

Learning with the Brain in Mind:
The Neurobiologic Basis of
Learning, Behavior, and Emotion

A REVOLUTION

International Dyslexia Assoc.

INLAND EMPIRE BRANCH

Feb. 12, 2011

Leonard "Skip" Baker MD
Descanso Medical Center for Development and Learning
La Canada, CA

descansomedicalcenter.com
dmcdl.com

Descanso Medical Center for
Development and Learning

- Leonard "Skip" R Baker MD
- admin@dmcdl.com
- dmcdl.com
- descansomedicalcenter.com

HISTORY

- This anonymous 15th century pre-Cartesian brain theories, followed views of Aristotle. Senses of touch and taste are connected to the heart.

Science keeps us from kidding ourselves

Science is a process that has a constant moving target. It is an approach to understanding.

A scientific hypothesis is an organized set of ideas that are tested and retested



A 1796 illustration shows Edward Jenner, center, giving the first vaccination.

Scientific advances-Jenner

- Edward Jenner and small pox
- Teacher John Hunter (1728-1793) wrote "why think , why not investigate?"
- Presentation of work to Royal Society in London was rejected
- Work was "in variance with the established knowledge and is incredible"

Jenner

- And he further warned "He had best not promulgate such a wild idea if he values his reputation."
- Opponents to vaccination in the USA declared it repulsive: people who got it grew horns and lowed like cows, and besides it was not mentioned in the bible.
- People were supposed to die from the disease.

ONE HALF OF THE PEOPLE IN
THE UNITED STATES BELIEVE
DINOSAURS AND HUMANS LIVED
AT THE SAME TIME

PHRENOLOGY

A phrenology
diagram maps
out the organs
of thought
and
associated
traits



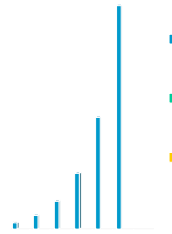
PHRENOLOGY

- Amativeness: reproductive instinct and the sexual drive. It is the faculty concerned with physical love and sexual attraction. When it is strongly developed, it may represent carnality and licentiousness. When undeveloped: coldness, frigidity, indifference towards the opposite sex.

Neuroscience research has revolutionized our understanding of the brain and its functioning. Much of it has occurred since 1989.

Neuroscience Knowledge Increase

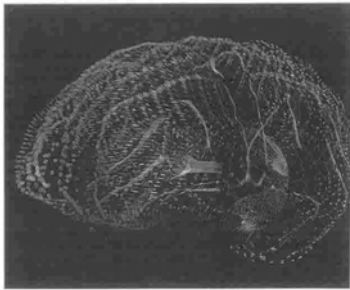
- DOUBLES EVERY TWO YEARS
- More in Last Year than since the DAWN OF MANKIND



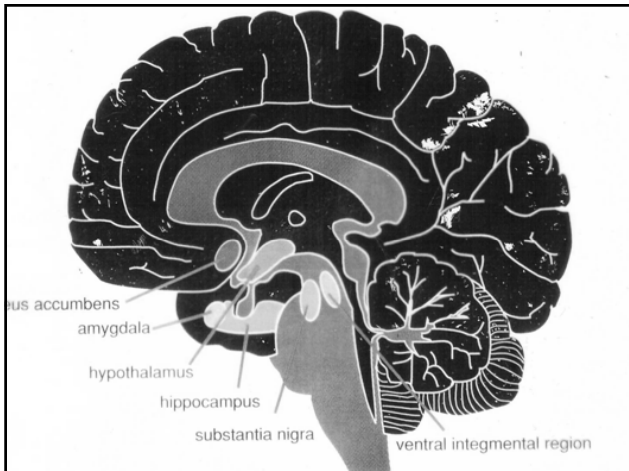
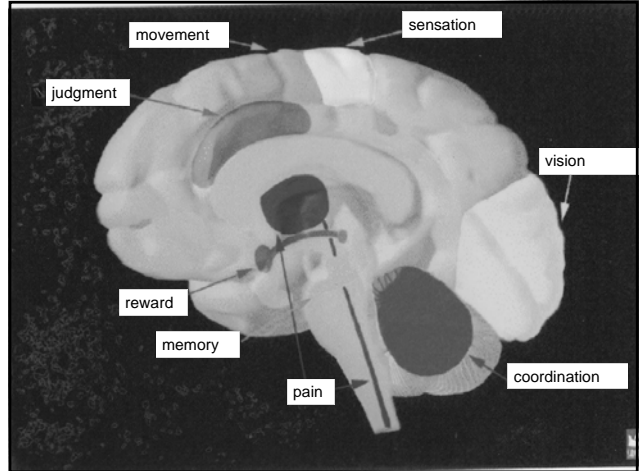
NATURE VS. NURTURE

NATURE AND NURTURE

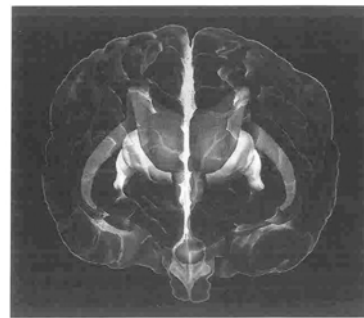
Three-dimensional mapping of the human brain can reveal striking anatomical differences in the gyral patterns of the cerebral cortex.



BODY: The Complete Human, National Geographic, 2007.



The hypothalamus and pituitary gland (both shown in green) sit squarely in the middle of this scan of the human brain.



BODY: The Complete Human, National Geographic, 2007.



PRIMATE BRAINS

- ABILITY TO DEVELOP, USE AND TEACH HOW TO USE TOOLS
- TALENT FOR MONEY AND TRADE
- HUMAN LIKE PROPENSITY TO PILFER AND DECEIVE

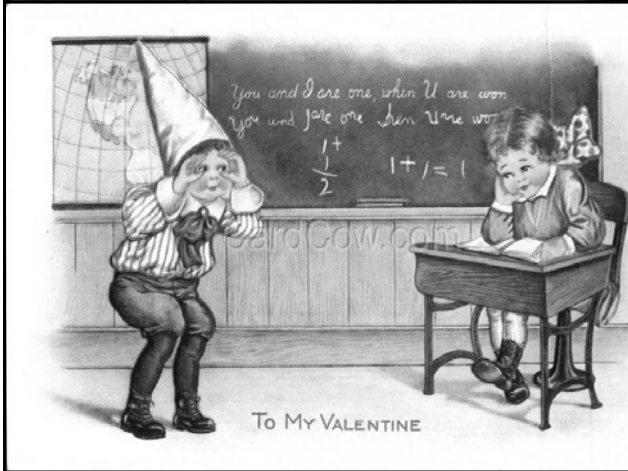
WEIRD MEDICAL FACT

About 98.4 % of human DNA
is found in chimps –

Physicians Practice, February 2007

WEIRD MEDICAL FACT

and about 70 % is found
in a SLUG



Evolution of learning differences

- SMART OR DUMB
- DYSLEXIA
- LEARNING DISABILITIES
- LABELING
- NEUROBIOLOGICAL DIFFERENCES THAT CONTRIBUTE TO DIFFICULTIES IN LEARNING, BEHAVIOR AND EMOTIONS

Helping Our Brains

- How does our brain function
- How does this affect our learning, behavior and emotions
- What are the implications when working with our children

MIND AND BRAIN

THE MIND
IS WHAT
THE BRAIN DOES

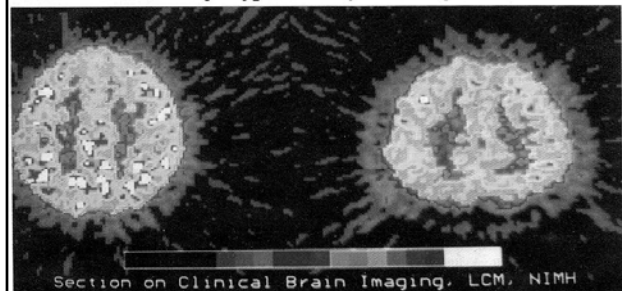
Listening To Prozac

KAMER MD

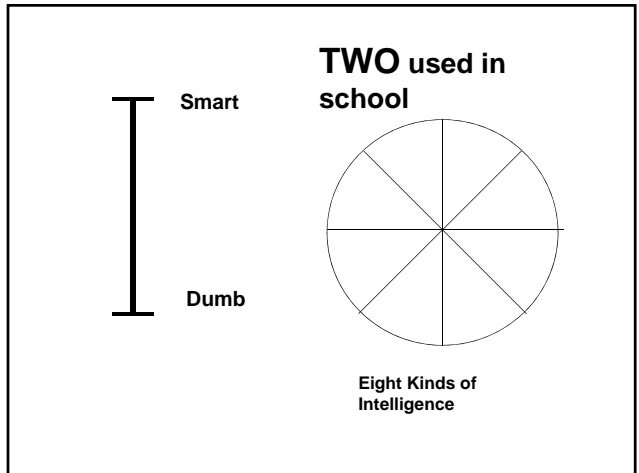
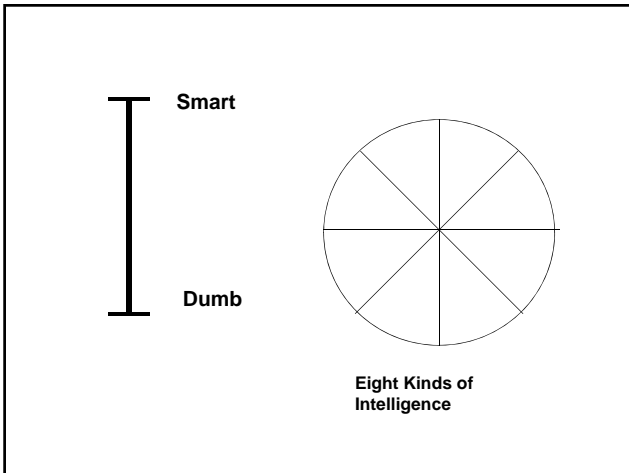
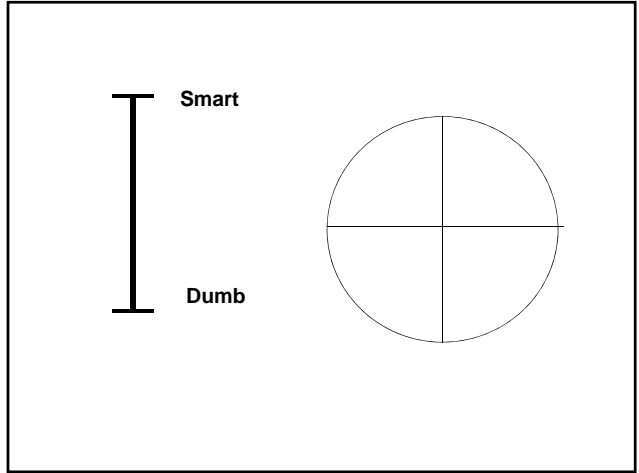
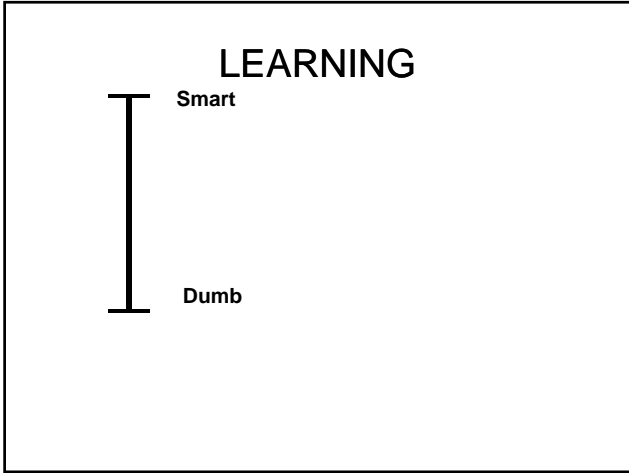
The Astonishing Hypothesis THE SCIENTIFIC SEARCH FOR THE SOUL

FRANCIS CRICK

Evidence of Hyperactivity's Biologic Basis



Compared to a PET brain scan of a normal adult (left), a PET scan in an adult with attention-deficit hyperactivity disorder shows low glucose metabolism in some regions of the brain (blue, green, and purple). White, red, and orange indicate areas of higher glucose metabolism. The purple halo is an artifact of imaging. See article on page 3.



EIGHT KINDS OF INTELLIGENCE

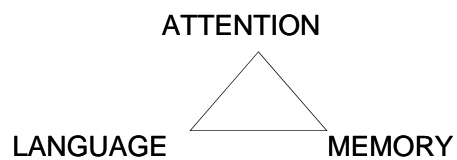
- MUSICAL
- LINGUISTIC
- LOGICAL-MATHMATICAL
- SPATIAL
- BODILY-KINESTHETIC
- INTRAPERSONAL
- INTERPERSONAL
- NATURALISTIC

GARDNER, 1983

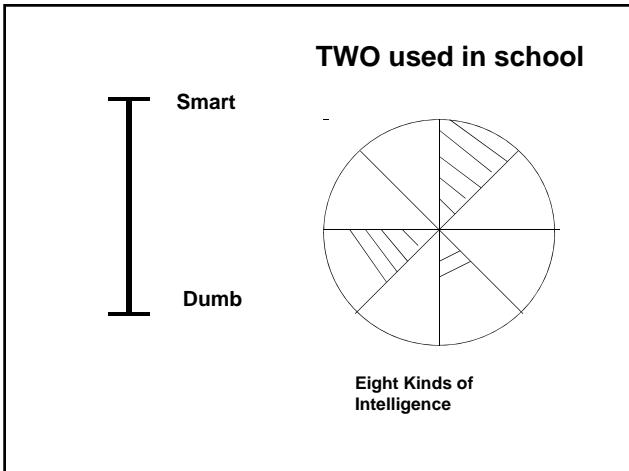
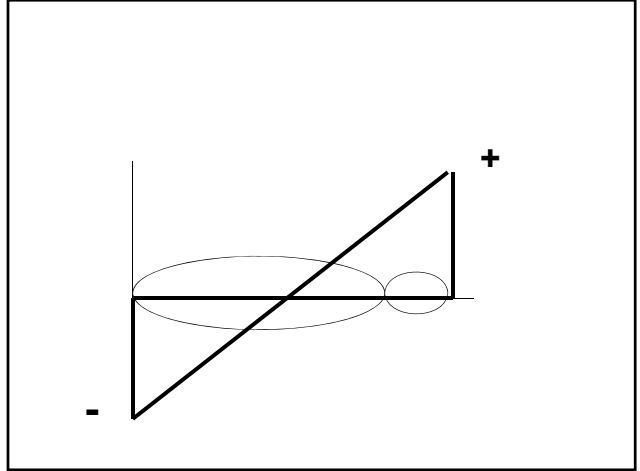
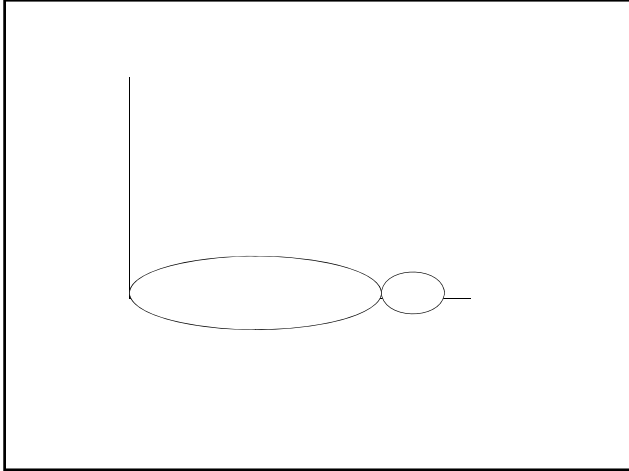
NUERODEVELOPMENTAL DIFFERENCES

- Dr Mel Levine
- Built In
- Recognizing Differences before having to do highly costly evaluations
- Strengths vs. Weakness
- Build on Strengths
- Use Strengths to help weakness
- Educate individual about S/W

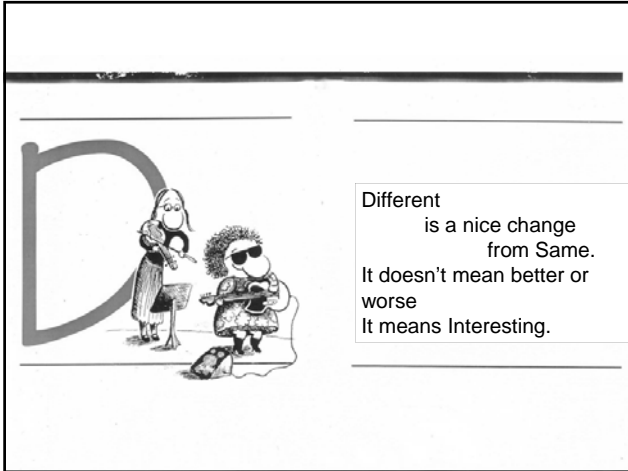
Triangle of Processing



Different
is a nice change
from Same.
It doesn't mean better or
worse
It means Interesting.



**PREFERRED LEARNING
PATHWAY**



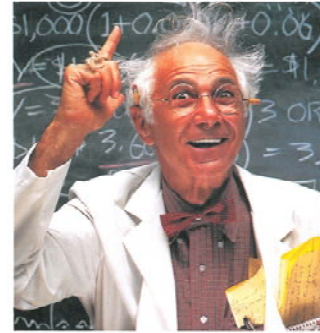
D can also be for

DISCOURAGEMENT

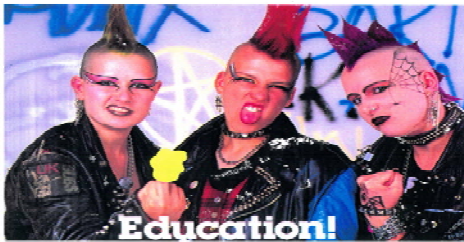
BAD HAIR DAYS
OVER AND OVER
AND OVER



OVER AND
OVER
AND OVER

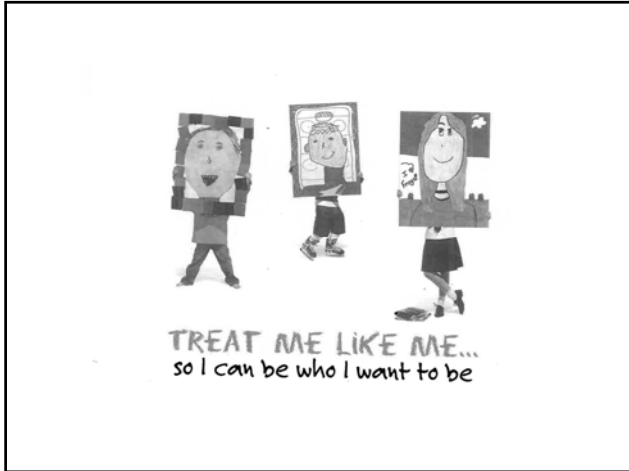


Punk

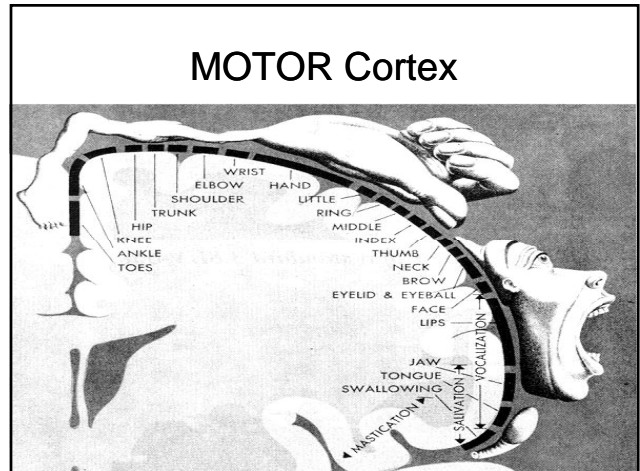
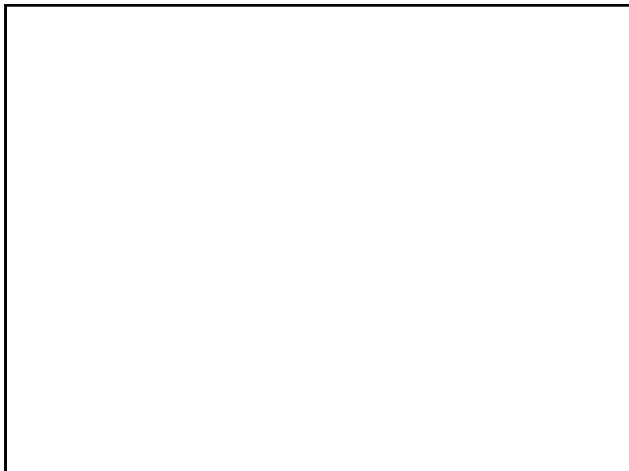


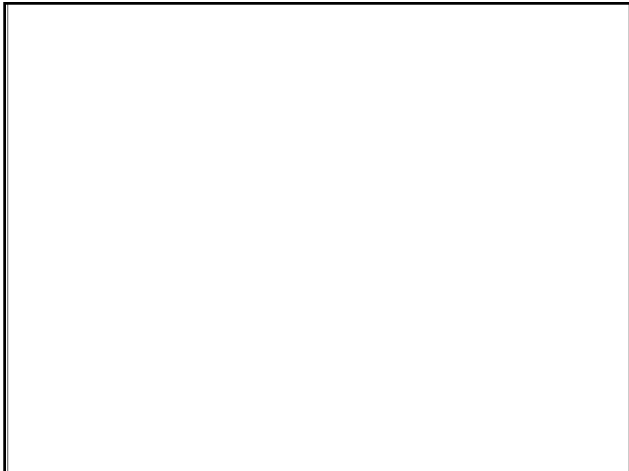
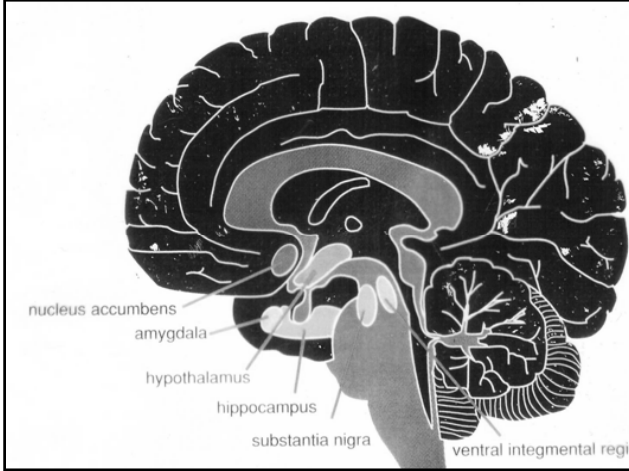
IMPACT

- 13 MILLION CHILDREN LIVE IN POVERTY
- MANY WITH READING DELAYS DO NOT HAVE A SINGLE BOOK IN THE HOME
- EXCEPT FOR THE YELLOW PAGES
- 30% OF OUR KIDS DROP OUT OF HIGH SCHOOL

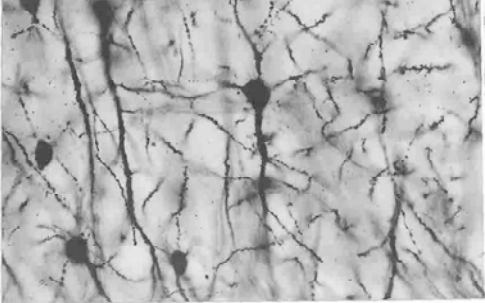


THE BRAIN AND THEREFORE THE MIND

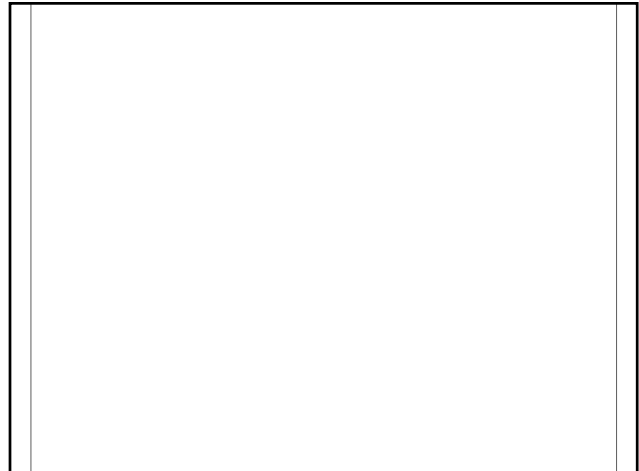
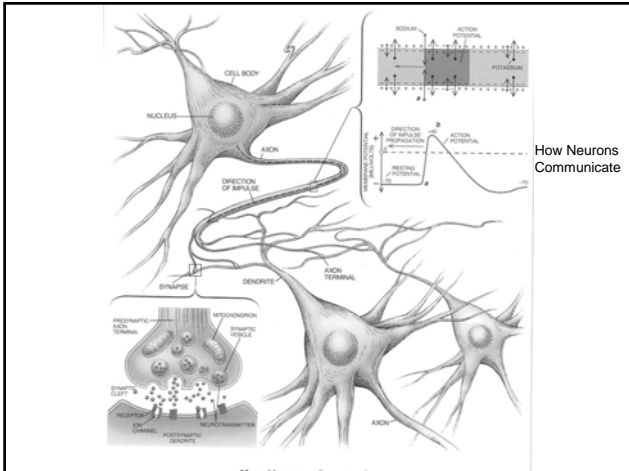
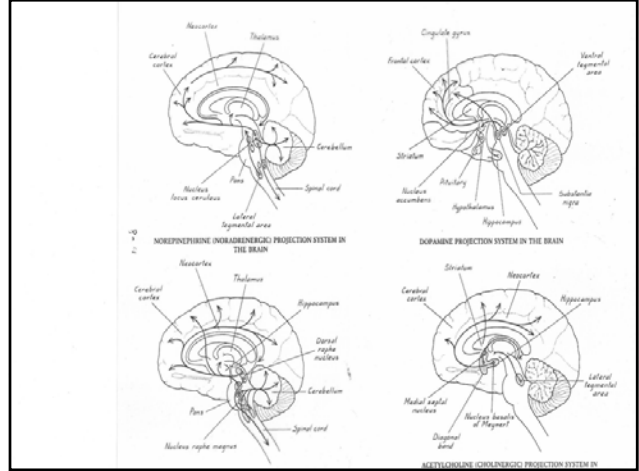
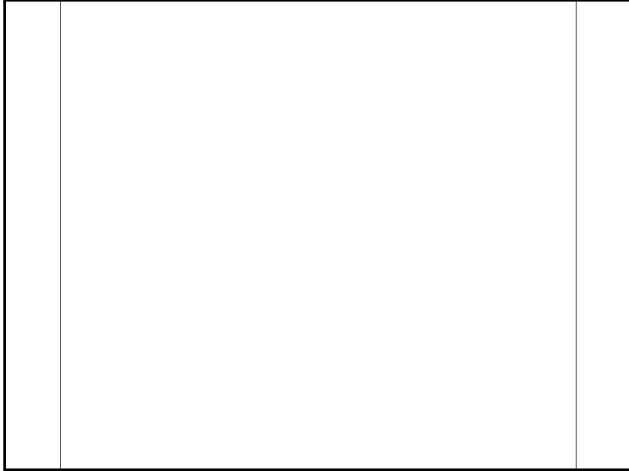


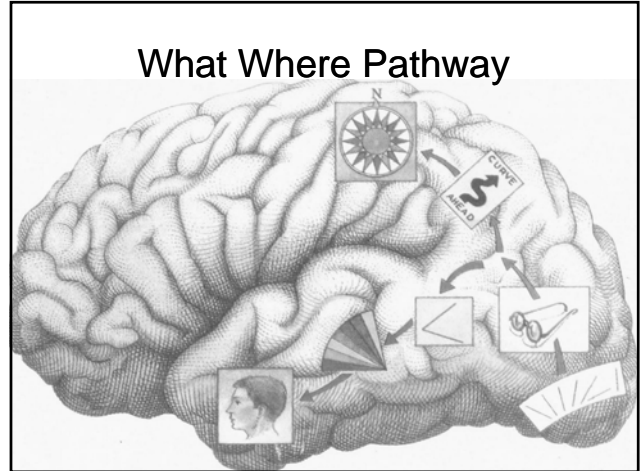
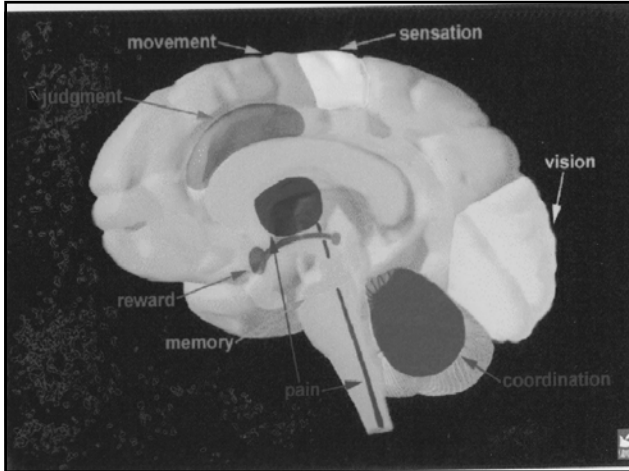


Neurons connect in the cerebral cortex – the brain region that controls conscious thought, memory and language.

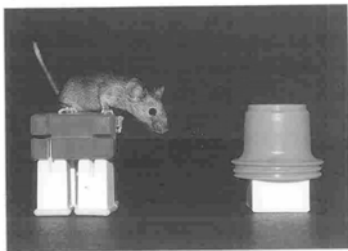


BODY: The Complete Human, National Geographic, 2007.



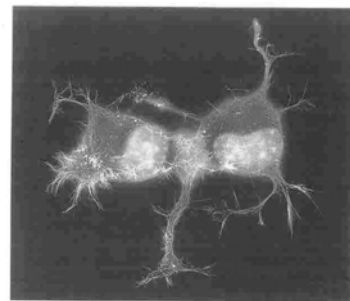


Researchers engineered the brain of a "Doogie" mouse to have more brain receptors and better memory.



BODY: The Complete Human, National Geographic, 2007.

After stimulation with nerve growth factor, nerve cells sprout neurites (pink and green). Cultures like these are used to investigate neural regeneration.



BODY: The Complete Human, National Geographic, 2007.

SEXUALITY



VOLES

- PRAIRIE VOLES ARE POLIGAMOUS
- MEADOW VOLES ARE MONOGOMOUS
- GENES ASSOCIATED INVOLVE OXYTOCIN AND DOPAMINE
- CHANGING THE GENES CHANGES BEHAVIOR



LOVE FOUND IN THE GENES: Altering the expression of a single gene can switch meadow voles from a promiscuous to a monogamous lifestyle.

AUTISM

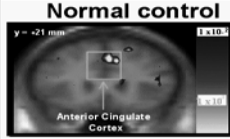
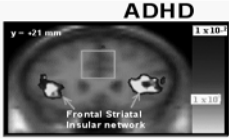
ADDING OXYTOCIN TO A MEDICAL THERAPY IMPROVES RECOGNITION OF ANGER AND HAPPINESS IN TONE OF SPEAKER'S VOICE

LOVE

OXYTOCIN BEING PRESCRIBED TO ENHANCE PERSONAL SEXUAL RELATIONS

ATTENTION

Neuroimaging and ADHD

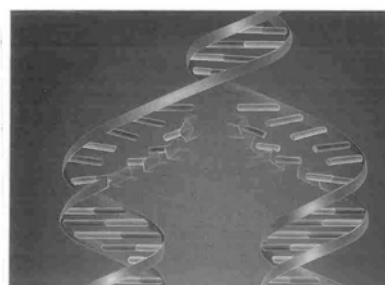
Normal control	ADHD
 <p>y = -21 mm 1x10⁶ Anterior Cingulate Cortex</p>	 <p>y = -21 mm 1x10⁶ Frontal Striatal Insular network</p>

- fMRI shows decreased blood flow to the anterior cingulate and increased flow in the frontal striatum
- PET imaging shows decreased cerebral metabolism in brain areas controlling attention
- SPECT imaging shows increased DAT protein binding

MGH-NMR Center & Harvard-MIT CTRP. Adapted from Bush, et al. *Biol Psychiatry*. 1999;45:1542-1552.

GENETICS

An unwinding strand of DNA picks up nucleotides to form two new, matching strands of DNA.

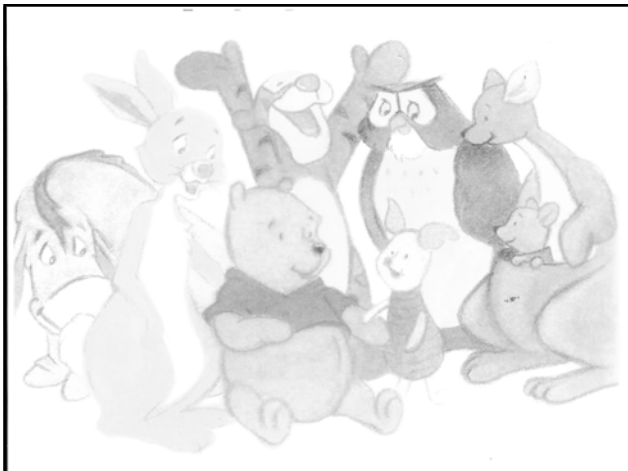


BODY: The Complete Human, National Geographic, 2007.

EPIGENETICS

- MOLECULE COMBINATIONS SUCH AS A METHYL GROUP ATTACHES TO THE GENES
- DETERMINES IF THEY ACTIVATE OR NOT
- IMPLICATIONS FOR BEHAVIOR AND CANCER
- CONTINUES TO FUNCTION AND CAN EVEN BE INHERITED

THE WORLD ACCORDING TO POOH



BRAIN DIFFERENCES

- ADHD
- ANXIETY
- DEPRESSION
- BIPOLARITY
- OCD
- ODD

Fearful Stories and Vile Pictures to Instruct Good Little Folks

Heinrich Hoffmann
Struwwelpeter 1845



THE STORY OF JOHNNY LOOK-IN-THE-AIR

Once, with head as high as ever,
Johnny walked beside the river.
Johnny watch'd the swallows trying
Which was cleverest at flying.
Oh! what fun!
Johnny watch'd the bright round sun
Going in and coming out;
This was all he thought about.
So he strode on, only think!
To the river's very brink,
Where the bank was high and steep,
And the water very deep;
And the fishes, in a row,
Stared to see him coming so.



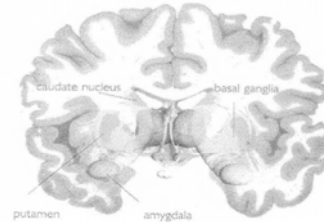
THE STORY OF CRUEL FREDERICK



This Frederick! this Frederick!
A naughty, wicked boy was he;
He caught the flies, poor little things,
And then tore off their tiny wings;
He kill'd the birds, and broke the chairs,
And threw the kites down the stairs,
And oh! far worse and worse,
He whipp'd his good and gentle nurse!

ANXIETY

- BIOLOGICALLY BUILT IN -GENETIC
- ACCENTUATED BY EXPERIENCE
- SOME EXPERIENCE STRESS MORE ACUTELY
- PREDEPOSES TO DEPRESSION
- WITHOUT IT--SOCIOPATHY



The caudate nucleus is closely connected to the amygdala, which gives rise to feelings of fear. The knock-on effect of caudate activity in OCD may partly explain why people with the disorder suffer such anxiety.

ANXIETY

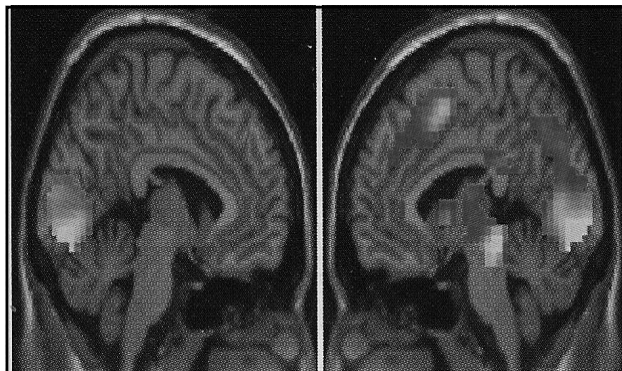
- AMYGDALA
- ACTIVATION DECREASES LEFT FRONTAL LOBE EXPLORATORY FUNCTION
- WHAT REMAINS IS RIGHT FRONTAL LOBE INHIBITION

ANXIETY

FREQUENTLY HIDDEN

ANXIETY

LACK OF FEAR IN EARLY CHILDHOOD
PREDICTS
LATER CRIMINAL BEHAVIOR



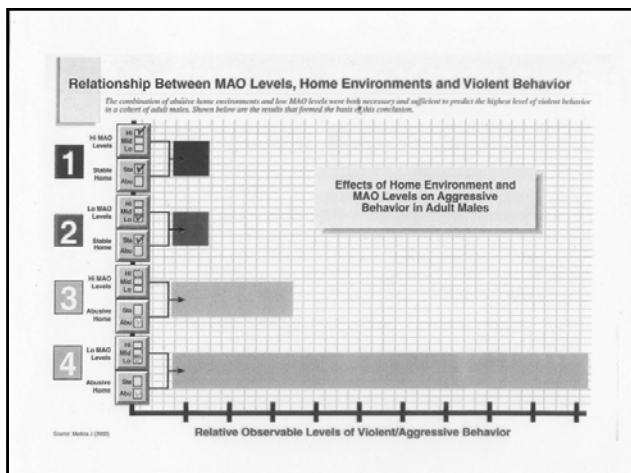
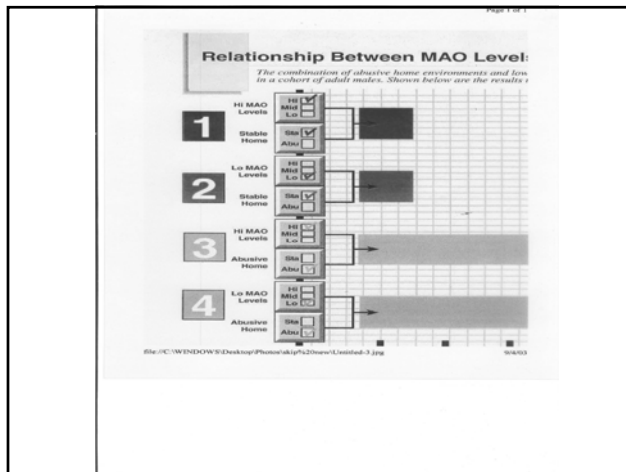
Tête-à-tête. Brain scans of the investor (*left*) and trustee in an economic exchange game shed light on the neural basis of trust.

ANXIETY

SOCIAL FEAR DISAPPEARS WITH
ELIMINATION OF ANXIETY
ELIMINATION OF ANXIETY ELIMINATES
RACIAL STEREOTYPING

GENES AND BEHAVIOR

THE BIOLOGICAL BASIS



- ## EPIGENETICS
- MOTHERLY LOVE IN MICE IS GROOMING AND ATTENDING
 - ABSENCE OF CAUSES THE BRAIN TO BECOME HYPERSENSITIVE TO CORTISOL AND MORE REACTIVE TO STRESS
 - MECHANISM IS THRU EPIGENETIC REGULATION

EPIGENETICS

- SUICIDALITY IN HUMANS
- STUDY OF BRAIN TISSUES OF SUICIDE VICTIMS
- ABUSED AND NEGLECTED ONES HAD DRAMATIC INCREASE IN METHYLATION IN AREAS RESPONSIBLE FOR GENES THAT REGULATE SENSITIVITY TO CORTISOL—INTOLERANT OF STRESS

POST PARTUM DEPRESSION

- ENZYME THAT DEGRADES SEROTONIN, NOR-EPINEPHRINE AND DOPAMINE
- INCREASED BY ESTROGEN
- WHICH FALLS PERCEPTUOUSLY AFTER DELIVERY
- WHICH CAUSES A RAPID RISE IN MAO-A
- WHICH CAUSES A DRAMATIC DECREASE OF NEUROTRANSMITTERS

Increased Cortisol Levels Linked to Decrease in Attention

APA 111TH Annual Conference:
Poster Session A-7, A-8.
Presented Aug. 8, 2003

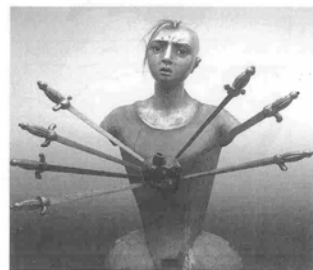
OBESITY

I eat when I'm stressed.



STRESS

- RELEASES CORTISOL FROM ADRENAL GLAND
- BATHES BRAIN AND SHUTS DOWN NEW NERVE GROWTH
- SHRINKAGE
- CORRELATES WITH DEPRESSION
- SSRI'S ALLOW NEW NERVES TO START TO REGROW



Our Lady of the Seven Sorrows
(polychromed wood, 18th century, Italy.)

SCIENCE, Vol. 318. October 12, 2007.

STRESS

- CAN INCREASE RITUALISTIC BEHAVIOR
- IN EARLY CHILDHOOD CHANGES BRAIN FUNCTIONING AND HAS AN IMPACT ON ADULT BRAIN

STRESS IN SPECIAL FORCES SOLDIERS

- HANDLE STRESS IN 2 HOURS THAT TAKES MOST OF US 2 DAYS TO RECOVER FROM
- IDENTIFIED BY WHO SURVIVES TRAINING
- ELEVATED DHEA IN BLOOD
- CLINICAL TRIALS NOW
- LOOKING FOR OTHER BIOLOGICAL MARKERS

MEMORY

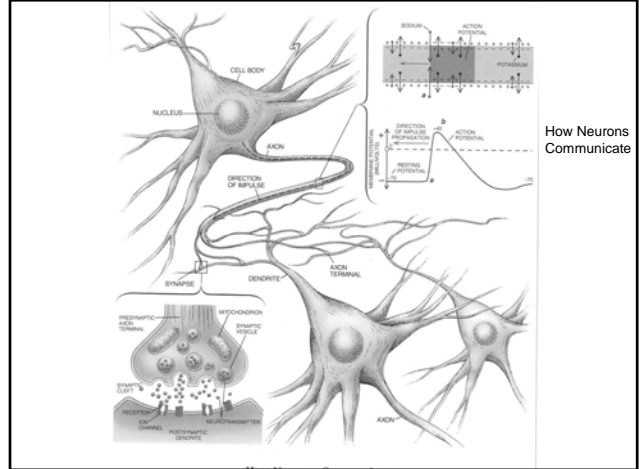
PLASTICITY AND NEW
NEURONAL GROWTH
3000 EACH DAY

Brain and Learning Two major pathways

- ARBORIZATION
- LONG TERM POTENTIATION

MEMORY

- New Genetic research
- Some have specific gene variation that allows better memory
- But if two copies of gene increased susceptibility to brain dysfunction



MEMORY
LONG TERM POTENTIATION

BRAIN AND LEARNING
Long term potentiation

Increased Sensitivity

1st synapse → 4 hours
2nd synapse → 1 ½ hours

Chemical Adjustment

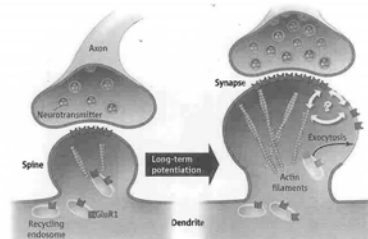
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Protein synthesis

IMPLICATIONS FOR LEARNING

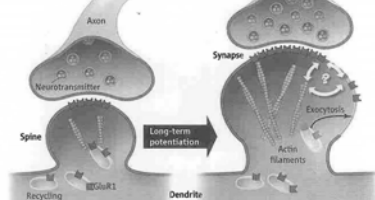
- REPETITION
- SHORTER PERIOD HIGHER IMPACT
Block scheduling

MATTERS OF SIZE



Balancing act. Long-term potentiation drives exocytosis of recycling endosomes, providing dendritic spines with more membrane and receptors (GLuR1). Actin polymerization provides structural support. These processes are somehow balanced to regulate the size of spines and the strength of synaptic connections. *SCIENCE*, December 8, 2006, Vol. 314

MATTERS OF SIZE



Bigger dendritic spines are associated with stronger neural connections. Now underlying mechanisms for this association are being revealed.

SCIENCE, December 8, 2006, Vol. 314

DYSLEXIA

- ADHD AND READING DISORDERS OCCUR FREQUENTLY TOGETHER
- POSSIBLE COMMON GROUND
- SLOW PROCESSING SPEED CAUSES DIFFICULTY IN MAKING SENSE OUT OF INFORMATION READ
- CHANGE THE SPEED OF PROCESSING AND CHANGES PERFORMANCE

READING DISABILITIES

COLORADO LEARNING DISABILITIES RESEARCH CENTER
CORTEX 2010

- 457 TWINS
- READING DIASABILITIES—WEAKENSS LANGUAGE AND MEMORY
- ADHD IMPULSIVITY ETC.
- BOTH COMPLEX AND NOT JUST ONE THING
- SIGNIFICANT GENETIC CORRELATION FOR BOTH
- BOTH SHOWED PROCESSING DELAYS

DISLUXIA

NATURE NEUROSCIENCE 2010

- RELATED TO INABILITY TO FILTER OUT VISUAL NOISE
- LINK WITH SPEED OF PROCESSING
- IMPROVED WITH IMPROVED CONCENTRATION
- SIGNIFICANT INCREASE IN SALIENCY DETERMINATION

DYSLEXIA

- 5-17% BUT 1/5 CAN LEARN TO READ
- VARIATION OF CAUSES—IT IS NOT ALL THE SAME
- BRAIN SCANS IN ADOLESCENTS CAN PREDICT AT A 90% ACCURACY WHO WILL LEARN TO READ IN 3 YEARS

DYSLEXIA LEARNING TO READ

- R.E.A.D—READING EDUCATIONAL ASSISTANCE DOGS
- INTERMOUNTAIN THERAPY ANIMALS
- READING TO A DOG INCREASES PERFORMANCE AND INCREASES CONFIDENCE
- PROBABLY THRU REDUCTION OF ANXIETY

EDUCATIONAL INTERVENTIONS

WITHOUT COST
Will demand increased creativity

STRESS REDUCTION

- New nerves about 3000/day
- Stress increases cortisol release
- Bathing brain daily shuts down new nerve growth
- YES program for stress reduction

ATTENTION

- Choice may activate interest
- Stimulation
- Variation
- Brain won't work without it!

PHYSIOLOGIC FUNCTIONING

- SLEEP
- EATING
- EXERCISE

EXERCISE

Aristotle and early Greek leaning required exercise first and then cognitive learning

EXERCISE

- SIGNIFICANT IMPROVMENT OF ATTENTION
- SIGNIFICANT INCREASE OF BRAIN DERIVED NEUROTROPHIC FACTOR



COGNITIVE ENHANCERS

- CHOCOLATE
- CAFFEINE
- NICOTINE
- METH
- POT
- Rx MEDICATIONS
 - e.g.. Methylphenidate etc. improves working memory, and listening and processing speed
- WALK IN THE WOODS

WALK IN THE WOODS

110TH MEETING OF THE AMERICAN SOCIETY OF ENVIRONMENTAL HEALTH AND TECHNOLOGY

- INHALED SOIL BACTERIA-MYCOBACTERIUM VACCAE
- INCREASED SEROTONIN AND DECREASED ANXIETY
- INCREASED MAZE NAVIGATION 2X FASTER
- 3 WEEKS AFTER REMOVAL FROM DIET BEHAVIOR PERSISTED

ELECTRONIC MEDIA

- Choice
- Video learning
- Interactive learning
- Can we create a new process based on research

Descanso Medical Center for Development and Learning

- Leonard "Skip" R Baker MD
- admin@dmcdl.com
- dmcdl.com
- descansomedicalcenter.com



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WHERE ARE WE

- Our minds and therefore our learning, behavior and emotions are built on a physiologic platform
- There are major physiologic differences between us
- Developing our brains requires multiple alternative strategies

