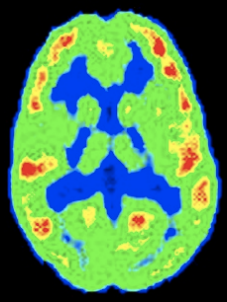
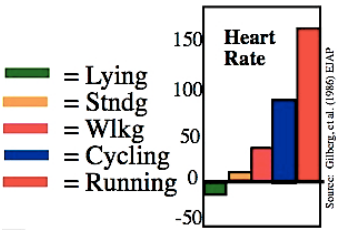
7 Amazing, Revolutionary Discoveries from Brain Research



eric@jlcbrain.com

Standing, a Simple Activity, Increases Circulation *(which improves cognition)*



Welcome to a Brief Introduction to Your Brain! This Will Move F-A-S-T, So Please, Take Notes. Use them as Reminders and "Talking Points" for Discussion.

Your Amazing Brain

It's involved in everything we do, learn and achieve at school. In fact it's about the only thing that is a constant among all your students. Isn't that worth learning about?

Today's Takeaway…

A – B – C

1. **Agree** on a clear, smart takeaway
2. **"Buy-in"** – are you "sold" on it?
3. **Commit** to implementation of one (1) powerful idea right away

You have much more to do with how your students turn out than you previously thought.

7 Discoveries

- **Allostasis**
- **Emotion/Cognition Links**
- **Neuroplasticity**
- **Malleability of Memory**
- **Neurogenesis**
- **Social Neuroscience**
- **Gene Expression**

Discovery #1 – Allostasis

Allostasis is the discovery that our bodies do NOT always return to homeostasis. This word describes the re-setting of your brain's stress thermostat.

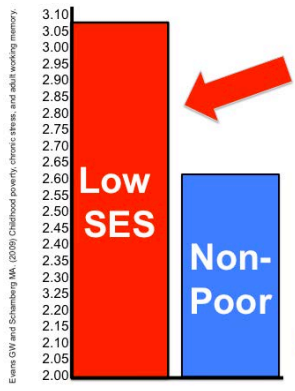
Chronic Stress Effects (T or F)?

1. Creates emotional problems (T or F)
   (Burgess et al. 1995)
2. Lowers IQ, reading scores (T or F)
   (Delaney-Black, et al. 2002)
3. Significant memory loss (T or F)
   (Lupien, et al. 2001)
4. Shortens dendrites (T or F)
   (Cook and Wellman, 2004), (Brown, et al. 2005)
5. Causes neuron death (T or F)
   (De Bellis, et al. 2001)
6. Fosters inappropriate attachments (T or F)
   (Schore, A. 2002)

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

✓**Stress** (on/off) is healthy for us. It often builds resilience. "Eustress" is the healthy stress you feel from a workout or excitement.

✓**Distress** (chronic or acute) is toxic to our brain and body. It typically drains resources.



In **Low SES Kids,** the Chronic Stress Indicators Are 17% Higher Than They Are for the **Non-Poor.**

Stress
is NOT "out there."
There are no stressful jobs;
only people who experience stress at their workplace!

Allostasis occurs when we re-set our brain's thermostat (our "set point") for metabolic functions

What Is Allostatic Load?

"Adjusted stress points which create excess demands on your mind and body that chronically deplete your available resources."

(McEwen, 1998)

EXAMPLES:
PTSD, Learned Helplessness, Depression, General Anxiety Disorder

Dendrites taken from rat PFC show effects.

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

a) 2 hrs./day…2 months
b) 30 min./day…7 weeks
c) 1 hr./day…10 weeks
d) 10 min./day…5 days

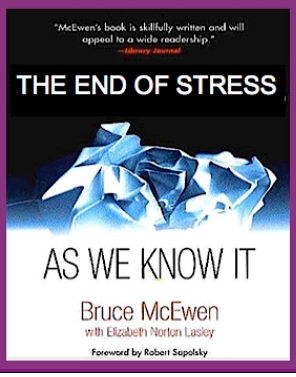
(Brown et al., 2005)

Distress Affects Neurons

Control Stressed

Pioneer in Allostatic Load

Originator of the "Allostatic Load" Concept, Bruce McEwen



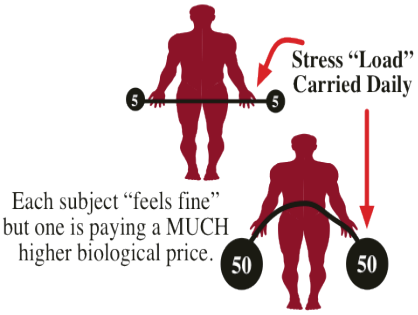
Stress Activates

- Provide short-term energy
- Designed for short-term survival response
- Selective attention/Tunnel focus
- Immune function/Clotting
- Heart Rate/Blood flow

Allostatic Load Suppresses

- Growth and repair hormones
- Androgens, overall health
- Classroom creativity, patience, social skills and cognition
- Memory retrieval, neurogenesis

Allostatic Loads: Plasticity of the Nervous System



What % of School Age Children (or staff) Experience Chronic or Acute Stress "Most or All or the Time?

Impact of Chronic or Acute Stress on Student Learning

Allostatic load reduces learning capacity in many ways:

1)reduced neurogenesis

2)impaired relationships

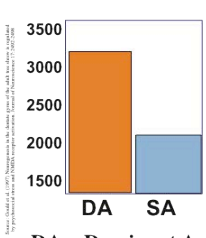
3)diminished cognition and memory

4)impaired creativity/patience

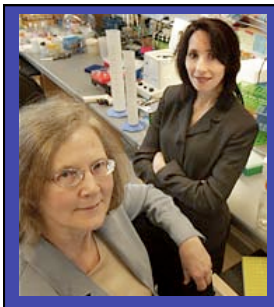
Distress is the "800 lb. gorilla" in the classroom every day.

21

Effects of Acute Environmental Stress on Neurogenesis



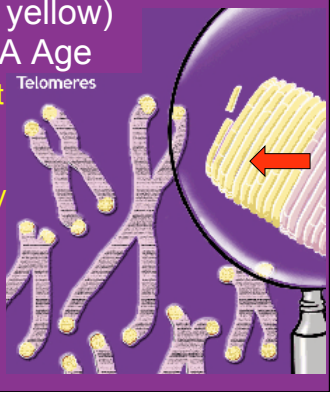
DA = Dominant Animals
SA = Subordinate Ones
BARS = # New neurons



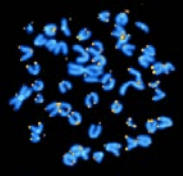
Dr. Elisa Epel (in the back) is an asst. prof. in the UCSF Dept. of Psychiatry. She studied the effects of chronic stress on accelerated aging in humans through DNA markers on chromosomes.

Telomeres (in yellow) Show Our DNA Age

A baby has about *1700* of these yellow bands (telomeres). They break off when cells duplicate. By age 70 we only have about *300 left.*



Effects of Chronic Stress on…?



- Two groups of moms ages 20-50
- One group each had a healthy child (control group)
- The other group each had a chronically ill child

One way to measure aging is to examine DNA. Each time it makes copies, it loses telomeres.

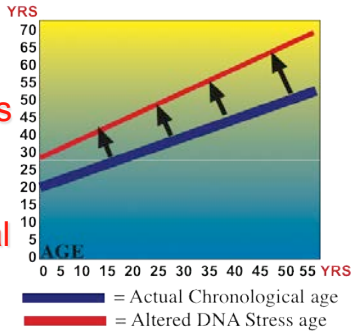
How Much Does Chronic Stress Age Your Body?

How much faster did the stressed women age than their official chronological age on their license?

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

Chronic stress aged women years faster than their healthy chronological DNA age!

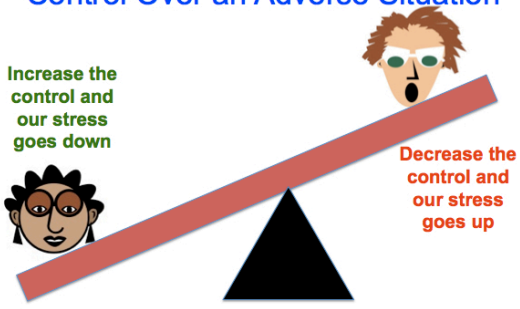
(Epel et al. 2004)



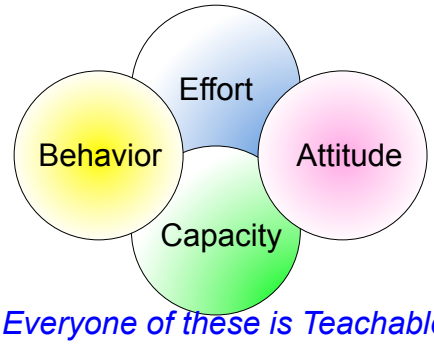
Do I have your attention yet?

Chronic Stress is Killing You!

The Stress We Experience Is Our Reaction To a Perceived Loss of Control Over an Adverse Situation



The Chronic Stress Tie-in



Everyone of these is Teachable!

Solutions

- Empower students/staff in self-regulation strategies
- Create outlets for stressed kids
- Reduce chronic stressors in school environment
- Increase control

How to Reduce Chronic Stress

- ✓Take Action *(get control)*
- ✓Write it Down for Later
- ✓1 Week Rule
- ✓Redirect Attention
- ✓Let it Go
- ✓Reframe the Experience
- ✓Burn off Energy (play/exercise)
- ✓Relax/Meditate/Sleep

Action Summary

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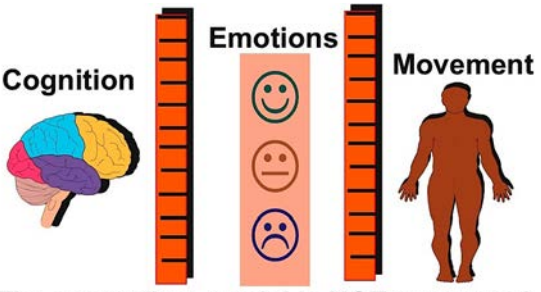
Stop distressing and start thriving: 1) there is no stress "out there" or at our school, 2) choose a novel strategy you can use to reduce your "killer" distress and stick to it.

Discovery #2: Emotion/Cognition Links

The discovery that emotions influence our mind and bodies far more than we ever believed.



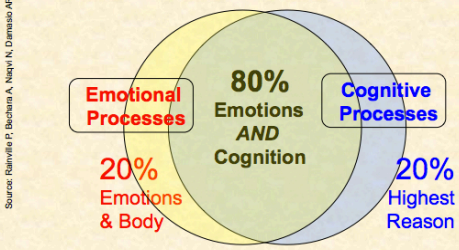
The separation model is NOT supported by recent brain research

Pioneers in Links Between Emotions & Cognition

Richard Lazarus

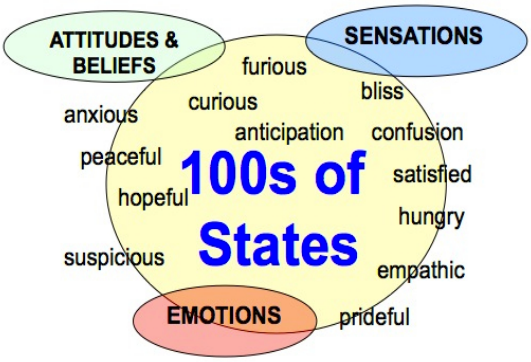
Antonio Damasio

Cognition and Emotions Overlap



Source: Ratnville P, Bechara A, Naqvi N, Damasio AR. (2006)

How we feel is what's real. It's the link to what we think.



39

Why are Good States So Critical to Learning?

Our Brain Can Learn Simple Things Under Extreme Conditions

But Complex Learning Requires Student Vesting, Working Memory, Retrieval, Critical Thinking and Risk Taking

(All of Which are State Dependent)

States

1. States usually last for s_____ or minutes, moods last for hours or days.
2. We experience 1____ of states every day.
3. More states i_____ learning than help it.

41

There's No Such Thing as an Unmotivated Student… Only Students in *Unmotivated States!*

42

Expert Teachers Will Consistently Orchestrate Optimal Learning States

Bored
Frustrated
Giddy
Starved
Angry
Skeptical
Apathetic
Annoyed
Revengeful
Hopeless
Fearful
Sleepy
Mischievous

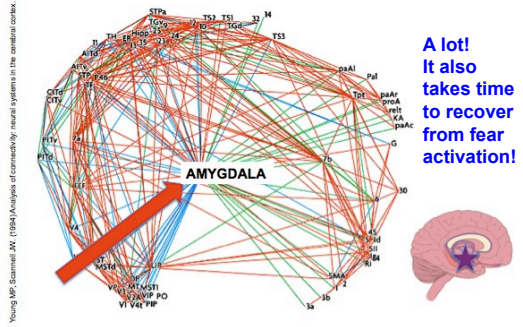
+ **TEACHER ACTIONS** =

Anticipating
Curious
Suspense
Inquisitive
Intrigued
Suspicious
Expectant
Puzzled
Challenged

Teachers who criticize, hold negative attitudes and use sarcasm as classroom discipline will activate the fear and stress areas of the student's brain.

This activation alters the student's ability to think and learn.

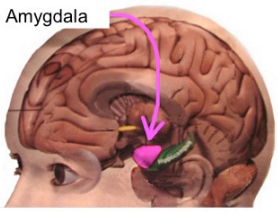
How Much Input Does the Amygdala Have to the Rest of the Brain?



A lot! It also takes time to recover from fear activation!

Fight, Flight or Freeze?

Once the amygdala is activated in class, it takes *at least 30 – 90 minutes* to calm down for quality learning.



Threats, insults, put-downs and sarcasm activate the amygdala

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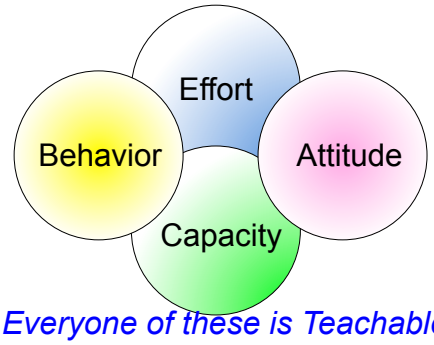
Emotional States: How To Influence Them

✓Compelling Questions
✓Social Structures
✓Purposeful Music
✓Celebrations
✓Environmental Changes
✓Storytelling

Savvy teachers are proactive and they orchestrate events, interactions and strategies in ways that enhance states.

The Emotions Tie-in



Everyone of these is Teachable!

Action Summary

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Get savvy: 1) there are no unmotivated students in your class, only students in unmotivated states, 2) you're in charge; change their states and you'll change the class climate

Discovery #3 Neuroplasticity

The discovery that the brain *is highly susceptible* to specific targeted environmental input and it follows reliable rules for change.

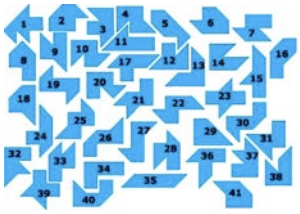
Pioneers in Neuroplasticity

Michael Merzenich

Paul Bach-Y-Rita

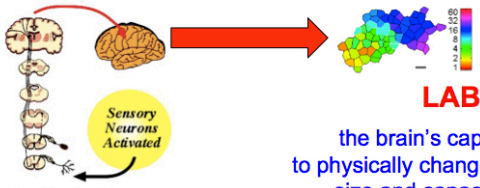
Paula Tallal

Your students *DO NOT* arrive at school "preassembled" by their DNA



Instead, they are "glued together" by life experiences

What is *Neural Plasticity*?



How Physical Experiences Can Cause Brain Changes

LABEL:

the brain's capacity to physically change the size and capacity of cells based on experience.

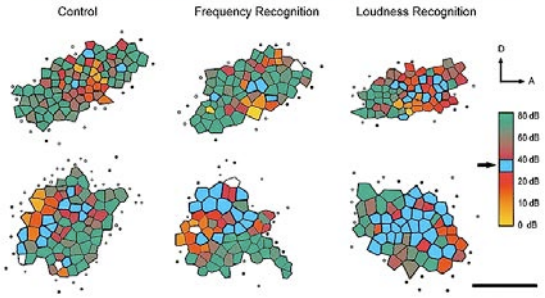
PROPERTIES:

1) it is present in all animals, 2) it allows for strategic differentiation, and 3) it is regulated by age, experience and chemical signals

Life Experiences Physically Change the Brain

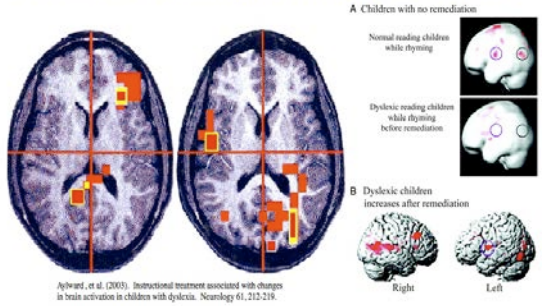
- Human brains exhibit lifetime plasticity (capacity to physically change)
- Wide range of measurable changes
- The brain are designed to change from
  a) genes
  b) gene-environment interaction
  c) environments

Plasticity in the Auditory Cortex



Polley, et al. (2006) Perceptual Learning Directs Auditory Cortical Map Reorganization through Top-Down Influence

Smart Teaching Changes Brains



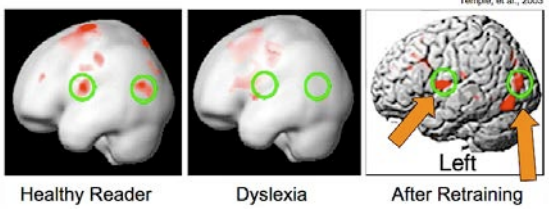
Aylward, et al. (2003). Instructional treatment associated with changes in brain activation in children with dyslexia. Neurology 61, 212-219.

56

Reading Program Changes Activation of Specific Brain Areas

Brain Areas Critical For Reading

Temple, et al., 2003



Healthy Reader | Dyslexia | After Retraining

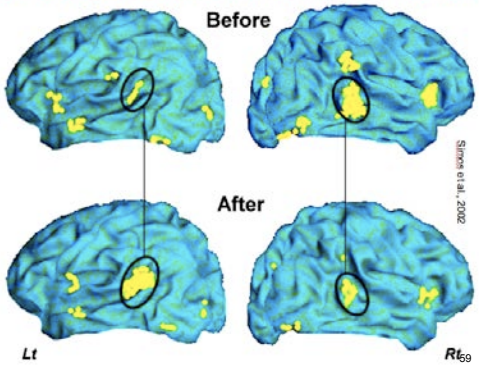
Follow the Rules for How the Brain Changes and You Will Get Dramatic Results

57

How do we know *(for certain)* that teaching changes brains?

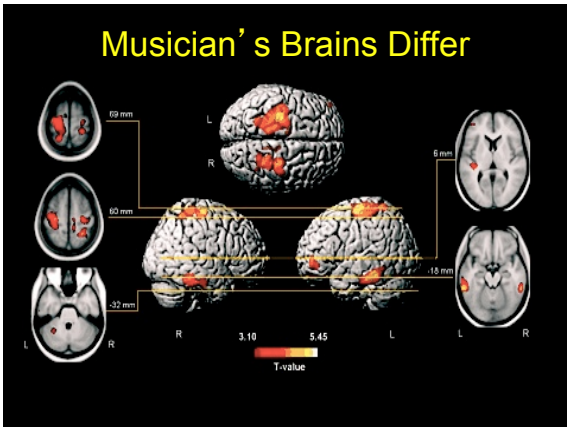
A wide body of evidence suggests that the human brain is highly susceptible to environmental input. Teaching is a highly targeted form of environmental input. Therefore, teaching changes brains.

Brain Changes: 2 Months of Instructional Treatment



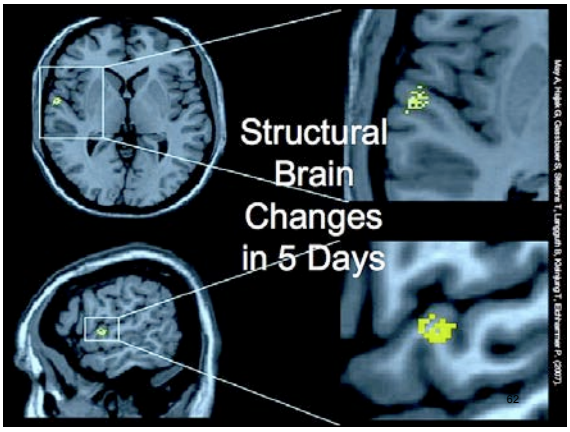
59

Musician's Brains Differ



DNA is NOT Your Destiny!

Sometimes the apple DOES fall far from the tree!

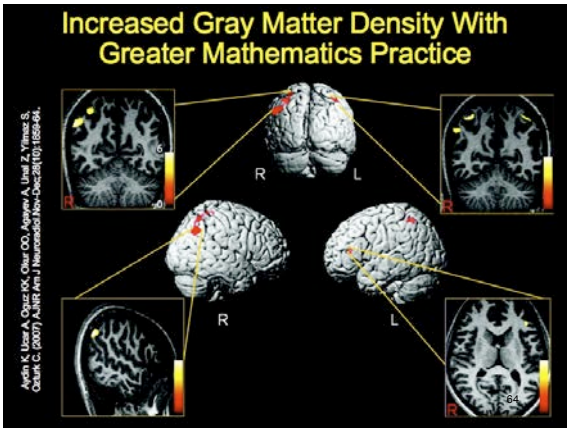


What this Discovery Suggests

• We can be more effective teachers when we use the factors known to change the brain.

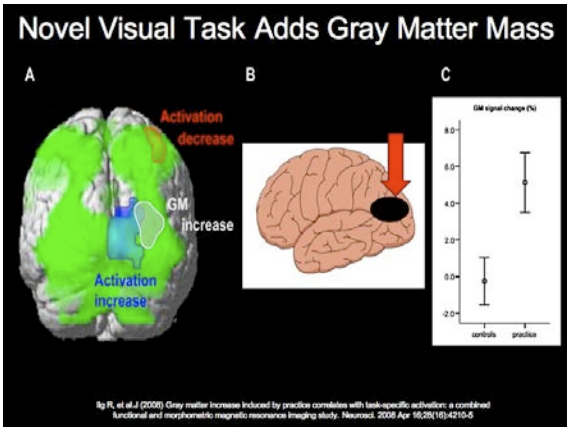
Our success is determined by…

1) quality of the plan
2) being consistent
3) staying persistent.



Schools and Brain Changing

- It is the consistency of positive environmental factors that counts.
- Your staff must buy-in to the process and goals of "upgrading the student's brain" instead of complaining about it.
- Staff needs to be relentlessly focused on the few variables that matter most, day after day, to get miracles.

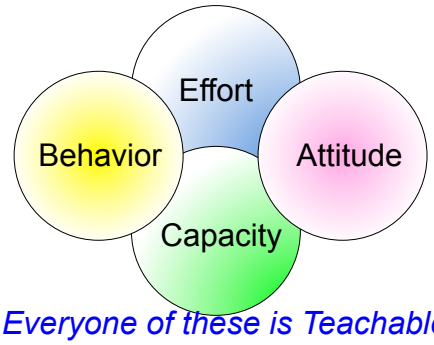


Here Are the Rules of How Brains Change!

1. Students absolutely must **buy into** it.
2. Process must be coherent to the student.
3. Their brains need **error-correction**.
4. The process needs increasing **difficulty.**
5. Students need to do it for 10-90 min. 3-5 days per week and the **longer is better.**
6. Once they get it right, they still need **practice.**

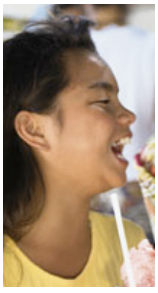
(How many staff could name these?)

Neuroplasticity Tie-in



Everyone of these is Teachable!

Which Factor, (When Tested at Age 5) is a *Far Greater Predictor* of Student Success at Age 11 than IQ?

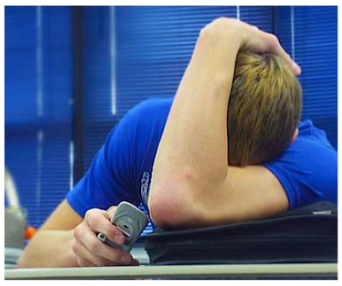


Alloway, T.P. & Alloway, R. G. (2010)

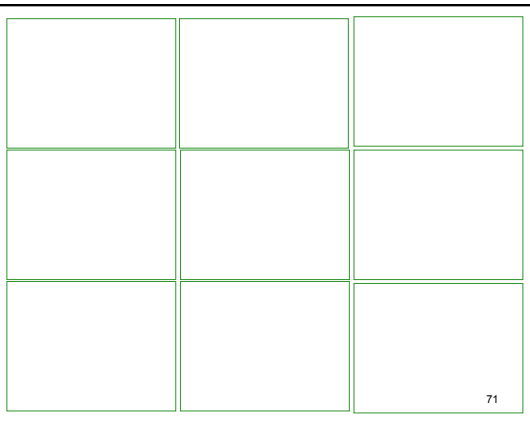
a) reading scores
b) motivation level
c) math scores
d) attitude
e) working memory

Working Memory is Free, Easy to Build and It's a Teachable Skill

If You Don't Teach It, Don't Punish Kids for Not Being Good At It.



Klingberg T, Fernell E, Olesen P, Johnson M, Gustafsson P, Dahlström K, Gillberg CG, Forssberg H, Westerberg H (2005)



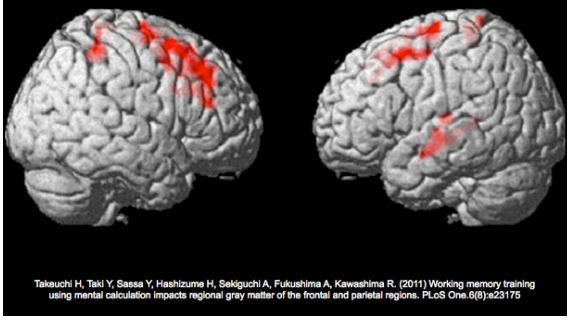
71

Working Memory and Attentional Skills Improved

Beck SJ, Hanson CA, Puffenberger SS, Benninger KL, Benninger WB. (2010, Nov.) A controlled trial of working memory training for children and adolescents with ADHD.

A research-based software program from was used for 5 weeks. Students showed significant levels of improvement in many areas of executive function including working memory and attention.

Impact of Working Memory Training on Gray Matter in 5 Days



Takeuchi H, Taki Y, Sassa Y, Hashizume H, Sekiguchi A, Fukushima A, Kawashima R. (2011) Working memory training using mental calculation impacts regional gray matter of the frontal and parietal regions. PLoS One.6(8):e23175

Strategies for Working Memory

1. Games (e.g. Simon Says)
2. Clapping repeats
3. Repeat the directions
4. Repeat prior effort then add (sound, number or word, sentence)
5. Long-term? Music lessons!

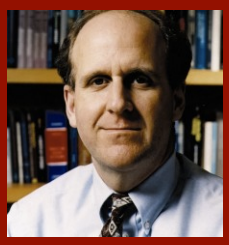
Action Suggestion:

Brains are not stuck.
You can make significant and lasting changes in your student's brains.
First, make the decision, then make a plan, then follow through.

Discovery #4 Malleability of Memory

The discovery that memories are not fixed; that they can and do change often.

Pioneers in Malleable Memories



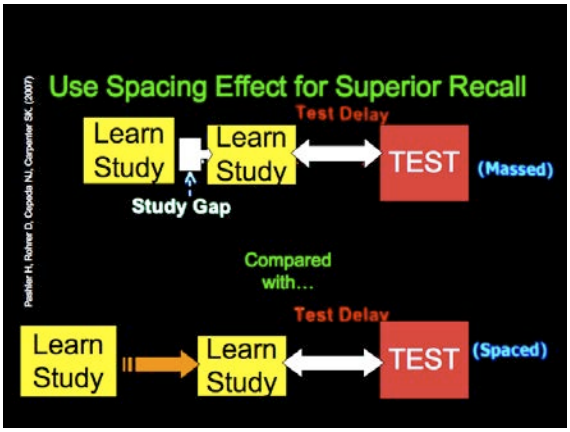
Daniel Schacter

Elizabeth Loftus

Write Your List Here

Our Brain as a "Gist" Gatherer

We rarely get new and complex explicit learning right the first time. Instead, we gather the "gist" and make "rough drafts." This is not what most teachers hope to happen. Nor is it what we test for.



Malleable Memories: What Do We Do About It?

- Attention/Buy-in
- Emotional Intensity
- Repetition/Revisit
- Coherent/Meaningful
- Embody/Physical
- Rhymes/Mnemonics
- Multiple pathways

"Great theory! But what do we do?"

Students will forget or have false memories about most of what they learn.

Staff must learn to teach working memory, do spaced (vs. massed) learning, error correct and review work.

Action Summary

Never complain that students forget things. Start teaching: 1) better memory tools for both long and short term, 2) use classroom strategies that make learning more meaningful and lengthen the time of the learning

7 Discoveries

- **Allostasis**
- **Emotion/Cognition Links**
- **Neuroplasticity**
- **Malleability of Memory**
- **Neurogenesis**
- **Social Neuroscience**
- **Gene Expression**

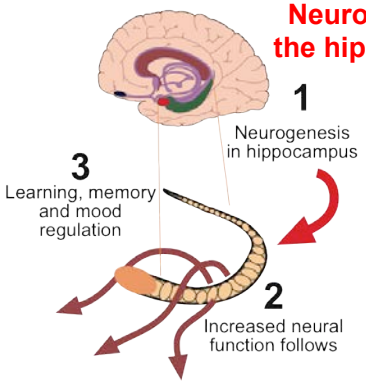
Discovery #5: Neurogenesis

The discovery that the human brain can grow new brain cells.

For Over 100 Years, Scientists Accepted as "Fact" that Our Brain ***Never*** Grew New Cells

After all, if it were true, it would mean that we could grow and "rewire" ourselves during our own lifetime!

Neurogenesis in the hippocampus



Neurogenesis Importance

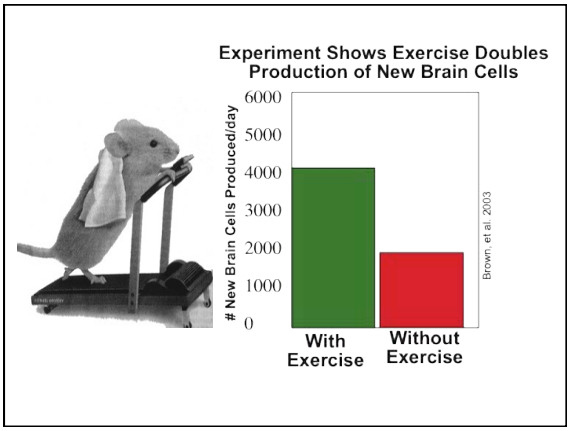
- That it occurs
- That neurons survive
- They become functional
- They influence mood, learning, memory and weight control
- The process is regulated by our everyday behaviors

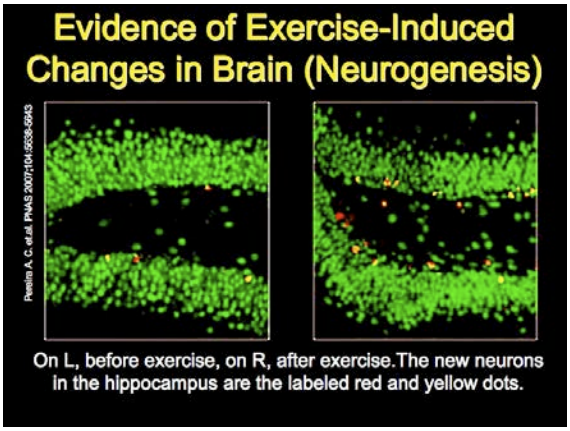
Neurogenesis ***(the production of brand new brain cells)*** **is...**

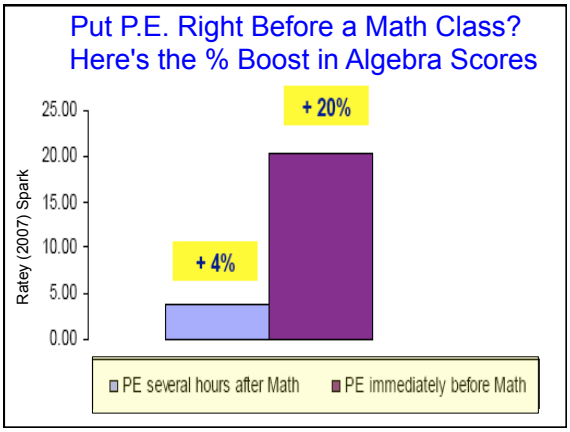
Enhanced by:
- Exercise
- Complex Environments
- New Learning
- Prosocial Contact
- Nutrition
- Low Stress

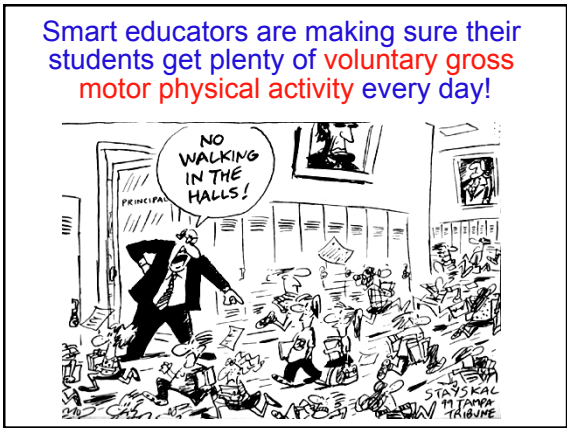
Reduced by:
- Distress
- Inactivity
- Boredom
- Depression
- Poor Nutrition
- Isolation & Low Social Status

P.S. Teachers can influence many of these factors! 90







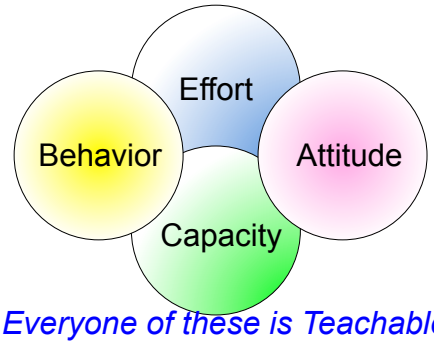


"Great theory! But what do we do?"

Your students will generate new neurons each day. Some neurons will die.

But whether your students have a "net gain" or "net loss" is partly up to how their school day goes. You can foster neurogenesis.

Neurogenesis Tie-in



Everyone of these is Teachable!

Action Summary

You can influence student's brains: 1) boost neurogenesis, 2) use physical activity like recess or PE, then add greater social bonding and cognitive complexity.

Discovery #6
Social Neuroscience

The discovery that social conditions have a much greater impact than previously believed.

Pioneers in Social Neuroscience

John Cacioppo

Gary Berntson

K-2 level
1. Relationship building

Grades 3-5
1. Relationships
2. Affiliation

Grades 6-12
1. Relationships
2. Affiliation
3. Status-building

Invest Time in Your Students Differently as Their Social Brain Matures

Students are Hard-Wired to Affiliate, Seek Acceptance, and Prefer Peer-Bonding

Lewis GJ, Bates TC. (2010)Genetic evidence for multiple biological mechanisms underlying in-group favoritism.

Yet much of their day they are disciplined for talking, texting, joking, passing notes, bonding and seeking friends.

When your classrooms and schools are run the way the brain naturally works, the kids will start learning and quit annoying you!

Social Conditions Influence:

Stress levels
Cognition
Mood and affect
Status
Immune systems
Self-concept
Motivation
Performance
Use of drugs

(Cacioppo et al., 2001)

Two Brain-Based, Hard-Wired Social On-going Student Quests

1. The quest for acceptance and affiliation ("How can I become part of a group?")
2. The quest for social status ("How can I feel special?")

HINT: DO NOT get in the way of these; simply anticipate and facilitate the inevitable process in productive ways!

Today's Teens Use Texting for Relationships, Boosting Their Affiliation and Status Seeking

Lenhart, A. (2010) Teens, Cell Phones and Texting. Pew Internet & American Life Project. Site: http://pewresearch.org/pubs/1572/teens-cell-phones-text-messages. Accessed 3/5/11.

- 72% use text messaging
- 50% send 50+ texts/day, or 1,500 texts/mo.
- 33% send 100+ texts/day, or 3,000 texts/mo.
- 15% send 200+ per day, or 6,000+ texts/mo.
- Boys average 30+ texts/day
- Girls average 80+ texts/day

Teachers Strongly Influence Student Social Status

How? Through decisions, privileges, affirmation, mentors drama, team culture, social recognition, cooperative learning, positive feedback, skill-building and giving responsibility and leadership roles.

Suggestions

- Make pro-social climate a school-wide priority
- Insist on mentoring, clubs, teams and social skill-building
- Nobody goes unnoticed!

Action Summary

,

Make your learning time half social and half individual. 1) put kids in cooperative groups or teams, 2) use partners or social media.

Discovery #7
Gene Expression

The discovery that our genes are NOT our destiny and that gene expression is more critical than the original "blueprint."

Old Paradigm: Brains Stay the Same; Kids Stay the Same

New Understanding: Brains can and do change everyday. But if the circumstances around a kid (home and school) remain the same, so will his or her brain!

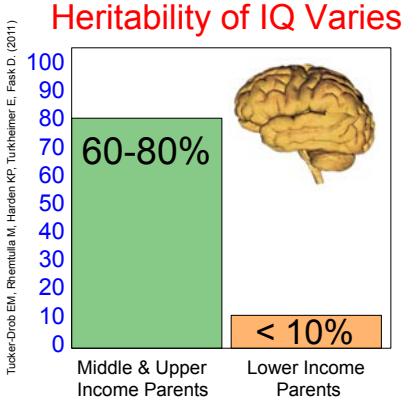
109

What Determines Our Destiny?

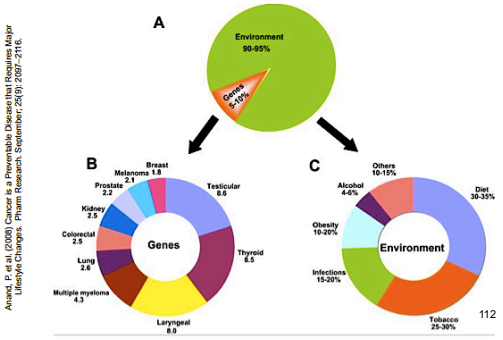
NEW!

30-40%	30%	30-40%
Genes	Gene/Environment Interaction	Environment

Heritability of IQ Varies



Genes Are Not Your Destiny: Both Genes (10%) *and* Environment (90%) Influence Cancer Risk



112

Can Educators Trigger Gene Expression? ***Yes!***

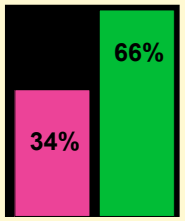
- ✓Stress/Distress
- ✓New Learning
- ✓Emotional States
- ✓Physical Activity
- ✓Social Conditions
- ✓Nutrition
- ✓Beliefs/Thoughts

✓Rossi, E. (2002) The Psychobiology of Gene Expression

The Relevance?

There's nearly a 2-1 advantage of the potency of environmental influences over genetic ones. This suggests hope for all students!

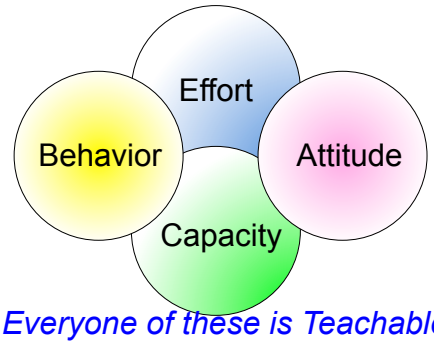
(Devlin et al., 1997)



What this Discovery Suggests

It's *the aggregate* of good things *over time* that make such a positive difference in the brain.

The Student's "Big Four"



Everyone of these is Teachable!

- Every staff member should know and use FACTORS that drive positive brain changes.
- There is plenty of time for your staff to transform student attitudes and learning IF they learn to teach SMARTER not harder.

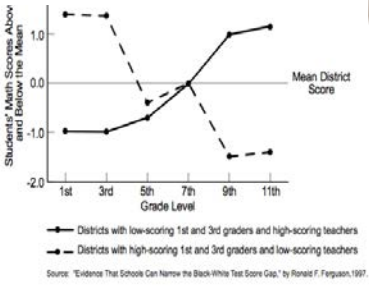
CRITICAL:

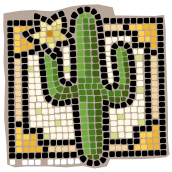
How Much do Teachers Matter?

Recent research suggests that in total, approximately **50-60%** of the variation in the performance of students comes from their school experience with the remaining being due to genes, student background, homelife or random influences.

Cuttance. P. (1998) *International handbook of educational change, Quality assurance reviews as a catalyst for school improvement in Australia, eds Hargreaves A, Lieberman A, Fullan M, Hopkins D (Kluwer, Dordrecht, Netherlands), Part 2, pp 1135–1162. Text passage from* pp. 1158–1159.

10-Yr. Effects of Low vs High Effective Teachers on State Test Scores in TX





Before Observing All Teachers, Watch Your Q1s and Learn What to Look and Listen For

DNA is NOT Your Destiny!

Brain Research May Effectively Be Used as a Filter for Understanding and Developing Policy as Well as Selecting Smart Classroom Practices

Policy makers and educators can either use what we know…
or
Struggle because you're working against yourself.

"What did you learn today?"

Let's Simplify…

A – B – C

1. **Agree** on a clear, smart path
2. **"Buy-in"** from yourself
3. **Commit** to implementation

7 Discoveries

- **Allostasis**
- **Emotion/Cognition Links**
- **Neuroplasticity**
- **Malleability of Memory**
- **Neurogenesis**
- **Social Neuroscience**
- **Gene Expression**

Transfer Time!

Take what you have learned and ask yourself how it might apply to your own job.

Which area of your work, in particular, can you apply this to and how would you do it ASAP?

Nothing will change in your classroom until you: 1) make a decision to change, 2) act on that decision, and 3) sustain and strengthen the strategy over time. So, what will it be?

My Follow-Up Plan

1 - WHAT WILL I DO DIFFERENTLY:

2 - EVIDENCE of MEASURES:

3 - START DATE

4 - WORK PARTNER:

The next two slides were from the working memory quiz given earlier.


Berry | 5 |

	Apple	Orange

130

tough	rocky
ready	sandpaper
enough	rugged
tumble	rider
scruff	coarse
scratch	gravel
draft	gruff