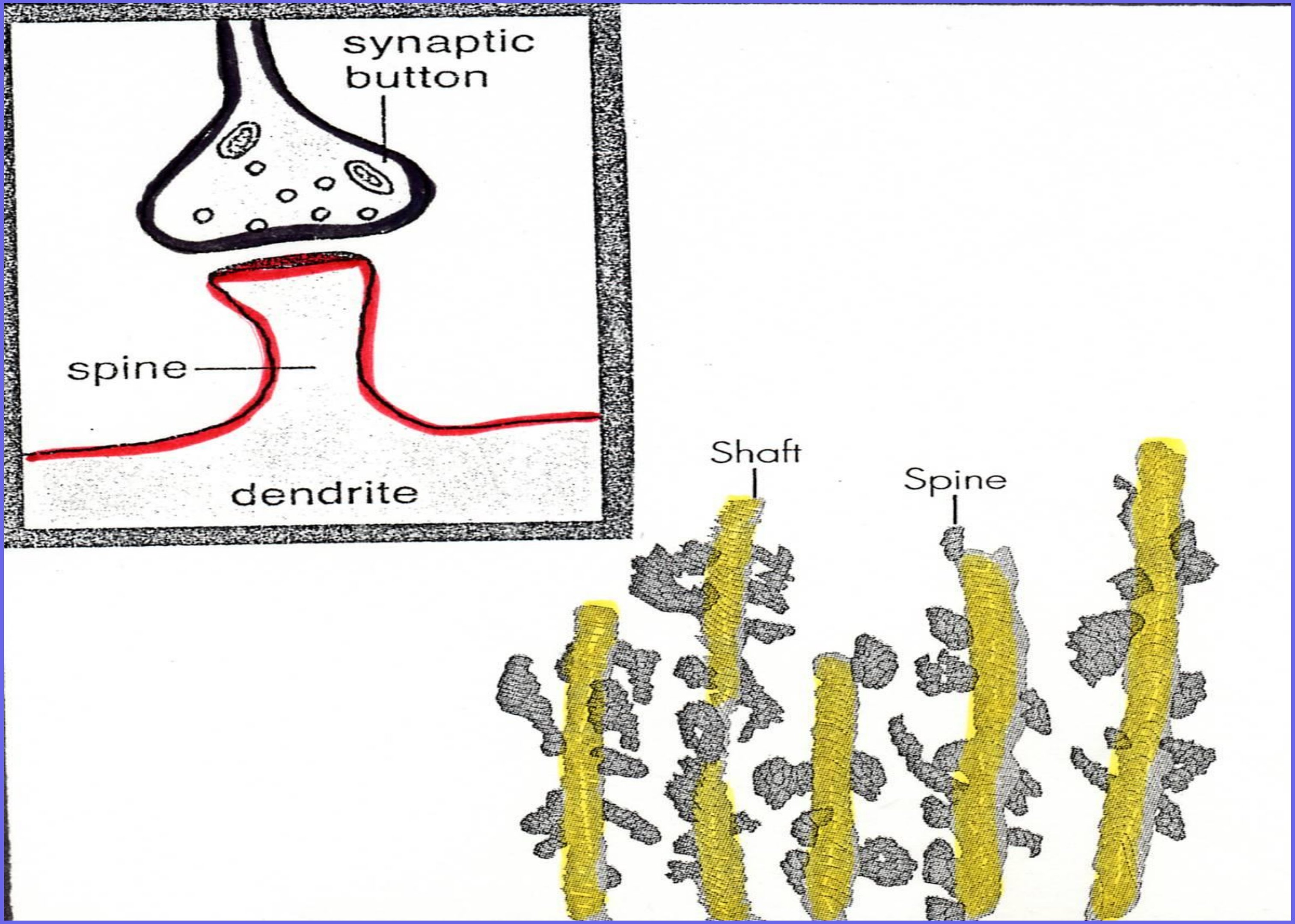


– Up-regulating their activity

– Glial cell availability

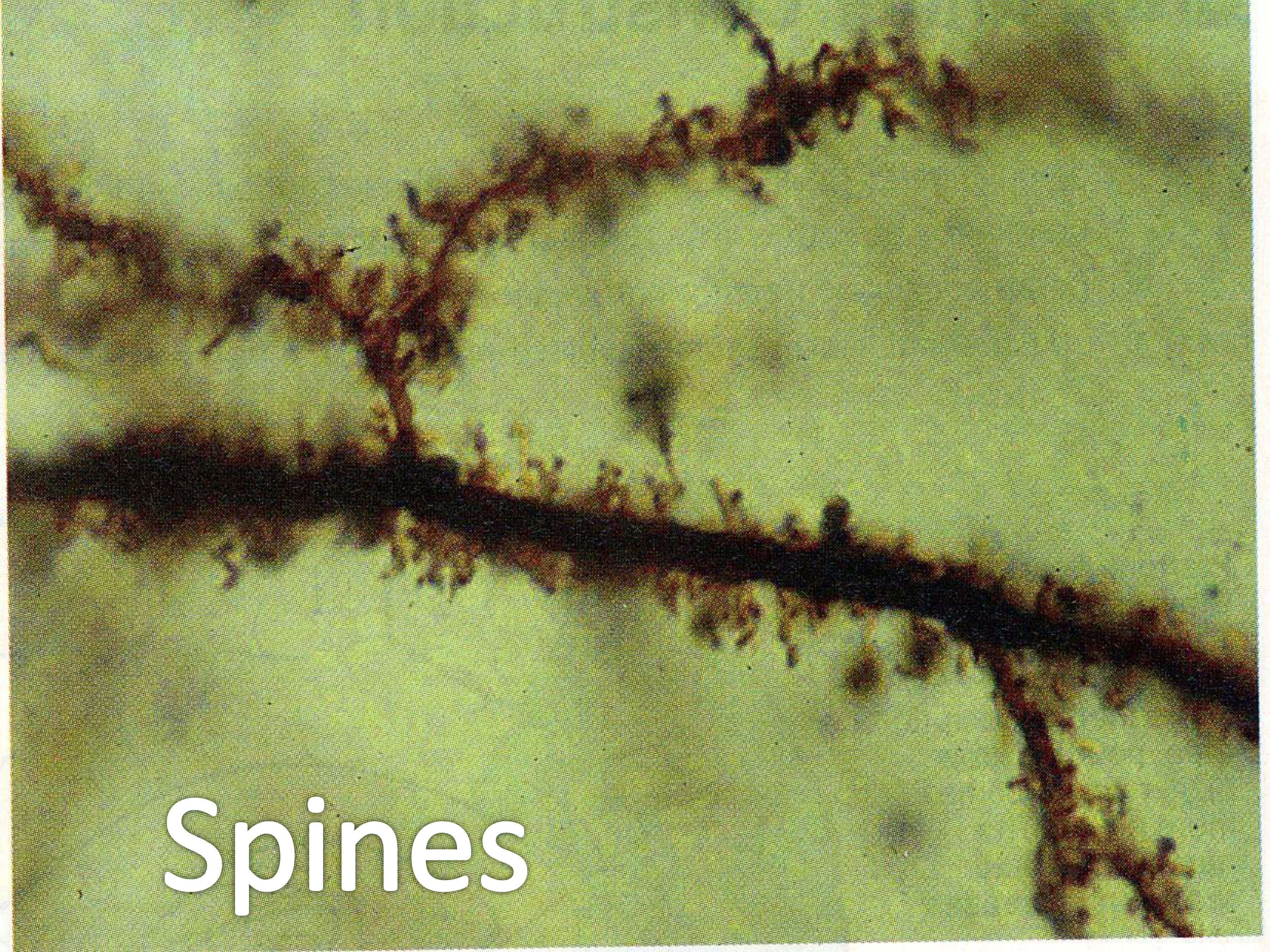
– Changes in the shape and structure of synapses

DENDRITE SPINES & SYNAPSES



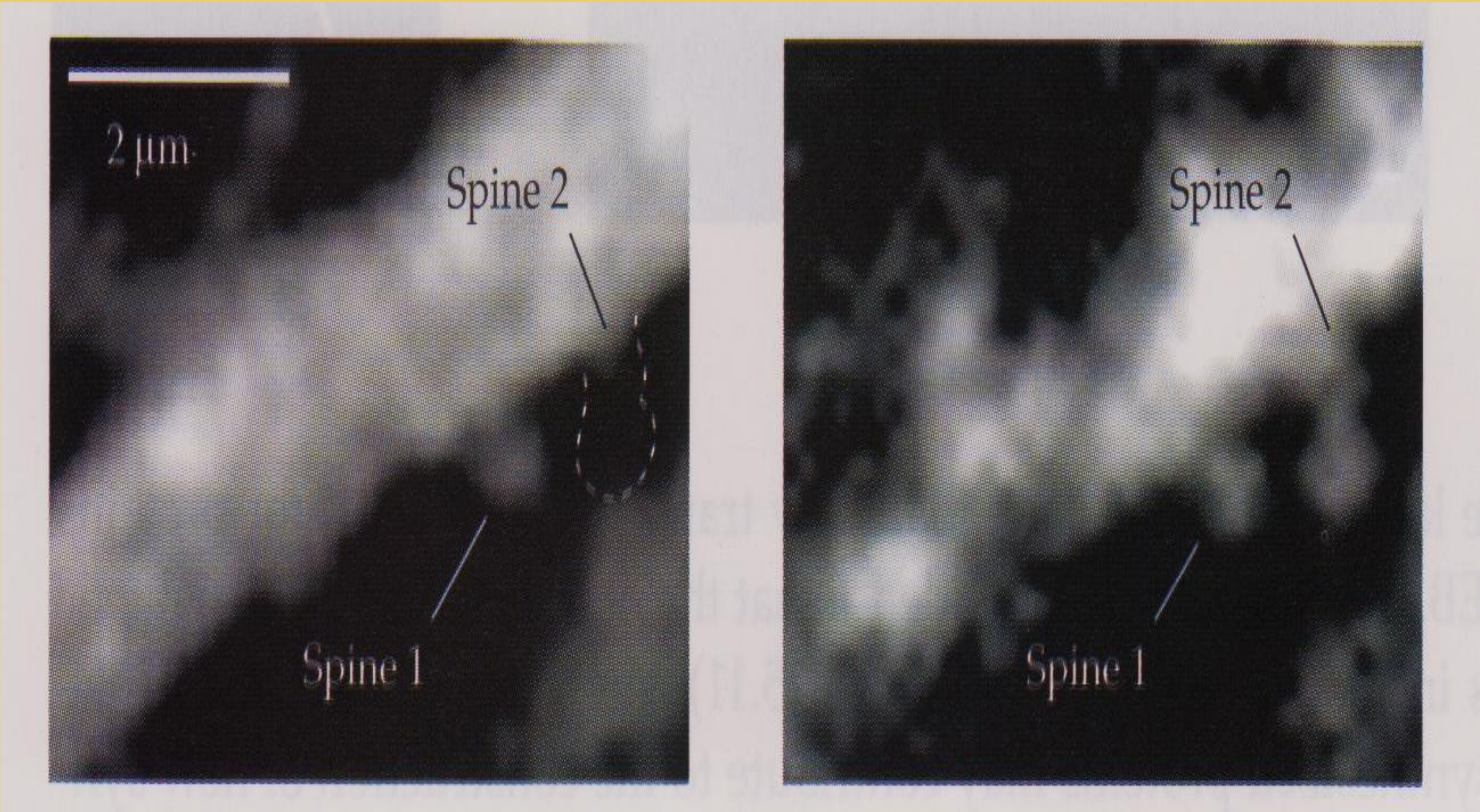
Client Education

- Your brain is not hardwired but soft-wired.
- Our job together is to rewire your brain so that you no longer suffer from anxiety and depression.

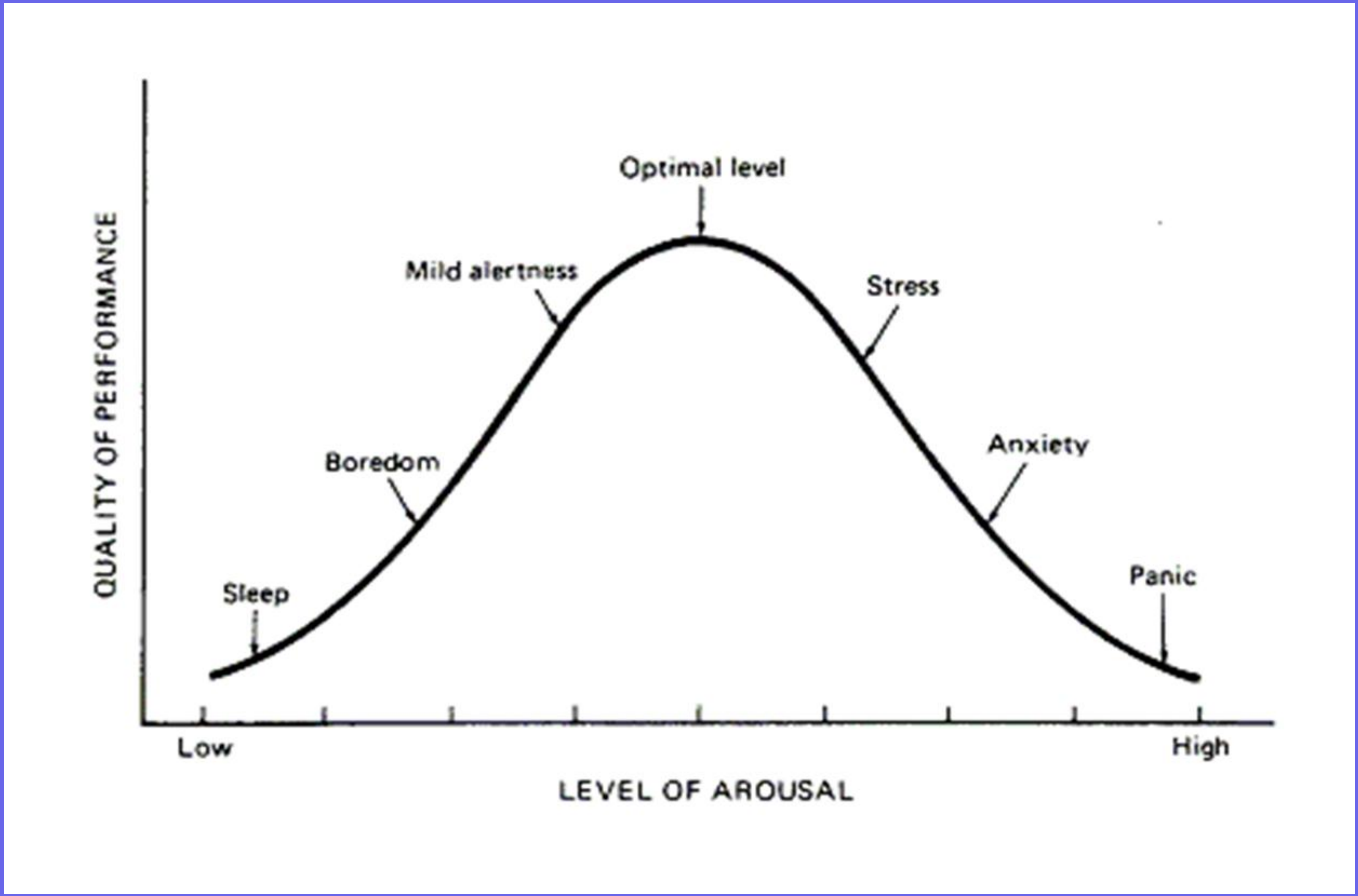

Spines

Spine Growth

one-half hour



Yerkes Dodson arousal curve



Client Education

- Though you feel like you're not ready to take the first step, actually it is <u>not</u> feeling ready that provides the brain chemistry necessary to rewire your brain.

Don't wait to feel ready!

Examples of Neuroplasticity

- London cabdrivers - larger right posterior hippocampus. The longer they were on the job, the larger the size of their hippocampus. (Maguire, et al, 2000)

- Adults who juggled three balls for 3 months increased grey matter in the midtemporal area and left posterior intraparietal sulcus. - 3 months of little or no juggling, -- grey matter decreased and approached baseline values. (Draginski, et al, 2003)

Examples of Neuroplasticity

- Musicians using specific fingers to play their instruments showed enlarged areas of their somatosensory strips associated with those fingers. (Pantev, et al, 2001)
- Blind Braille readers showed enlarged cortical areas associated with their reading finger compared to blind non-Braille readers and to sighted people. (Pascul-Leone & Torres, 1993)

Self-Regulation Factors

- **Social**
- **Exercise**
- **Education**
- **Diet**
- **Sleep**

The Mind’s Operating Systems:

- **Salience Network:**
- the material “me”
- emotional and reward saliency;
- **Default Mode Network:**
- mind-wandering; ruminating
- mentalizing, projecting to the future or past;
- **Central Executive Network:**
- moment to moment monitoring of experience
- selection, planning, toward goals;

Salience Network:

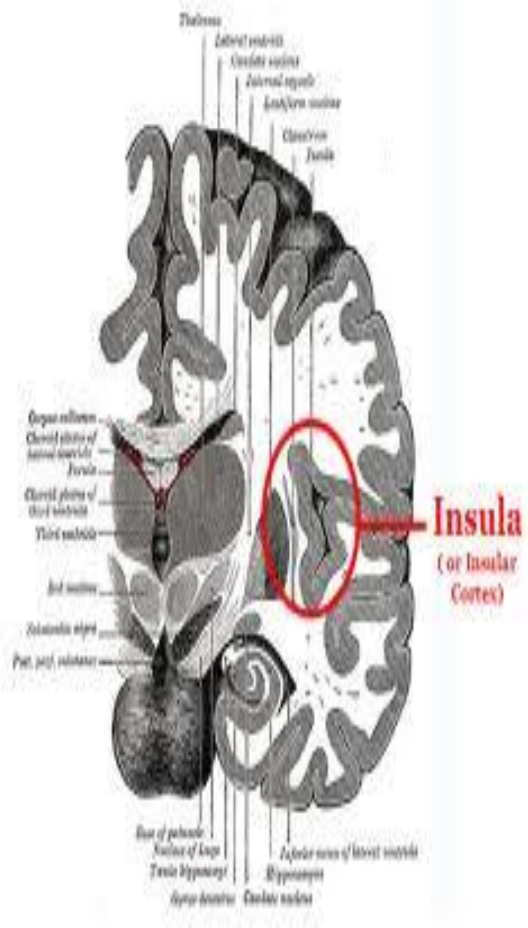
- referred to as the ‘sentient self’ (the material “me”)
- detecting emotional and reward saliency;
- detecting and orienting toward external events in bottom-up fashion;
- bilateral anterior insula, dorsal anterior cingulate, amygdala

Anterior Cingulate Cortex

- ACC integrates cognitive and emotional information (Bush, et al, 2000)
- Active when detecting emotional signals from self and others (Critchley, et al., 2004)
  - The ACC is involved in both physical pain and social rejection (Eisenberger & Lieberman, 2005)
  - The dorsal ACC activates when fear of rejection occurs (Lieberman, 2005)
  - Activated when someone we love experiences pain or social ridicule (Botvinick, et al, 2005)
- Density of oxytocin receptors – the degree of empathy
- Damage results in reduced empathy and/or maternal behavior (Brothers, et al., 1996)

Insula and Empathy

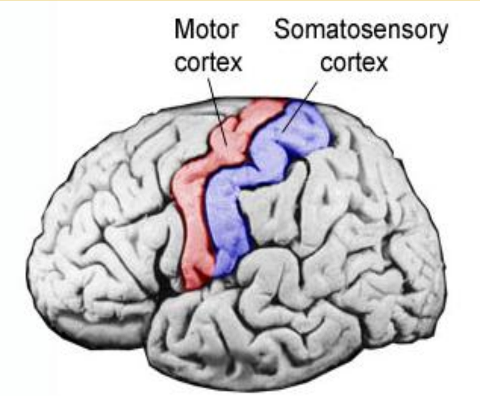
- Conduit between subcortical areas and cortex
- Draws on information from body areas, and input from amygdala and hippocampus
- Works with medial PFC to interpret and regulate emotional experiences
- Links mirror neuron systems with body states “Insula Hypothesis of empathy (Carr, et al, 2003)

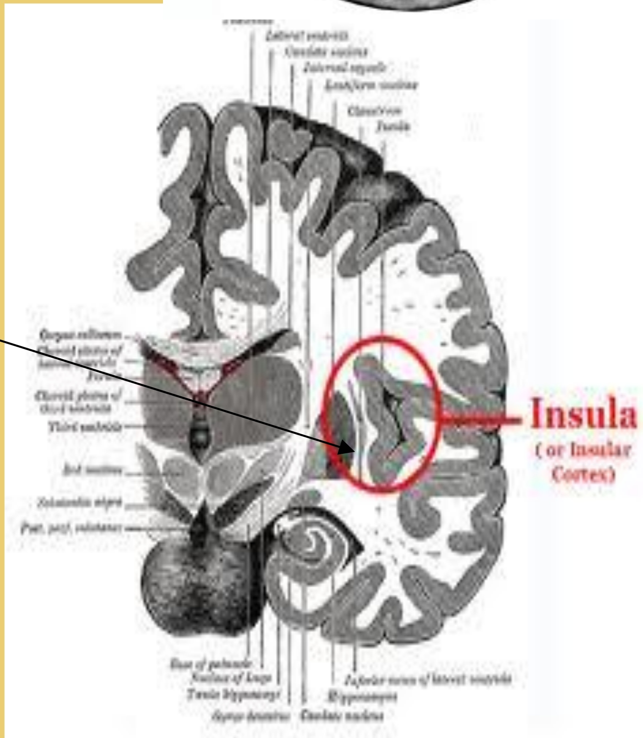


Insula and Touch

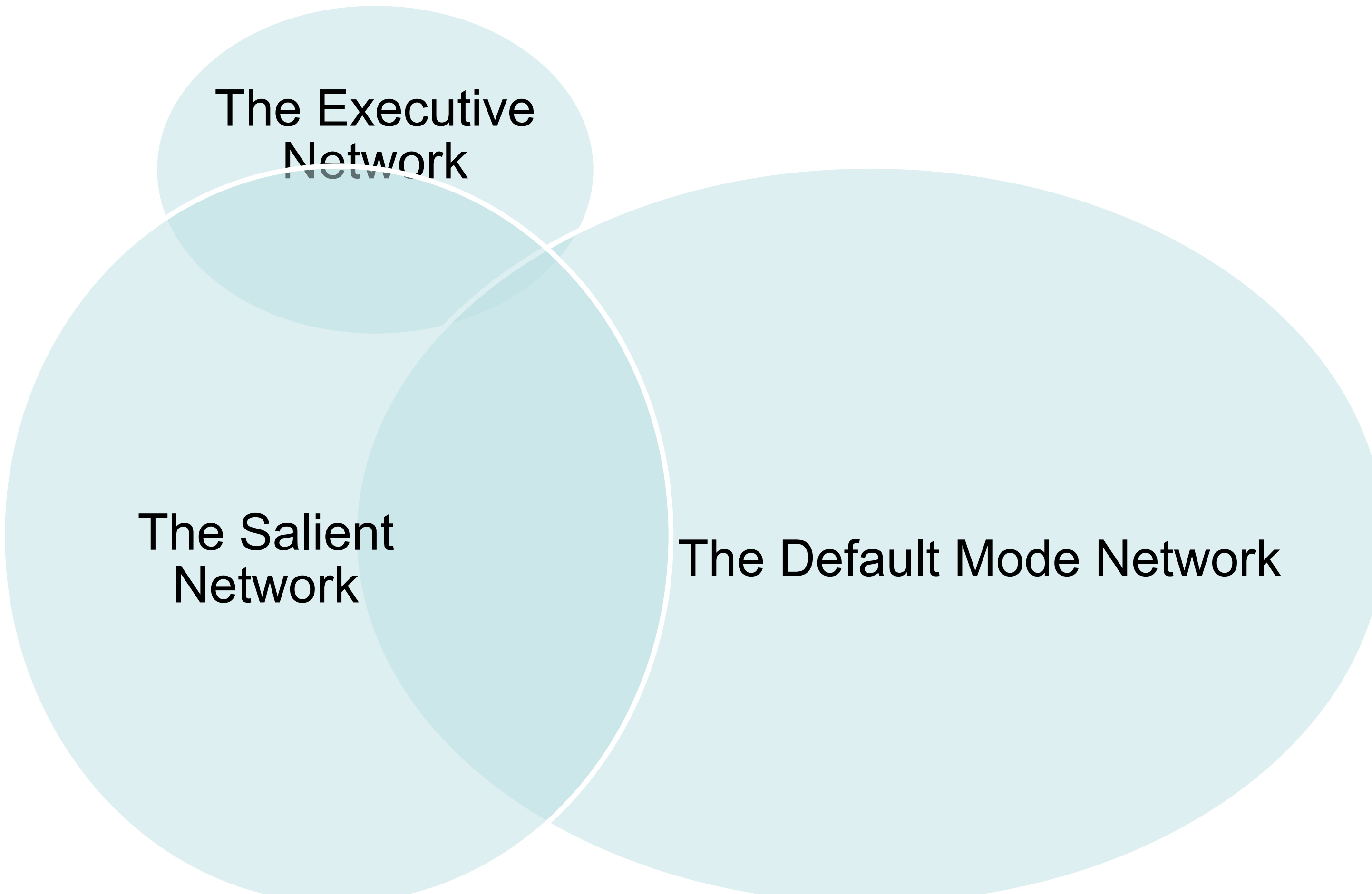
- Soft touch: C—Tactile fibers (CT)
  - Unmyelinated—thus slower, tracks to the:
    - **insula** (part of the Salience Network
    - Emotional touch
    - Oxytocin
    - Impaired people struggling

    with forming relationships

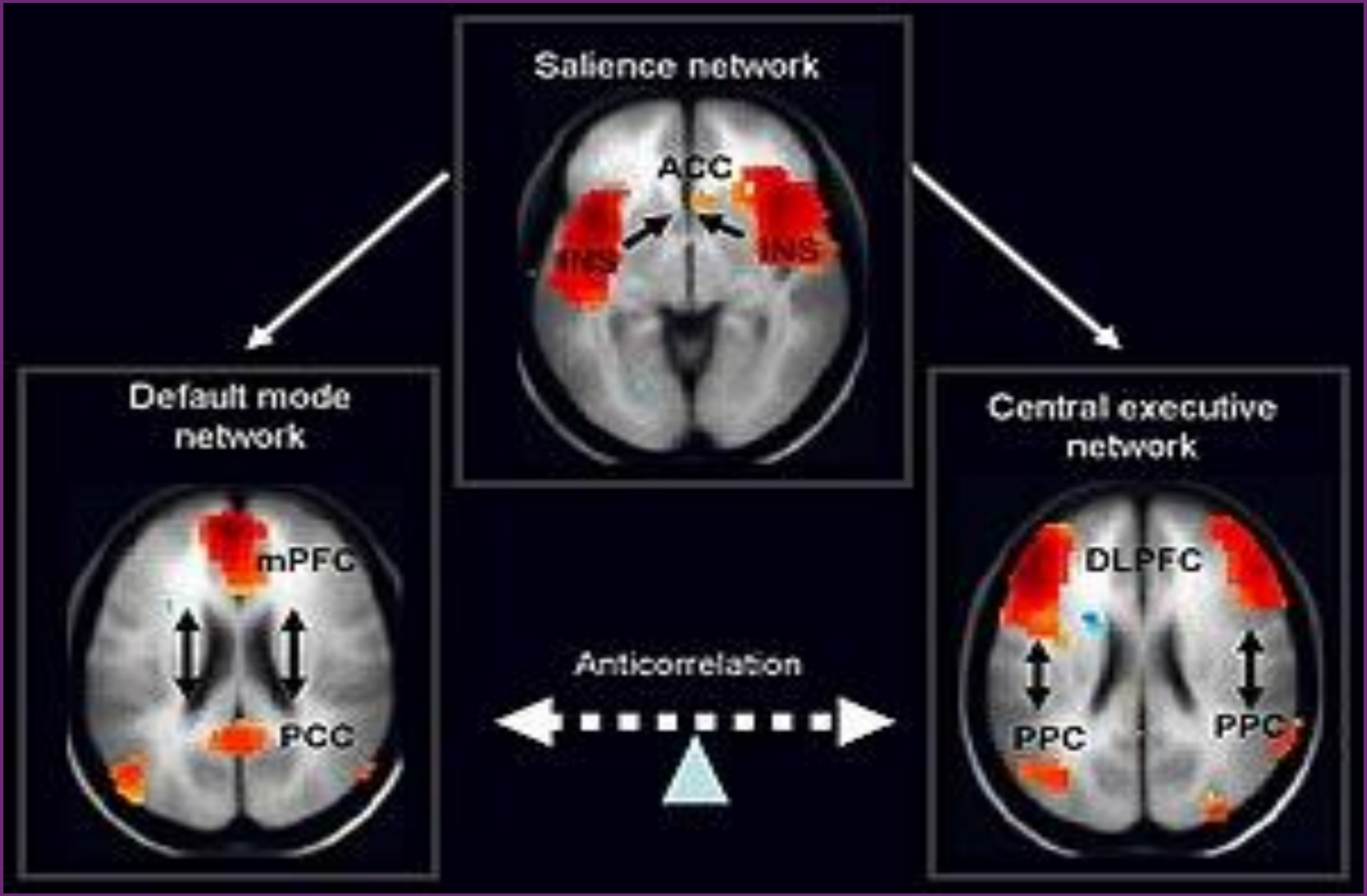




Imbalanced Mental Networks



The Mental Neworks



Default Mode Network:

- reflecting, spontaneous thoughts or mind-wandering;
- activated during tasks of mentalizing, projecting oneself into the future or past;
- activation when reflecting on social relationships;
- anterior and posterior midline and cingulate cortex

Client Education

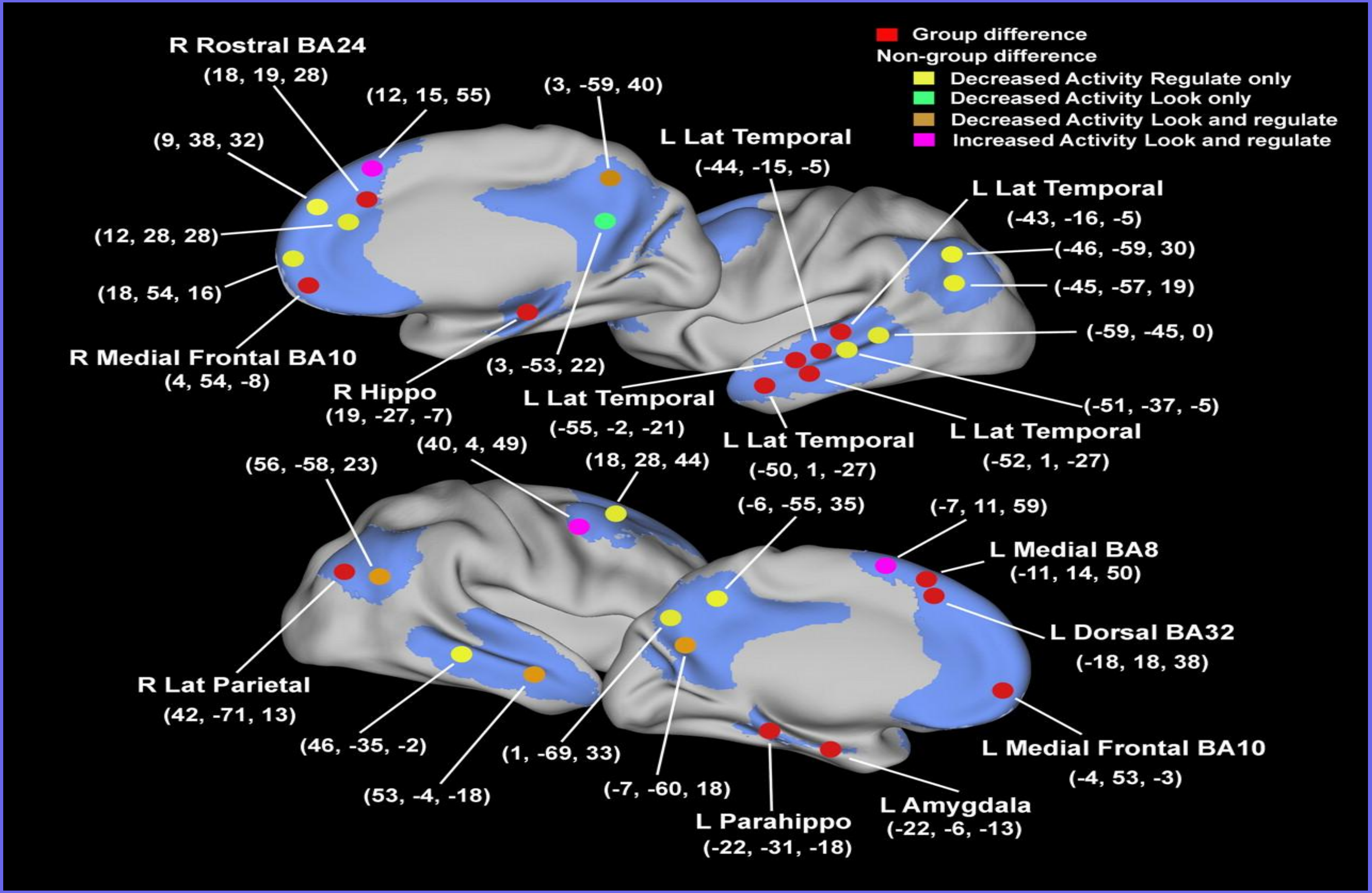
- It’s natural and normal to fade off and reflect every once in awhile.
- Try to make these periods useful by reflecting on ideas and impressions about what just occurred or positive and creative thoughts.

DMN Variations

- Increases when DLPFC is not engaged:
  - Stressed, bored, no novelty, or tired
- Social and self-referential –needed for sense of self
- Malfunctions in the DMN:
  - Schizophrenia—impaired self reflection—not sure where thoughts come from
  - Depression—negative ruminations

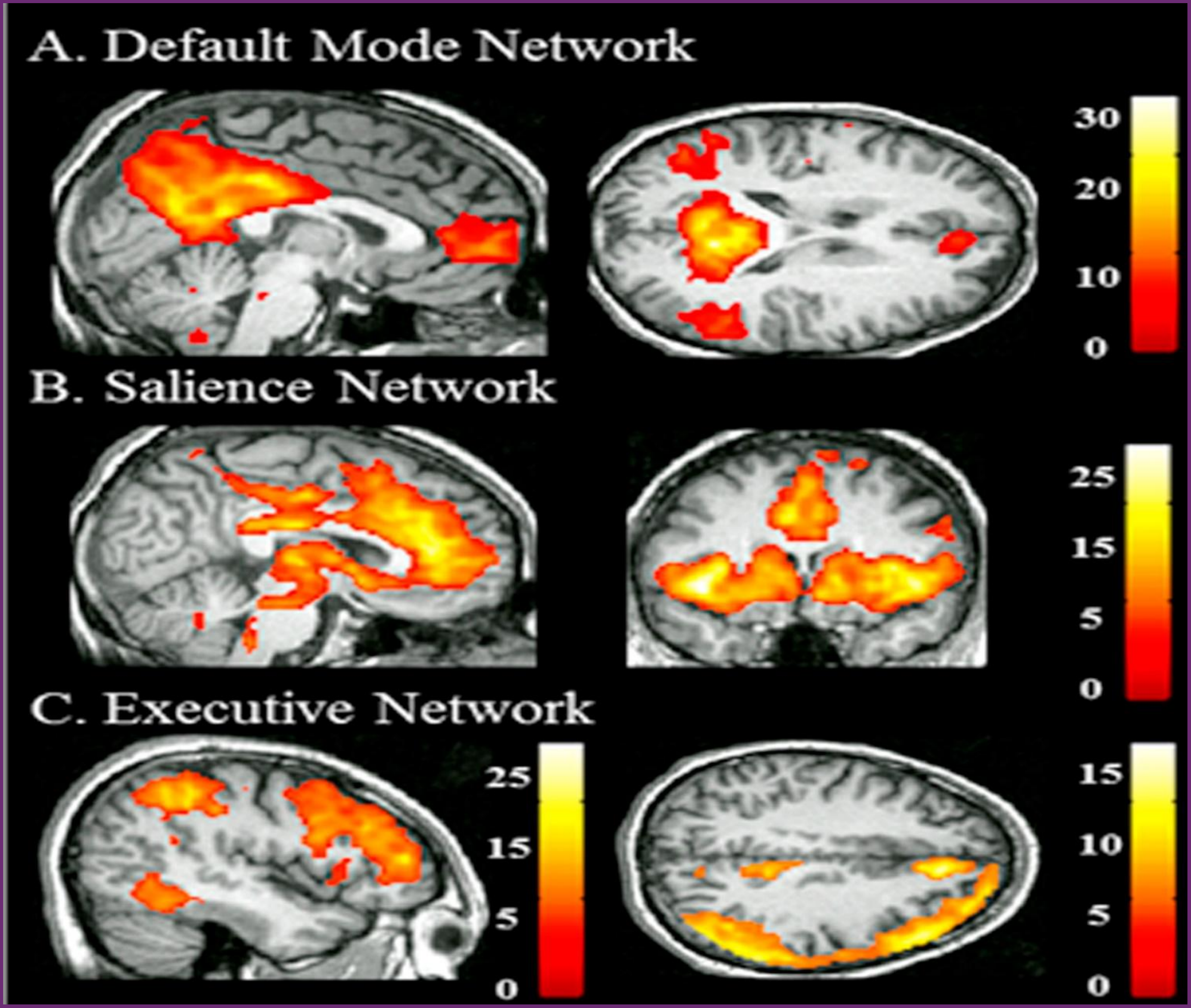
“Where is the Anxiety?” bumping the DMN

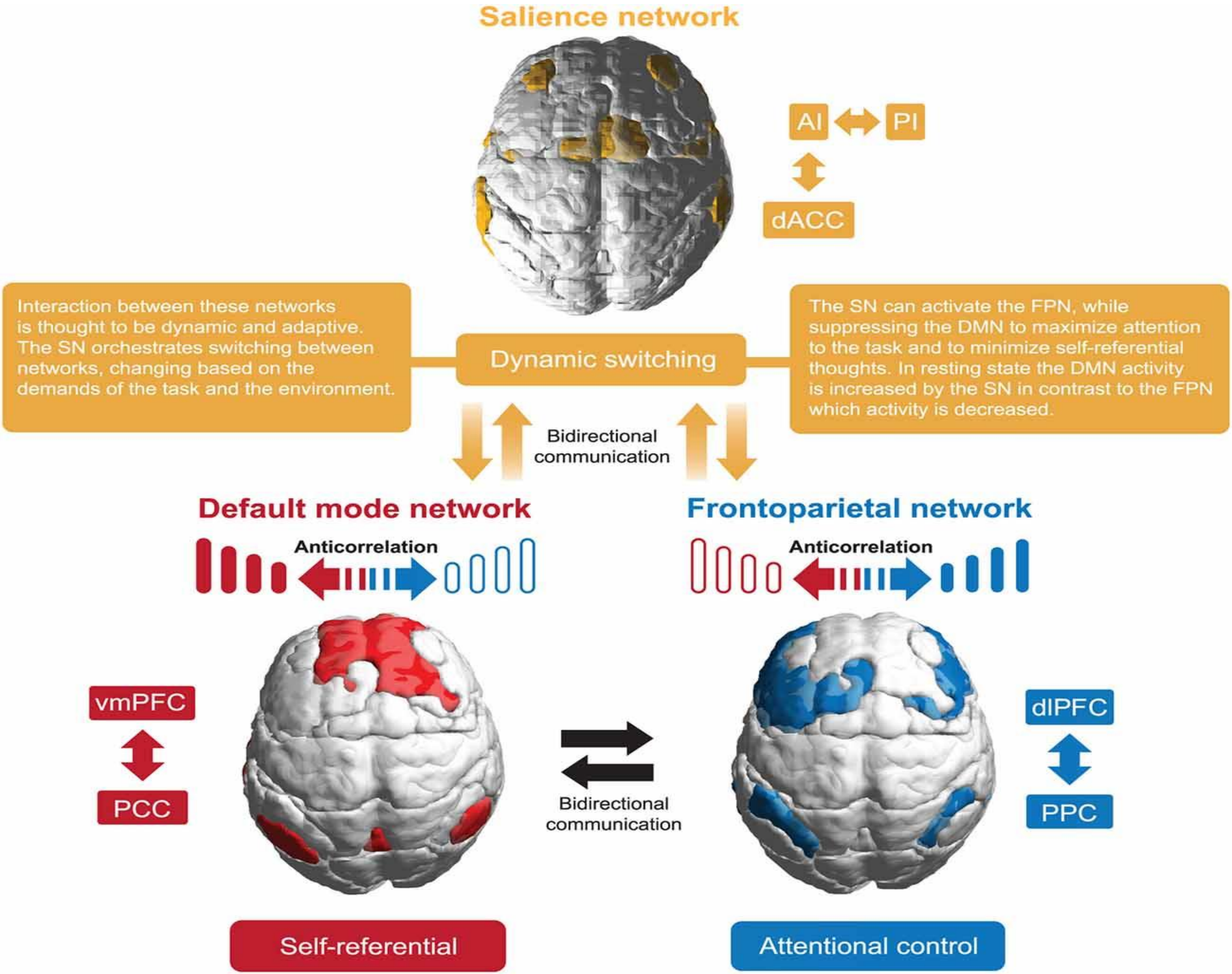
Activity in the default mode network



Sheline Y I et al. (2009)

The Mental Neworks

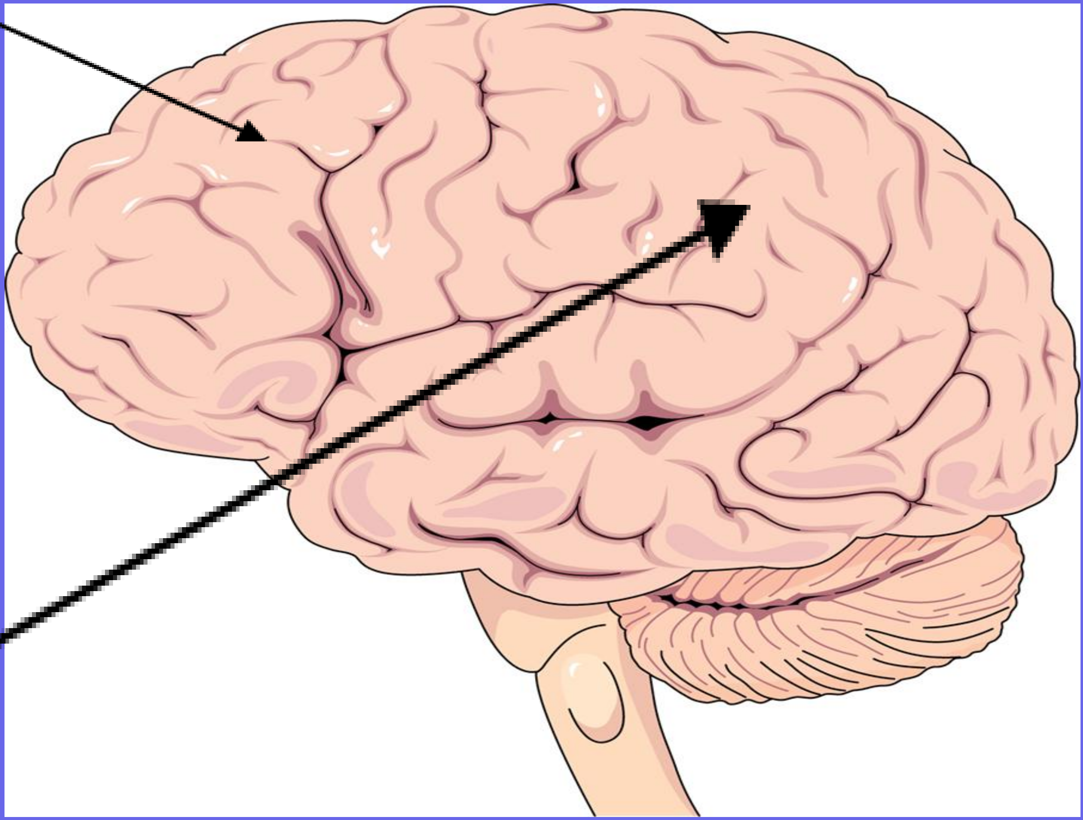



Salience network
AI
PI
dACC
Interaction between these networks is thought to be dynamic and adaptive. The SN orchestrates switching between networks, changing based on the demands of the task and the environment.
Dynamic switching
The SN can activate the FPN, while suppressing the DMN to maximize attention to the task and to minimize self-referential thoughts. In resting state the DMN activity is increased by the SN in contrast to the FPN which activity is decreased.
Bidirectional communication
Default mode network
Frontoparietal network
Anticorrelation
Anticorrelation
vmPFC
PCC
Bidirectional communication
dlPFC
PPC
Self-referential
Attentional control

Central Executive Network: CEN

DLPFC and the OFC

Dorsolateral Prefrontal Cortex



Posterior Parietal Cortex

Central Executive Network:

- moment to moment monitoring of experience (meta-cognition)
- responsible for selection, planning, and decision-making toward goals;
- working memory that helps select, orient, and maintain an object in the mind;
- bilateral dorsolateral prefrontal cortex

The CEN is primarily responsible for:

- **Working Memory:** Holding and manipulating information in “mind” to complete a task.
- **Attentional Control:** Focusing attention, filtering out distractions, and shifting focus as needed.
- **Decision-Making and Problem-Solving:** Evaluating options, weighing risks and rewards, --making right.

The CEN is primarily responsible for:

- **Cognitive Flexibility:** The ability to adapt your behavior and thinking in response to changing situations.
- **Inhibition:** Controlling impulses, thoughts, and behaviors.
- **Planning and Organization:** Creating and executing a plan to achieve a goal.

CEN: Cognitive and Attentional Deficits:

- **Difficulty with working memory:** Struggling to remember instructions, follow multi-step directions, or perform mental calculations.
- **Poor attentional control:** Easily distracted, inability to stay focused on a task, and "spacing out." -Key symptom of conditions like ADD.
- **Impaired planning and organization:** Trouble starting tasks, organizing their thoughts, or managing their time effectively.

CEN: Cognitive and Attentional Deficits:

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- **Impaired planning and organization:** Trouble starting tasks, organizing their thoughts, or managing their time effectively.

CEN: Emotional and Behavioral Deficits:

- **Impulsivity:** Impaired inhibition. Acting without thinking, blurting out inappropriate comments, or struggling with self-control.
- **Emotional dysregulation:** The CEN helps to regulate emotions, and its dysfunction can contribute to emotional lability, chronic anxiety, or depression.
- **Difficulty with goal-directed behavior:** Inability to initiate and complete tasks. -procrastination and a sense of being "stuck."
- **Maladaptive social behaviors:** Impaired social cognition and social awkwardness or difficulty maintaining relationships.

CEN: Emotional & Behavioral Deficits:

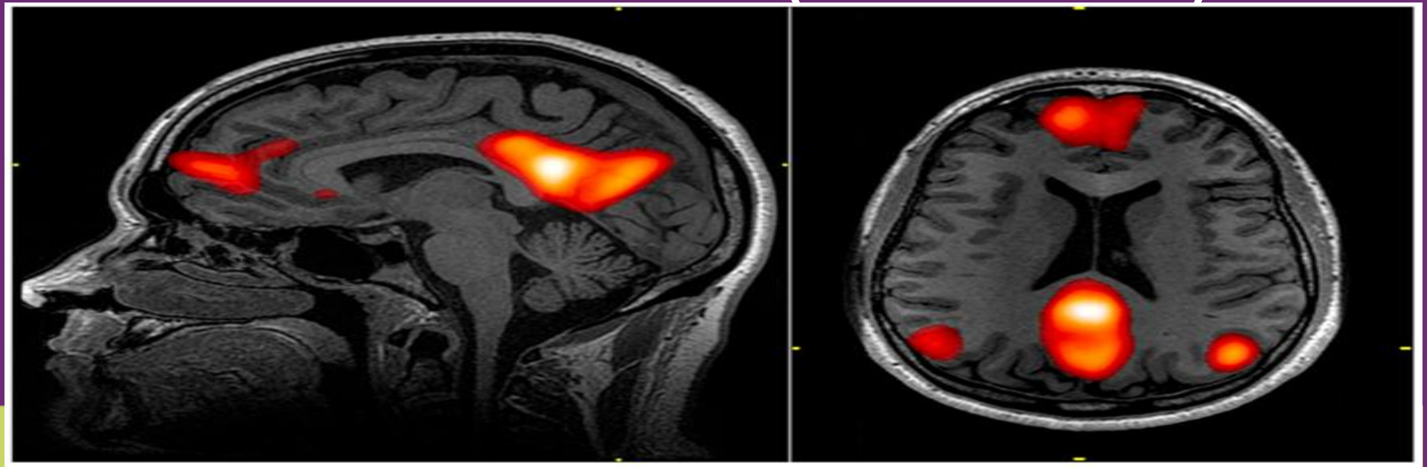
- **Attention-Deficit/Hyperactivity Disorder (ADD):** Inattention, impulsivity, and hyperactivity.
- **Schizophrenia:** Deficits in working memory and attention.
- **Major Depressive Disorder:** Cognitive deficits such as concentration, indecisiveness, and memory problems.
- **Neurodegenerative Diseases:** Alzheimer’s Disease -cognitive decline -loss of independence.

Trauma and Networks

- Decreased triple network connectivity
  - Decreased connectivity of left middle frontal gyrus (CEN)
  - Decreased connectivity right insula (SN)
  - Decreased connectivity bilateral mPFC (DMN)
    - Reduced functional connectivity in the DMN
-

Life Satisfaction or Not

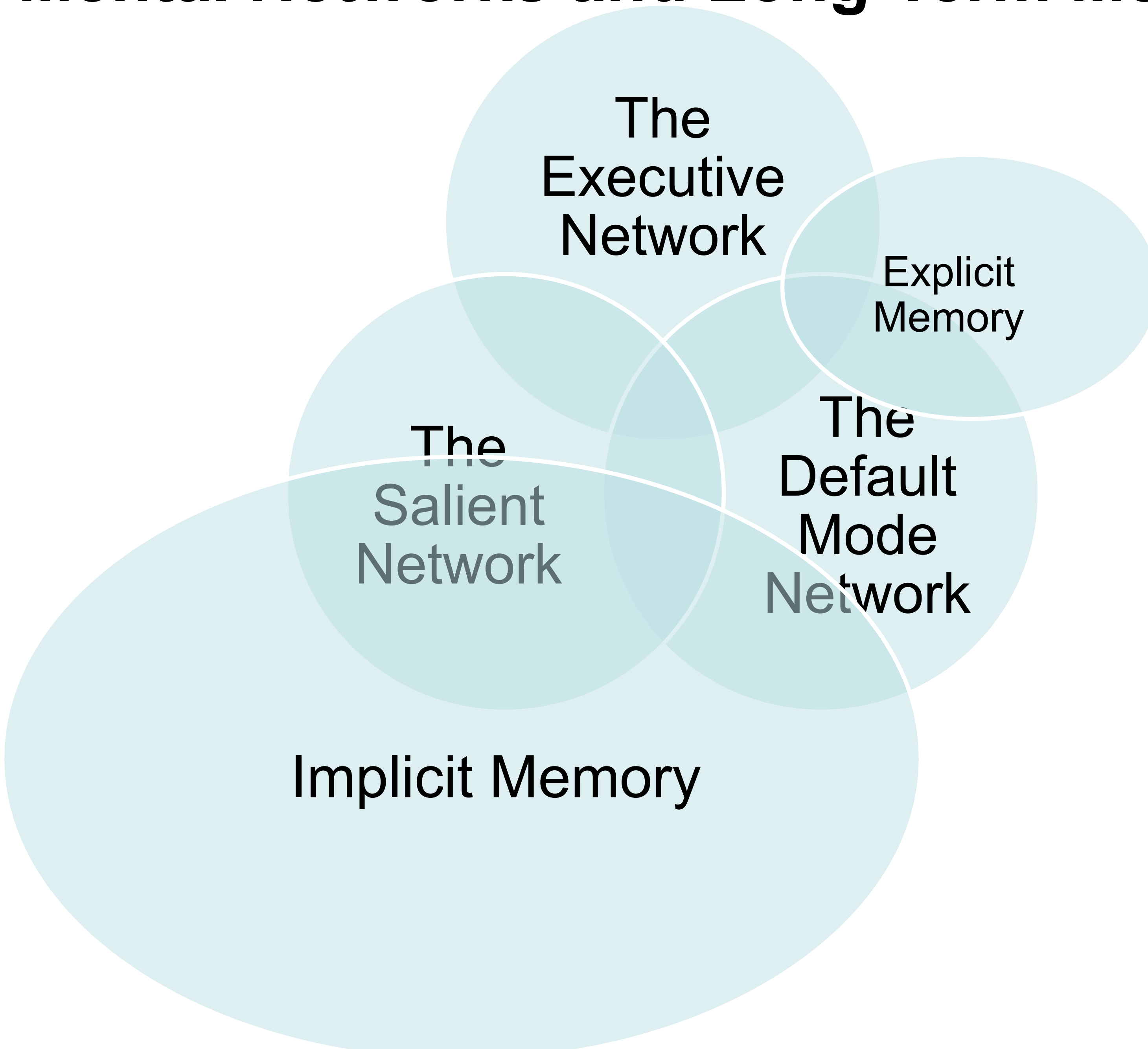
- Self-construal—narrative
  - mPFC involved in the representation of self-referential information and affect regulation
  - pCC is involved in the integration of self-referential info (narrative)



Symphony of Wellbeing

- mPFC involved in the representation and evaluation of self-referential information
- pCC involved in the integration of self-referential
- Together they support self-evaluation
- Increased connectivity within parts of the DMN

Mental Networks and Long-Term Memory



It is an evolutionary imperative to nurture our SEEDS





Socialise

Calms nervous system
↑ Oxytocin (feel good)
↓ Cortisol (less stressed)
↑ Sense of connection
↑ Problem solving
↑ Attention
↑ Humour and fun
↑ Energy

Exercise

Calms nervous system
↑ Serotonin & Dopamine
↑ GABA (calm)
↑ Energy levels
↑ Growth new brain cells
↑ Sleep
↑ Alertness and thinking
↑ Attention
↑ Chance to socialise
↑ Cardiovascular strength
↑ Physical strength
↑ Flexibility & endurance

Education

↑ Brain power
↑ Serotonin & Dopamine
↑ Growth of new brain cells
↑ Thinking ability
↑ Working memory
↑ Challenge to learn
↑ Novelty – try new things
↑ Social connection
↑ Interest in life
↑ Ability to focus
↑ Sense of achievement

Diet

Calms nervous system
↑Brain chemistry
↑ Brain clarity
↑ Mood
↑ Sleep
↑ Energy
↑ Alertness
↑ Concentration
↑ Ability to focus

Sleep

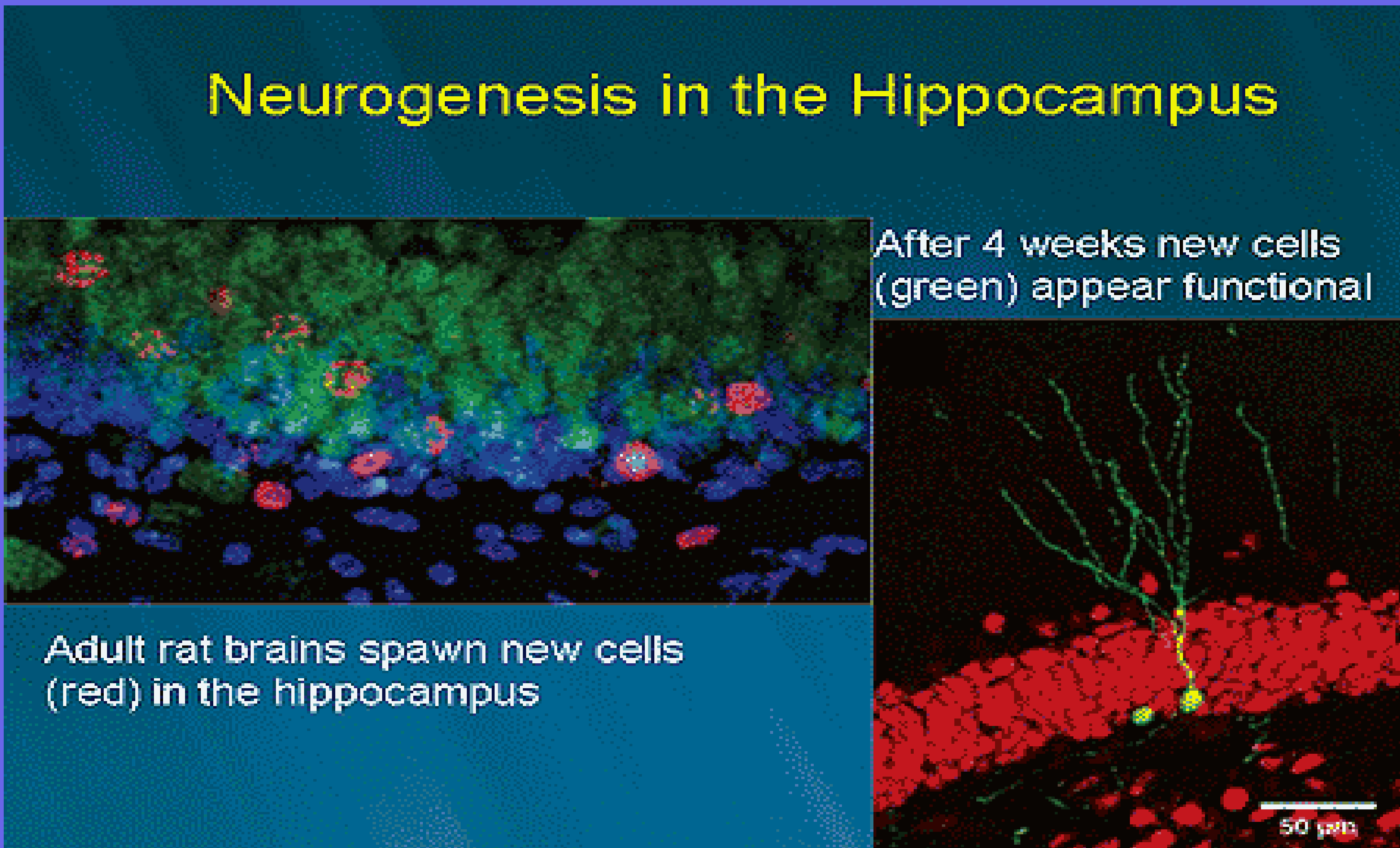
↑ Hippocampus activity
↑ Memory
↑ Brain cell growth
↑ Serotonin
↑ Immune system
↑ Mood
↑ Energy
↑ Alertness
↑ Concentration

…AND MUCH MORE…

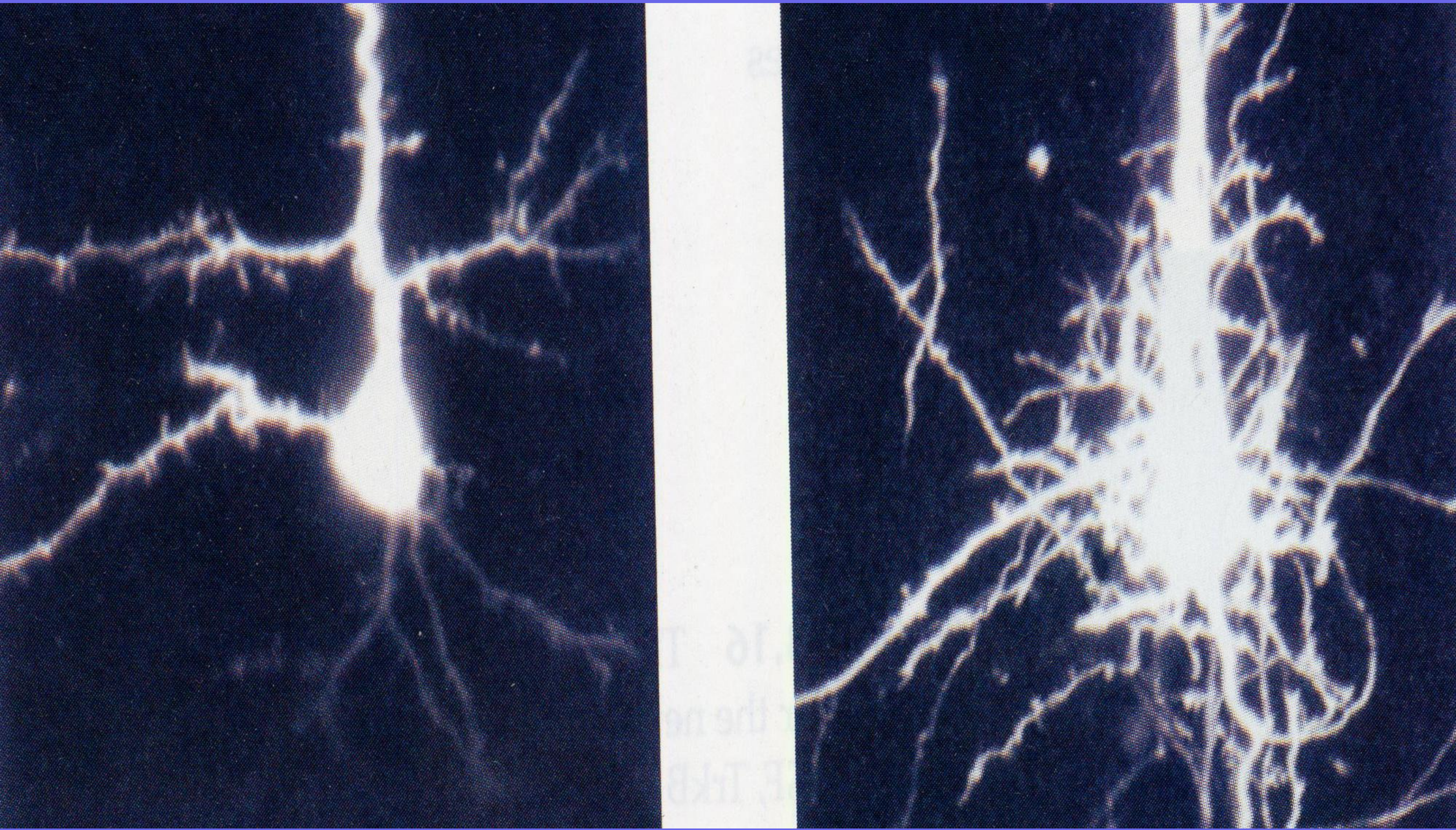
Brain Derived Neurotropic Factor

- BDNF plays a crucial role in reinforcing neuroplasticity and neurogenesis. It helps:
  - Consolidate the connections between neurons.
  - Promotes the growth of myelin to make neurons fire more efficiently
  - Act on stem cells in the hippocampus and PFC to grow into new neurons

Neurogenesis



BDNF: Impact on Dendrite growth: 24 hours



Factors that Increase Neurogenesis

Exercise

Fasting

Fewer calories consumed

Food content --(Omega—3)

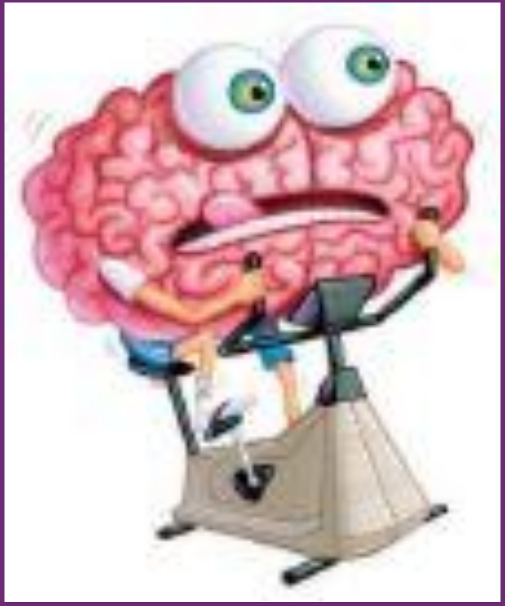
Weight loss

Client Education

You can grow new neurons in the area of your brain that gives you the capacity for memory. The first steps include maintaining a healthy diet, aerobic and cognitive exercise.

Exercise Optimizes

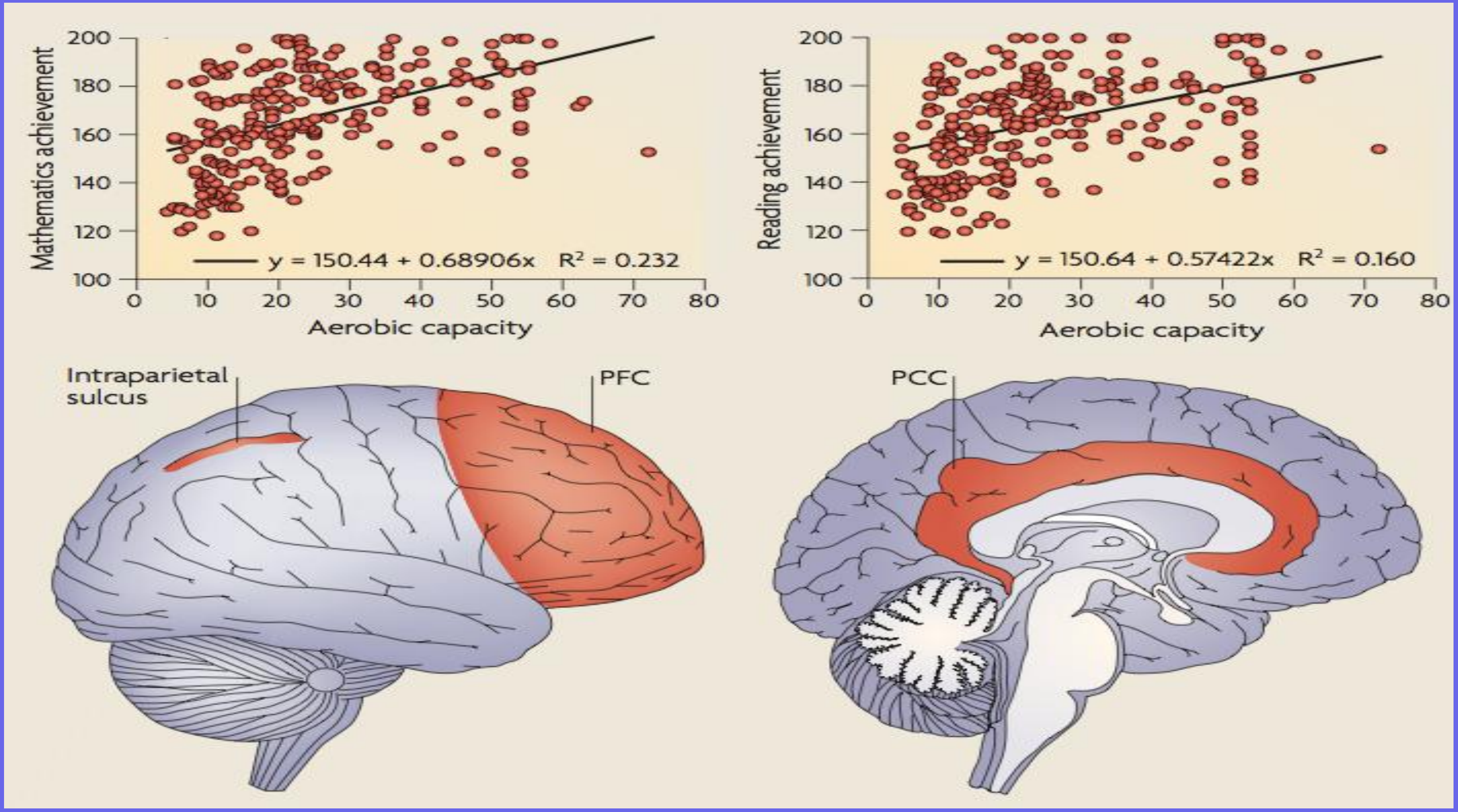
- Mood
  - ↑ neurotransmitters
    - » Serotonin
    - » Dopamine
    - » norepinephrine
  - physical health



Exercise Optimizes

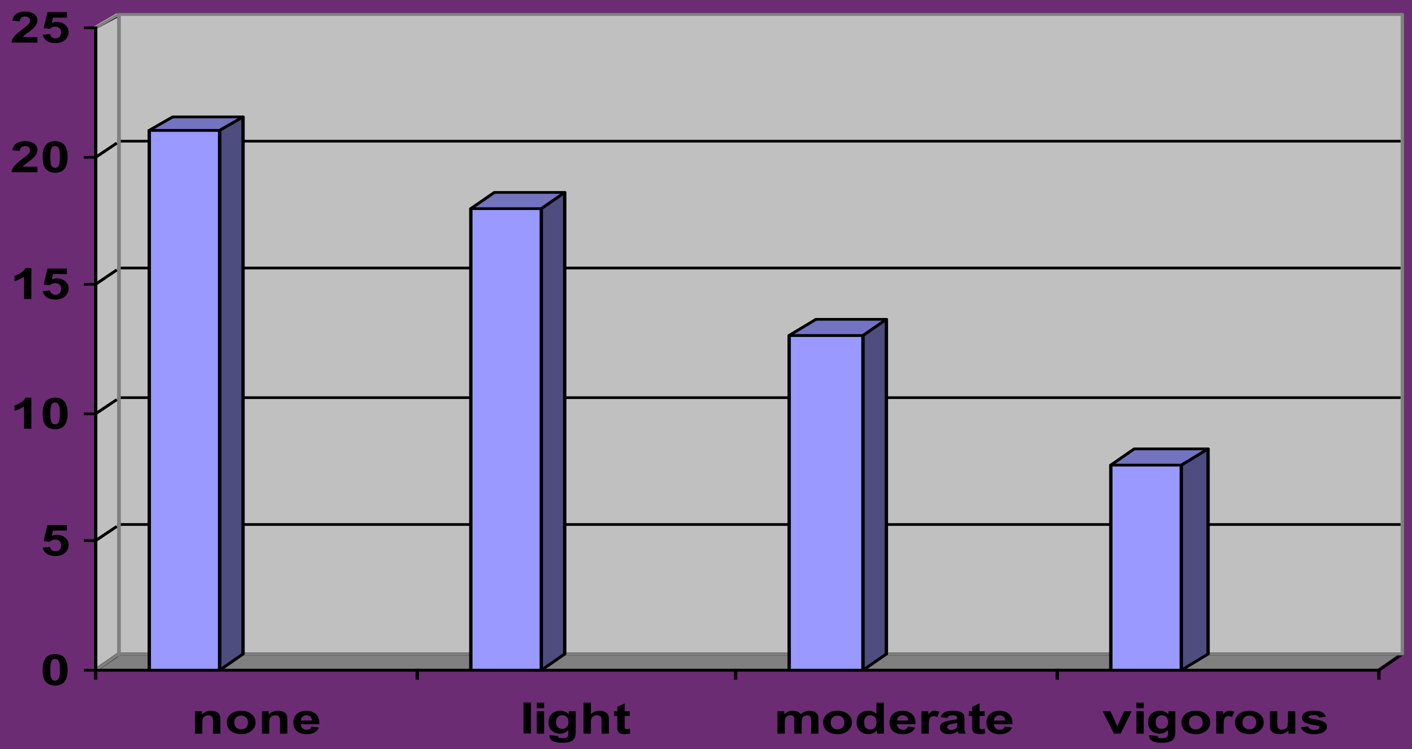
- Cognition
  - alertness
  - attention
  - motivation
  - cognitive flexibility

Fitness Correlates with Academic Achievement



Effect on C-Reactive Protein

- The effect of exercise on C-Reactive Protein (inflammation chemical). Degree of physical activity by level of C-Reactive Protein Based on study of 13,748 people (Ford, 2002)



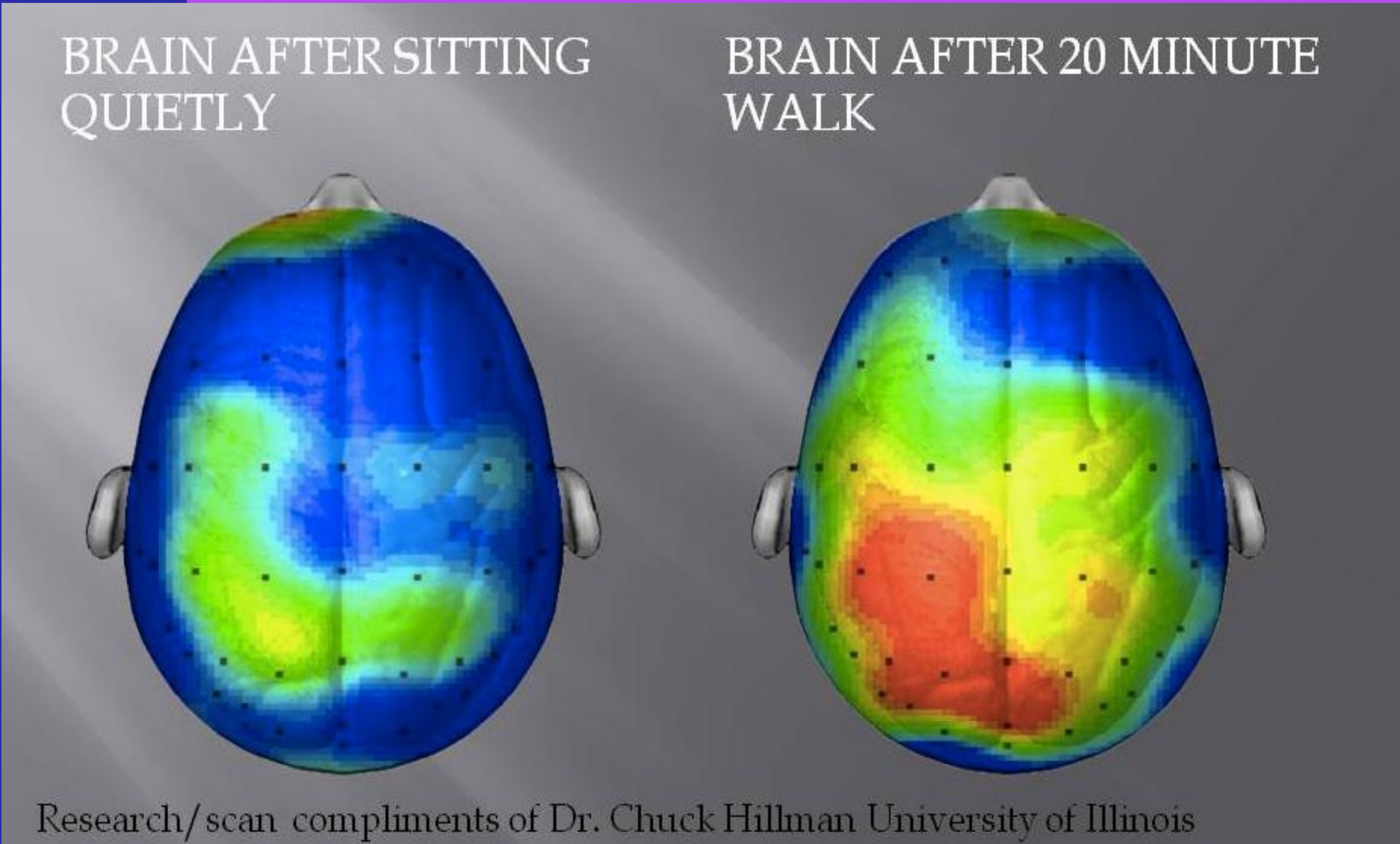
Exercise and Depression

- Alameda County study of 8,023 tracked for 26 years
  - Those that didn't exercise were 1.5 times more likely to be depressed
- Finnish study of 3.403
  - those that exercised 2 to 3 times per week were less depressed, angry, stressed and cynical
- Dutch study of 19,288 twins and their families –
  - those that exercised were less anxious, depressed, neurotic and more socially outgoing
- Columbia University study of 8,098
  - same inverse relationship between exercise and depression (Ratey, 2008)

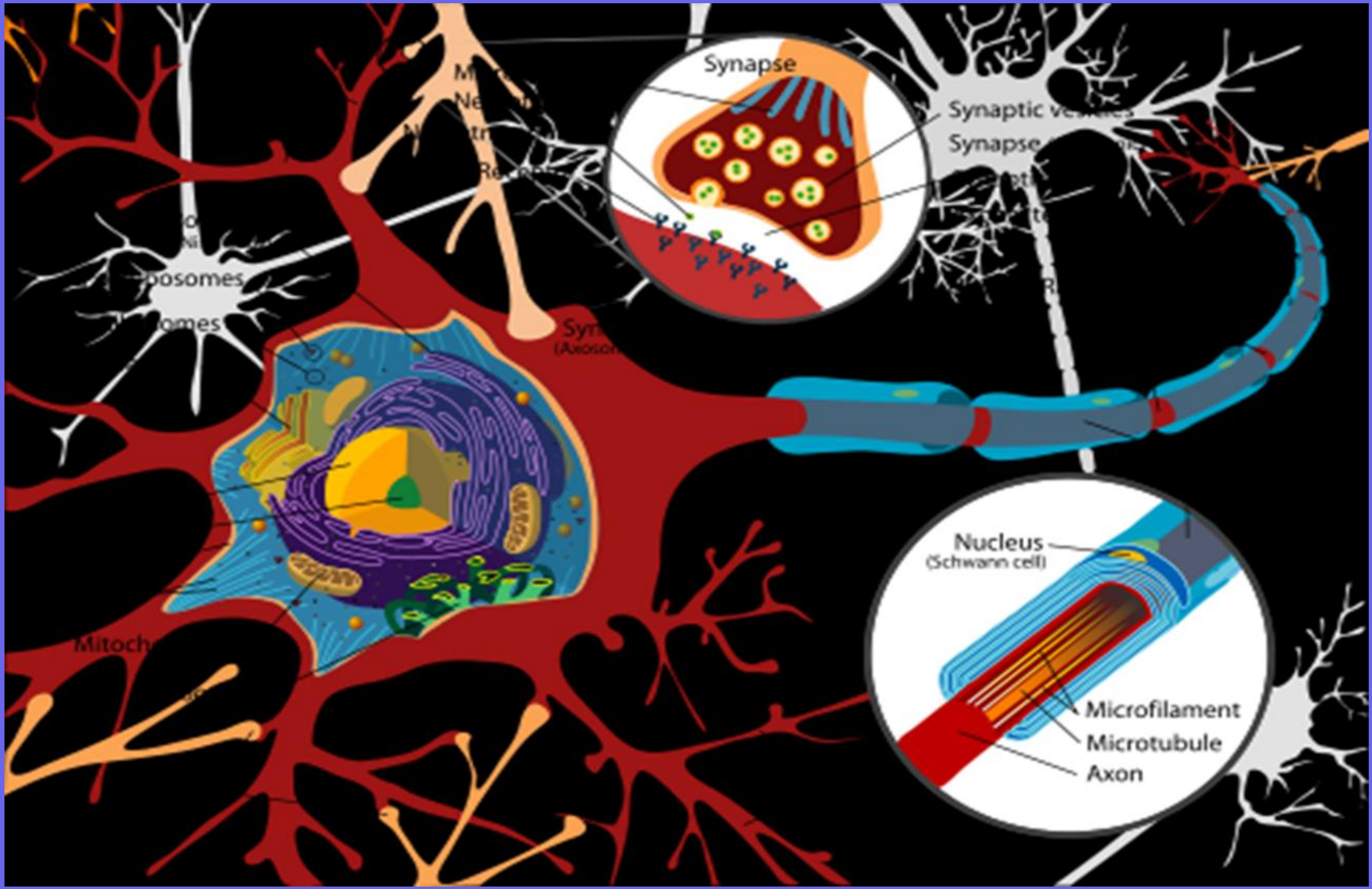
Exercise and the Brain

Mechanism	Impact
Gene Expression	Neuroplasticity (Cottman & Blanchard, 2002)
Brain Derived Neurotrophic Factor (BDNF)	Neuroplasticity (Adlard, et al, 2005)
Insulin-like Growth Factor (IGF-1)	Enhanced Neural (Carro. et al 200)
Nerve Growth Factor	Enhanced Neuroplasticity (Neeper, et al, 1996)
Vascular Endothelial Growth factor (VEGF)	Enhanced Neurogenesis (Fabel, et al, 2003)

Exercise to Clear the Mind



100 Billion Neurons with 10,000 Synaptic Connections



Neurons that fire together, wire together

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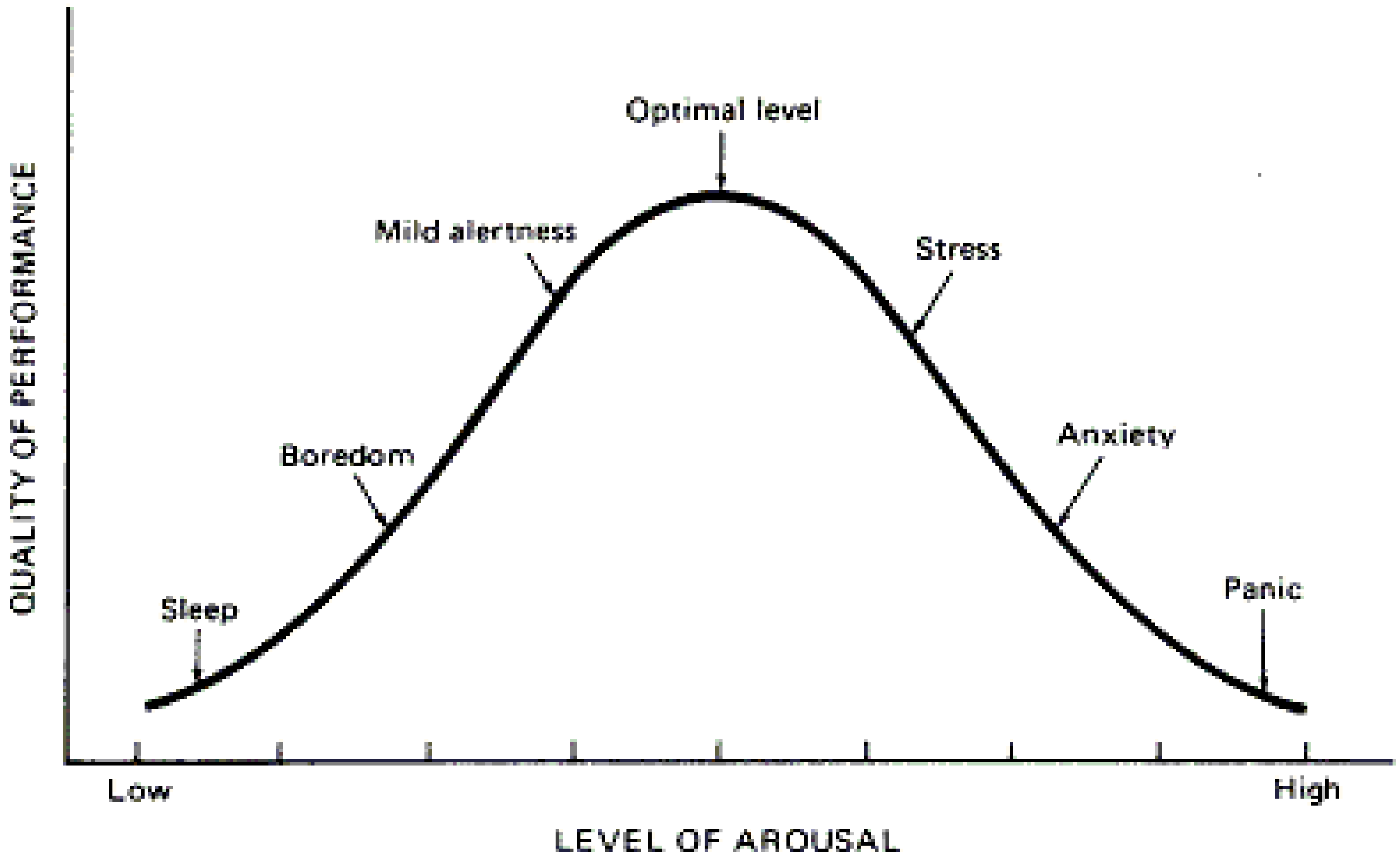
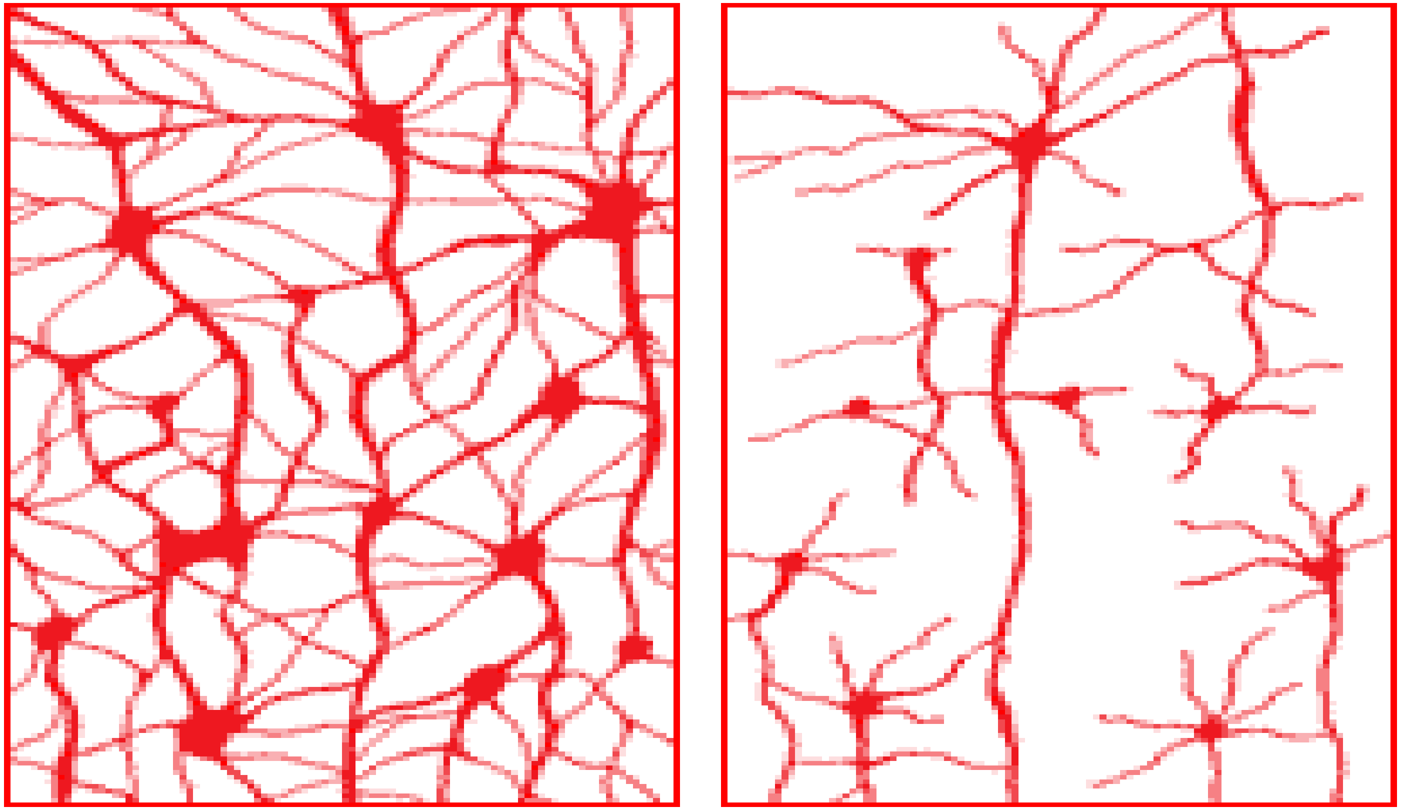
Yerkes Dodson arousal curve



Brain cell connections



section of a stimulated brain

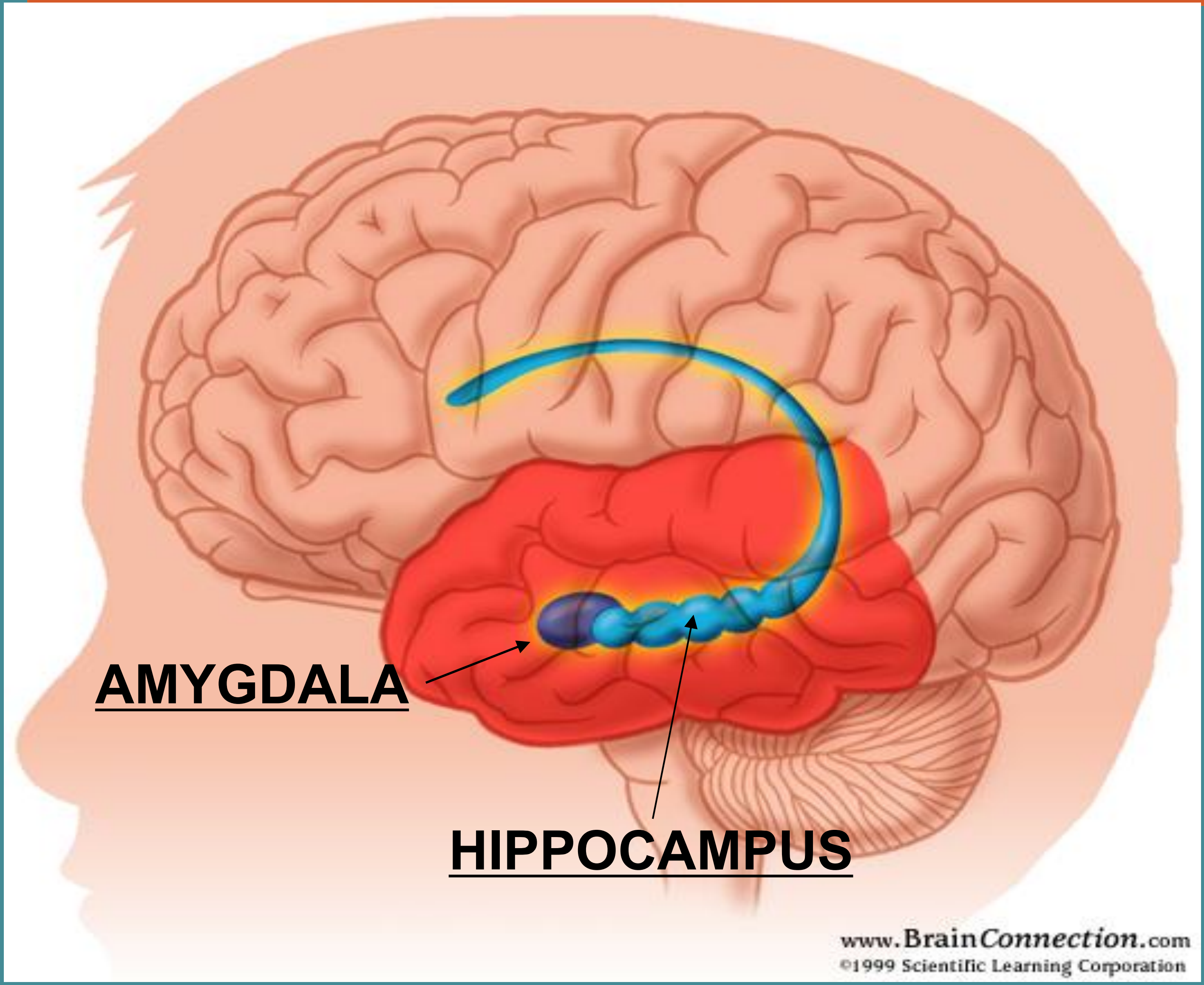
section of an unstimulated brain

Two LT Memory Systems

Implicit	Explicit
Non-declarative	Declarative
• Procedural • Emotional • Generalized • Classical conditioning	• Episodic • Autobiographical • Semantic • Context Specific
Amygdala and BG-driven	Hippocampus-driven

Procedural Memory

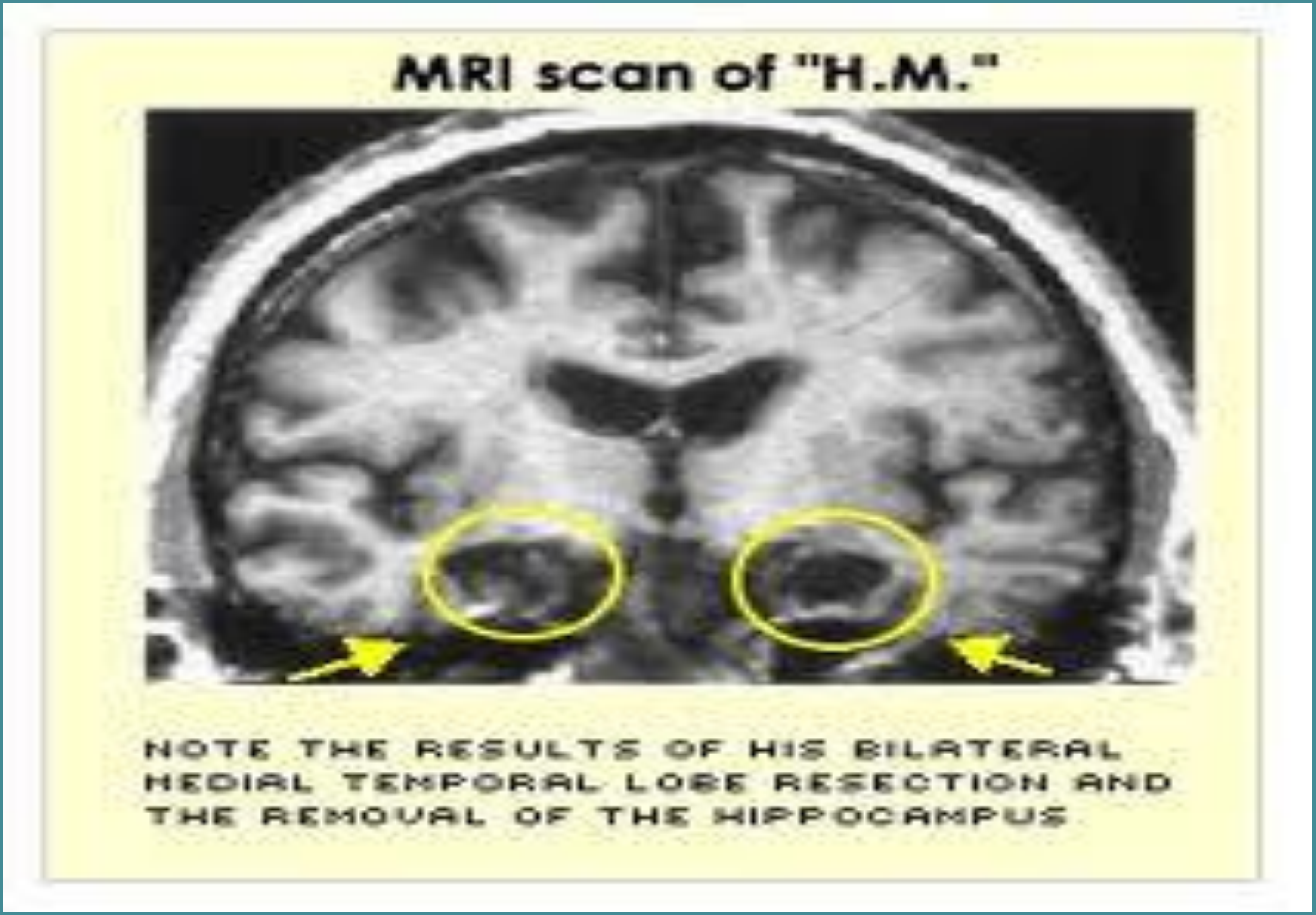
AMYGDALA *Implicit Memory System*	**HIPPOCAMPUS** *Explicit Memory System*
•Fear Conditioning •Emotional Valance •Generalized •Cortisol Heightened •Sensitivity • (Hypervigilence) •Matures Early •"Little Albert" •"LSMFT"	• Many Cortisol Receptors • Context Specific • Heightened Cortisol leads to atrophy • Matures Later • Vs. Infantile Amnesia • "H.M."


AMYGDALA
HIPPOCAMPUS
www.BrainConnection.com
©1999 Scientific Learning Corporation

Henry Molaison

Dr. Brenda Milner

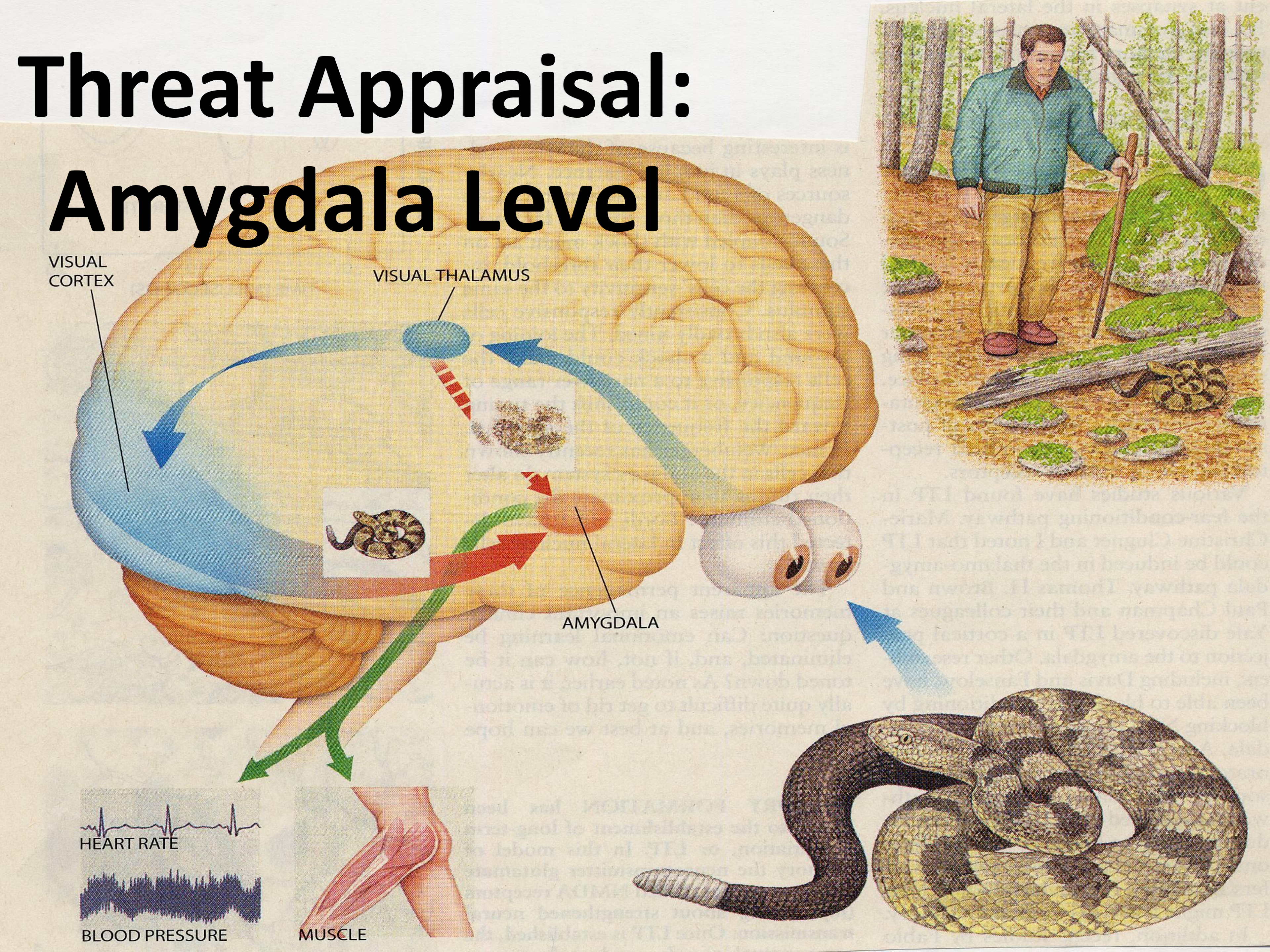
Henry's Brain



Hippocampal Coding

- Needed temporarily to bind together distributed sites in cortex that together represent a whole memory
  - Index to database of explicit memory
- Novelty detector: compares incoming info to stored knowledge; if difference, triggers dopamine increase
- Specialty is binding new to old information
  - Pattern completion (CA3)
  - Pattern separation—the ability to distinguish between similar experiences: (denate gyrus) ---**without it new safety memories cannot form and anxiety spreads**

Threat Appraisal: Amygdala Level



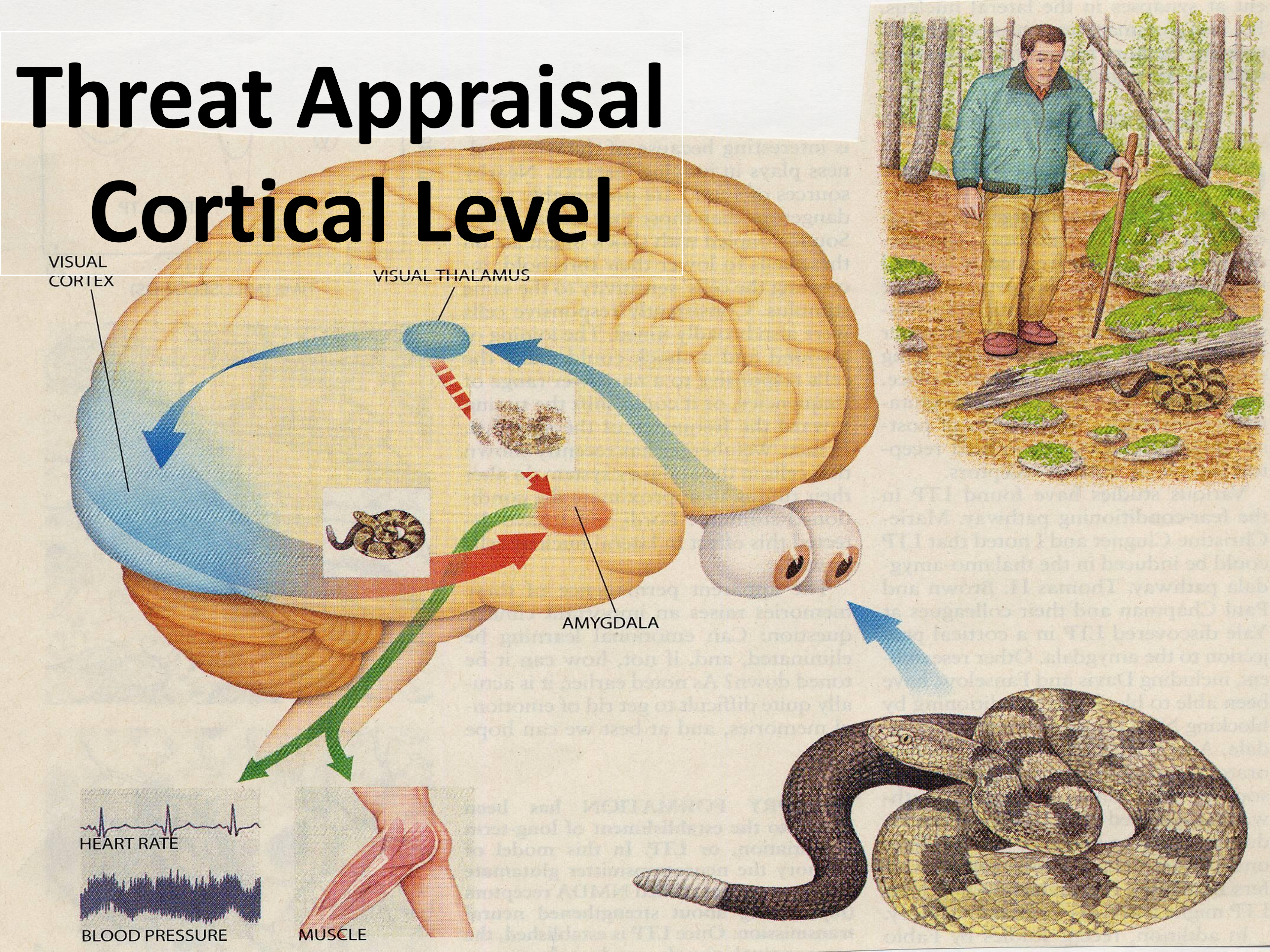
The Fast Circuit to the Amygdala

- Sensory info goes to the Thalamus then directly to the Amygdala:
- Fight or Flight: SNS and HPA activation
- Emotional Learning
- Fear Conditioning
- PTSD, panic, etc.
- Flashbacks
- “Bottom up”

The Fast Track to Survival

- Rapid, crude, adaptive, and immediate
- Cannot reality test
- Prone to false alarms

Threat Appraisal
Cortical Level



The Slow Circuit to the Amygdala

Sensory info goes to the Thalamus through the Cortex and Hippocampus to the Amygdala

Complications:

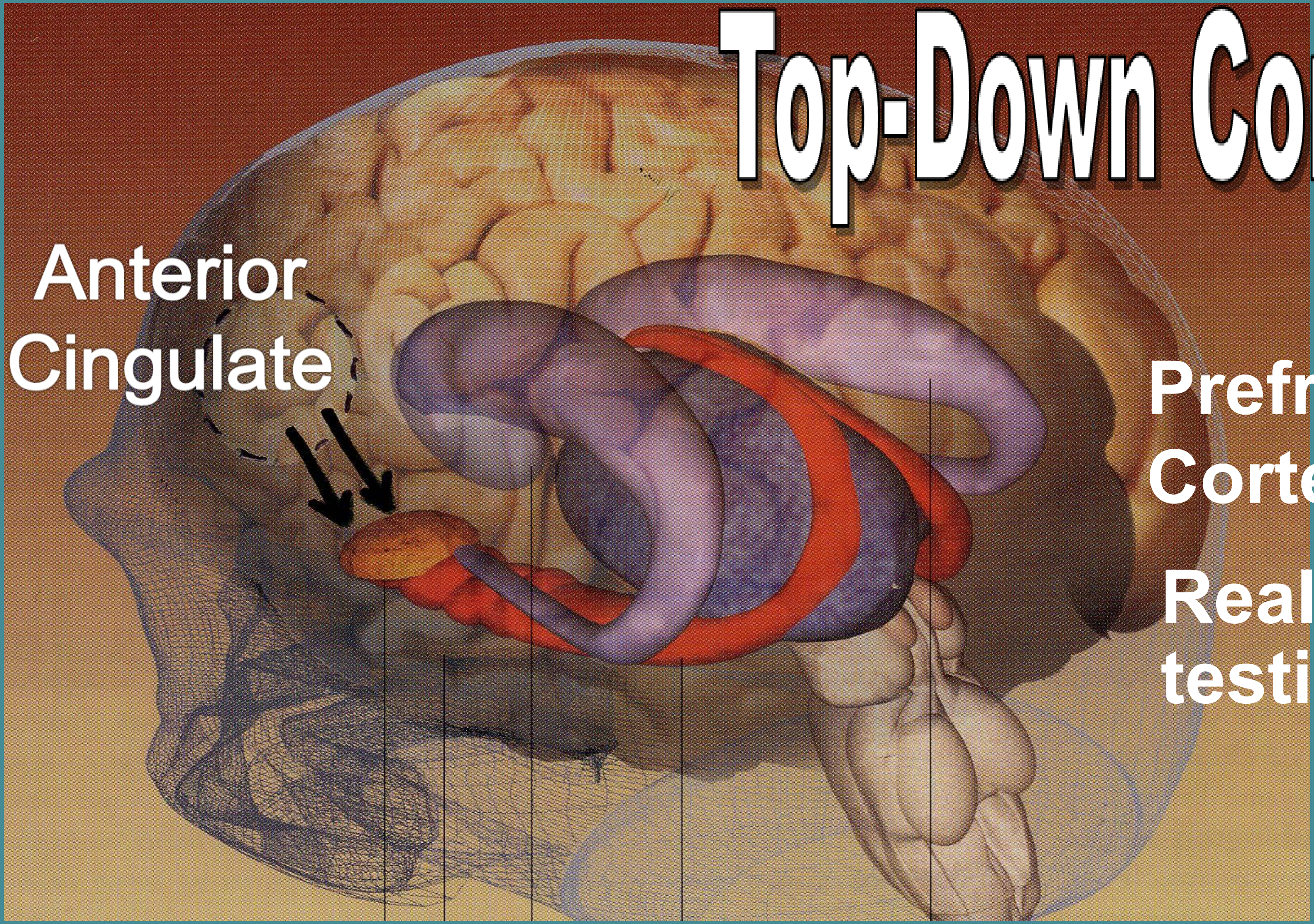
- Worries and GAD
- Fears and Phobias

Benefits:

- Tames the Amygdala
- With exposure, New Thinking (cortex)

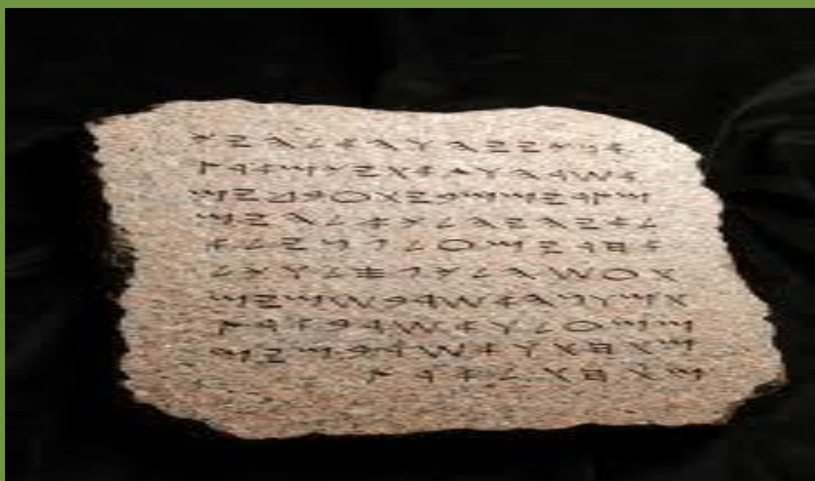
“Top down”

Cortical-level Appraisal



The Dynamics of Fear

- Amygdala memories are hard to forget (“Stone tablet”)



- Hippocampal circuits tell us what to fear and in what context (“Etch-a-Sketch”)

Negative Memories

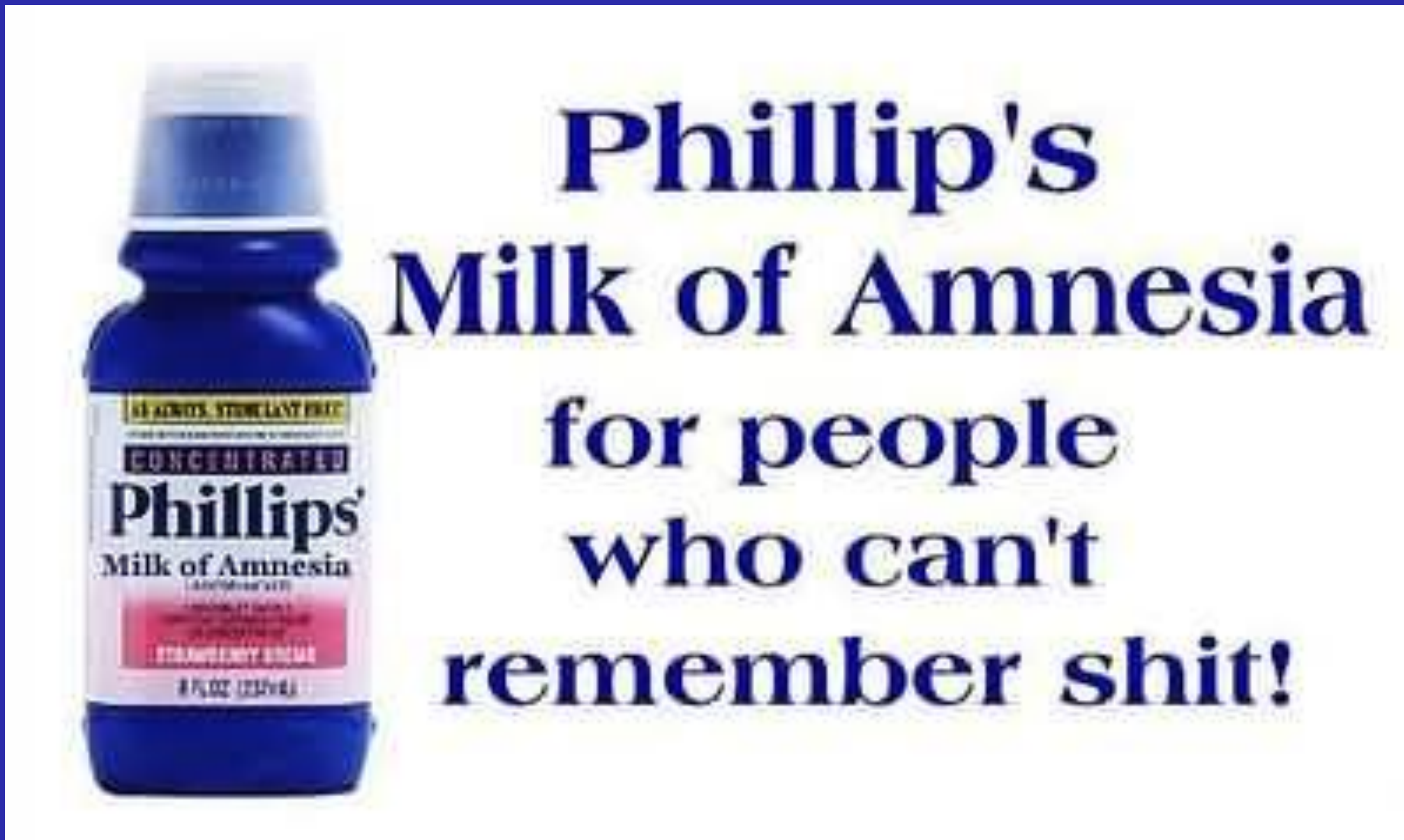
- Fear and negative emotion narrows attention to threat:
  - **"weapons focus"**
- Thus, less accuracy for peripheral memory of stimuli (i.e. color of the car or person's hair) more to the object of threat (gun, knife, etc.)

Client Education

- Your brain is not like a computer, coding every program used or website visited.
- Your memories change in response to new experiences. That’s what therapy does.

Memory (summary)

- Attention is critical to the coding of new memory
- The power of mnemonics
- The “Inverted U”: too little stimulation (e.g., boredom) or too much stimulation (e.g., trauma) conflict with the coding of new memory
- A moderate degree of anxiety works best to facilitate neuroplasticity and new memory


CONCENTRATED
Phillips'
Milk of Amnesia
Phillip's
Milk of Amnesia
for people
who can't
remember shit!

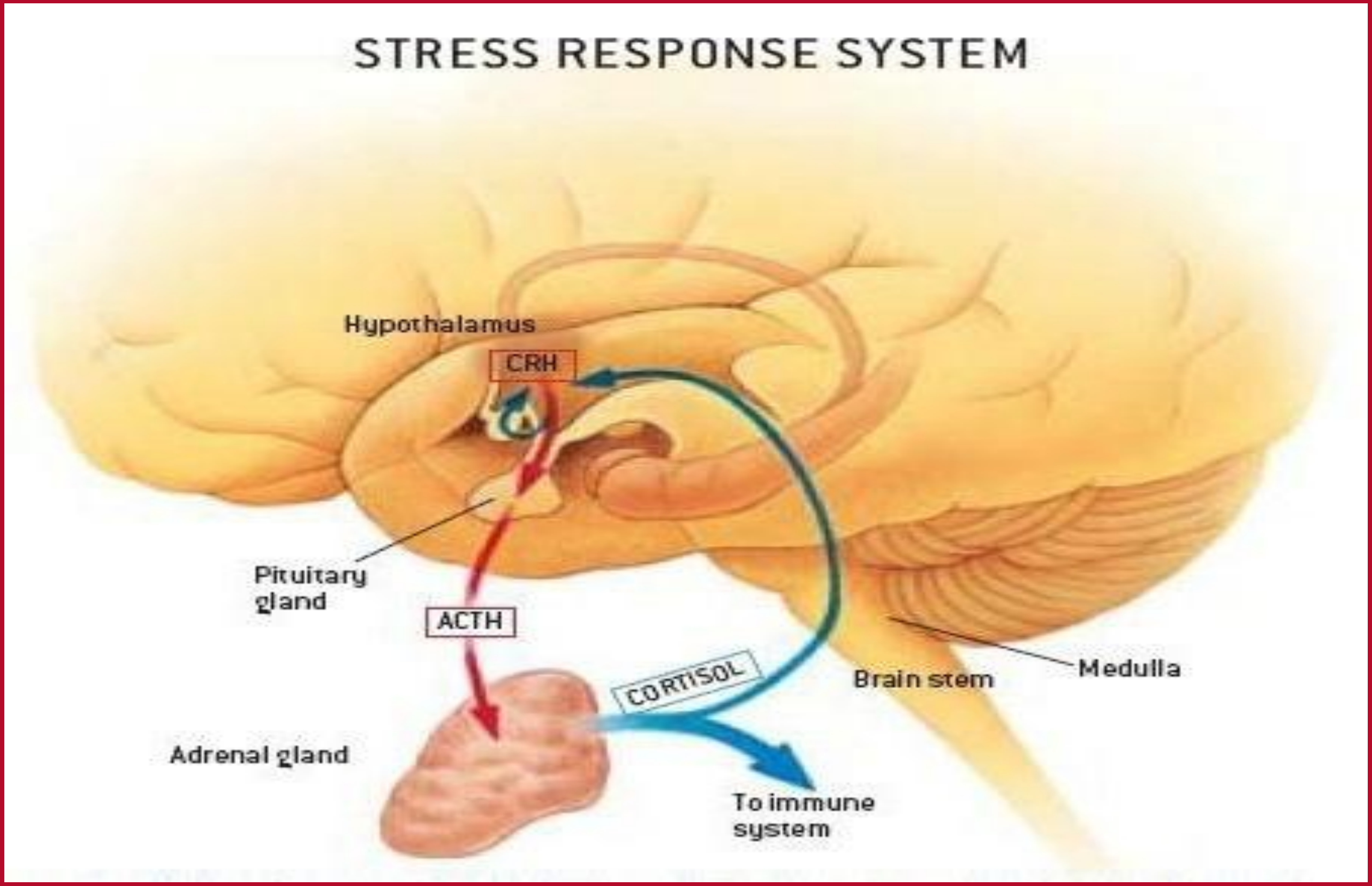
Allostasis

- Allostatic adjustments are adaptive over the short term with moderate and fluctuating levels of cortisol to help orchestrate adjustments by:
  – enhancing or inhibiting gene transcription
  – regulation of BDNF
  – up regulates amygdala activity
  – targets prefrontal systems involved in stress and the emotion (Sullivan & Gratton, 2002).
  – maintaining stability through a change (McEwen, 1998).
- *Allostatic load* --When demands exceed the balance of energy and regulatory gains from rest and recuperation. (McEwen and Wingfield, 2003).

Client Education

- Just as your car needs shock absorbers for bumpy roads, so too can you develop the durability to adapt to daily challenges.

Sympathetic ANS and Neuroendocrine Systems

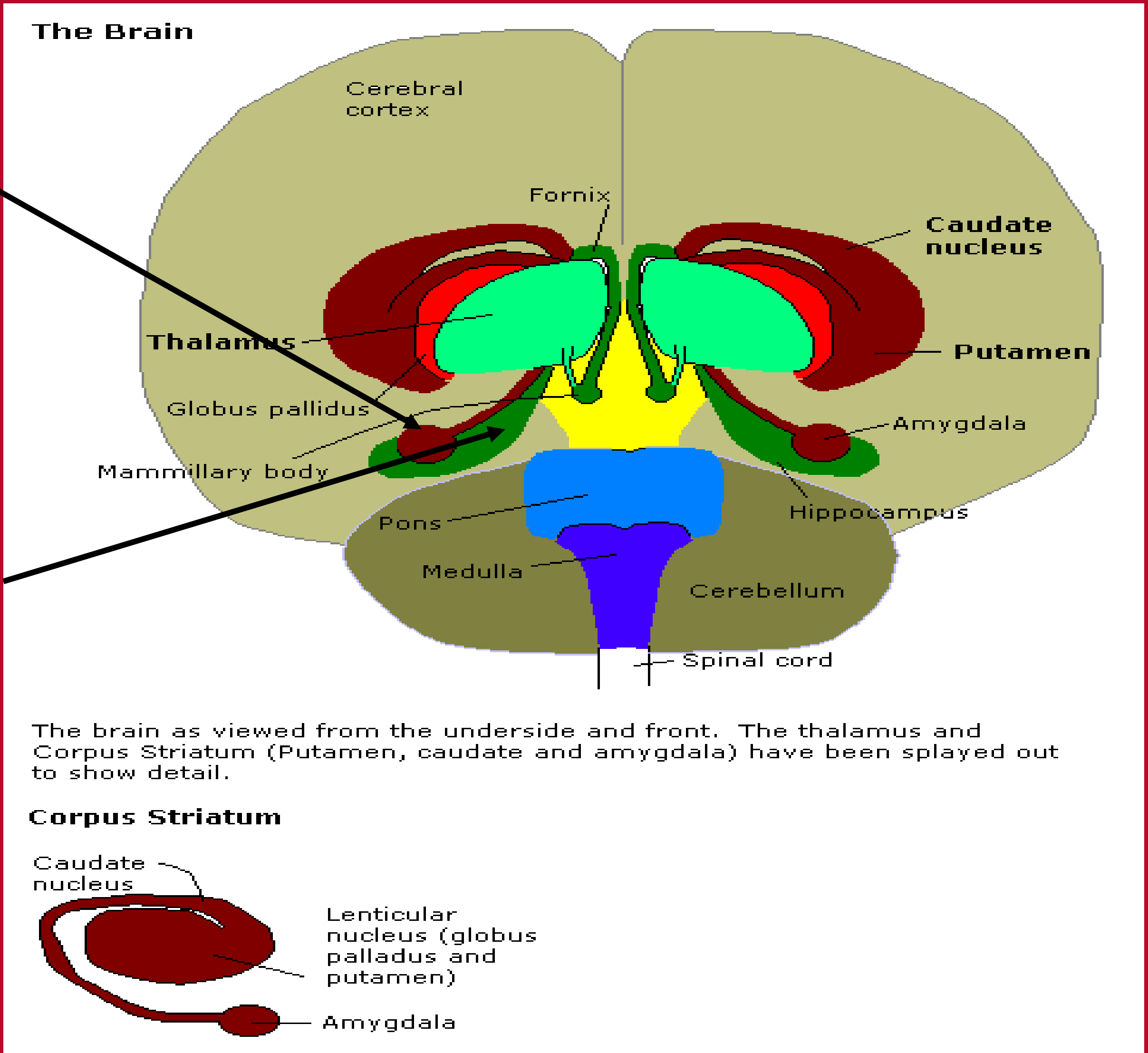


Locus Coeruleus (LC) source of NE which has extensive projections throughout the brain and can trigger the HPA axis **(Aston-Jones, et al., 1994).**

The Seahorse and the Almond

Amygdala *turns up* the HPA axis and sympathetic NS

Hippocampus *turns down* the HPA but may get saturated with too much cortisol and the thermostat can break



Cytokines

– Proteins released by immune cells that act on target cells to regulate immunity
  - Proinflammatory (IL-1, IL-6, TNFἀ) *coordinates* inflammatory responses
  - Anti-inflammatory (IL-10) *controls* proinflammatory responses.

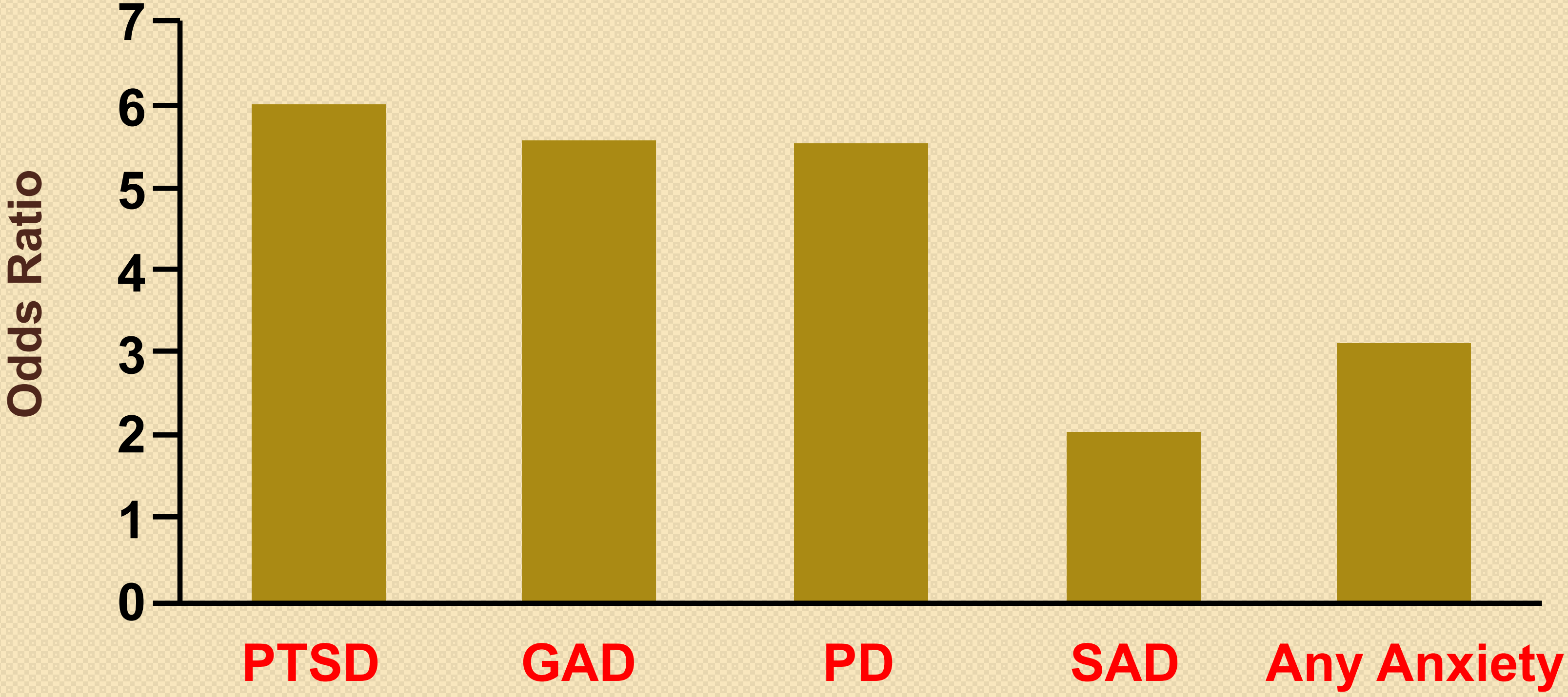
Hypocortisol vs. Hypercortisol Activity

- Chronic stress (especially uncontrollable) alters the cortisol system
- Early on there can be *higher* cortisol
  - Can lead to agitated depression
  - Kills white blood cells
  - Metabolic syndrome
- More distant traumas may result in an inadequate cortisol response
  - Autoimmune disease
  - Inflammation
  - depression

Dysregulation of the HPA axis

- Adrenaline and NE increases PICs
- PICs increase HPA axis
- Excessive CRH and low ATCH results in:
  - Low cortisol= high PICs
  - High PICs increase depression
    - Suicide victims—higher IL-6, TNFợ and lower IL-2

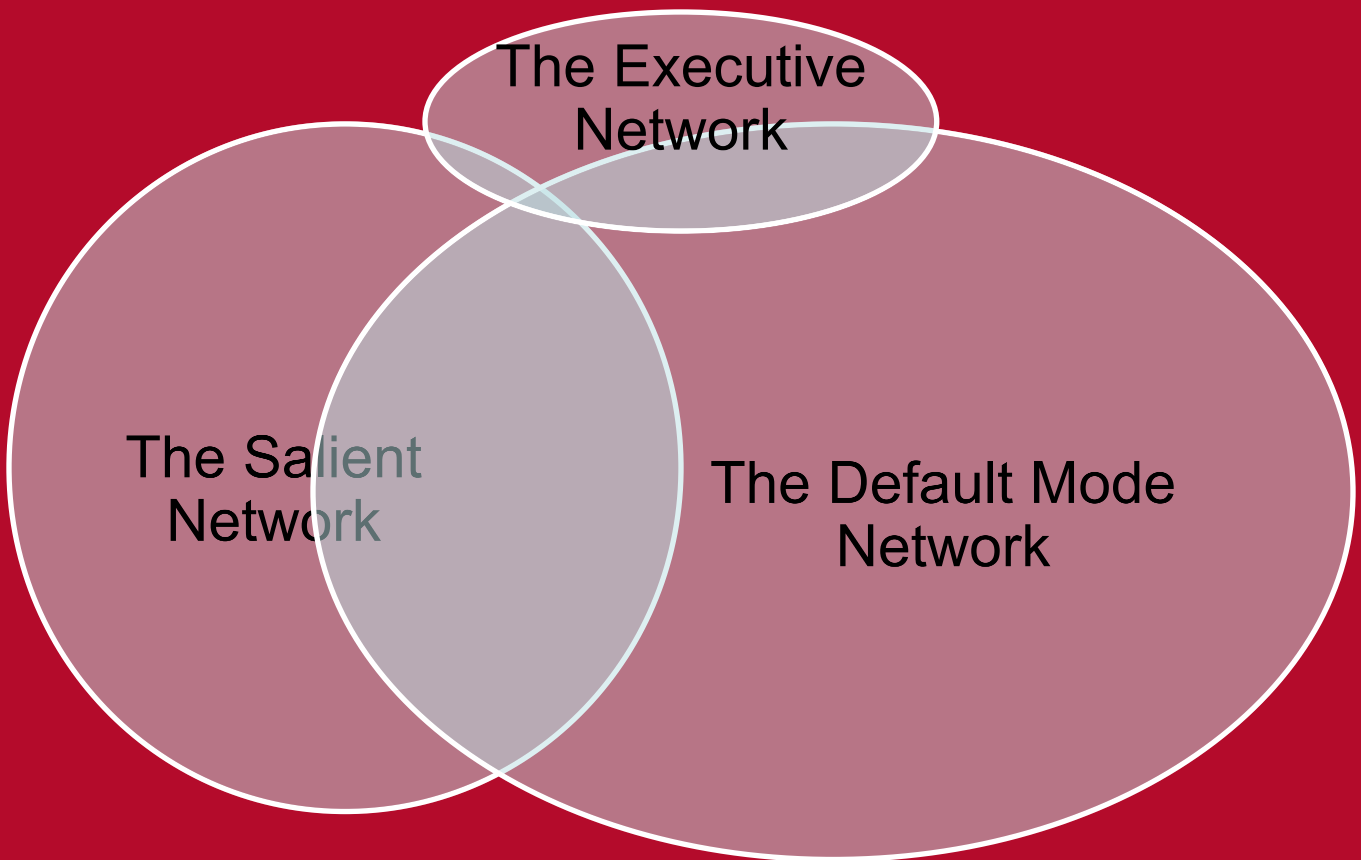
Risk of Suicide Attempts Among Patients with Anxiety Disorders



Kessler et al. Arch Gen Psychiatry. 1999;56:617

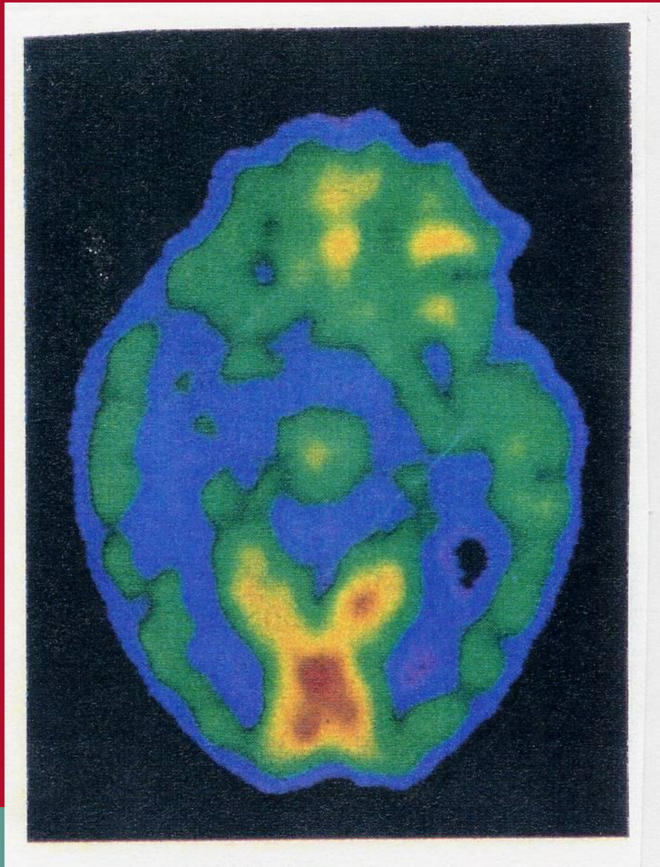
Worry as Cognitive Avoidance

- **Excessive DMN ruminations with little Executive Network**



Neurodynamics of Anxiety

- Two routes to the amygdala, the fast and slow
- Right frontal bias in general for anxiety disorders
- Under-activation of the left frontal lobes and in Broca's area explains why some people feel "speechless" when they're scared (Rauch et al., 1997).



Shifting Perspective to Speed Up the Slow Track

- Labeling thoughts—”That is an anxiety provoking thought” vs. “This makes me anxious!”—R-vlPFC
- Externalizing—”What would another person in this situation say and how is s/he right?”
- Temporal Distance—”How will I sensibly view this situation in six months?”
- Humor—”What is funny about this?”
- Wisdom—”How can I grow from this?”

Avoidance: the Polarizer

- Over-Sensitizing the Amygdala
  - Forms of Avoidance
    - » Escape behaviors
    - » Avoidant behaviors
    - » Procrastinating
    - » Safety behaviors

Why avoidance is hard to resist

- It works to reduce fear over the short term
- The more you avoid the harder it is to resist repeating --they become habits
- There is a superficial logic to avoidance, ---"Why wouldn't I avoid something that makes me anxious?"
- You get some secondary gain from it like extra care because people around you feel sympathy

Deceptively Simple but so Complex Exposure Techniques

Beta- endorphin is co-released along with ACTH but is momentarily blocked by ACTH at the common receptor sites.

The therapeutic effects from exposure in part result from beta-endorphin anxiolytic effects 20 minutes after the exposure

Critical Aspects of Exposure

1. To maximize violation of expectancies
2. To multiple feared conditioned stimuli individually and in concert
3. Occasionally reinforcing a CS with an UCS
4. Removal of safety signals or safety behaviors
5. Stimulus variability
6. Retrieval skills in other contexts that are transferable for real life situations
7. Multiple contexts

Neurodynamics of Anxiety

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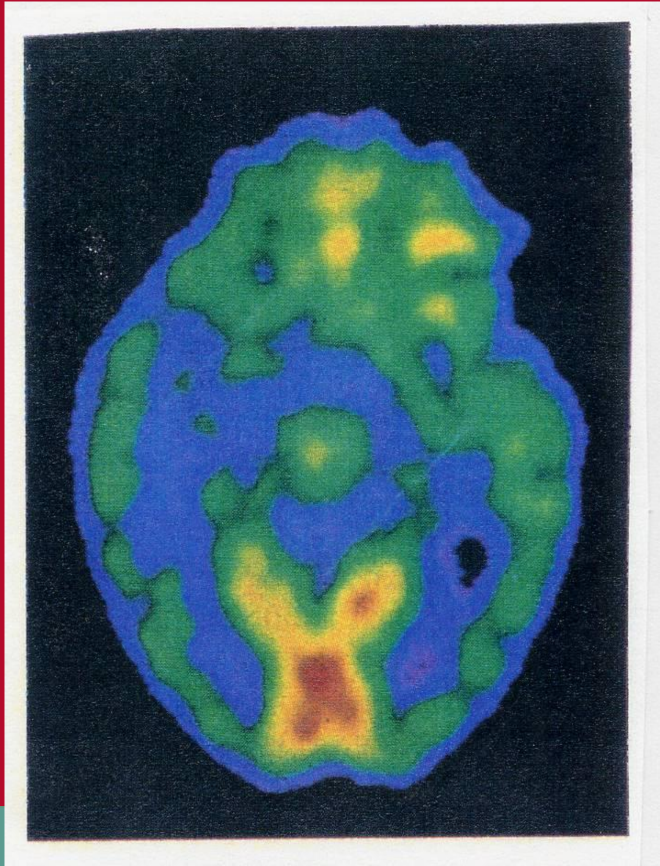

Slow Track—Allostasis

- *Automatic thoughts*—fast track impulse—interrupt with curiosity and time
- *Assumptions*—from pessimism to incremental optimism
  - "I'm working on it and can tolerate distress"
- *Core beliefs*—existential self descriptor
  - "I'm a survivor."

- Global/Passive (R-PFC) vs. Detail/Action (L-PFC)

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    - Avoidant behaviors
    - Procrastinating
    - Safety behaviors

Avoidance

- **Interpersonal trauma vs. natural disasters, etc…**

  “mistrust schemas”
- **Do not reach out to others**

  for comfort (withdrawal)

Why avoidance is hard to resist

- It works to reduce fear over the short term
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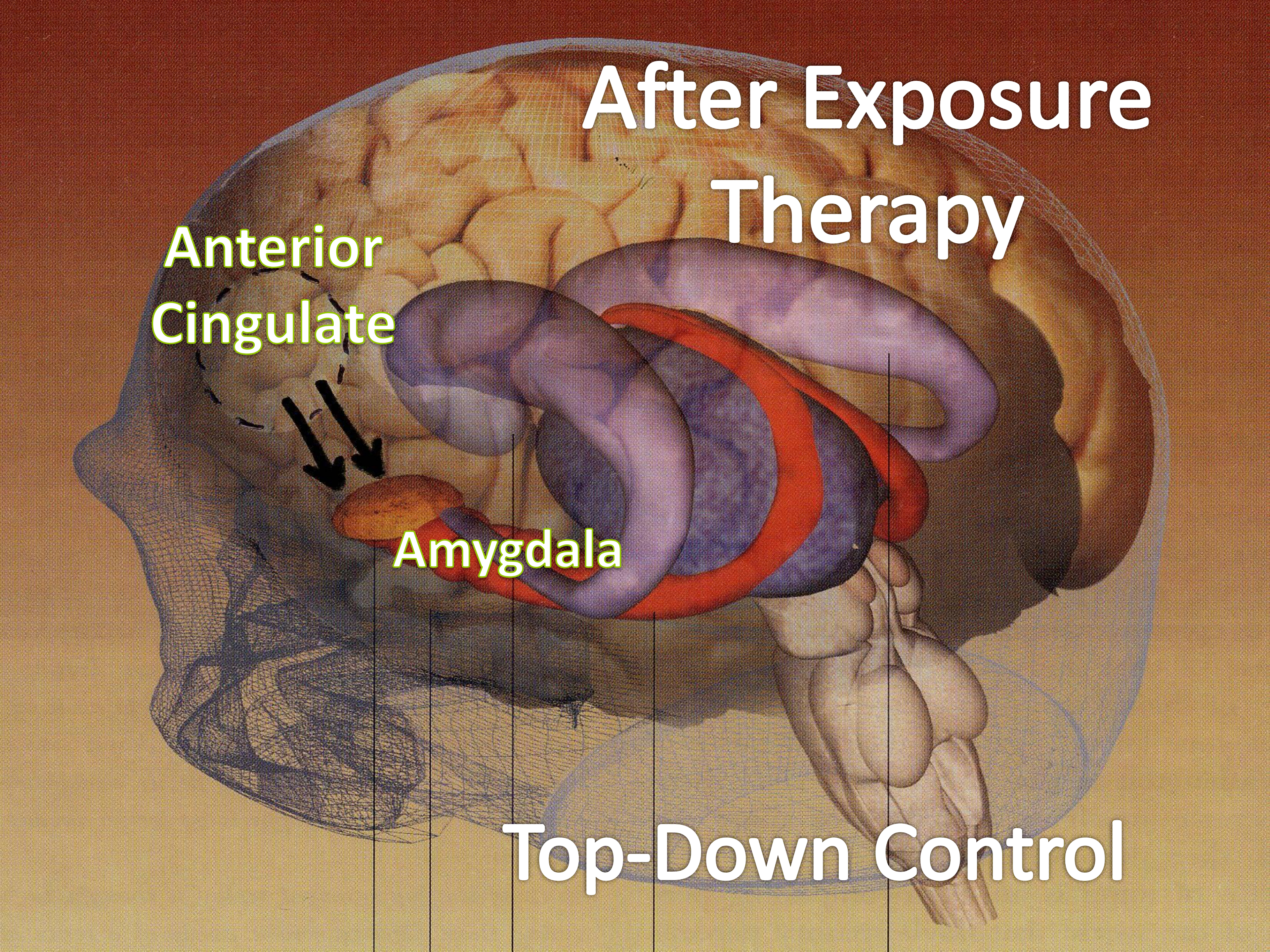
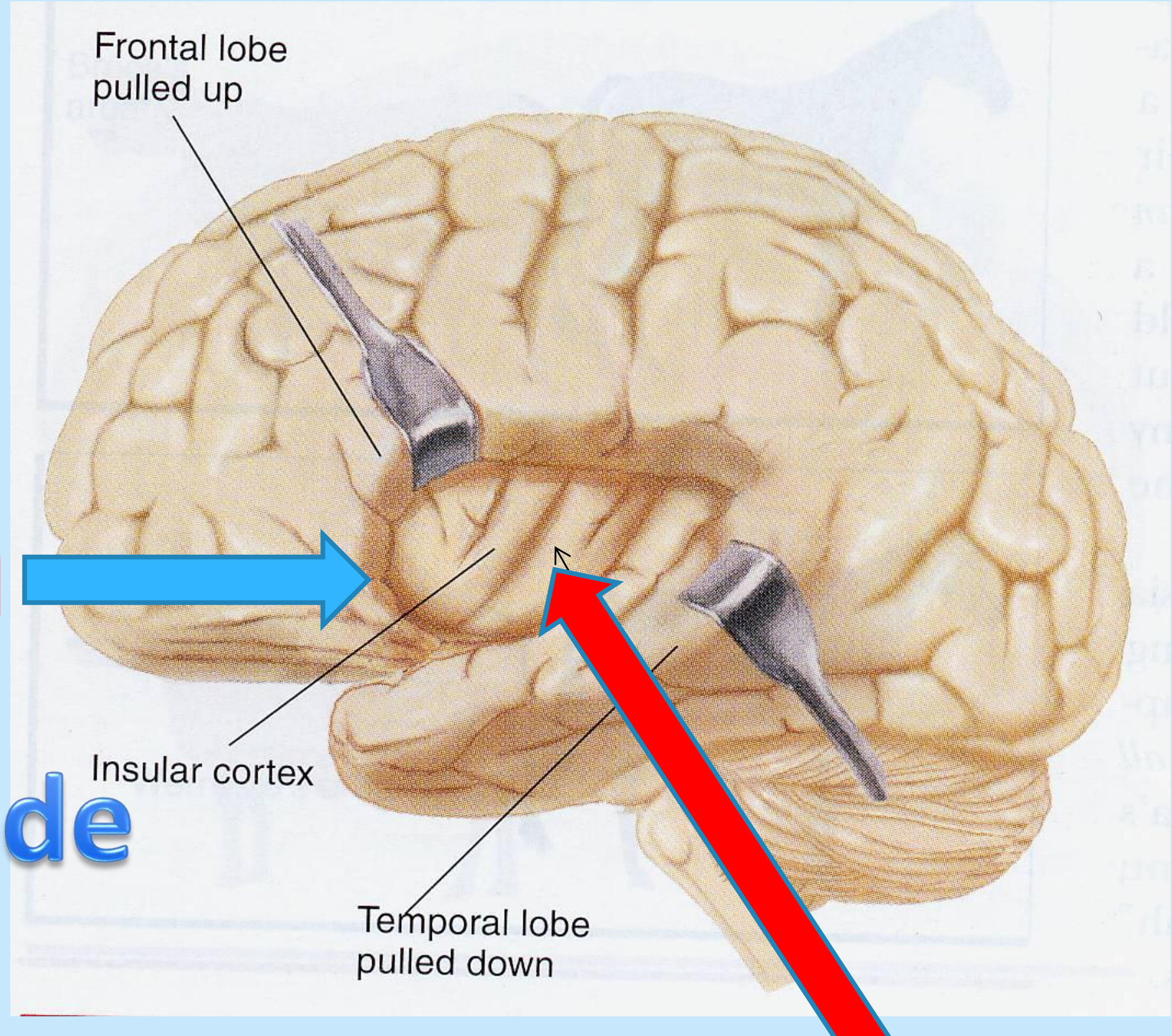
Exercise and Anxiety

- Since fight/flight is meant for action exercise provides the method to feelings – take action.
- Exercise:
  - Reduces muscle tension
  - Builds brain resources (neuroplasticity and neurogenesis)
  - Increases GABA and serotonin
  - Interoceptive exposure
  - Improves resilience – self-mastery


After Exposure
Therapy
Anterior
Cingulate
Amygdala
Top-Down Control

Interoceptive Feedback



Insula

Left side

Client Education

- Do you have shortness of breath, rapid heartbeat, sweating, headaches, or nausea?
- Each one of these are normal body sensations. It's when you <u>overreact</u> to them you may tumble into a panic attack.
- Befriend your own body sensations.

Client Education

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- Each one of these are normal body sensations. It's when you <u>overreact</u> to them you may tumble into a panic attack.
- Befriend your own body sensations.

Interoceptive Exposure +

- –Swallowing quickly--- to cause a lump in the throat
- –Tensing the body--- leading to chest constriction
- –Standing up quickly from lying on the floor---to cause dizziness.
- –Staring at one spot---to increase the feeling of being trapped

Interoceptive Exposure +

- There are a variety of interoceptive exercises including:
  - Running in place--- to increase heart rate and hyperventilation
  - Holding your breath--- to simulate sensations of suffocation
  - Spinning--- leading to dizziness
  - Hyperventilation or breathing through a straw---leading to light-headedness

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BBT and Panic Disorder

- Desensitizing the Amygdala—Avoiding avoidance
- Interceptive exposure exercises—Embracing body sensations
- Speeding up the slow track—Getting the L-PFC and L-Anterior Insula cortex involved

BEAT Panic

"B" is for body. When you feel your heart race or breathe too fast just ride it out. Say, "I can befriend my own body!

"E" is for exposure. Through interceptive exposure exercises you can regain tolerance to body sensations. Say, "this is not a heart attack but just my own body sensations that I've felt many times before."

"A" is for the amygdala. With its fast and slow tracks. "I can learn to slow down my fast track and speed up my slow track."

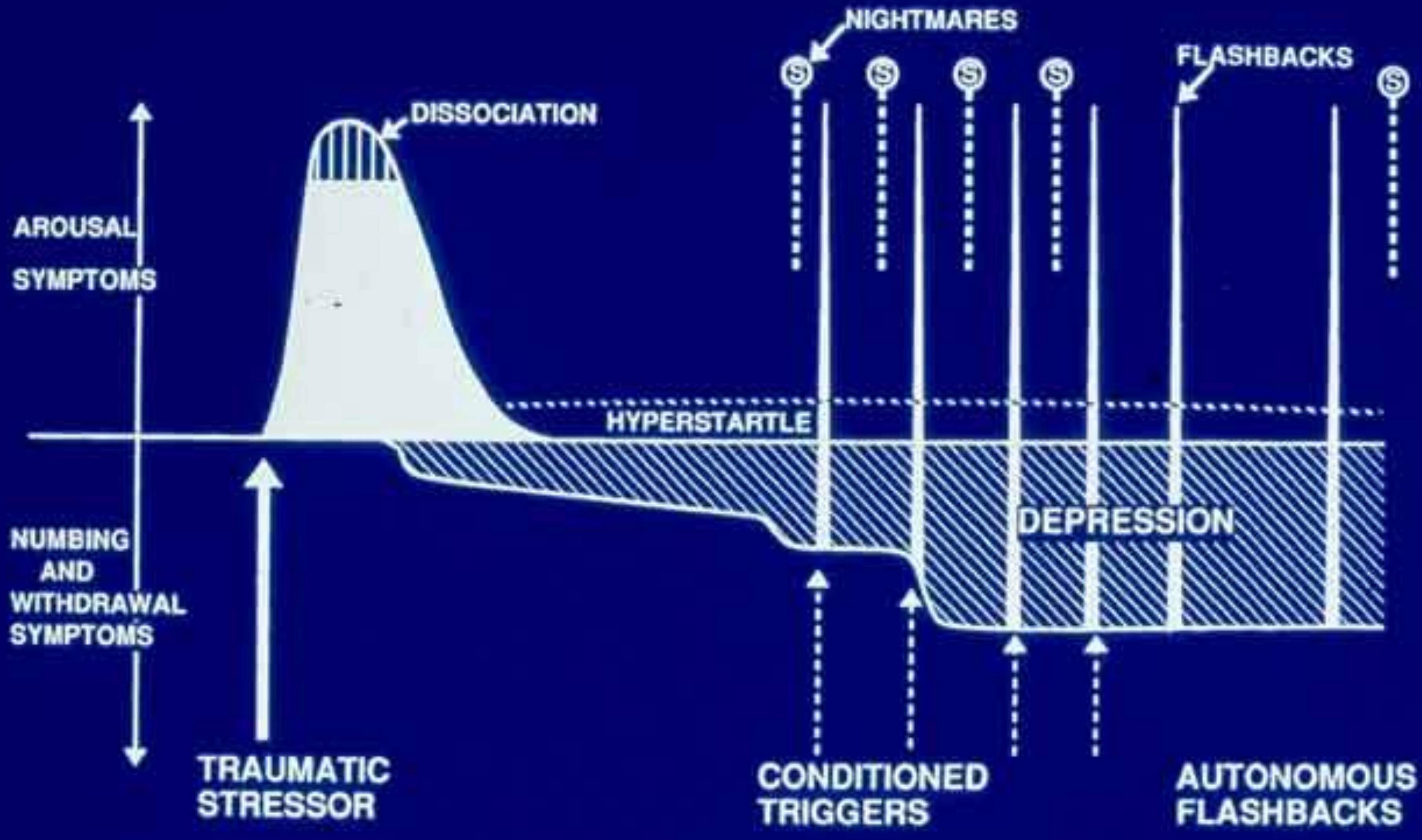
"T" is for thinking. To speed up your slow track, remind yourself that what you think is happening has a dramatic effect on what you feel is happening.

Chad

WHO estimates the prevalence of PTSD

- In Ukraine at approximately 25%.
- **In Gaza:** 63.40%
- Upward of 40% of refugees, and as many as 90% of refugee children

Time Sequence



Phylogenetic Responses to Stress

- 1) Trigger the social engagement system—the myelinated vagus
- 2) Fight or flight—SNS and HPA axis arousal
- 3) Immobilization—freeze, collapse, and feigned death:
  - 2 stages
    - Freezing in terror
    - Paralyzed—shut down—total submission, trancelike, dissociation

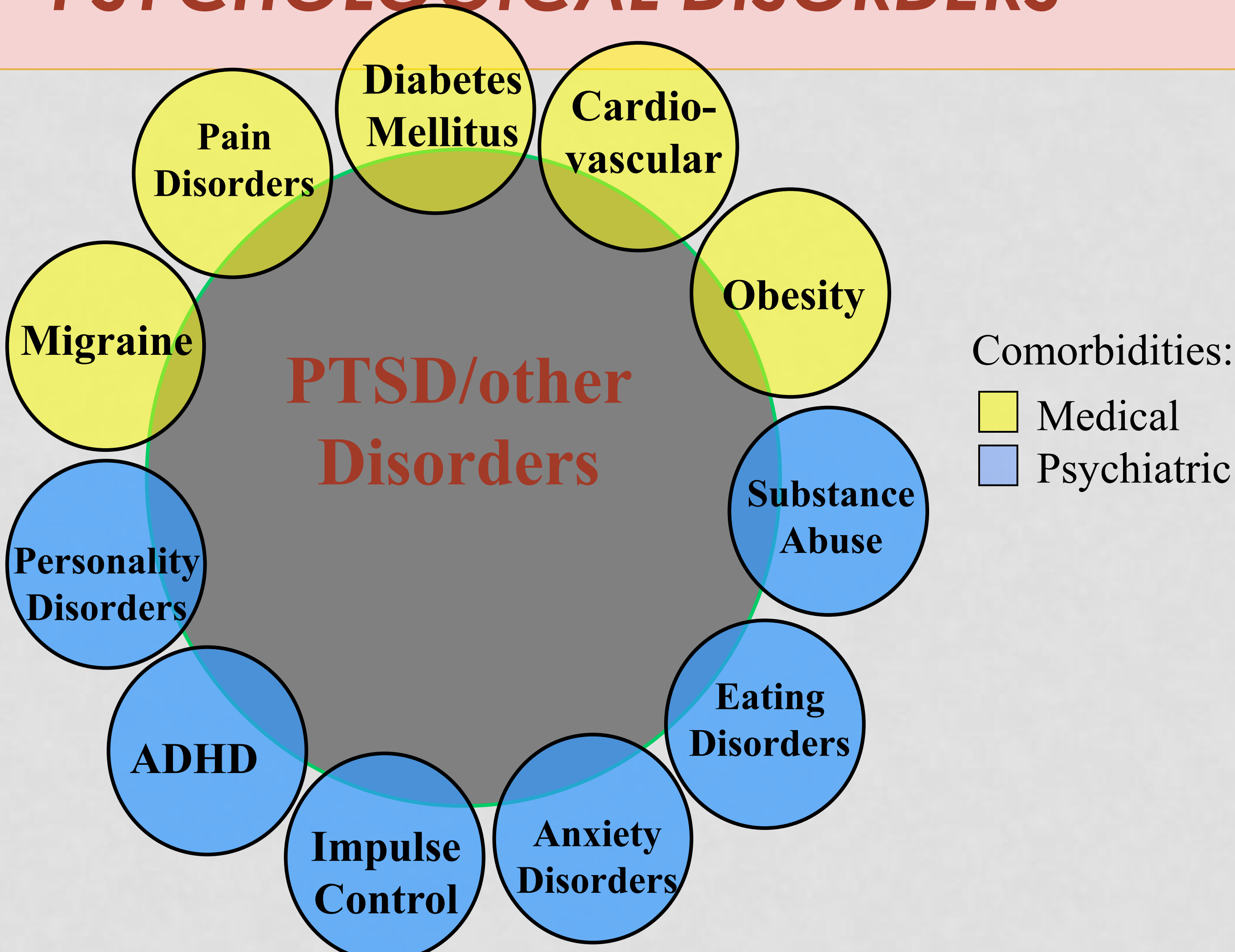
PTSD Neurodynamic Aspects

- ↑ amygdala—general false positives for threat
- ↓ mPFC especially the ACC (reduced neurointegration and cortical volumes) (De Bellis, et. al., 2000) (inadequate top down inhibition of the amygdala)
- ↓ hippocampus (cortisol, excitotoxity, blocking of neurogenesis)

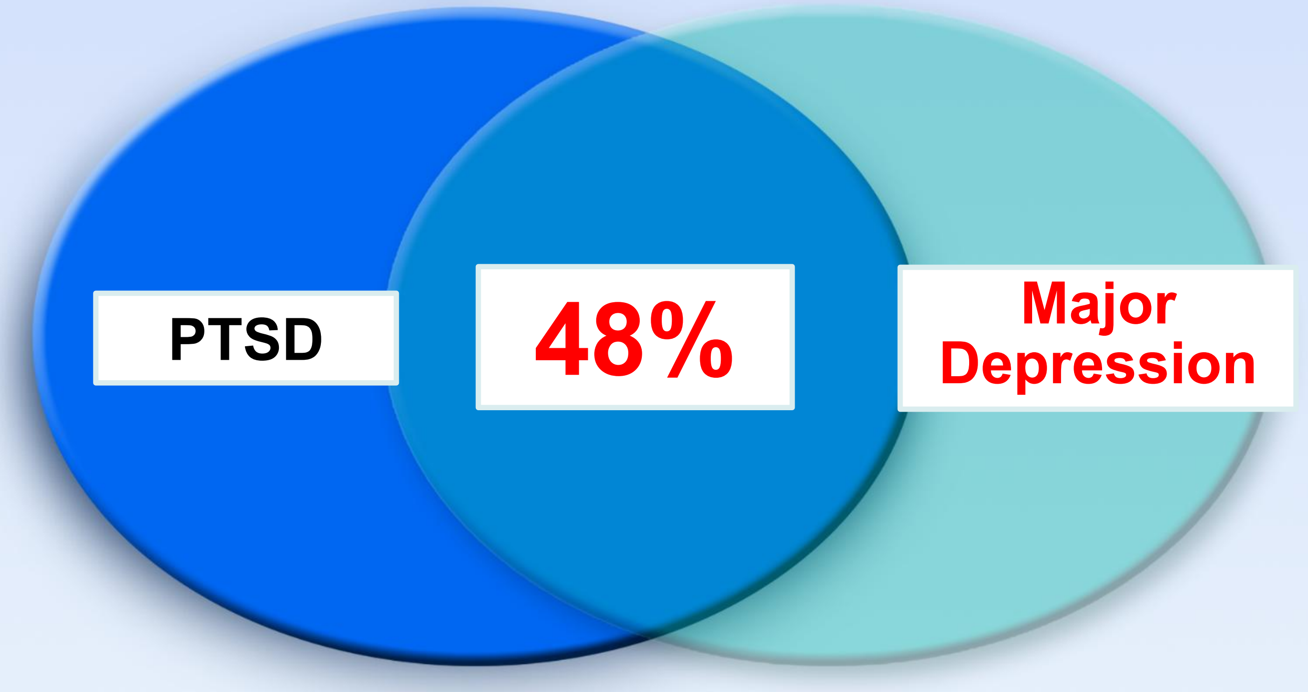
Most Common Acute Post-Traumatic Stress Response

- Depression
- Anxiety Disorders
- Substance use / abuse
- Acute Stress (ASD) only later PTSD
- Adjustment disorders
- Persistent complex bereavement

THE RULE NOT THE EXCEPTION THE MULTIDIMENSIONALITY OF NEURO-PSYCHOLOGICAL DISORDERS



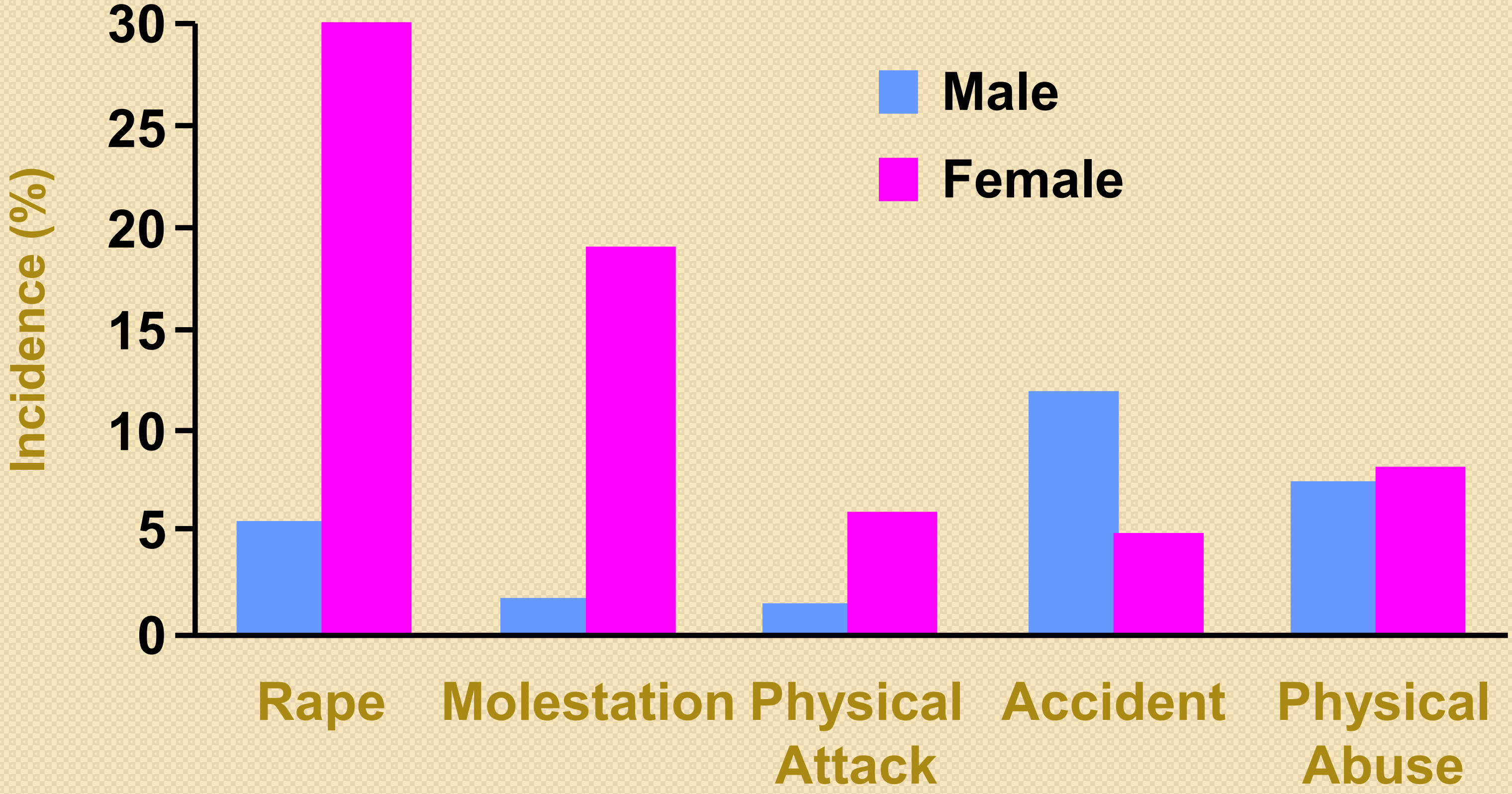
Common Occurrence of PTSD and Depression



A Big Problem:
Reluctance to tell or seek out help

- **Sexual assaults**
- **Bullying** (kids and adults)
- **Work-place violence**
- **Domestic violence**

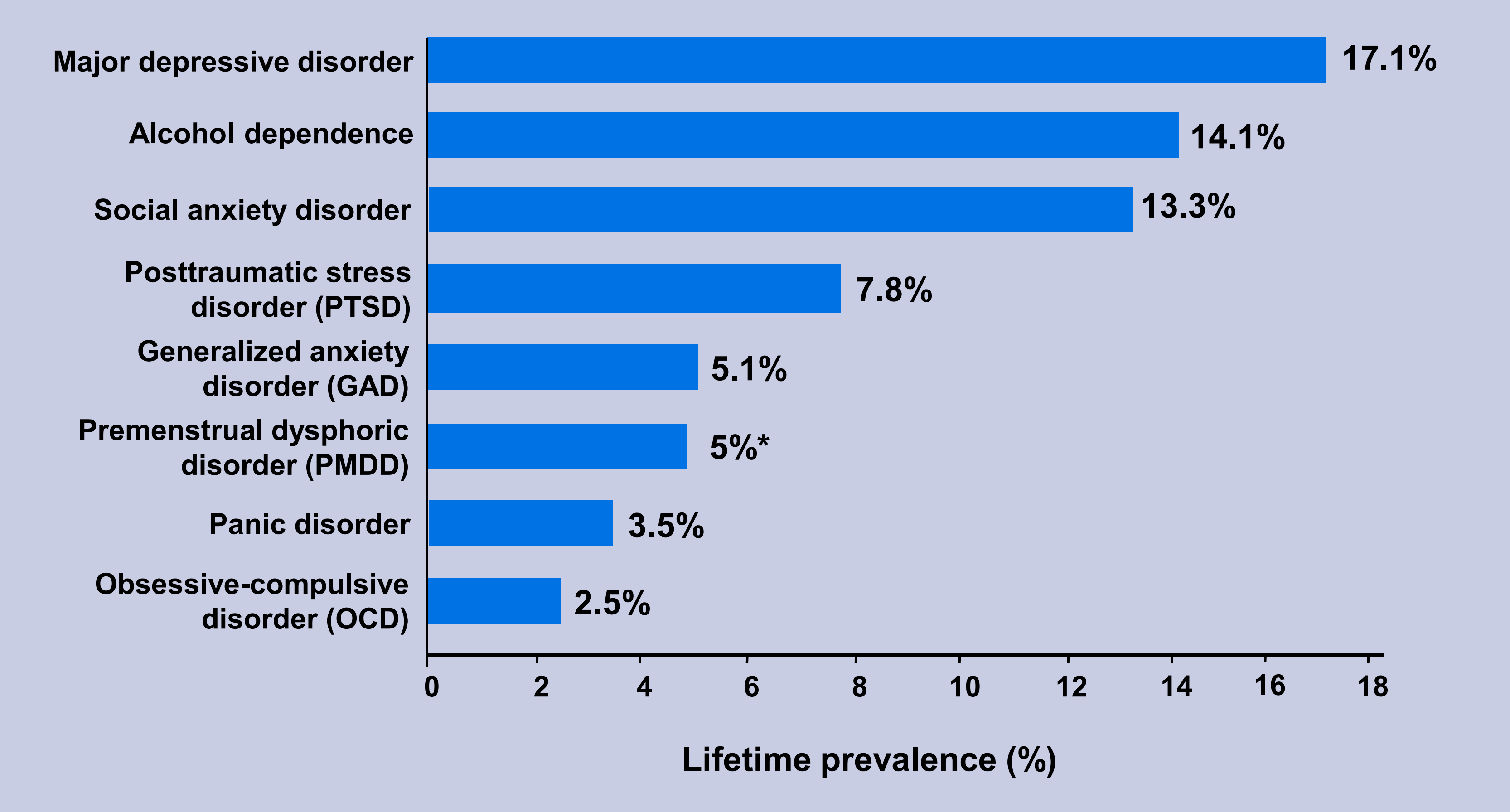
Non-Combat-Related Trauma Associated with PTSD



Kessler et al. Arch Gen Psychiatry. 1995;52:1048

Courtesy of: David V. Sheehan, M.D., M.B.A.

Lifetime Prevalence of Common Psychological Disorders



<u>Predicting PTSD</u>

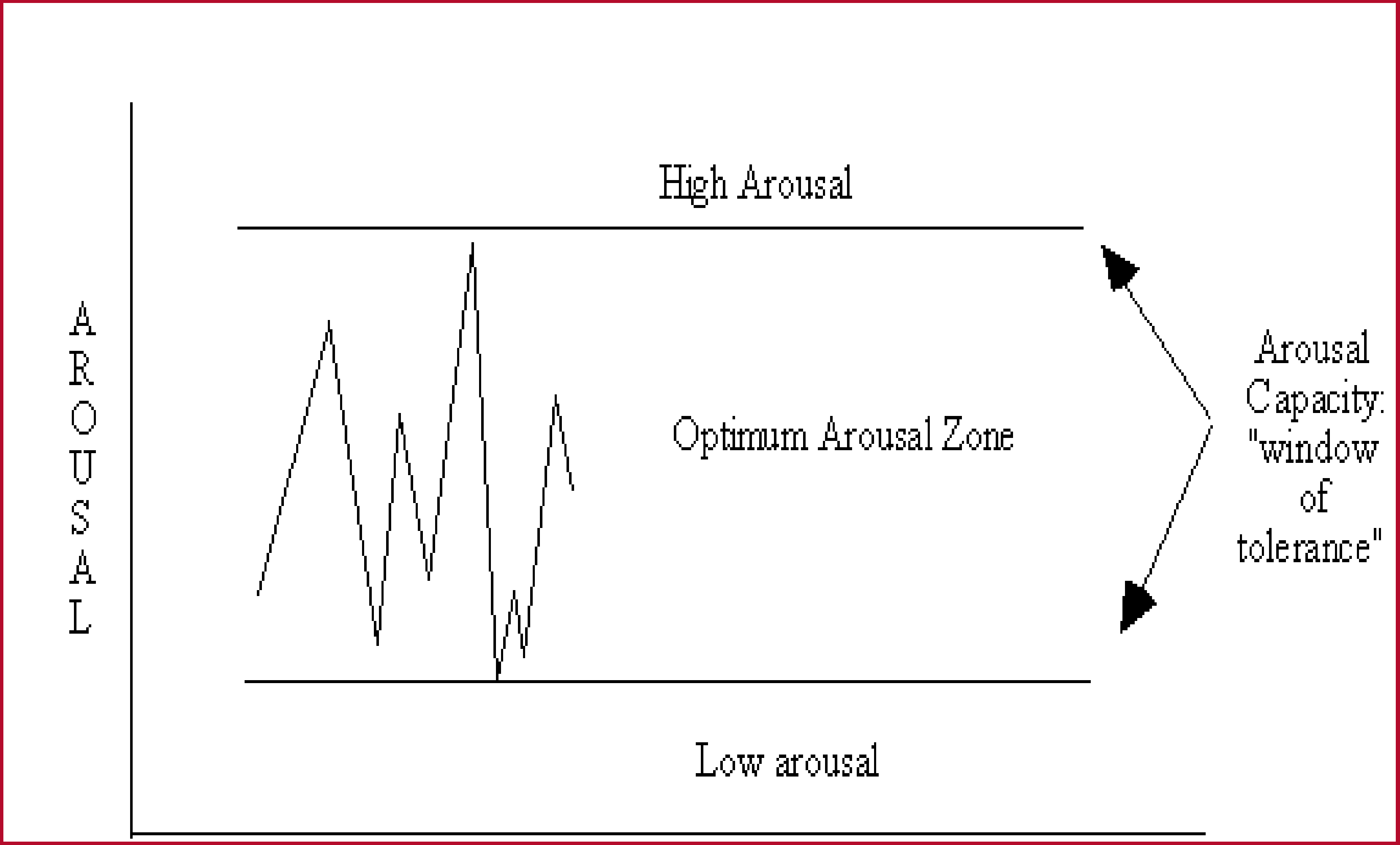
Dissociation or amnesia at the time of traumatic event

Panic attack: first 24 hours

70% greater risk

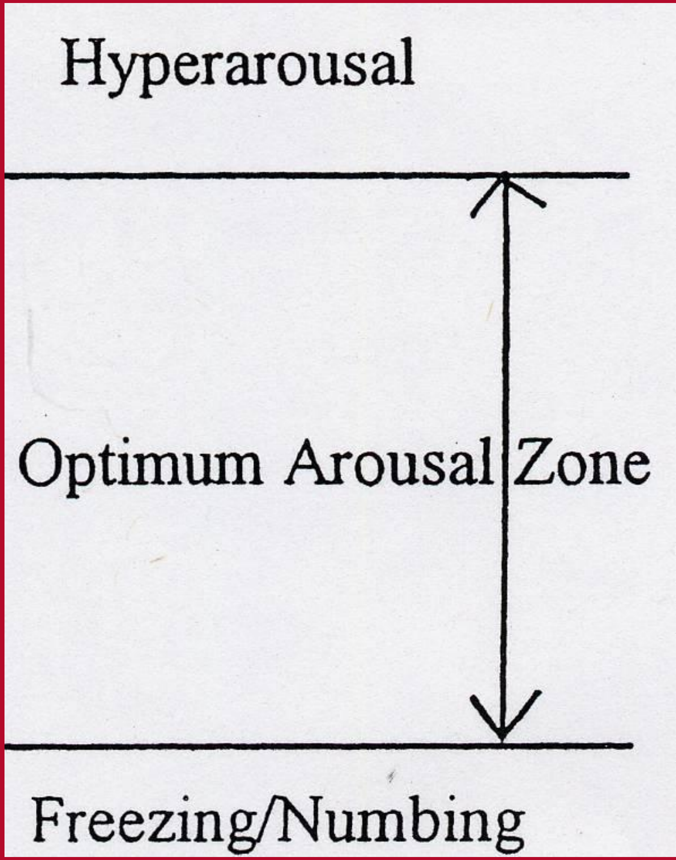
The Severity of the Traumatic Event is <u>not</u> predictive of outcome

Window of Tolerance



Working the "Therapeutic Window"

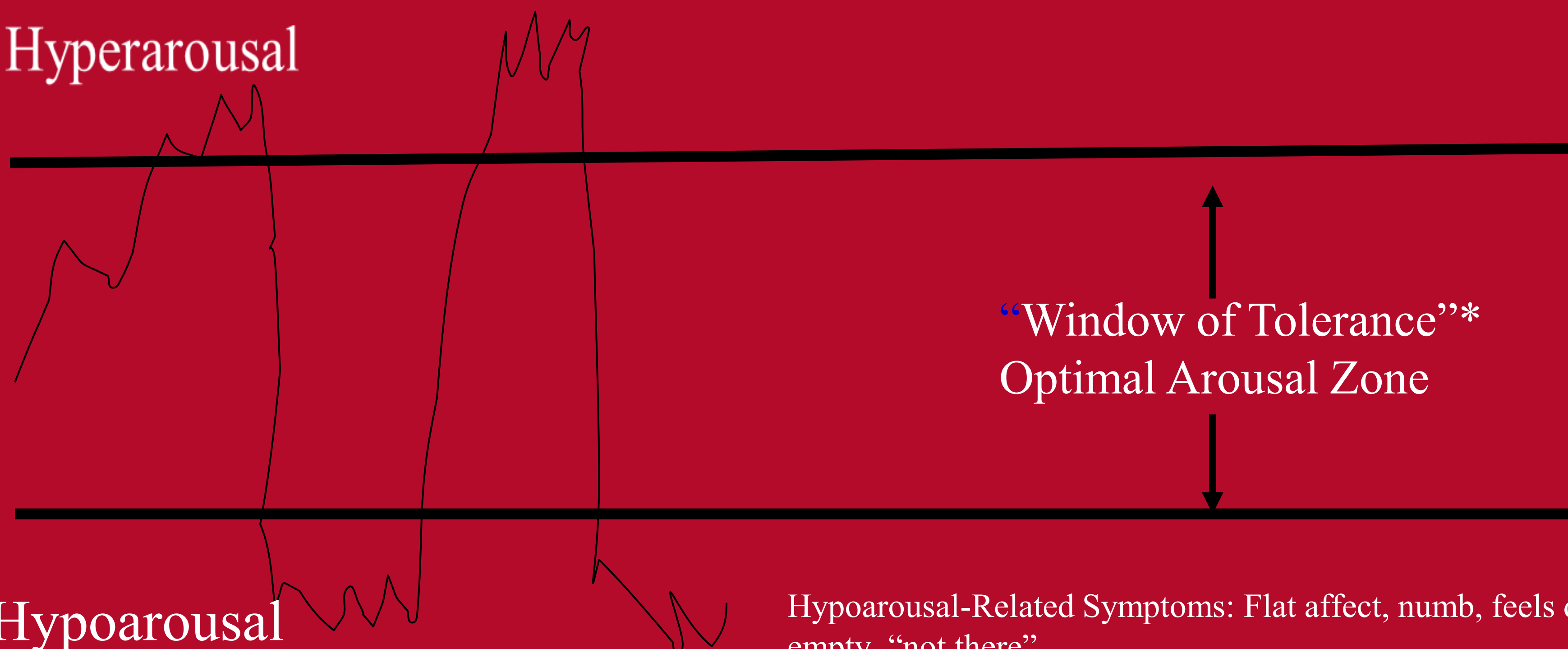
Over-Shoot



Under-Shoot

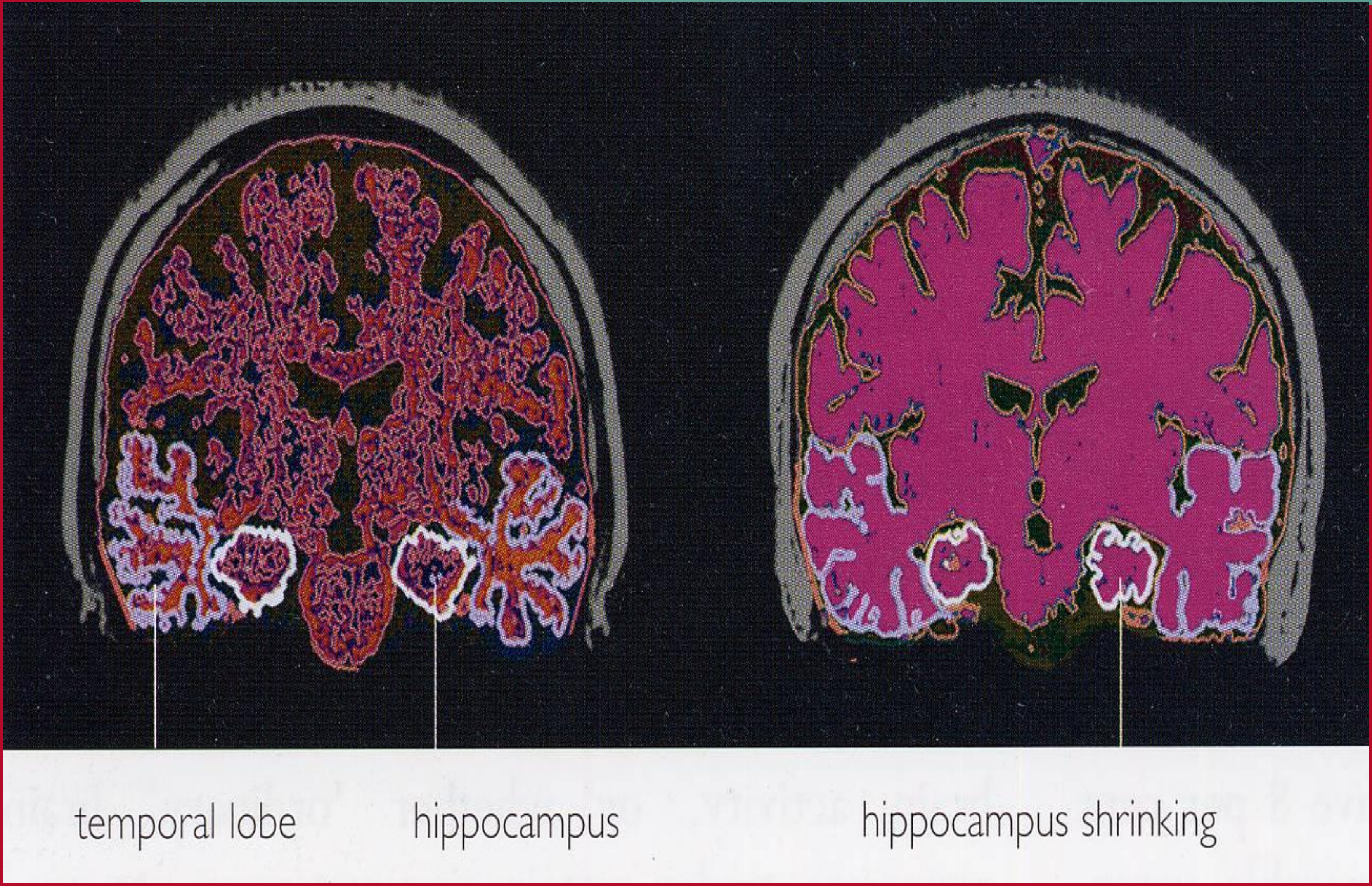
Trauma Responses are Autonomically Driven

Hyperarousal-Related Symptoms:
High activation resulting in impulsivity, risk-taking, poor judgment
Chronic hypervigilance, post-traumatic paranoia, chronic dread
Intrusive emotions and images, flashbacks, nightmares, racing thoughts
Obsessive thoughts and behavior, cognitive schemas focused on worthlessness and dread



Hypoarousal-Related Symptoms: Flat affect, numb, feels dead or empty, "not there"
Cognitively dissociated, slowed thinking process
Cognitive schemas focused on hopelessness

Hippocampal atrophy



Client Education

- Though your memory may be temporarily impaired, you can revitalize these areas of your brain by aerobic exercise followed by learning and goal oriented behaviors.

Possible Neurochemical Vulnerability of PTSD

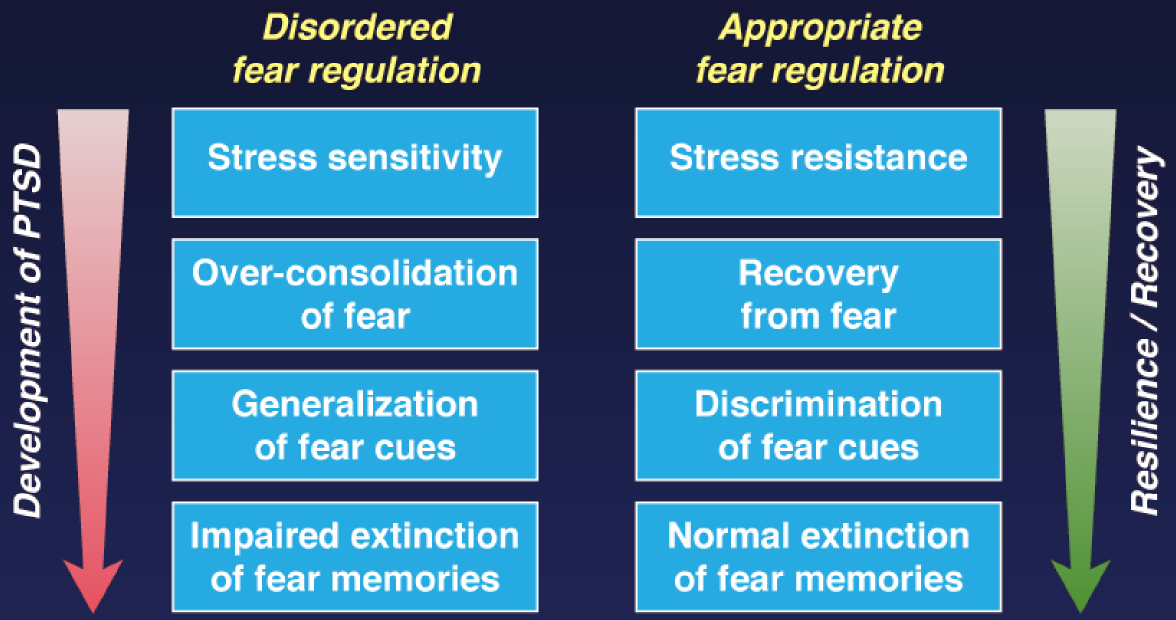
- ↑ NE post trauma may predict PTSD (Yehuda, et. al., 1998)
- ↑ cortisol in the evening not in the morning
- ↑ proinflammatory cytokines post trauma
  - The secretion of IL-6 inflammatory cytokines can be triggered by B-adrenergic receptors with ↑ NE
  - Inflammation can occur post trauma via CRH/substance P-histamine axis with ↑ cortisol and IL-6 (Elenkov, et. al., 2005)

Client Education

- It's common to feel like being alone after a traumatic event. But, isolating now will make you worse and feel even more alone.

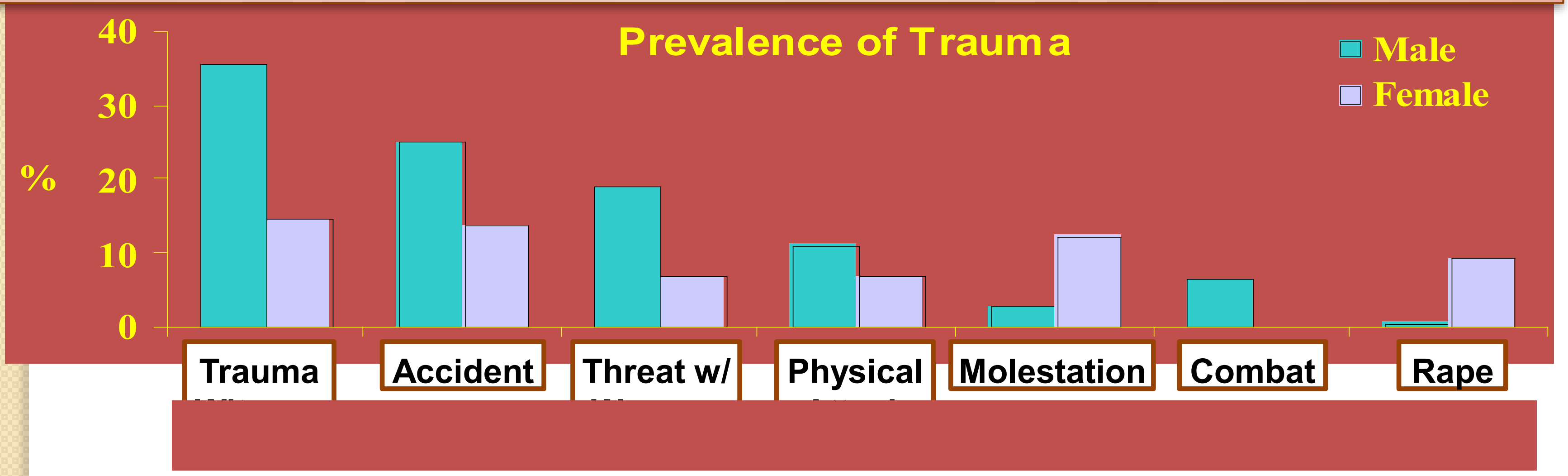
- Parts of your brain activate when you are with people which helps you buffer anxiety and lift depression.

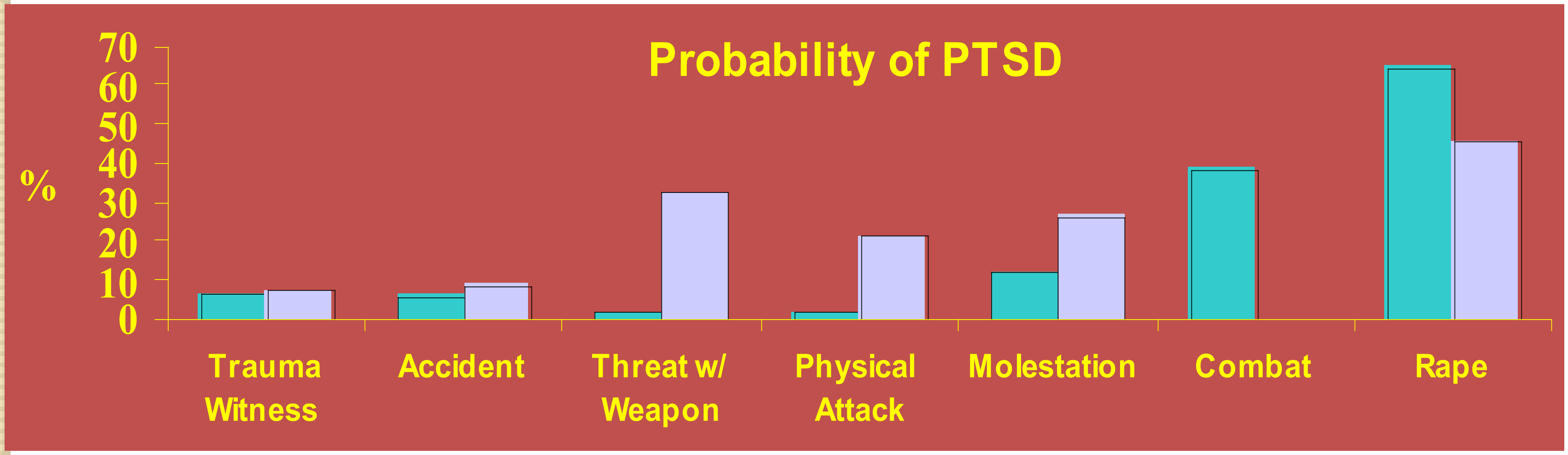
Disordered Fear Regulation in PTSD



From: Mahan AL, Ressler KJ. Trends Neurosci, 2012, 35:24-35.

Prevalence of Trauma and Probability of PTSD





Kessler. *J Clin Psychiatry*. 2000;61(suppl 5):4.
Kessler et al. *Arch Gen Psychiatry*. 1995;52:1048.

Avoidance

The major factor in perpetuating PTSD and contributing to a more chronic course

Avoiding specific trauma triggers; Reminders:

- People
- Situations
- Conversations
- Media
- Medical Treatment

Suicidality and PTSD

- PTSD patients are 6 times more likely to attempt suicide than the general population

- PTSD has higher risk of increased number of suicide attempts than all other anxiety disorders

Amygdala-Level Processing

Rapid, Crude, Generalized
Many false alarms
Non-Responsive to
new “Data”
Outside awareness & Automatic
Beneath the radar of consciousness

Watch for Implicit Memory of Trauma

- Notice that….
- Wow! What just happened
- Did you feel the change in….
- Noting somatic communication
  - “The body knows the score”
- Gentle exposure to changing somatic
  - sensory motor experience

Research on PTSD Treatments

- Institute of Medicine (IOM) 2007 Review
  - Thorough review of psychotherapy research for PTSD (requested by the VA)
- Treatments not found to have clear empirical support:
  - EMDR, group therapy, hypnotherapy, eclectic, CBT alone….
- Exceptions: review found strong efficacy of exposure:
  - Prolonged Exposure (PE)
  - Cognitive Processing Therapy (CPT)

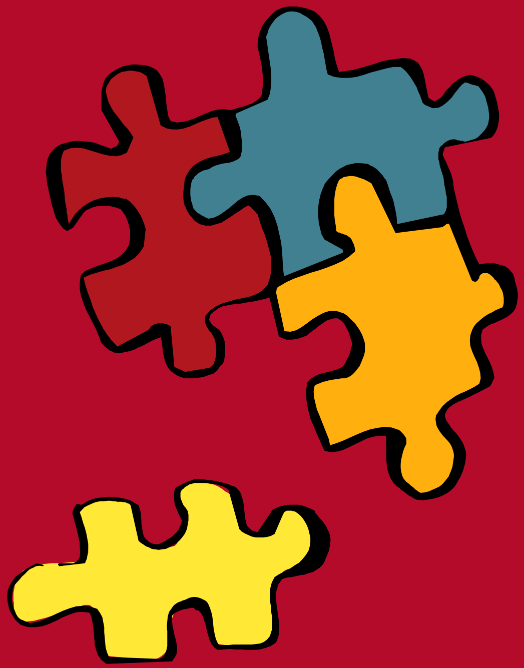
Exposure

- Imaginal exposure (trauma memory)
  - Exposes client to memory of the trauma in structured, controlled way
  - Trauma exposure helps client in two ways:
    - Helps reduce anxiety associated with trauma memory (via extinction of conditioned fear)
    - Helps client organize memory into coherent narrative (calms overactive amygdala)
  - Generally need minimum of 12 sessions (CBT, PE, CPT)
    - CBT approach starts with psychoeducation, anxiety management, and coping skills
    - Minimum 4-6 imaginal exposure sessions (temp. increase of anxiety and re-experiencing symptoms)
    - Cognitive processing of trauma memory & associated meaning (beliefs)
- Situational exposure (CBT & PE)
  - targets avoidance of trauma-related situations (and agoraphobic avoidance)
- Interoceptive exposure
  - Targets "fear of fear" or somatic phobia (treatment for panic disorder)

Impaired Information Processing in Post-Traumatic Stress Disorder

Dissociation at time of trauma (encoding)
Fragmented, “jigsaw” memories

images, emotions,
bodily sensations,
cognitions………
dis-integrated



Watch for Implicit Memory of Trauma

- Muscle tension
- Motor impulses
- Heart rate
- Facial expression
- Trembling
- Breathing rate
- Mood changes

Dual Processing Theory

- Limitations of the “fear network” theory – doesn’t account for implicit memory:
  - Verbally accessible memories (VAMs) on the conscious memory level. VAMs can be accessed in therapy through deliberate recall.
  - Situationally accessible memories (SAMs) non-conscious. SAMs are only accessible through exposure cues that activate the non-conscious network (Brewin, Dalgleish, and Joseph, 1996).

The Explicit system

- Verbally accessible memory (VAM) system—the narrative—autobiographic
  - Can be deliberately retrieved (Brewin, 2005)
  - Cortex and hippocampus
  - Past, present, and future
  - Available to verbally communicate
  - Restricted by attention and arousal
- Traumatized people use the VAM system to evaluate the trauma
  - They ask themselves “could it have been prevented?”
  - “What are the consequences….the meaning?”

The Explicit system

- VAM system memories are accompanied by “secondary emotions” (not experienced at the time of the trauma)
  - Directed at the past—i.e. regret or anger about the risks taken
  - Often involves guilt or shame over perceived failure or not preventing the event
  - Thoughts about the future—i.e. sadness at the loss of cherished plans or hopeless at the thought of not finding fulfillment

The Implicit System

- Lower level perceptual processing—too briefly apprehended to be bounded together in consciousness memory required for VAMs
  - Sights
  - Sounds
  - Physiological sensations including changes in heart rates, temp, or pain

The Implicit System

- Primary emotions—fear, horror, helplessness
- Accounts for flashbacks that can be triggered involuntary by cues related to the trauma (sight/sounds etc.)
- Not structured by verbally coded memories—therefore more extensive
- The more drawn out the trauma, the greater the tendency to experience a range of sensations and emotion
- Difficult to access in therapy

Client Education

- Every time you go through this exposure exercise it will get easier.
- The higher parts of your brain, will rewire to put the brakes on the alarm button in the lower part of your brain.

Converting traumatic memories into meaning

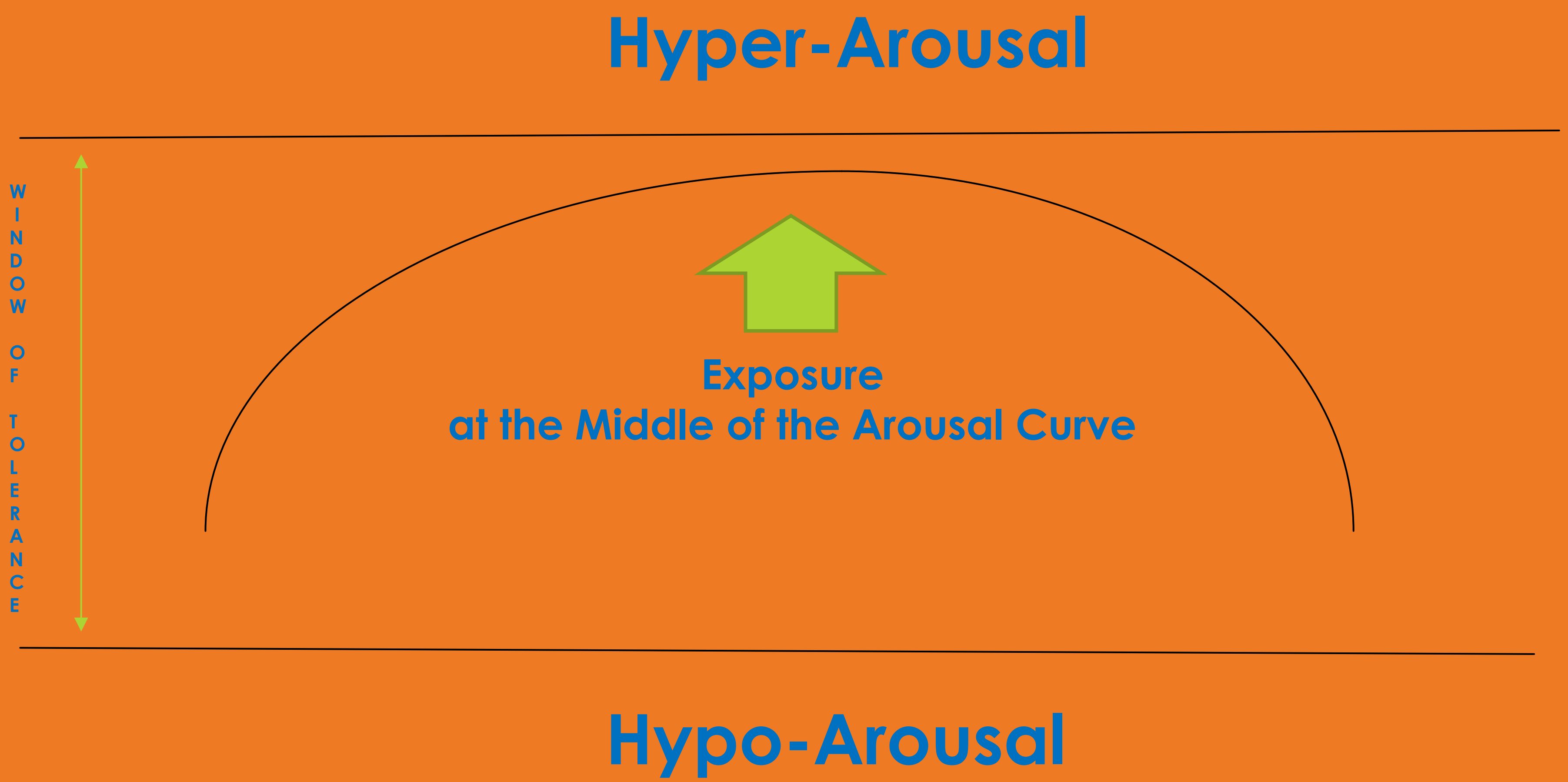
- Traumatic memories are fragmented and disorganized into “hotspots” which can spur flashbacks
- Hotspots occur where there is maximal functioning separation between SAMs and VAMs (i.e. less integration) (Brewin, 2005)
- They need to be integrated and converted into a coherent and an organized form to reduce the risk intrusions into flashbacks (Ehlers & Clark, 2000; Conway & Playdell-Pearch, 2000)

Client Education

- Step-by-step. I am going to help you expose yourself to the cues that trigger the flashbacks so that you can bring them under control.

Explicit and Implicit Integration

- The process needs to be repeated for:
  - Neuroplasticity—the inverted “U”
  - To neutralize the traumatizing quality of the SAM system
  - So that VAMs can compete with SAMs and integrate them
    - The new VAM system puts the SAM system in perspective


Hyper-Arousal
WINDOW OF TOLERANCE
Exposure
at the Middle of the Arousal Curve
Hypo-Arousal

Client Education

- By getting your memory systems in sync, what had triggered flashbacks will fade away.
- Those flashbacks will lose their ever presence and be placed where they belong, in the past as you develop a meaningful future.

Continuum of Detachment

- Traumatized people can experience:
  - Mild detachment or absorption: involving a breakdown in the ability to notice outside events and extending to an altered sense of self.
  - Moderate detachment: involving feelings of depersonalization and derealization. The person sees himself as if from afar as an observer.
  - Extreme detachment: involving a state of unresponsiveness. The person can act catatonic and have no sense of self or time. (Allen, 2001)

Affective Regulation of Condition Emotional Response (CERS)

- The skill of perceiving, labeling, and accepting emotion
- Identifying and modifying thoughts that exacerbate emotions
- Practical action—act in concert with values
- Insight into why/how the emotions are coming up
- Titrate the exposure within the window of tolerance in the middle of the inverse "U"
  - Highest affect in the middle of the session then calm at the intensity curve at the end

Exposure

- An activity that provokes or triggers memories of the traumatic event:
  - Repeated or extended (prolonged) to objectively harmless but feared stimulus
  - For at least 20 minutes allows enough time to habituate and enough time to recoup with sufficient support
  - Also allows for the release of BE release
  - Start low—go slow

Exposure

Goal—for traumatic memories to lose their power

- a disparity between what a client is feeling (i.e. fear) and the objective reality that there is nothing to fear in the current environment
- Counterconditioning—the presence of positive phenomena that are antithetical to physical or psychological danger. "Cells that fire out of link lose their link." LTD

Client Education

- Delay tension reduction behaviors
  - "Urge surfing"-ride it out, they are only temporary
  - Hold off long enough to defuse the power
  - The upsetting feeling will eventually become tolerable
  - Don't try to change the feeling but change your relationship to it.

Activation

- Conditioned Emotional Responses (CERs e.g. fear, sadness, or horror)
- CERs are critical to trauma processing to extinguish emotional-cognitive associations to a given trauma memory must be:
  - Activated
  - Not reinforced
  - Counter-conditioned

Dissociative Disorders

- Depersonalization/Derealization disorders + persistent or reoccurring experiences of unreality from mind, self, body, and/or surroundings
- Dissociative amnesia – psychogenic inability to recall autobiographical info. Specifier—dissociative
- Dissociative identity disorder (DID)—2 or more personalities with reoccurring memory “gaps” (episodes of amnesia can include possession)

Dissociative Dynamics

- Because the development of a coherent and durable sense of self thrives on safety and positive attachment:
  - When interpersonal environment is dangerous hypervigilance and attention is drawn outward away from the development of a coherent self-system
  - Attention inward could be punished
  - Internal representations could be fragmented

"Identity Training" from Dissociation

- Therapy entails helping the client build a coherent and positive model of the self by facilitating self-exploration and self-reference
  - Helping the client identify, label, accept feelings, and needs
  - Development of a coherent internal life (DMN) and self-determination (EN)

“Identity training” from Dissociation

- Because relational schemas (internal working model—attachment styles) are framed before explicit memory, their implicit nature are “triggered” by situations & feelings states that need reconditioning—activation—reconsolidation
  - Emergent “relational feedback” do not contain the contextual representation of the past (i.e. abuse)
  - “corrective emotional experience” (psychodynamic)

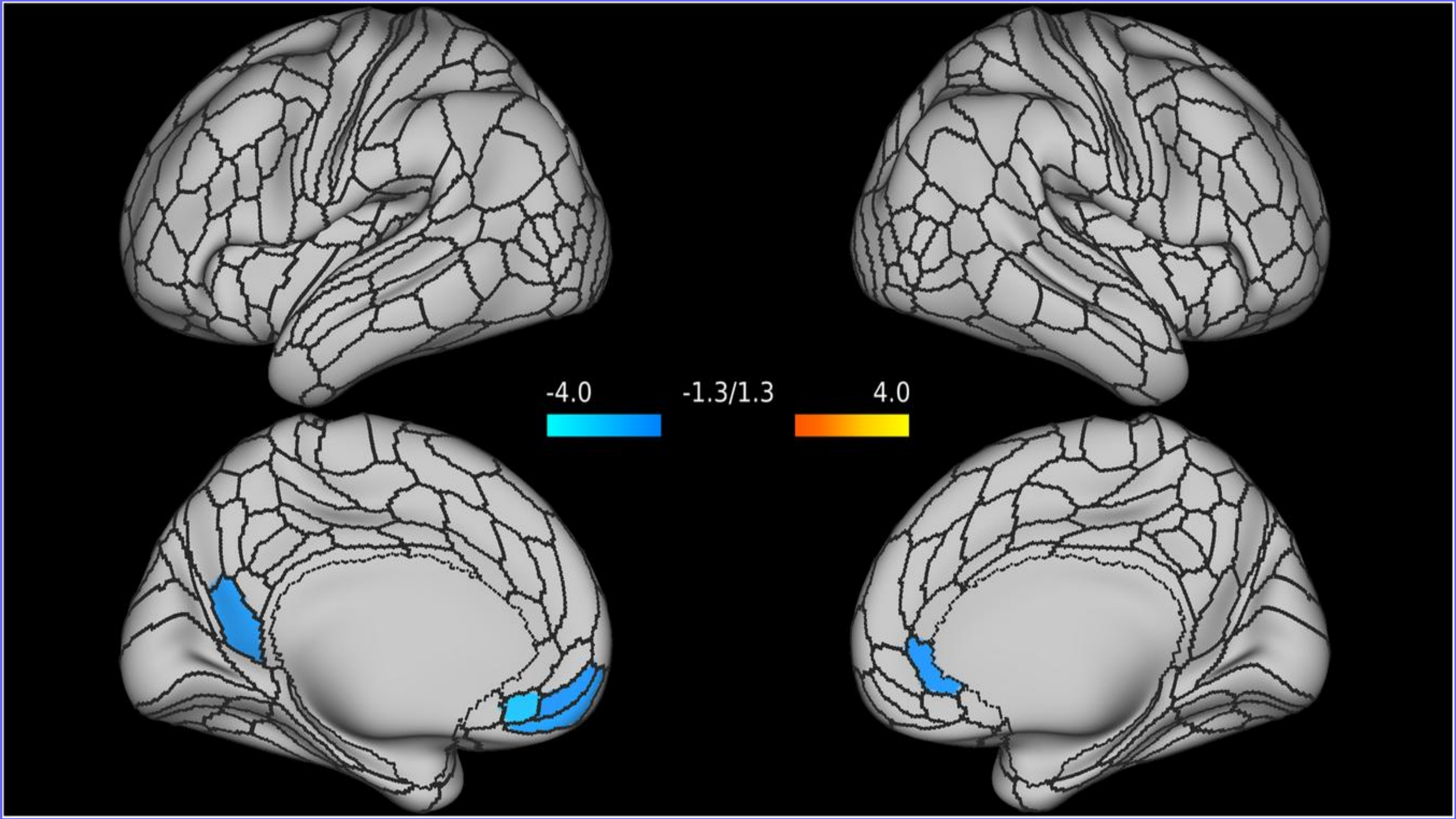
PTSD Treatment

- Increased size and activity of DLPFC
- Increased size and activity of the hippocampus
- Decreased activity of the amygdala
- SNS activity within the window of tolerence
- Decreased PICs
- Recalibrated HPA

Culture, DMN, and PTSD

- People with high neural variability between the DMN, SN, and EN tend to enjoy wellbeing.
- A Collectivist orientation in DMN tend toward social connectiveness
- However, with PTSD diminished activity in the vmPFC (part of the DMN)
- The vmPFC is critical for affect regulation
- Self-identity undermined by emotional dysregulation
- Healthy DMN is bolstered by social connections

Alterations of the DMN connectivity strength are primarily localized in the vmPFC (specifically, nodes of the left medial orbitofrontal, and of the right rostral anterior cingulate) and in the left precuneus.



Averill, C.L., Averill, L.A., Akiki, T.J. *et al.* Findings of PTSD-specific deficits in default mode network strength following a mild experimental stressor. *NPP—Digit Psychiatry Neurosci* **2**, 9 (2024)

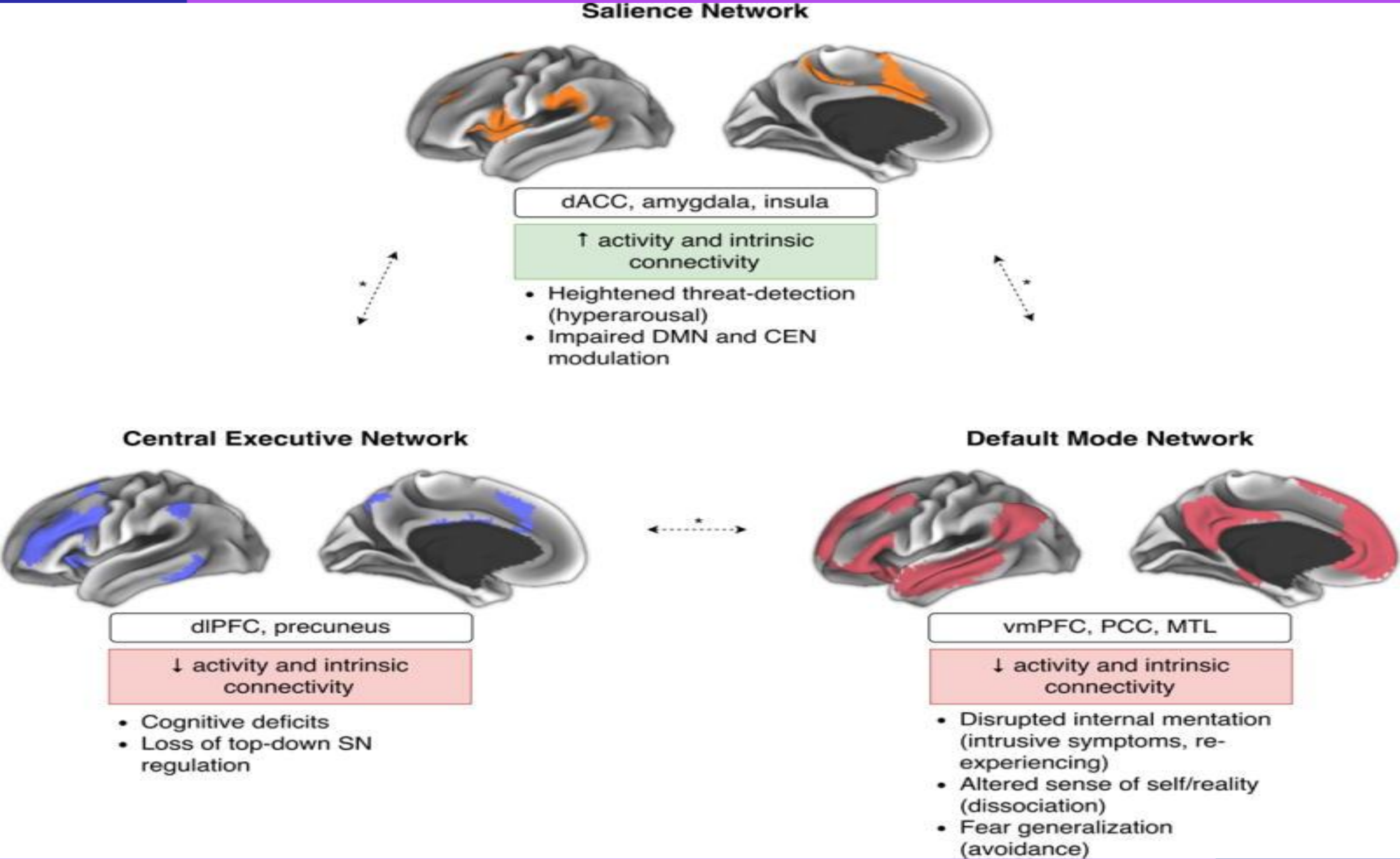
The DMN Narrative

- Connects with autobiographical memory, reflecting on the past and future, producing cohesive self-organization.
- Provides meaning—ongoing narrative, commentary of experience
- Reflects on what others are thinking—TOM
- From me to we—to fit in
- What we think about relates to predicting how best to change or stay the same

Culture and the DMN

- People with high neural variability between the DMN, SN, and EN tend to enjoy wellbeing
  – A person with collectivist orientation is quite socially oriented in their DMN
    - With PTSD diminished activity in the vmPFC
    - The vmPFC is critical for affect regulation
  – Self-identity undermined by emotional dysregulation

States of mind in conflict



Orienting Response and Somatic Stimulation

- First identified by Pavlov in 1927
  - *Shto takoe?* (Что такое? or *What is it?)*
  - Reorienting of attention -- triggered automatically when a sudden movement grabs attention or intentionally when you chose to look at an object
  - The reorienting of attention requires you to release your focus on one location so that it can shift to a new location
- Somatic stimulation of the orienting response (i.e. via EMDR, EFT, acupressure etc.) involve involves:
  - The orienting response (Sokolov, 1990)
  - facilitate cortical integration of memories

Orienting Response

“I have long thought that, if there is any analogy between psychic and physical processes, the orienting system of the brain must lie subcortically on the brainstem,” (Jung, 1958).

- **Superior colliculus--**sensorimotor structure that is specialized for detecting, localizing, and orienting toward environmental events **–the “where”**
- **Periaqueductal gray (PAG)--** integrated behavioral responses to internal (e.g., pain) or external (e.g., threat) stressors—the “what”
- **Locus coeruleus**--modulating pain and stress, releasing norepinephrine—the “shock”

Orienting Response

- Amygdala—relevance, threat detector
- ATP—circulation of blood and energy
- Norepinephrine, dopamine, acetylcholine
- Hippocampus—context
- PFC—conscious attention

Orienting Prediction Error

- Surprise activates the dACC and amygdala which increases vigilance
- When stimulus is surprising and novel there is a causal link between prediction errors, dopamine neurons, and learning.
- The superior colliculus, positioned next to the thalamus, and connection to the amygdala
- Shifts in attention activates the PFC, hippocampus, and dopamine networks

Priming the DMN

- New narratives practiced in sessions between sessions
- Therapy anticipates the challenges—the different contexts that new narratives must be practiced
- Narratives maximized social connectiveness and post-traumatic growth

Orienting and Recoding

- A stimulus that prompts a person to notice what happens next primes PFC activity.

- Coding in novelty, an unexpected somatic sensation, integrates PFC, anterior cingular cortex, hippocampus, and basal ganglia circuits by moderate bursts of dopamine,
  - orienting serves as a sort of a kickstart to the connectivity between the executive and the salience networks

Shifts in attention and asymmetry

- **Why activate the RH when it is already overactive? How about tapping the right hand and/or foot?**
- **The right limb tapping method still includes:**
  - **reorientation response**
  - **attentional shift**
  - **grounding**
- **This method is portable—the client can practice on his own (neuroplasticity)**

Client Education

- I'm going to ask you to direct your attention to the specific movement while at the same time you describe the traumatic event.
- This will help you reset your brain so that it will no longer be stuck in the past and you can move ahead to a positive future.

Trauma Reactions

- Alerting the superior colliculi, PAG, and locus coeruleus
- BG, hypothalamus, amygdala
- With hippocampus and PFC impairment fear gets generalized. Without context any situation elicits fear
- Dysfunction in contextual processing leads to maladaptive interpretations and rigid perceptions.

Activate to recalibrate

- Recalibrate visceral and memory networks
- Using somatic awareness to normalize interoceptive reactions
- Simultaneously build in new and adaptive narrative with post-traumatic growth

Post-Traumatic Growth

- "That which does not kill us makes us stronger"
  - –Nietzsche
- Key narrative is to see oneself as a survivor <u>not</u> a victim
- Transformational coping-- beyond resilience (not returning to the old self)
  - self-organization—a new self

Post-Traumatic Growth

- Greater connection with others
- Inclusiveness
- Feeling felt and understood
- Increased altruism. (giving is receiving)

Post-Traumatic Growth

- Greater meaning in life
- Beyond the whole is greater than the sum of it parts—its different
- Wisdom of inclusive and interdependence
- Operationalizing wisdom

Resiliency

- Changing the narrative
- Seeing life through the eyes of others
- Learning from mistakes
- Acceptance
- Purpose

Personal growth following trauma

- Enhanced relationships and increased empathy
- New opportunities and paths
- A newfound sense of resilience in facing challenges.
- A shift in spiritual beliefs or a deeper spirituality.

Personal growth following trauma

- *An increased appreciation for life.*
- Cognitive, making sense of the event, reevaluating life priorities, and developing a new narrative about their experience.
- Resilience, individuals use new coping strategies.

Growth may not be immediate; it often takes time and reflection.

Resiliency

- Ability to withstand adversity and bounce back from difficult life events
- The 5Cs:
  - Commitment,
  - Control,
  - Challenge,
  - Connected,
  - Confidence

Phases and PTSD

- Phase 1: Psychological first aid—stabilizing ASD and preventing PTSD
- Phase 2: Integration of implicit and explicit memory systems:
  - Explicit memories (VAMs) –The conscious memory level, which can be accessed in therapy through deliberate recall.
  - Implicit memories (SAMs) –The nonconscious, which are only accessible through cues that activate the network.
  - Aided by somatic reorienting method
- Phase 3: Posttraumatic growth—developing meaning and direction (Constructivism)

SAFE from PTSD

"S" is for stabilizing. To establish a healthy foundation for recovery.

"A" is for acceptance of what happened.

"F" is for future. To visualize a hopeful future--posttraumatic growth.

"E" is for exposure. To confront the feelings and sensations that trigger flashbacks.

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