Principles and Strategies for Improving Executive Function Skills

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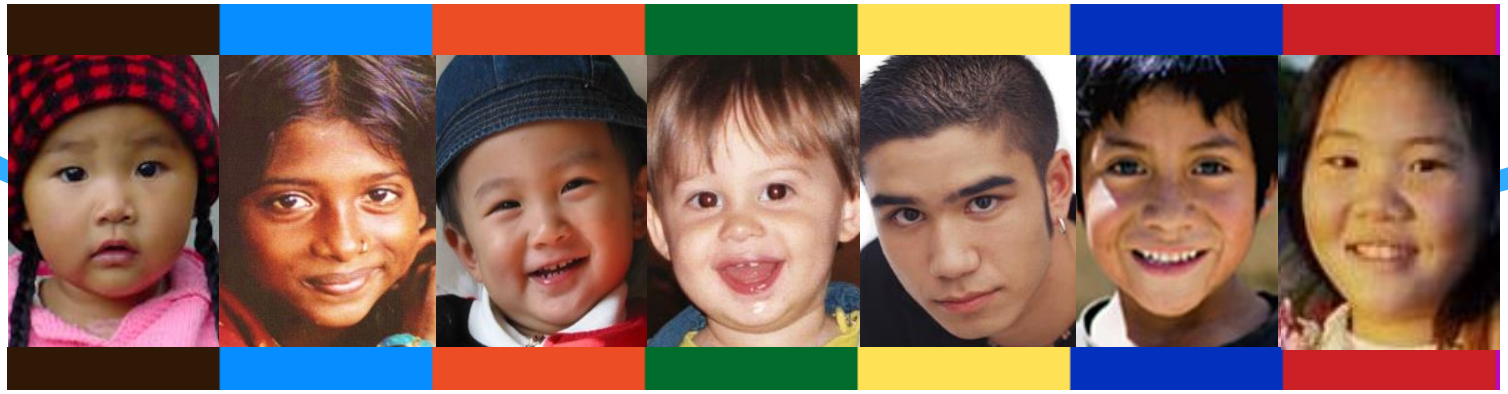
What abilities and skills will people need to be successful in the 21st century?



What will it likely take to be successful in the 21st century?

1) Creativity

- Coming up with new ideas, hypotheses and Inventions.
- If one way of solving a problem isn't working, how else might we succeed here? Can we think outside the box to come up with a way of attacking this no one else has considered before?

2) Flexibility

- Seeing opportunities and seizing them: I was planning to do X, but an amazing opportunity has arisen to do Y, do I have the flexibility to take advantage of serendipity?
- Circumventing unexpected obstacles, wisely changing strategies when something isn't working
- Being able to admit you were wrong when you get new information

An example of poor cognitive flexibility:

When one door closes, another door opens;
but we often look so long and so regretfully upon the closed door, that we do not see the ones which open for us.

- Alexander Graham Bell

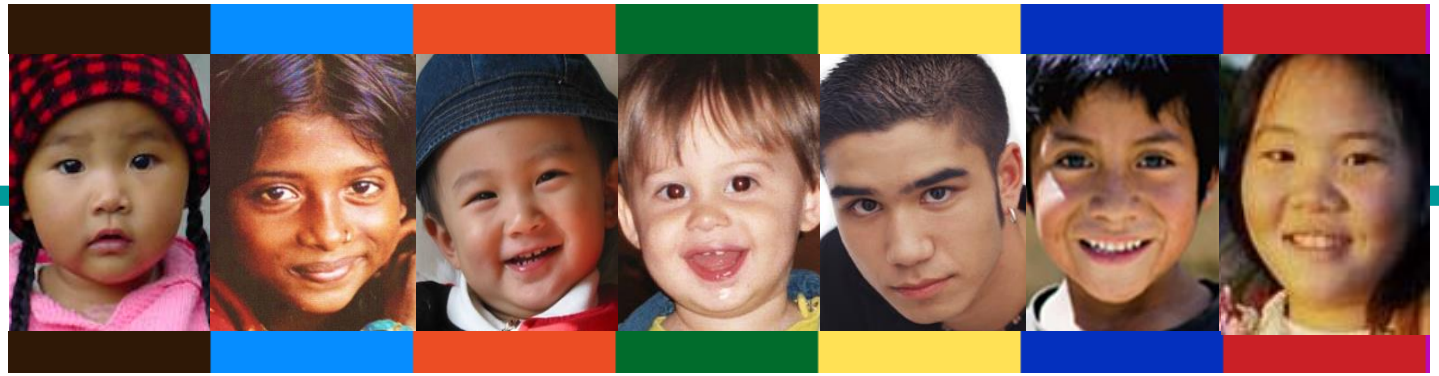
3) Discipline / Perseverance

Having the discipline to stay on task…

- seeing it through to completion despite unexpected problems, some aspects being boring or perhaps frustratingly difficulty, & tempted by lots of things far more fun
- continuing to work at something though the reward may be a long time in coming

Evidence shows that discipline accounts for over twice as much variation in final grades as does IQ, even in college.

(Duckworth & Seligman, 2005)



4) Self-control

Having the self-control to resist temptations and not act impulsively -- be able to:

- think before you speak or act -- give a considered response instead of an impulsive one
- not over-indulge or indulge in the wrong things
- resist saying something socially inappropriate (or hurtful)
- resist 'tit for tat' (hurting someone because that person hurt you)
- resist jumping to an interpretation of what something meant or why it was done

ALL of the above are

"Executive Functions"

or rely on them

The 3 core Executive Functions are:

- **Inhibitory Control**
  (which includes self-control & discipline, also selective attention)
- **Working Memory** (holding info in mind & MANIPULATING it; essential for reasoning)
- **Cognitive Flexibility** (including creative problem-solving & flexibility)

Higher-order Executive Functions are:

- Problem-solving
- Reasoning
- Planning

Inhibitory control

involves resisting a strong inclination to do one thing,

and instead doing what's most appropriate or needed.

Makes it possible for us to resist acting on our first impulse so we don't do something we'd regret.

Inhibitory control of attention

enables us to inhibit distraction & selectively attend, focusing on what we choose and suppressing attention to other stimuli

SELECTIVE or FOCUSED ATTENTION

such as screening out all but one voice at a cocktail party

Children with better inhibitory control (i.e., children who were more persistent, less impulsive, and had better attention regulation) as adults 30 years later have…

- better health
- higher incomes and better jobs
- fewer run-ins with the law
- a better quality of life (happier)

than those with worse inhibitory control as young children,

controlling for IQ, gender, social class, & home lives & family circumstances growing up

across diverse measures of self control.

That's based on a study of 1,000 children born in the same city in the same year followed for 32 years with a 96% retention rate.

by Terrie Moffitt et al. (2011)
Proceedings of the Nat'l Academy of Sci.

"Interventions that achieve even small improvements in [inhibitory control] for individuals could shift the entire distribution of outcomes in a salutary direction and yield large improvements in health, wealth, and crime rate for a nation."

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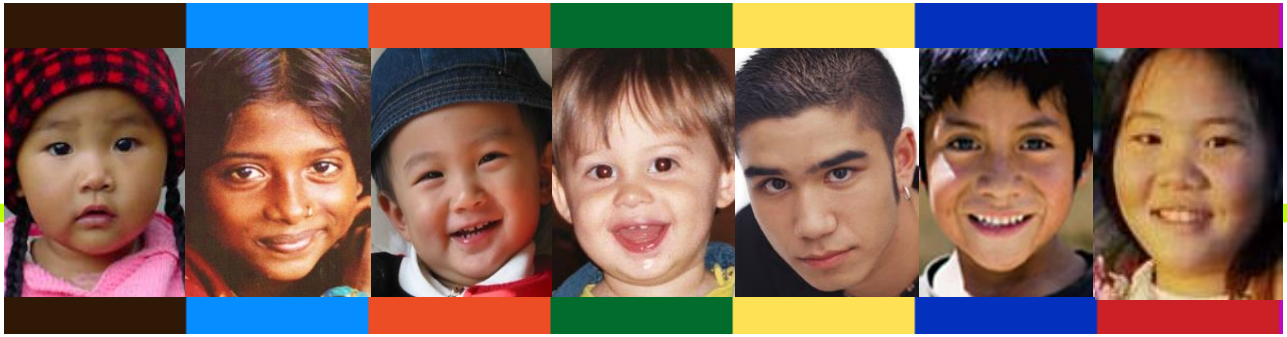
(b) Working Memory:

Holding information in mind and mentally working with it

Working memory is critical for making sense of anything that unfolds over time, for that always requires holding in mind what happened earlier & relating that to what is happening now.



- relating one idea to another
- relating what you read (or learned / heard) earlier to what you are reading (learning / hearing) now
- mental math calculations
- understanding cause and effect
- remembering multi-step instructions & executing them in the correct order

Reasoning would not be possible without working memory, for reasoning requires holding bits of information in mind and seeing how they relate. Working memory enables us to consider the past and possible future in making plans and decisions.

WORKING MEMORY is critical to our ability to see connections between seemingly unconnected things, and hence to **CREATIVITY**, for the essence of creativity is to be able to disassemble and re-combine elements in new ways.

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For example, try to think of as many uses for a TABLE as you can.

What are all the things you might use a table for?

A table might be used to write on or to eat food on.

It might be turned on its side and used to keep a door closed or used as a shield against bullets or snowballs.

You could get under it to hide or to keep dry.

You could cut it up for firewood.

How can we stop ourselves from get really upset when a child misbehaves? What we usually get upset about is the intent we think is behind an action.

Could use Cognitive Flexibility to re-frame:

A child might be acting in the most awful manner because he has been terribly hurt and is afraid of being hurt again, so he will push you away before you have a chance to reject him or he will test you to see if are *really* someone he can feel safe with.

If we see the misbehavior as coming from hurt, we can react completely differently.

One of the most important findings to emerge from neurobiology is that biology is not "destiny."

Neuroscience research has shown that experience plays a far larger role in shaping the mind, brain, and even gene expression than ever imagined.

Very little is fixed or unchangeable.

90% of our genes are switched off.
To a large extent, our experiences, and our reactions to them, determine which genes get turned on (& off), when this happens, & which genes stay on (epigenetics).

"Brain-based" does NOT mean fixed or unchangeable.

Experience and activity change the brain (neural plasticity).

EFs depend on the brain -- but they can be improved.

There are 3 basic ways to improve functioning that requires EFs:

(a) work on EFs - train them, challenge them, & practice, practice, practice

(b) work on reducing things that impair EFs (stress, lack of sleep, etc.)

(c) find ways of reducing the demands on EFs (circumvent the need for EFs, in part)

Executive Functions depend on Prefrontal Cortex and the other neural regions with which it is interconnected.

Nowhere is the importance of social, emotional, and physical health for cognitive health more evident than with PFC & EFs.

PFC & EFs are the first to suffer, & suffer disproportionately, if we are

- sad or stressed
- lonely
- or not physically fit

Conversely, we show better EFs when we're happy, feel socially supported, & we're physically fit.

If we ignore that someone is stressed, lonely, or not healthy because of poor nutrition, lack of sleep or lack of exercise those unmet needs will work against that person exercising the EFs s/he needs to function properly at work and at home.

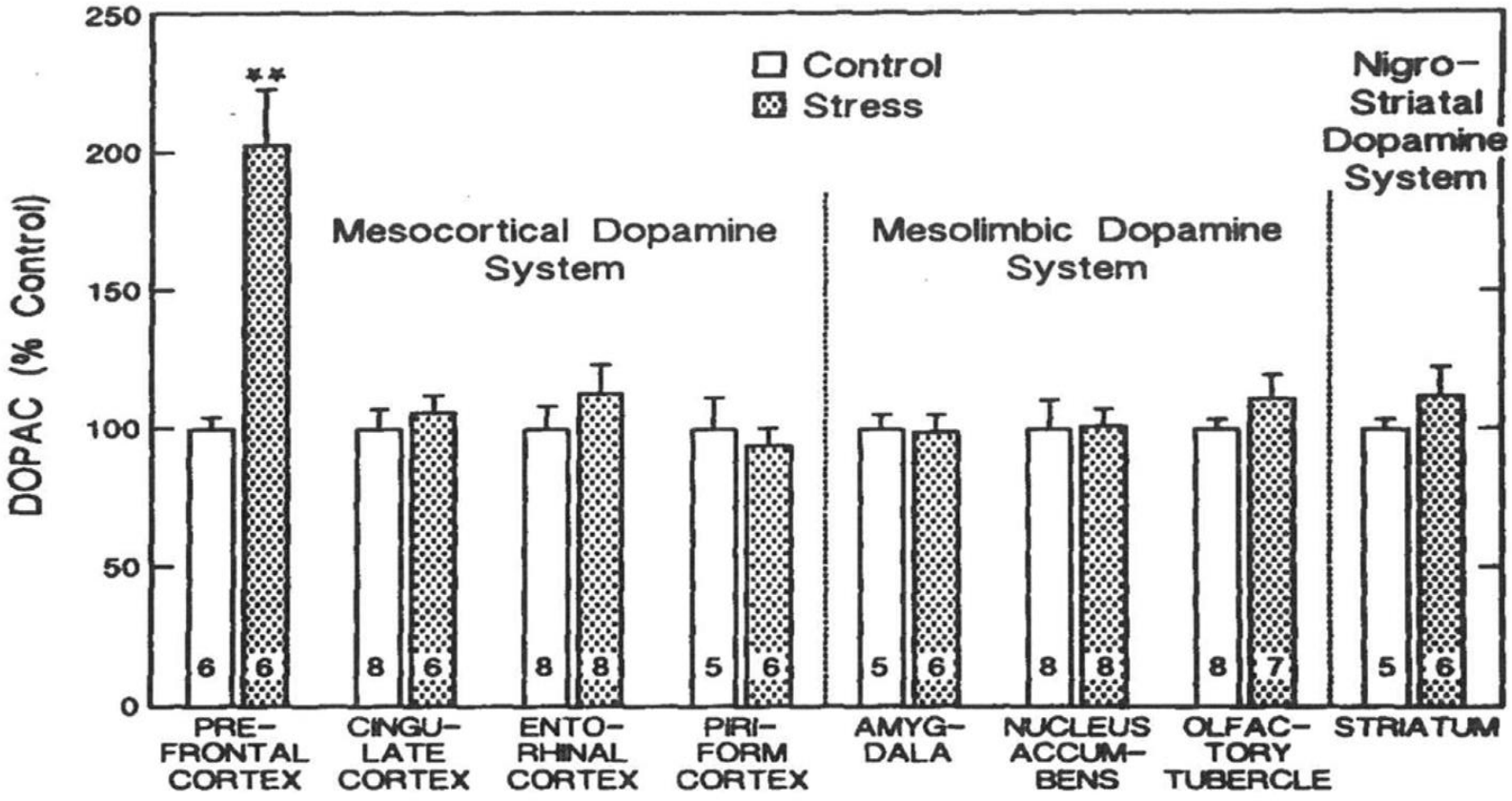
Our brains work better when we are not in a stressed emotional state.

Amy Arnsten, 1998
The biology of being frazzled
Science

This is *particularly* true for PFC & EFs.

Stress and Prefrontal Cortex

Even mild stress increases DA release in PFC but not elsewhere in the brain



(Roth et al., 1988)

When we are sad we're worse at filtering out irrelevant information (i.e., worse at selective attention).

Desseilles et al., 2009
von Hecker & Meiser, 2005

When we are happy we are better at selective attention.

Gable & Harmon-Jones, 2008

People show more creativity when they're happy

THE most heavily researched predictor of creativity in social psychology is mood.

The most robust finding is that a happy mood leads to greater creativity (Ashby et al. 1999). It enables people to work more flexibly (Murray et al. 1990) & to see potential relatedness among unusual & atypical members of categories (Isen et al. 1985, 1987).

Hirt et al. 2008: 214

Stress impairs EFs and can cause anyone to look as if he or she has an EF impairment (like ADHD) when that's not the case at all.

(You may have noticed that when stressed you can't think as clearly or exercise as good self-control.)

If you're stressed,

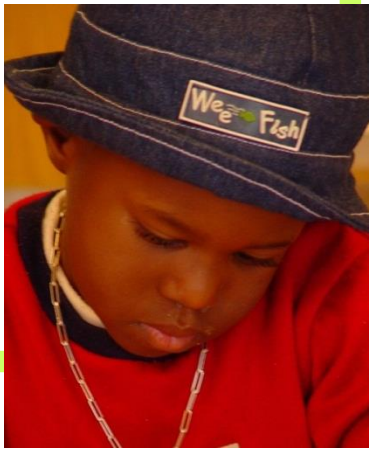
you cannot be the

parent you want to be.

If you're stressed,

your children will pick on it.

It will cause them to feel stressed.



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RELAX

Imperfect ≠ Worthless

You're not perfect.

You're going to make mistakes.

That's OK.

You don't need to be perfect.

Besides, no one ever is.

I can guarantee 100% that worrying about whether you are a good enough parent will NOT improve your parenting – it will only make it worse.

Your humanity is more important than your knowledge or skill or doing the textbook-perfect thing.

The Spirit rather than the Technique

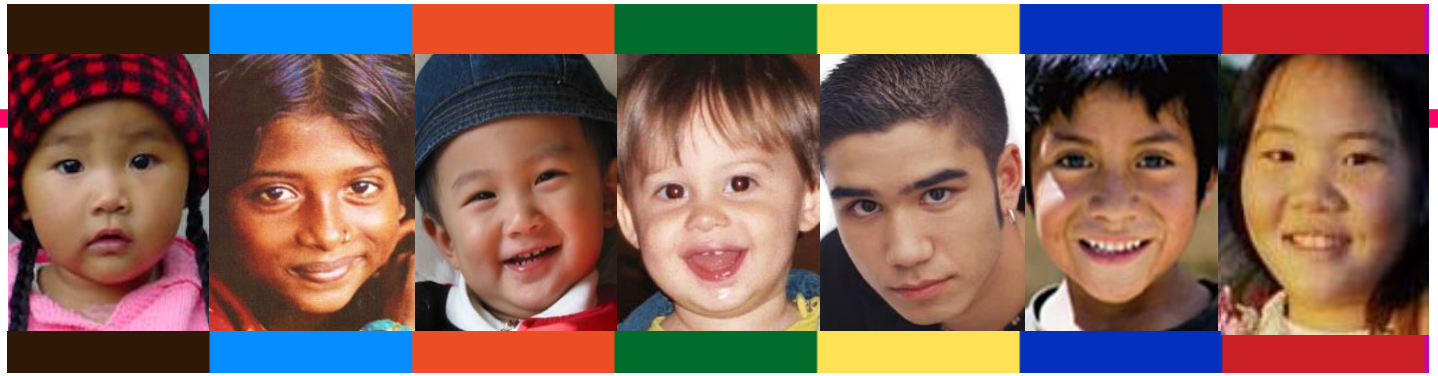
Who would you rather listen to….
the musician who plays from the heart or the musician with absolutely perfect technique but no heart?

You can do the textbook-perfect thing, but if it doesn't come from the right place, it won't have the desired result. You can mess up, but if it comes from the right place, it will be okay.

Relax: Your ability to love your children, and be genuinely present for them, is what is most important.

What do children need most?

TO BE LOVED



What children need most is to feel you care about them, to feel loved.

"Children who are truly loved…know themselves to be valued. This knowledge is worth more than any gold."

Scott Peck, *The Road Less Traveled*

Jerome Frank conducted a study comparing several different forms of psychotherapy to one another.

He concluded:

"A totally untrained therapist who exercises a great capacity to love will achieve psychotherapeutic results equal to the best."

The best body of work on the relative effectiveness of different types of psychotherapies comes from

Bruce Wampold, Prof. at Univ. of Wisc. - Madison.

In 2001, he wrote a landmark book:

The Great Psychotherapy Debate: Models, Methods, and Findings

He comprehensively reviewed the research on psychotherapy and concluded that:

the client-therapist relationship trumps technique hands down.

What matters in Early Childhood Ed?

Not the # of children

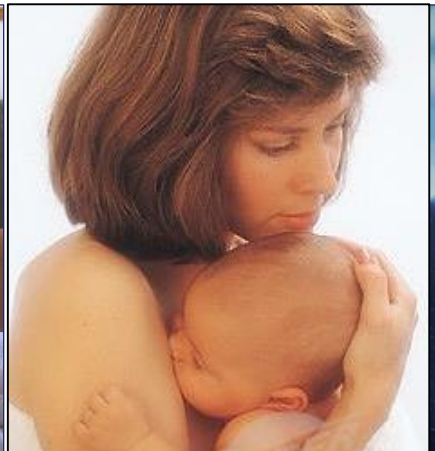
Not the caregiver: children ratio

Not having the best materials

but the caring relationship between the teacher and the children

As international studies show (e.g., Melhuish , 1990 a & b)

Don't have much money? Can't afford the newest toys or gadgets? **Relax.** Your humanity is more important than material possessions or even doing the textbook-perfect thing.



How do we show children we care about them?

"The principal form that love takes is giving of your time....When something is of value to us we spend time with it. So it is when we love our children.... we give them our time."

Scott Peck

Sometimes we're so busy doing all the things we need to do, we forget how important it is to stop & take time to simply be with our children.

The most powerful way to communicate to our children that we care about them is to listen to them. Truly listen.

Give them our time and our attention.

The quality of our listening, rather than the wisdom of our words, is often what has the most impact.

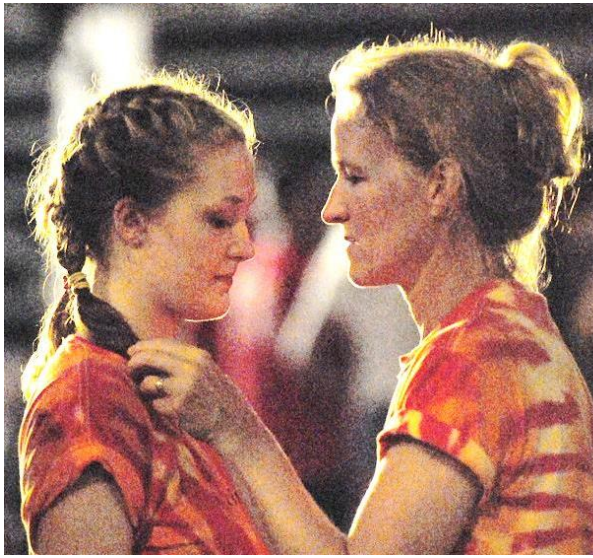
"Perhaps the most important thing we ever give each other is our attention. And especially if it's given from the heart..."

"Listening is the oldest and perhaps the most powerful tool of healing."

-- Dr. Rachel Naomi Remen

"The greatest gift
I can conceive of
having
from anyone
is
to be seen by them,
heard by them,
to be understood."

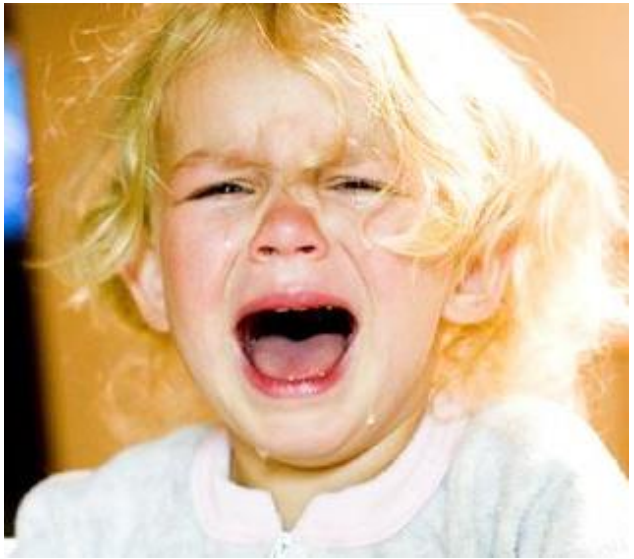
-- Virginia Satir



It's important is to be heard / understood –

and to be liked anyway

When a child doesn't feel understood, little things can become BIG issues.



In Gottman's studies, if the wife felt she was being heard the marriage was essentially divorce-proof.

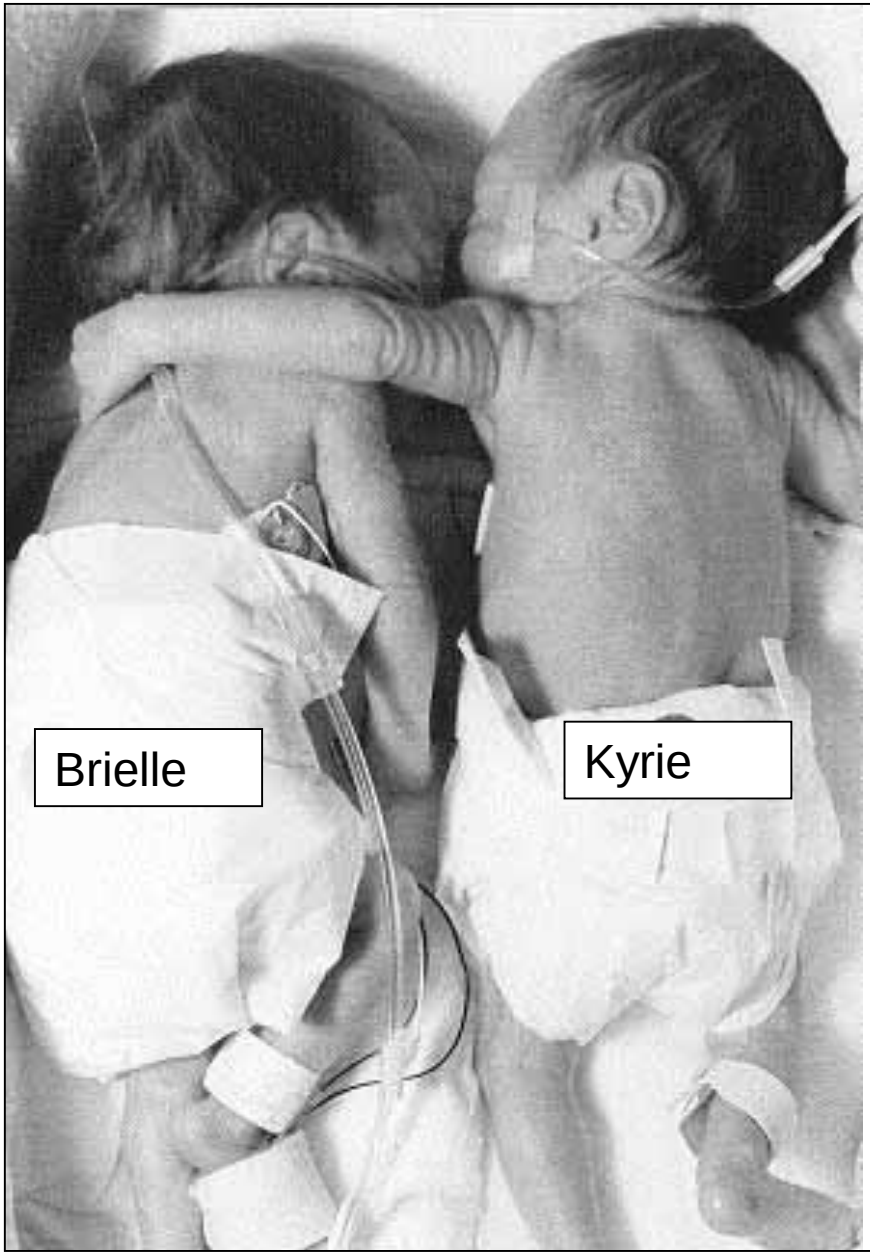
Gottman JM & Levenson RW. (1999). Rebound from marital conflict and divorce prediction. Family Process. 38(3):287-92.

"Differences must be grasped, even if no problems are solved. One of the reasons empathy works so well is because it does not require a solution. It requires only understanding."

John Medina, *Brain Rules for Baby*

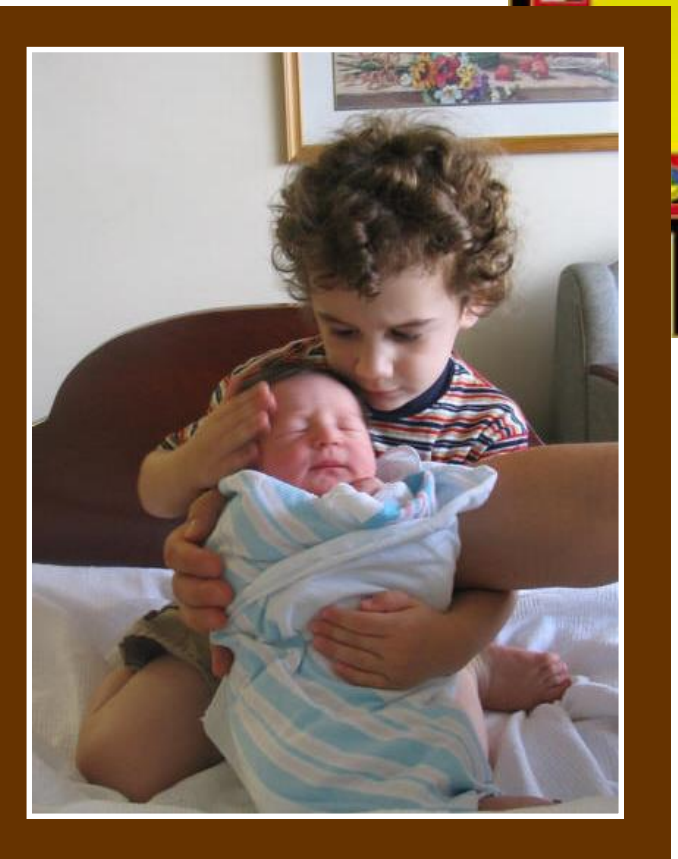
Ways to Relieve Stress

Touch relieves Stress



Born 12 weeks early, these twins were whisked into separate incubators. Brielle (on the left) had breathing and heart-rate problems, didn't gain weight, and fussed when anyone tried to comfort her. Finally a nurse put the two sisters together. As Brielle dozed, Kyrie wrapped her arm around her smaller sibling. With her sister nearby, Brielle began to calm down and thrive. Sooner than expected, the girls went home.

first reported in the *Worcester Telegram & Gazette* Nov. 18, 1995
picked up by *Life Magazine*, June 1996



Exercise Reduces Stress

Exercise in almost any form can act as a stress reliever.

Being active can boost your feel-good endorphins and distract you from daily worries.

Williamson et al. (2001) Mood change through physical exercise in nine- to ten-year-old children. *Perceptual Motor Skills. 93*(1):311-6.

64 9 & 10-year-old children responded to a self-report mood measure after two different types of aerobic exercise of 15 min. Significant increases in positive mood and significant decreases in negative mood were found after each exercise treatment

Annals of Behavioral Medicine (1999): College students who exercised regularly coped with stress better and had 37% fewer physical symptoms than those who did not exercise regularly. Sedentary students had 21% more anxiety than the students who exercised regularly.

Lane & Lovejoy (2001) The effects of exercise on mood changes: the moderating effect of depressed mood. *Journal of Sports Medicine and Physical Fitness, 41*:539-545

Exercise improved the mood of depressed individuals. 80 volunteers took a mood test prior to an aerobics class; 52 were determined to be in a depressed mood. The questionnaire was given again after the class. Participating in the class improved the mood of depressed individuals and reduced feelings of anger.

Mindfulness Reduces Stress

It also trains the executive function of inhibitory control and disciplining your attention.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84, 822-848.*

Chiesa, A., & Serretti, A. (2010). A systematic review of neurobiological and clinical features of mindfulness meditations. *Psychological Medicine, 27, 1-14.*

Ortner, C. N. M., Kilner, S. J., & Zelazo, P. D. (2007). Mindfulness meditation and reduced emotional interference on a cognitive task. *Motivation and Emotion, 31, 271-283.*

van der Oord, S., Bögels, S. M., & Peijnenburg, D. (2012). The effectiveness of mindfulness training for children with ADHD and mindful parenting for their parents. *Journal of Child and Family Studies, 21(1), 139-147.*

Pets reduce stress

The presence of a dog in the classroom reduces stress and helps children perform better.

Gee, N. R., Church, M. T., & Altobelli, C. L. (2010). Preschoolers make fewer errors on an object categorization task in the presence of a dog. *Anthrozoös, 23, 223-230.*

Gee, N. R., Crist, E. N., & Carr, D. N. (2010). Preschool children require fewer instructional prompts to perform a memory task in the presence of a dog. *Anthrozoös, 23, 173-184.*

Gee, N. R., Harris, S. L., & Johnson, K. L. (2007). The role of therapy dogs in speed and accuracy to complete motor skills tasks for preschool children. *Anthrozoös, 20, 375-386.*

Beetz, A., Julius, H., Turner, D., & Kotrschal, K. (2012). Effects of social support by a dog on stress modulation in male children with insecure attachment. *Frontiers in Psychology, 3*.

Beetz, A., Kotrschal, K., Turner, D. C., Hediger, K., Uvnäs-Moberg, K., & Julius, H. (2011). The effect of a real dog, toy dog and friendly person on insecurely attached children during a stressful task: An exploratory study. *Anthrozoös, 24, 349-368.*

In the PATHS program, children are taught that when they get upset they should stop (Turtle), take a deep breath, say what the problem is and how they feel, and construct an action plan.

Teachers are taught techniques to generalize skills learned during PATHS lessons to other contexts during the school day.

Communicate loud and clear the faith and expectation that each child will succeed.

“Treat people as if they were what they ought to be and you help them become what they are capable of being.”

– Johann W. van Goethe

When a toddler falls while trying to learn to walk, we don't say he gets a 'D'; we say, "Don't worry; I'm sure you're going to be able to do this."

Starting point: "There's no question you are going to do this."

Powerful Role of Expectations (by others AND yourself) and Attitude

Pygmalion in the Classroom -- powerful role of expectations Robert Rosenthal

Stereotype threat - female performance on math exams Claude Steele

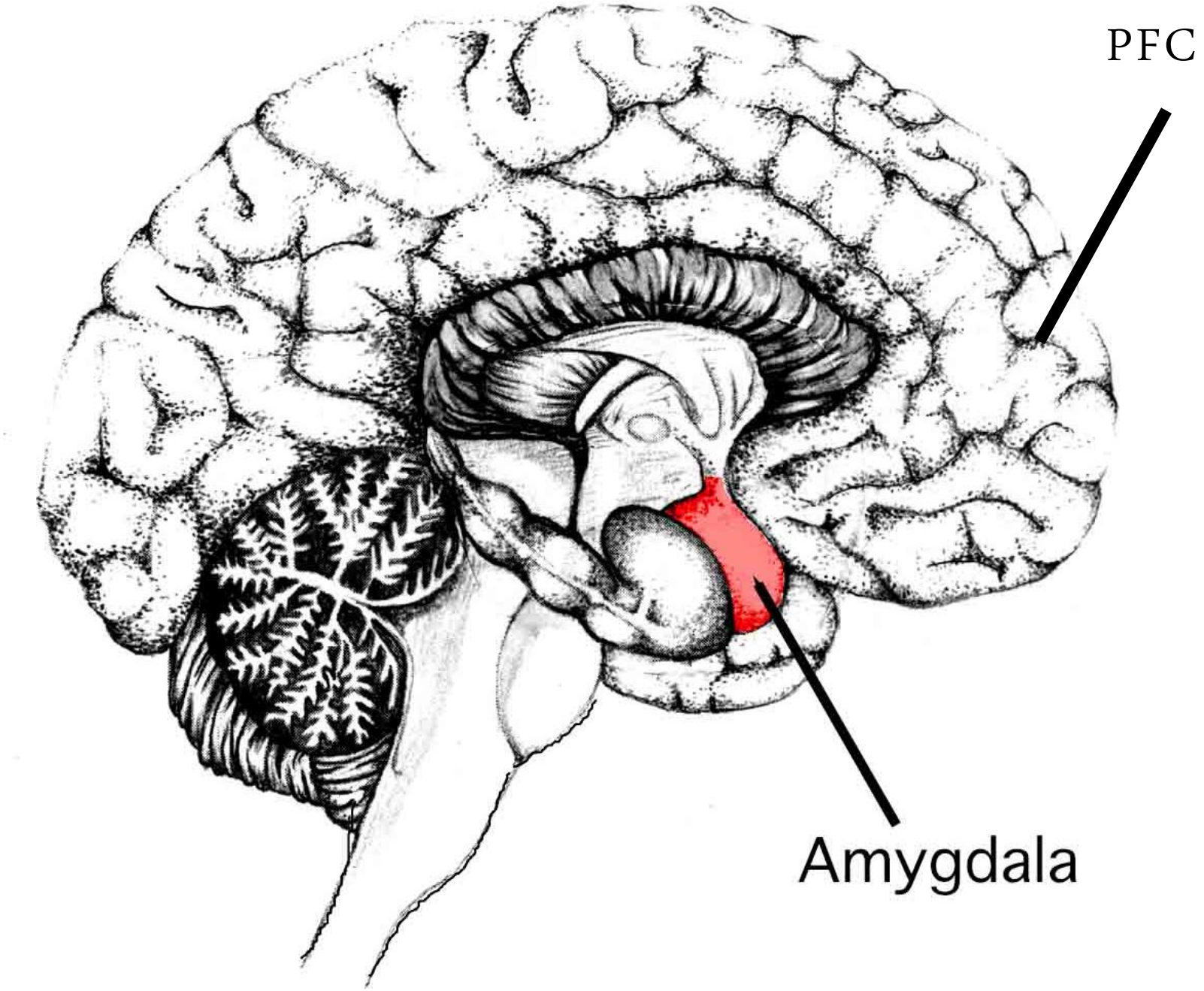
Putting feelings into words reduces stress.

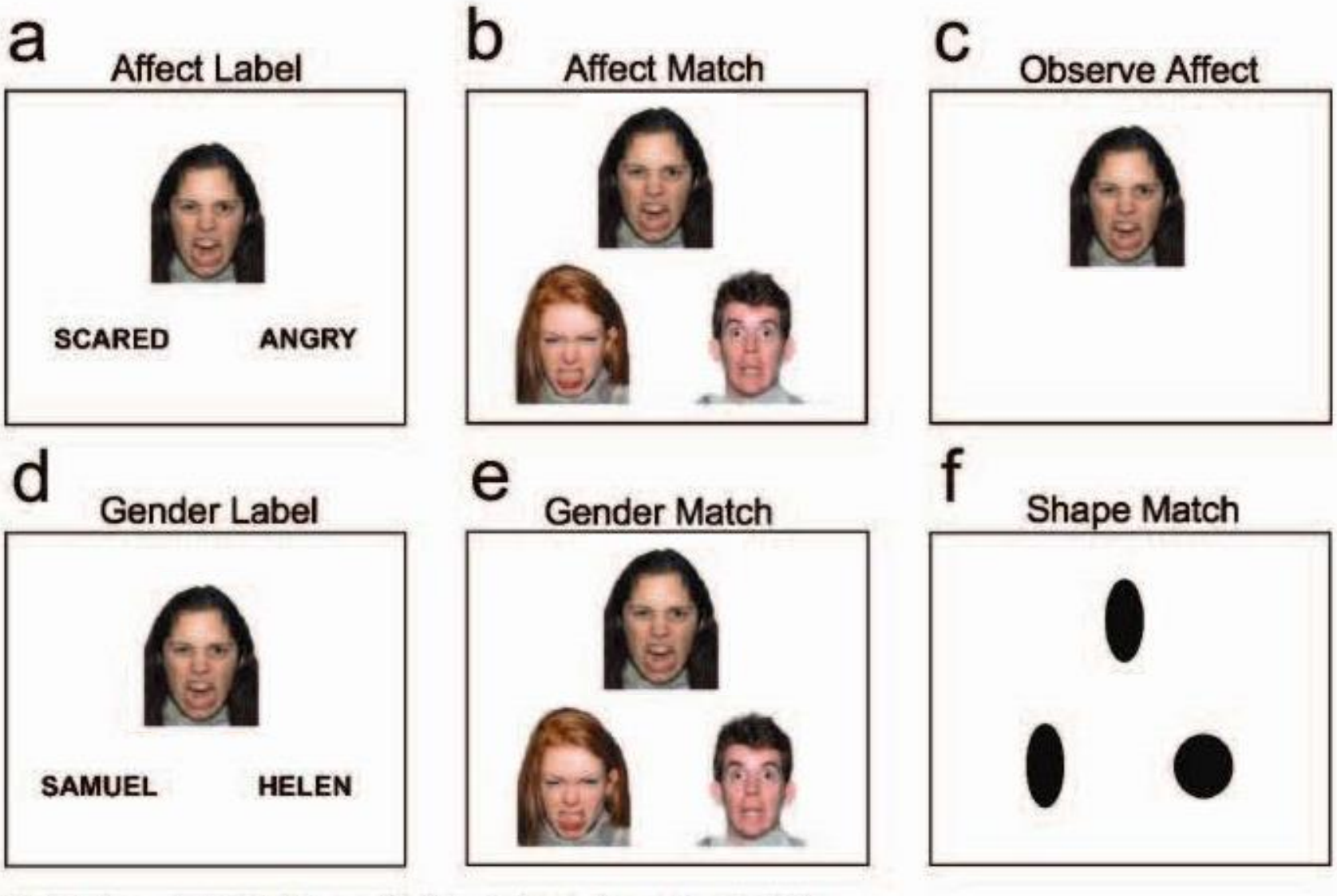
If people to talk or write about their problems, their psycho-logical and physical health improves.

--- James Pennebaker,
Opening Up: The Healing Power of Expressing Emotions

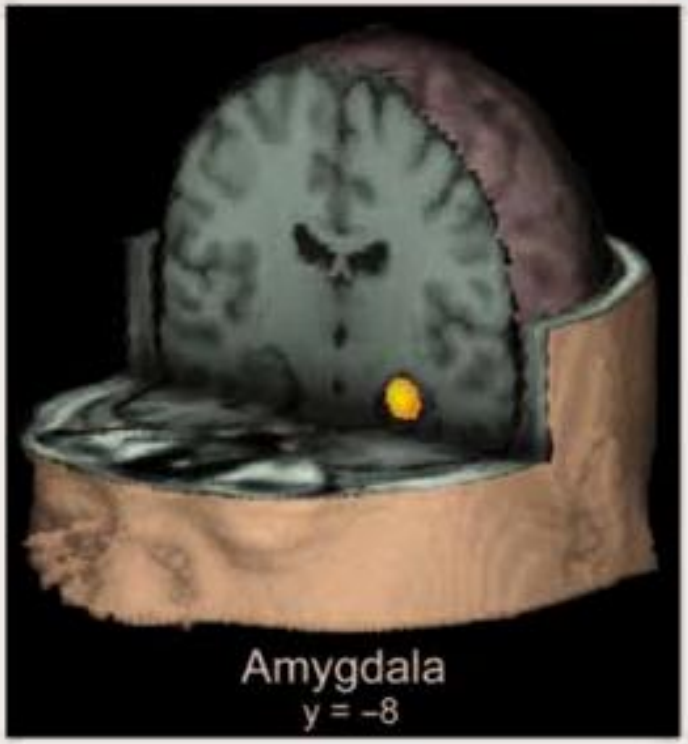
Putting Feelings Into Words Produces Therapeutic Effects on the Brain

When you put feelings into words, you increase activation in prefrontal cortex and that produces a reduced response in the amygdala.


PFC
Amygdala


a
Affect Label
SCARED
ANGRY
b
Affect Match
c
Observe Affect
d
Gender Label
SAMUEL
HELEN
e
Gender Match
f
Shape Match

Amygdala activation went up in ALL conditions when an angry or fearful face was shown, but ONLY in the one condition (a) where subjects had to assign a verbal label to the emotion, did amygdala activation GO DOWN.



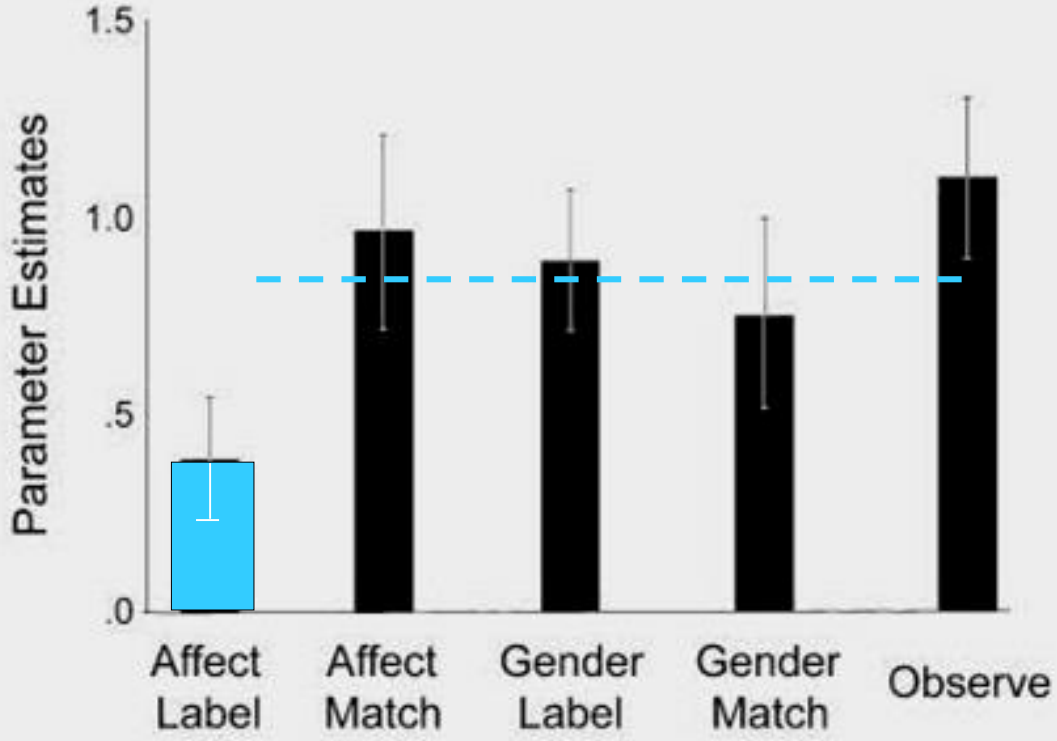
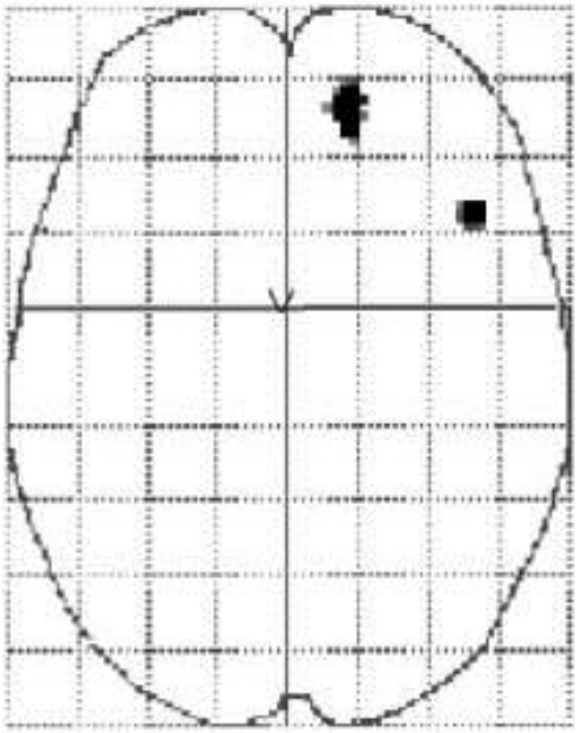


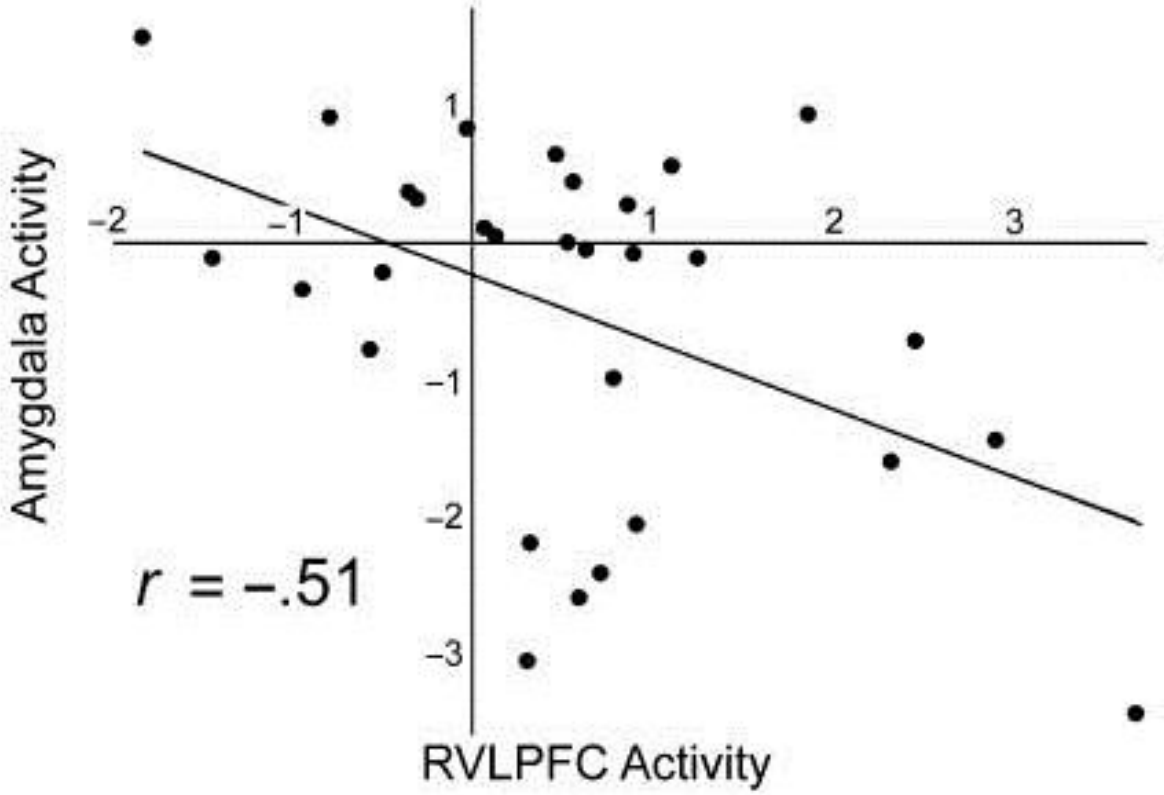
Fig. 2. Parameter estimates of activity during five conditions (relative to activity in the shape-match control condition) in an amygdala region of interest (ROI). The ROI was identified by comparing activity in the observe condition and activity in the shape-match condition. The illustration on the left shows an axial slice indicating the extent of the ROI.

Matt Lieberman et al., 2007

Inverse Relation between Activation in PFC and the Amygdala in the Lieberman et al. study

(When activation in PFC goes up, activation in the amygdala goes down.)





Translating an emotional experience into language, talking or writing about, alters the way it is represented and understood in our mind and our brain (gets prefrontal cortex more involved).

Painful feelings we try to ignore or suppress NEVER go away or subside as long as we keep them buried. The only way they lose their strength is by our confronting them.

Zeigarnik Effect: the mind keeps working on things that aren't complete.

Coming to an understanding allows closure.

Zeigarnik, 1967

Writing forces some degree of structure and organization of one's thoughts. When writing, the thinking process has to slow down.

The act of repeatedly telling about your experience results in both an organization of the event and a summarizing of it. Over days, the description of the event is gradually shortened and summarized.

Constructing stories -- day by day, as you write, the episode takes on shape as a coherent story.

Any type of event is less overwhelming and easier to think about once it is summarized.

Once organized, events are often smaller and easier to deal with.

Experiences that are not fully processed can create unresolved and leftover issues that can easily get triggered in the parent-child relationship.

At these times, we're not acting like the parent we want to be and are often left wondering why parenting sometimes seems to "bring out the worst in us.

Attachment is what we call the love between a baby and a caregiver.

Normally this happens quite naturally because babies are built to especially like the human face, human voice, human pace of walking, etc.
And we adults are built to especially like happy responses from babies.

But this can get off track if the baby is premature, has FASD, etc.

Berry Brazelton - videos

Change your expectations. Give the baby more time to respond. Slow down.

Less excitement. Less exuberant bouncing. Softer tones.

Before the term ‘attachment’ existed,
ERIK ERIKSON called this

BASIC TRUST, which he defined as

- knowing beyond any shadow of a doubt that you are loved
- feeling the world is basically a good, safe, trustworthy place
  - where you’ll be helped if you need it
  - where things make sense and are predictable.

He considered this ‘the cornerstone of a healthy personality.’

The major insight of Mary Main et al. (1985): the direct intergenerational transmission of relationship patterns, while relatively common, is NOT inevitable.

Some parents who experienced abusive or rejecting relationships growing up have children who are securely attached to them.

What distinguished that group of parents, from other parents with similarly unfortunate childhoods whose own children were insecurely attached, was their ability to discuss adverse childhood experiences with emotional openness, coherence, and reflective insight. They seemed to have come to terms with what had happened to them, and had gained an understanding why their parents had behaved as they did.

Inge Bretherton

Outcome of secure vs. insecure attachment:

It's better to be securely attached.

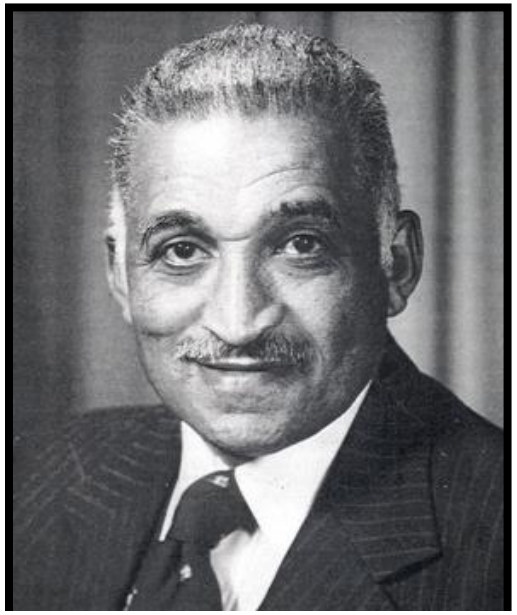
But outcome is AS GOOD for those insecurely attached IF they have organized their attachment experience into a coherent story.

You've never failed until you've tried for the last time, and you've never lost until you quit.

-- Samuel Proctor Massie

Few people have attained the respect, admiration, and degree of excellence achieved by Samuel Massie, born in the segregated South.

Born in Little Rock, Arkansas in 1919, Samuel Massie was the grandson of slaves. In 1966 he became the first African-American professor at the US Naval Academy. He was named 1 of the 6 best college chemistry professors in the US & one of the 75 premier chemists of the 20th century, along with Marie Curie, James Watson, and Francis Crick. In 1995 Dr. Massie's portrait was hung in the National Academy of Science gallery and in 2002 the US Dept. of Energy chose to name its Chairs of Excellence in the environmental sciences in his honour.



It's never over 'til it's over

We are not just intellects,

we have emotions

we have social needs

& we have bodies

Our brains work better when we are not feeling lonely or socially isolated.

Loneliness: Human Nature and the Need for Social Connection
2008
a book by John Cacioppo & William Patrick

This is *particularly* true for PFC & EFs.

Roy Baumeister et al. (2002, *Journal of Personality and Social Psychology*)

- One group of subjects were told beforehand they'd have close relationships throughout their lives;
- another group was told the opposite;
- a third group was told unrelated bad news.

On simple memorization questions, the groups were comparable.

On sections involving logical reasoning (EF), subjects told they'd be lonely performed much worse.

Campbell et al. (2006) found that during math tests there was Prefrontal Cortex worked less efficiently among participants who felt isolated.

We are fundamentally social.

We need to belong.

We need to fit in & be liked.

Children who are lonely or ostracized will have more difficulty learning.

We are not just intellects,

we have emotions

we have social needs

& we have bodies

Our brains work better when our bodies are physically healthy.

Bachen, E. A., Cohen, S., & Marsland, A. L. (2007)

This is *particularly* true for PFC & EFs.

You can’t think clearly when you have a cold.

You need your sleep.

Lack of sleep will produce deficits in EF skills, and cause someone to look as if he or she has an EF impairment, like ADHD.

Our brains work better when our bodies are physically fit.

Nature Reviews Neuroscience (January 2008)

"Be Smart, Exercise Your Heart:
Exercise Effects on Brain and Cognition"

Charles Hillman, Kirk Erickson & Art Kramer

"There is little doubt that leading a sedentary life is bad for our cognitive health."

This is *particularly* true for PFC & EFs.

The brain doesn't recognize the same sharp division between cognitive and motor function that we impose in our thinking.

The SAME or substantially overlapping brain systems subserve BOTH cognitive and motor function.

For example, the pre-Supplementary Motor Area (SMA) is important for sequential tasks,

whether they are sequential motor tasks or

sequential numerical, verbal, or spatial cognitive tasks.

Hanakawa et al., 2002

Science asked me to write a review of all interventions shown to improve EFs in young children

Diamond, A. & Lee, K.

(2011)

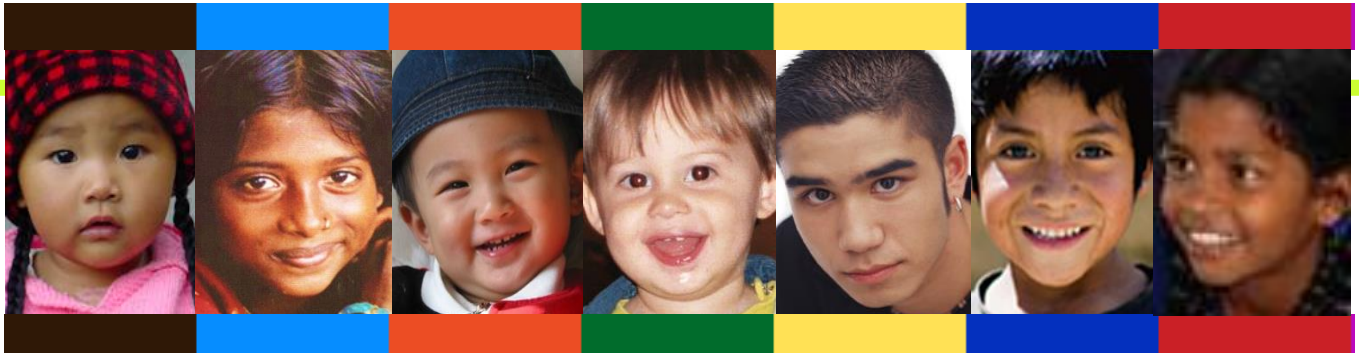
Interventions shown to Aid Executive Function Development in Children 4-12 Years Old

***Science,* vol. 333**

accompanying online tables

Diverse activities including computerized training, games, aerobics, martial arts, yoga, mindfulness, & certain school curricula all have at least a little published evidence that they improve executive functions.

Exercise alone appears not to be as effective in improving EFs as exercise-plus-character-development (traditional martial arts) or exercise-plus-mindful-ness (yoga).



Lakes & Hoyt (2004) randomly assigned children in grades K thru 5 (roughly 5-11 years-old) by homeroom class to Tae-Kwon-Do martial arts (N = 105) or standard physical education (N = 102).

Children who had been assigned to Tae-Kwon-Do training showed greater gains than children in standard phys. ed. on all dimensions of EFs studied (e.g., cognitive [distractible —focused] and affective [quitting —persevering] and emotion regulation). This generalized to multiple contexts and was found on multiple measures. They also improved more on mental math (which requires working memory).

Traditional martial arts emphasize self-control, discipline (inhibitory control), and character development.

In a study with adolescent juvenile delinquents (Trulson, 1986), one group was assigned to traditional Tae-Kwon-Do (emphasizing qualities such as respect, humility, responsibility, perseverance, honor as well as physical conditioning). Another group was assigned to modern martial arts (martial arts as a competitive sport).

Those in traditional Tae-Kwon-Do showed less aggression and anxiety and improved in social ability and self-esteem.

Those in modern martial arts showed *more* juvenile delinquency and aggressiveness, and decreased self-esteem and social ability.

Whether EF gains are seen depends on the **way** an activity is done.

Regardless of the program to improve EFs, a few principles hold.

For example:

1. EF training appears to transfer, but the transfer is not wide. Computerized working memory training improves working memory but not inhibition, speed or intelligence.

Commercial computerized training programs claiming cognitive benefits are making astronomical profits, but beware:

Wide transfer does not occur

(on the rare occasions where it has been found, those findings have not been replicated).

Across intervention approaches & target skills, participants improve on the skills they practice & that transfers to other contexts where those same skills are needed (narrow transfer) -- but people ***only*** improve on what they practice.

To see widespread benefits, diverse skills must be practiced.

Because of that, real world activities such as martial arts & school curricula (that train diverse executive-function abilities) have shown more widespread cognitive benefits than targeted computerized training.

2. EFs need to be continually challenged to see improvements - not just used, but challenged.

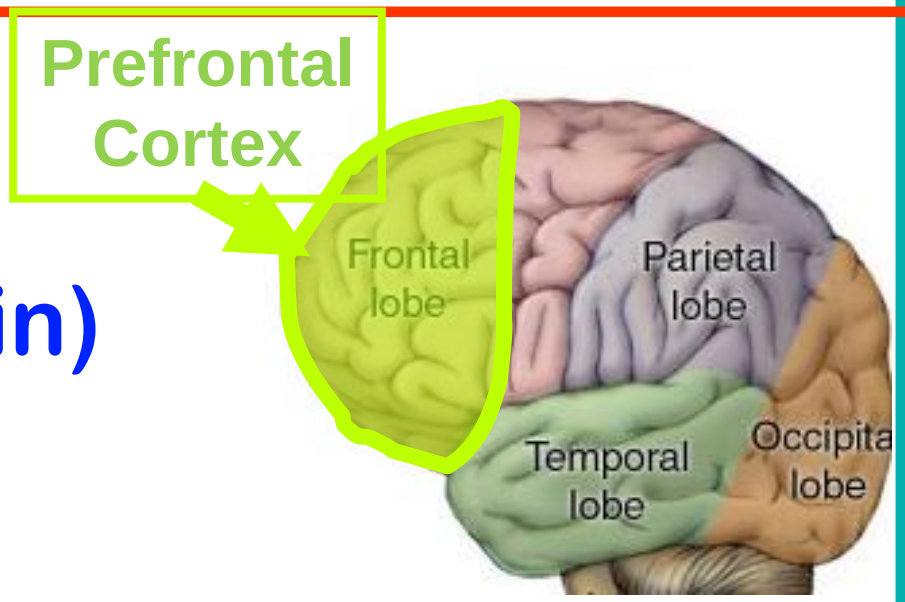
Consistent with: what Ericsson reports is key for being truly excellent at anything -- need to keep trying to master what is just beyond your current level of competence and comfort

(working in what Vygotsky would call the 'zone of proximal development')

The Importance of Repeated Practice

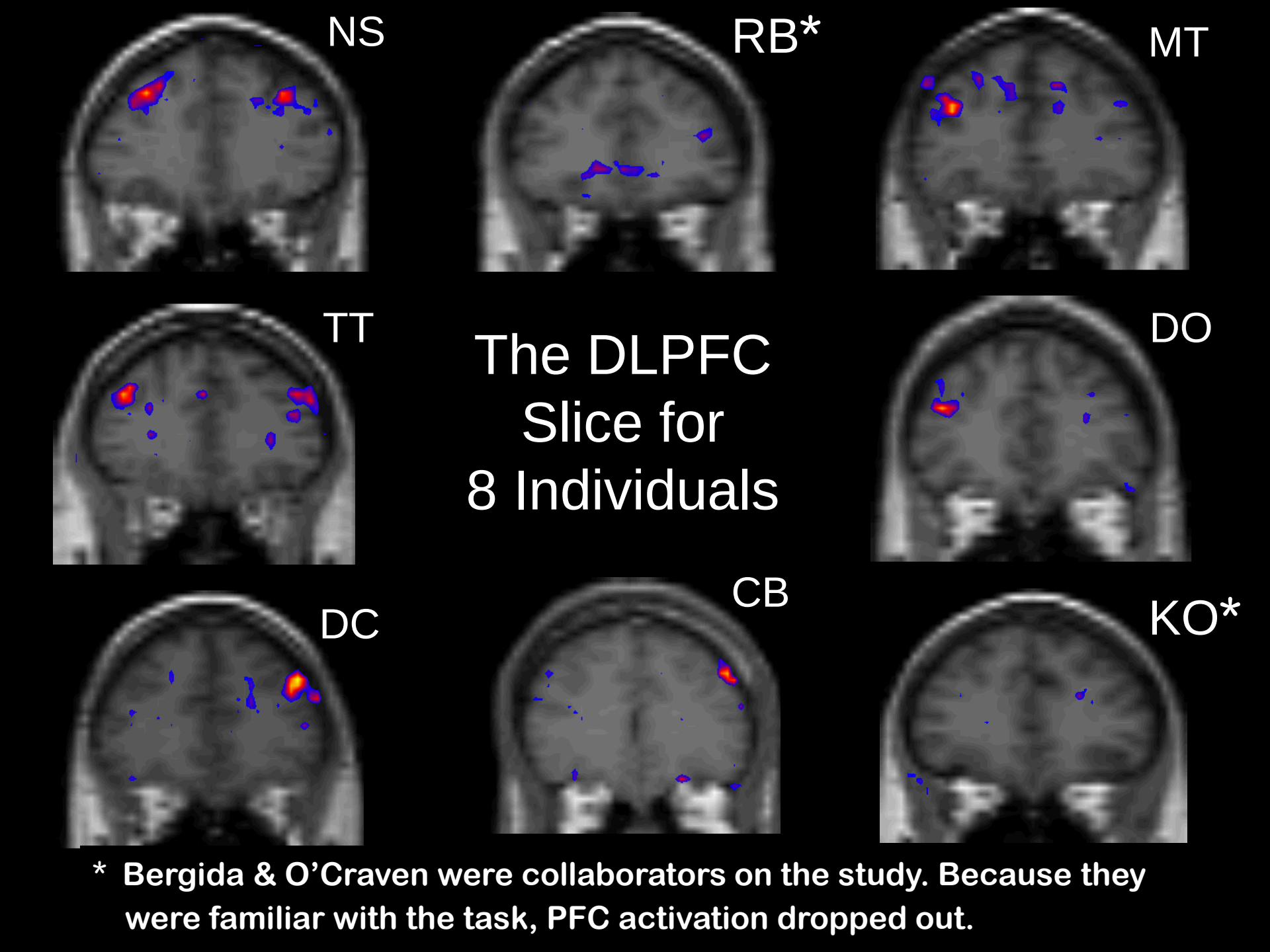
Whether EF gains are seen depends on the amount of time spent practicing, working on these skills, pushing oneself to improve.

Prefrontal cortex (what I specialize in) is over-rated.



To learn something new, we need prefrontal cortex.

But after something is no longer new, those who perform best often recruit prefrontal cortex *least*.



* Bergida & O'Craven were collaborators on the study. Because they were familiar with the task, PFC activation dropped out.

When something is new, those who recruit PFC most, usually perform best.

(Duncan & Owen 2000, Poldrack et al. 2005)

But when you are really good at it, you are NOT using PFC as much.

(Chein & Schneider 2005, Garavan et al. 2000, Landau et al. 2007, Milham et al. 2003, Miller et al. 2003)

Want tasks to become so familiar and well learned that PFC is NOT needed.

Want those tasks to be handed off to older brain regions that have had far longer to perfect their functioning; they can subserve task performance ever so much more efficiently than can PFC.

(re: *Zen and the Art of Archery*)

A child may know intellectually (at the level of PFC) that he should not hit another, but in the heat of the moment if that knowledge has not become automatic (passed on from PFC to older brain regions) the child will hit another (though if asked, he knows he shouldn't do that).

knowing what one should do

vs.

2nd nature (automatic)

(i.e., NOT dependent on PFC)

The only way something becomes automatic (becomes passed off from PFC) is through action, repeated action.

Nothing else will do.

"We are what we repeatedly do.
Excellence, then, is not an act, but a habit.

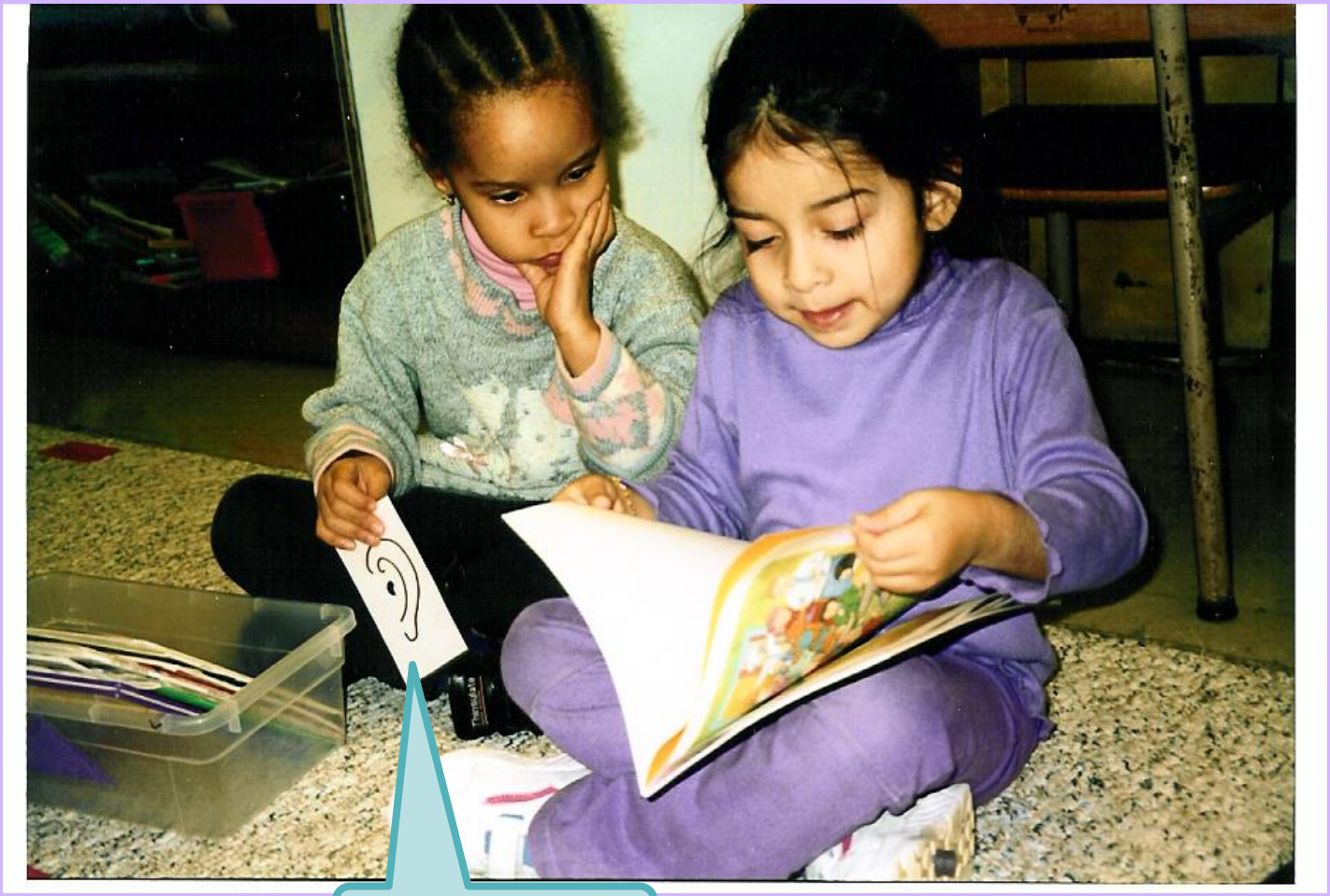
We don't act rightly because we have virtue or excellence, but we rather have these because we have acted rightly; these virtues are formed in a person by doing the actions;
we are what we repeatedly do."

Aristotle, *Ethica Nicomachea*, 4th century BC

How can someone practice a skill he or she is not yet capable of performing on his or her own unaided?

The answer: Scaffolds

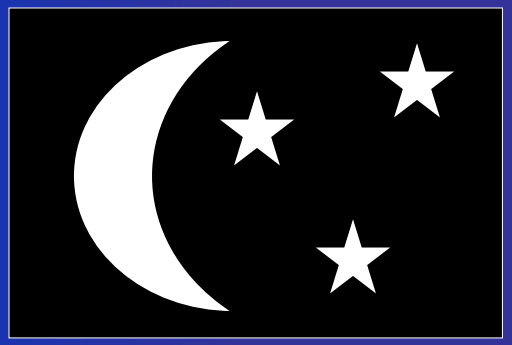
Buddy Reading



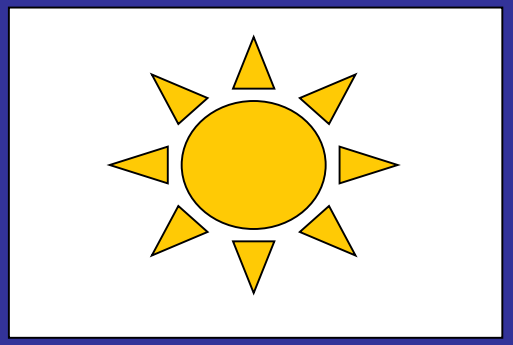
THE DAY-NIGHT TASK

(Gerstadt , Hong, & Diamond, 1994)

Semantically conflicting labels



"Day"



"Night"

Requires holding 2 rules in mind, and inhibiting saying what the images really represent, saying the opposite instead.

DITTY

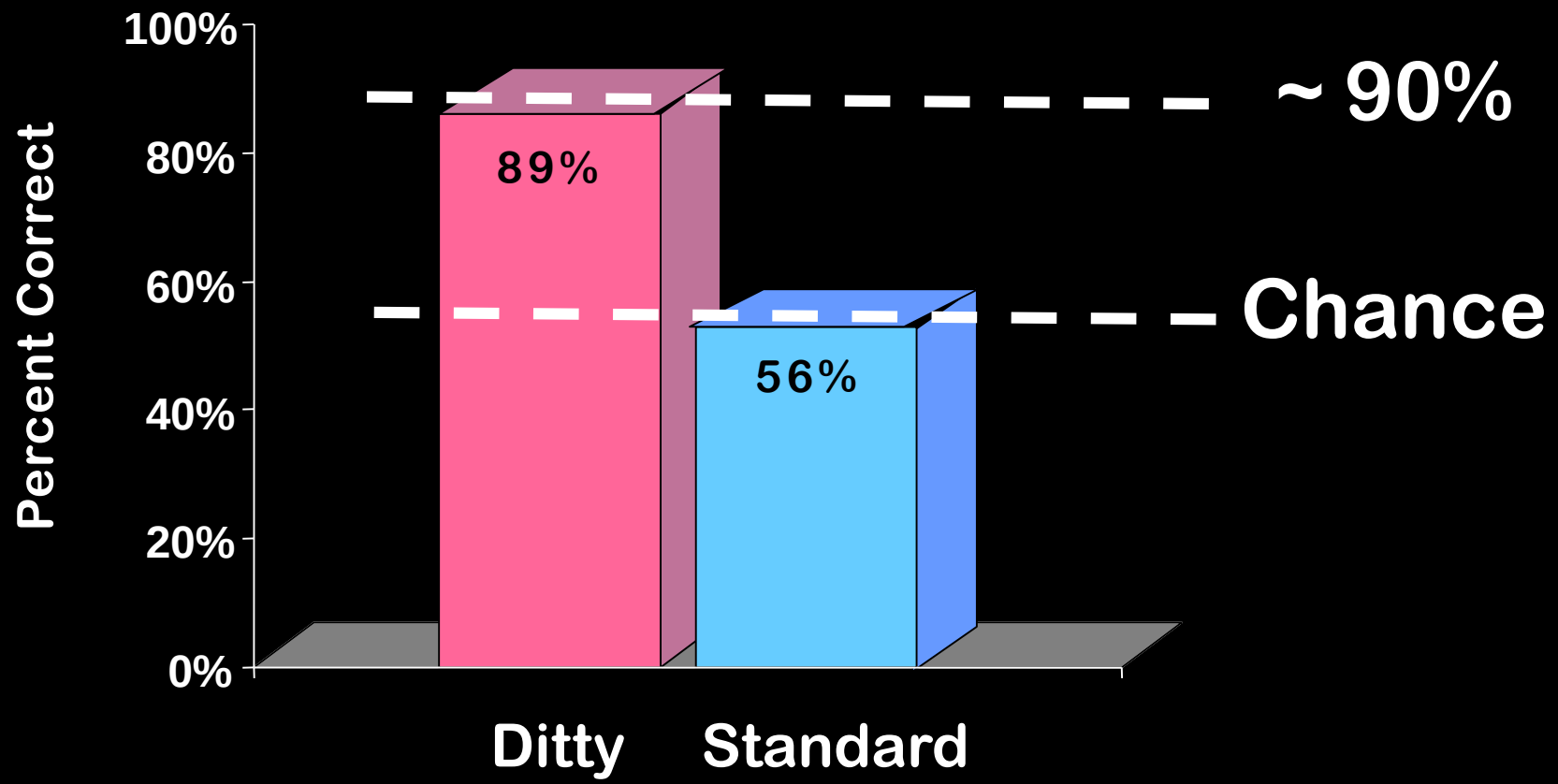
Experimenter sings a little ditty

♫ think about the answer, don't tell me ♫

before the child responds.

Imposes time between presentation of stimulus and response to make children take the time they need to 'compute' the answer

Percentage of Correct Responses by 4-Year-Old Children on the Ditty and Standard Conditions of the Day-Night Task



Most EF tasks assess the ability to exercise EFs, but on Walter Mischel's delay of gratification task those children who succeed usually do so by finding ways to minimize the EF demands (e.g., by looking away or finding something else to do so they are not so tempted to eat the treat).

Much of Baumeister's work finds better self-control outcomes in adults who find ways so that their self-control is not taxed as much.

- Write yourself notes.
- Set your smart phone or watch to beep you before appointments.
- Don’t leave unhealthy foods where you can see them.
- Don’t go food shopping when you are hungry.

I predict that almost any activity can be the way in, can be the means for disciplining the mind and enhancing resilience.

MANY activities not yet studied might well improve EFs.

For 10's of 1,000's of years, across *all* cultures, storytelling, dance, art, & play have been part of the human condition.

People in *all* cultures made music, sang, danced, and played games. There are good reasons why those activities have lasted so long and been found so ubiquitously.

Music-making, singing, dance, and play address our physical, cognitive, emotional, and social needs.

They

- challenge our executive functions,
- make us happy & proud,
- address our social needs, &
- help our bodies develop

The different parts of the human being are fundamentally interrelated.

Each part (cognitive, social, emotional, & physical) probably develops best when no part is neglected.

Diamond, 2000

thank you for your attention

My thanks to the NIH (NIMH, NICHD, & NIDA), which has continuously funded our work since 1986, & to the Spencer Fdn, CFI, NSERC, & IES for recent support our work - and especially to all the members of my lab.

Why are Executive Functions important?

Executive Functions are also critical for job success.

Poor EFs lead to poor productivity and difficulty finding and keeping a job (Prince et al. 2007).

Executive Functions are also important for marital harmony.

People with poor EFs are more difficult to get along with, less dependable, and more likely to act on impulse (Eakin et al. 2004).

Executive Functions are also important for making and keeping friends, for being accepted by other children.

Children with poor EFs often respond impulsively, have trouble resisting urges, & are forgetful; they don't wait their turn, forget the rules that all agreed to, etc.

Poor EFs cause social problems such as disinhibited or criminal behavior.

The incidence of social problems reflecting poor EFs (crime, incarceration, and being unemployable) is increasing dramatically and the cost is staggering (Atkinson et al. 2005).

Poor EFs can also lead to poor physical health including obesity, over-eating, poor food choices, substance abuse, & poor sustained adherence to doctors' orders (Crescioni et al. 2011; McAuley 2011; Riggs et al. 2010).

In a large sample of >14,000, Miller et al. (2011) found that youths with poorer self-control were "exponentially more likely" to suffer from 9 of the 10 adverse health conditions they examined.

In short, EFs are core skills

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