

# What Executive Functions are, why They're Important, and Ways to Improve them in Young Children



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**What abilities and skills  
will be needed for  
success in the 21st  
century?**

# 1) Self-control

to resist temptations and not act impulsively

- thinking before you speak or act so you don't do something you'd regret or put your foot in your mouth
- to wait before making up your mind; not jumping to a conclusion or to an interpretation of what something meant or why it was done
- resist grabbing another child's toy
- resist 'tit for tat' (hurting someone because that person hurt you)

## 2) Discipline & Perseverance

Having the discipline to stay on task and complete it

- resisting the temptation to quit because you're frustrated, bored, or more fun things are calling
- continuing to work even though the reward may be a long time in coming

### 3) Creativity in seeing connections between seemingly unconnected ideas or facts.

Playing with information and ideas in your mind, relating one to another, then disassembling those combinations and recombining the elements in new ways.

**Working memory** involves holding information in mind and working with it.

## 4) Creativity in seeing familiar things in new ways / from different perspectives

If one way of solving a problem isn't working, can we conceive of the problem in a different way?

Can we think outside the box to come up with a different way of attacking the problem?



## 5) Flexibility

- Having the flexibility to take advantage of serendipity
- ...to navigate around unforeseen obstacles, and
- ...to admit you were wrong when you get more 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**



**“Executive Functions”**  
is shorthand for  
all of the abilities  
I just mentioned.



# 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

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.



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## Executive Functions

are important for every aspect of life –  
success in school and in the workplace,  
making & keeping friends,  
marital harmony, and avoiding things like  
unplanned pregnancy, substance abuse, or  
driving fatalities.

In other words, self-control, creativity,  
reasoning, mental flexibility, discipline and  
perseverance are really important – they are  
often more predictive than IQ.

**Executive functions predict  
academic performance in the  
earliest elementary grades thru  
university better than does IQ.**

(Alloway & Alloway, 2010; Bull & Scerif, 2001;  
Dumontheil & Klingberg, 2012; Gathercole et al., 2004;  
McClelland & Cameron, 2011; Nicholson, 2007;  
Passolunghi et al., 2007; St Clair-Thompson &  
Gathercole, 2006; Savage et al., 2006; Swanson, 2014).

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.”



**If we want children to do  
well in school & in life, we  
need to help them develop  
healthy exec. functions.**

**The good news is that  
Executive Functions  
can be improved.**



In fact, many different activities have been shown to improve EFs, including...

computerized training,

games,

aerobics,

traditional martial arts,

yoga,

mindfulness, &

certain school curricula (like Tools of the Mind, Montessori, and PATHS).

*Nature Reviews Neuroscience* (January 2008)

“Be Smart, Exercise Your Heart:  
Exercise Effects on Brain and Cognition”  
Charles Hillman, Kirk Erickson & Art Kramer

The evidence shows that physical activity (especially aerobic exercise) robustly improves cognition and brain function.

In particular, the frontal lobe and the executive functions that depend on it show the largest benefit from improved fitness.

The positive effects of aerobic physical activity on cognition and brain function are evident at the molecular, cellular, systems, and behavioral level.

Exercise without a social or cognitive component (e.g., riding a stationary bike) improves recognition and recall memory, but it is not clear that it improves EFs.

Exercise alone appears not to be as effective in improving EFs as exercise-plus-character-development (traditional martial arts) or exercise-plus-mindfulness (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 assigned to Tae-Kwon-Do showed greater gains than children in standard phys. ed. on all dimensions of EFs studied (e.g., cognitive [focused vs. distractible] and affective [persevere vs. quit] and emotion regulation). This generalized to multiple contexts and was found on multiple measures.



**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 respect, humility, responsibility, perseverance, honor as well as physical conditioning). Another group was assigned to modern martial arts (martial arts simply as a competitive, physical activity.)

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.



To the extent that exercise  
alone improves EFs, that  
might be due to...

...exercise improving the  
quantity &/or quality of sleep  
&/or

...exercise improving mood

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



**1. Those with initially poorest EFs  
gain the most.**

**e.g., lower-income, lower WM  
span, or ADHD children**

**consistently show the most EF  
improvement from any program**

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**Children at-risk start school with worse EFs than more economically advantaged children and fall progressively farther behind each school year**

(O'Shaughnessy et al. 2003).





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**Small differences at the beginning can lead to bigger and bigger differences over time.**





Why?

# Feedback Loops



**Consider negative feedback loops beginning with poor initial EFs:**

Poor EFs lead to problems paying attention in class, completing assignments, and inhibiting impulsive behaviors.

School is less fun...

the teacher is always getting annoyed with you  
& compliance w/ school demands is very hard.

Teachers come to **expect** poor self-regulation and poor work, and the children come to **expect** themselves to be poor students.

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On the other hand, children who have better EFs are likely to be praised for good behavior, enjoy school more and want to spend more time at their lessons. Their teachers **expect** them to do well and the children come to **expect** they'll succeed -- a self-reinforcing positive feedback loop is created.

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No wonder children at-risk fall progressively farther behind other children over the school years.

That widening achievement gap may result from 2 feedback loops going in opposite directions.



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Improving EFs early  
might nip that in the  
bud.



Thus early EF training might be an excellent candidate for **reducing inequality** (because it should improve the EFs of the most needy children most) -- thus **heading off gaps in achievement and health between more- and less-advantaged children.**

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2. EF training appears to transfer,  
but the transfer is **not wide**.

**For ex.,** computerized working  
memory training improves  
working memory **but not self-  
control, creativity, or flexibility.**

Commercial computerized training programs are claiming widespread cognitive benefits but beware:

**Wide transfer does not occur**

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

People improve on the skills they practice & that transfers to other contexts where those same skills are needed -- but people only improve on what they practice – improvement does not transfer to other skills.

To see widespread benefits, diverse skills must be practiced.

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

**3. 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')



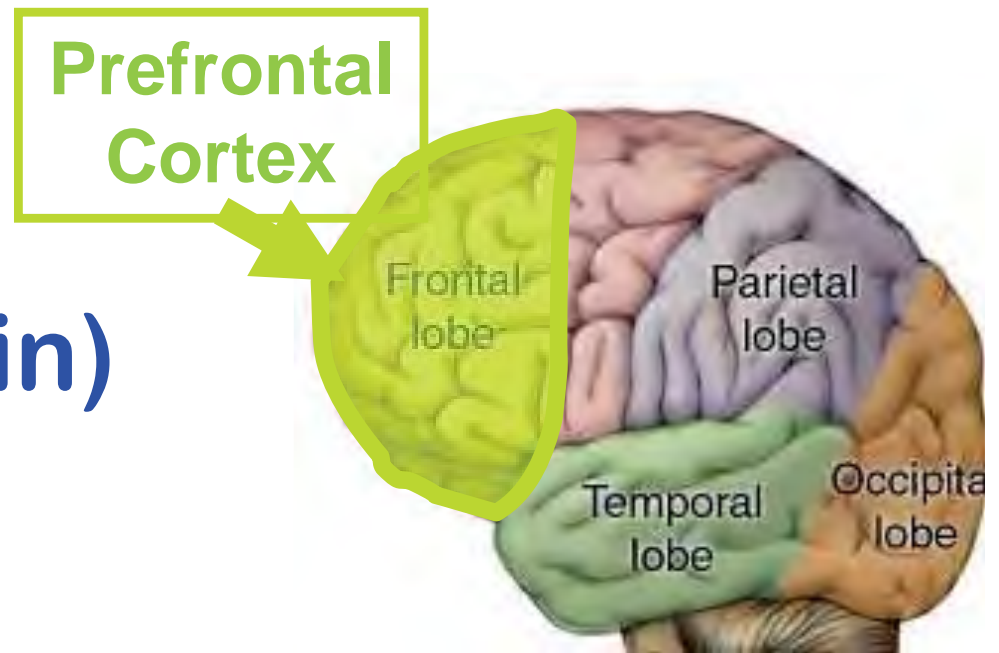
# **The Importance of Repeated Practice**

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

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

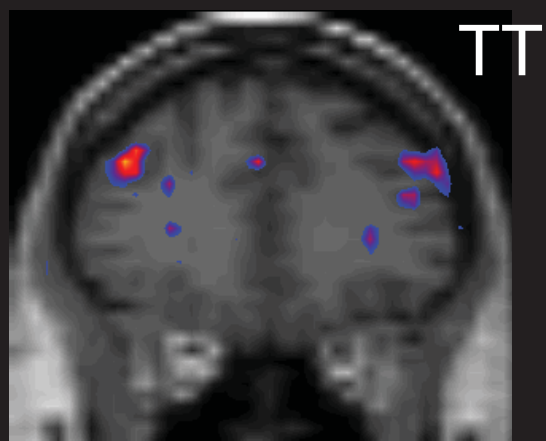
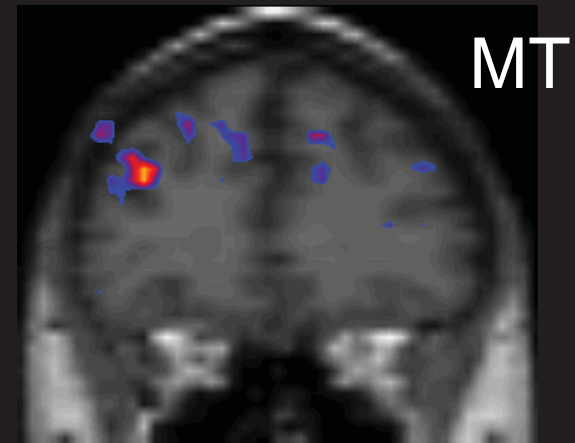
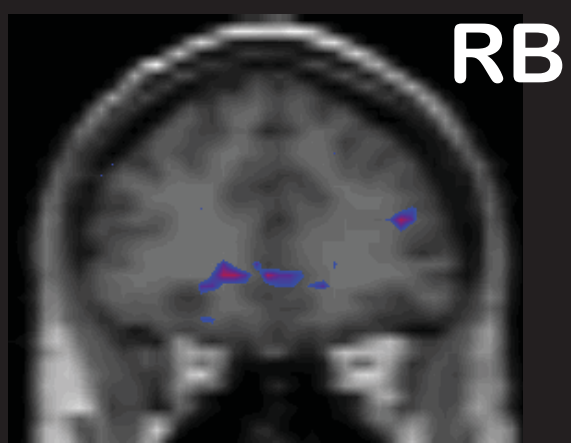
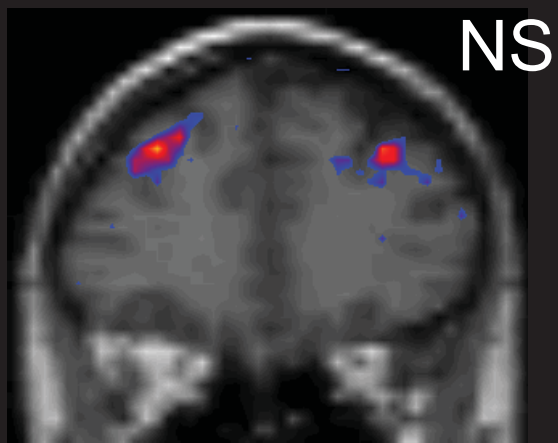


Prefrontal cortex  
(what I specialize in)  
is over-rated.

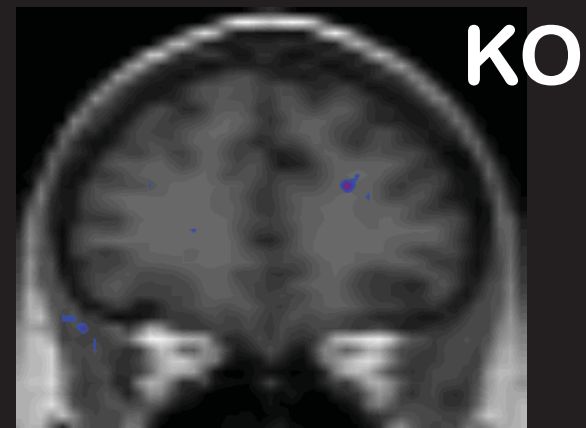
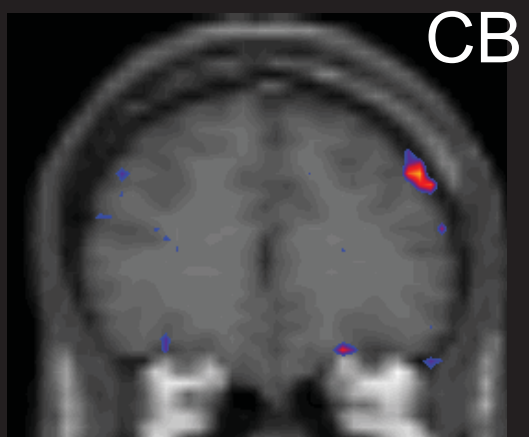
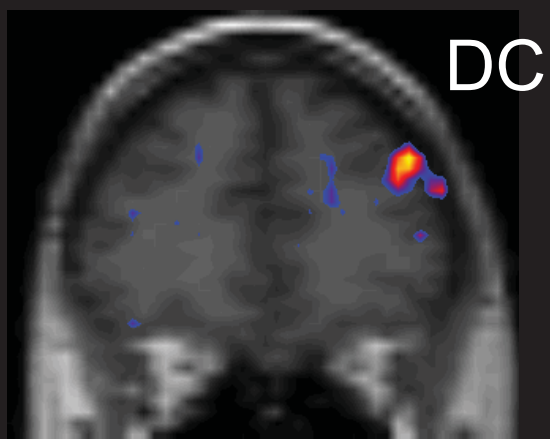
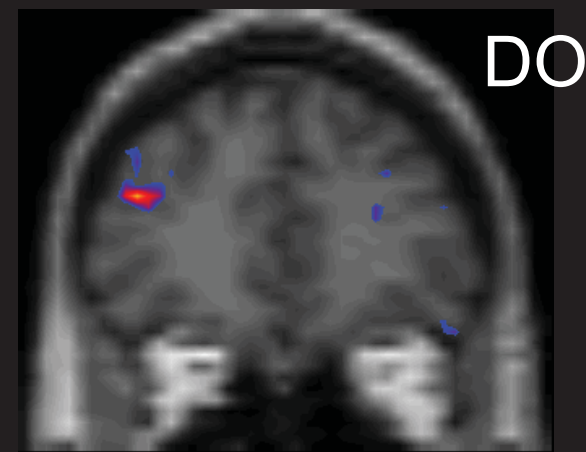


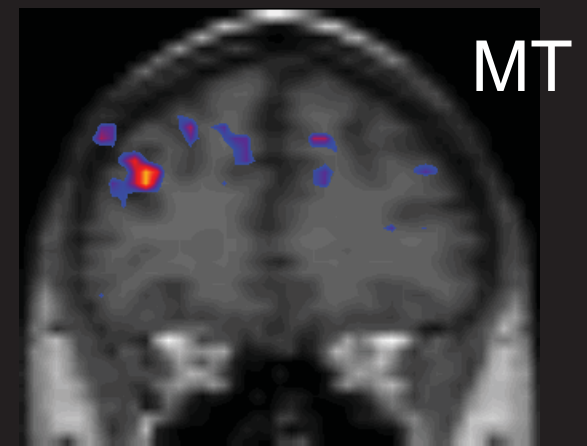
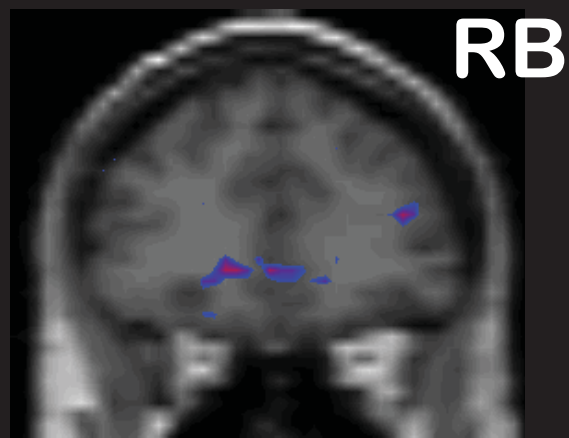
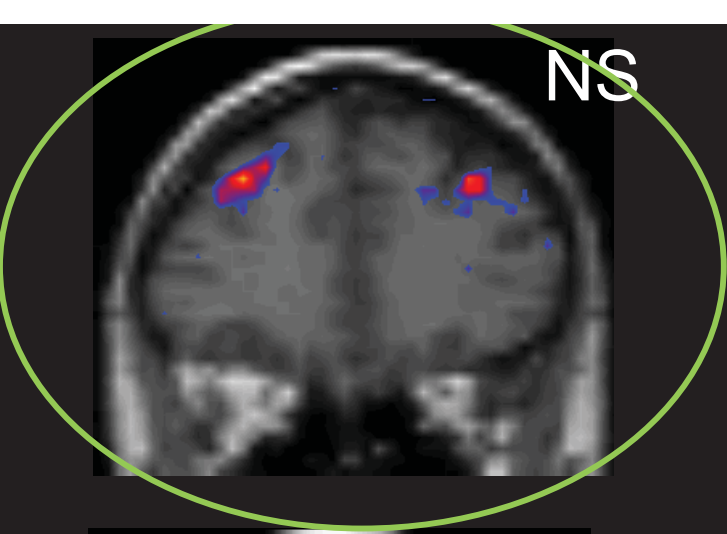
To learn something **new**, we **need**  
prefrontal cortex.

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

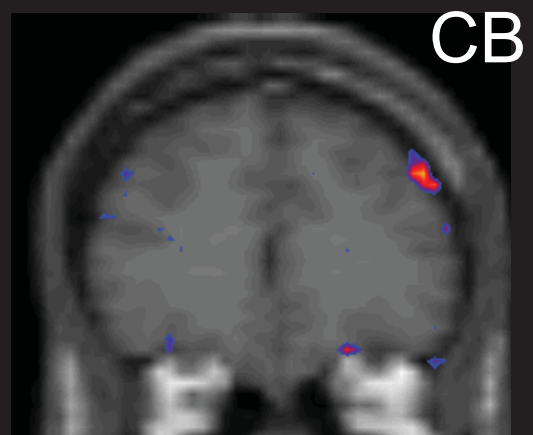
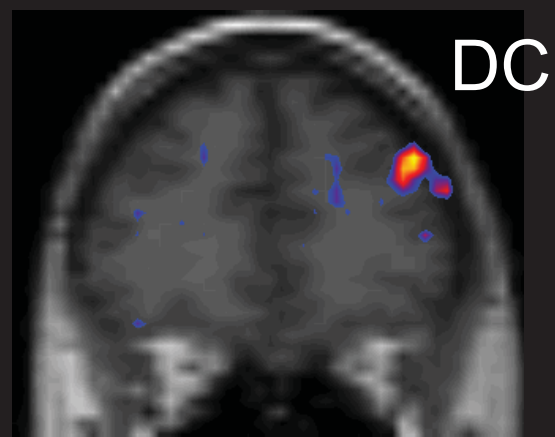
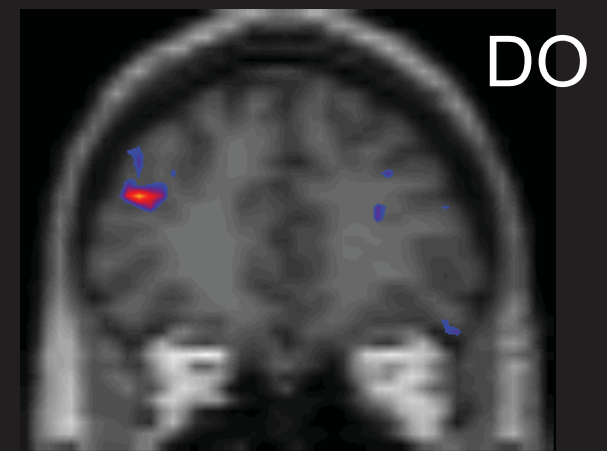


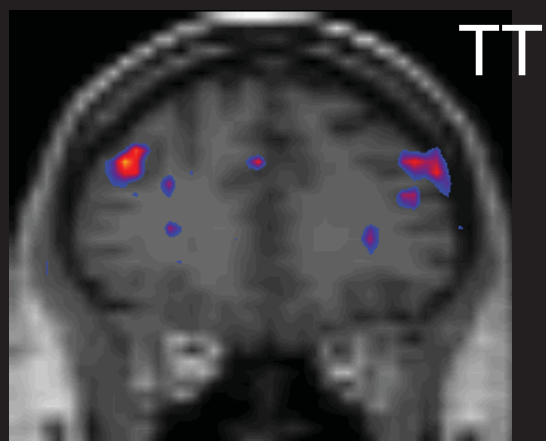
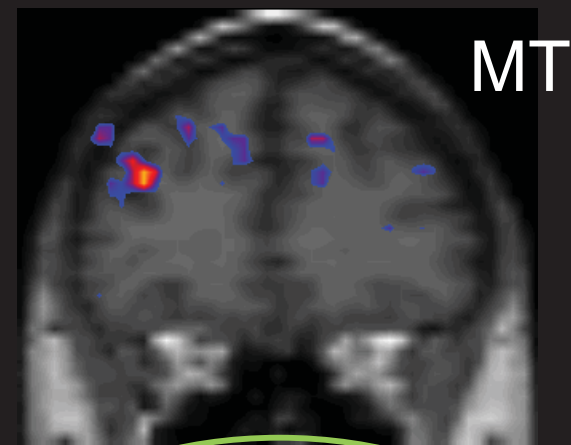
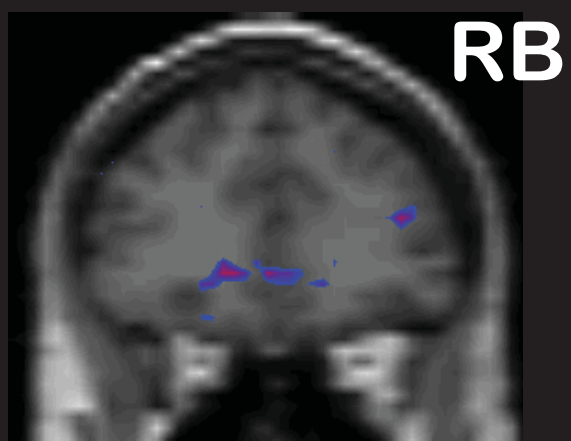
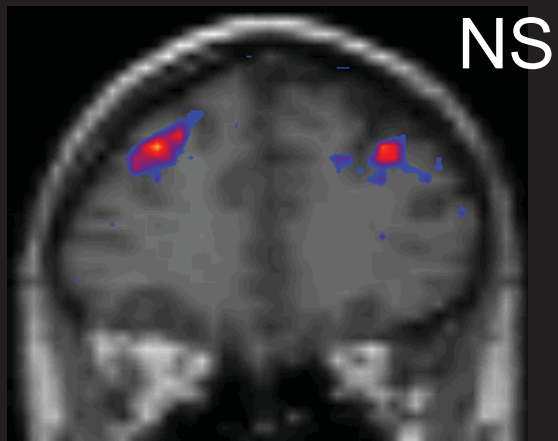
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8 Individuals



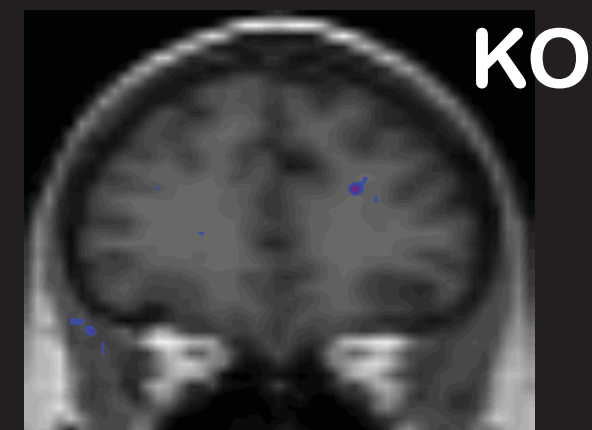
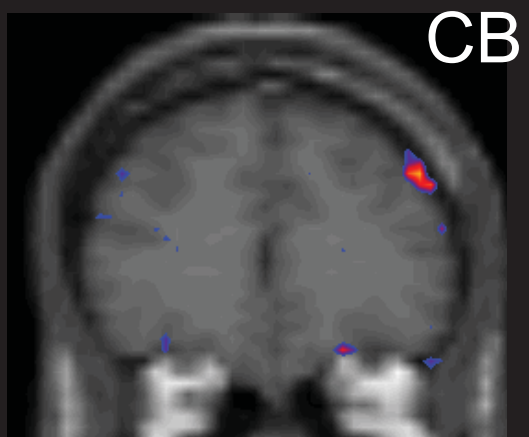
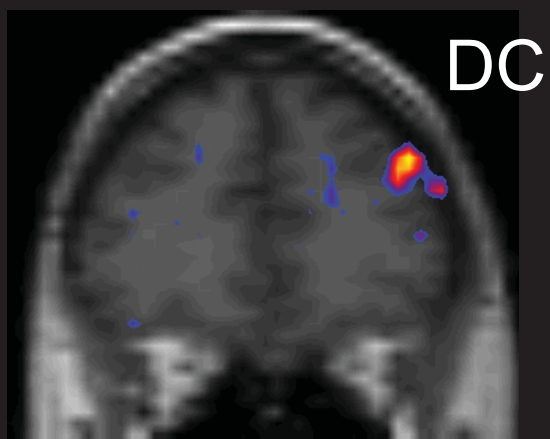
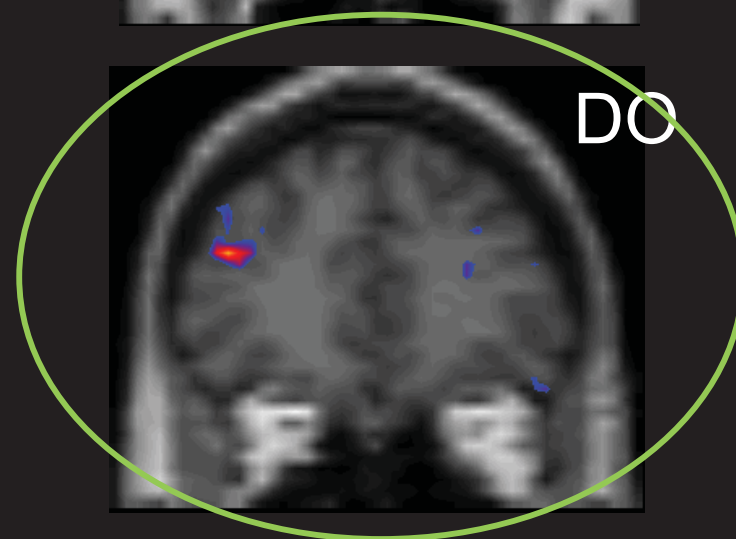


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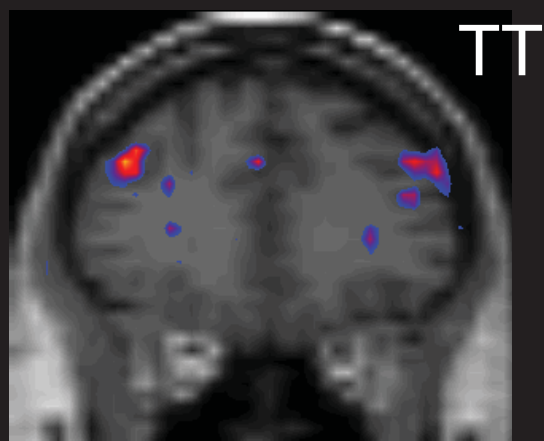
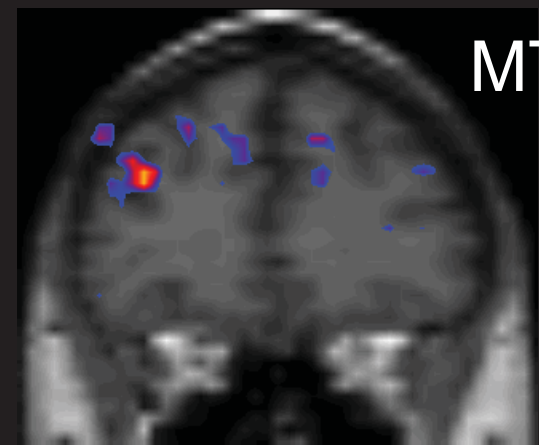
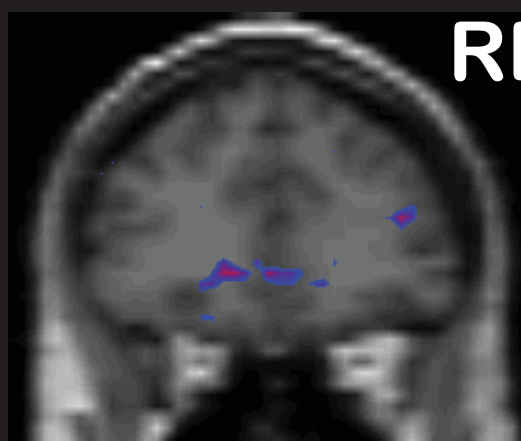
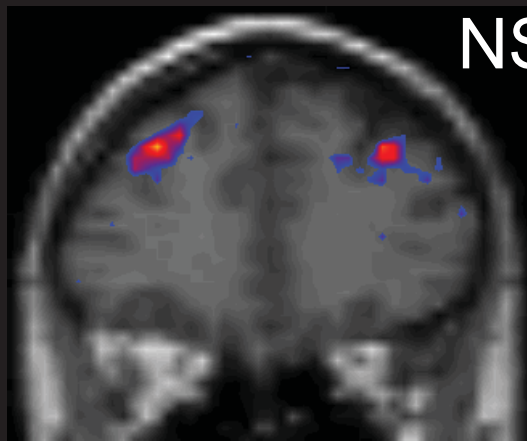




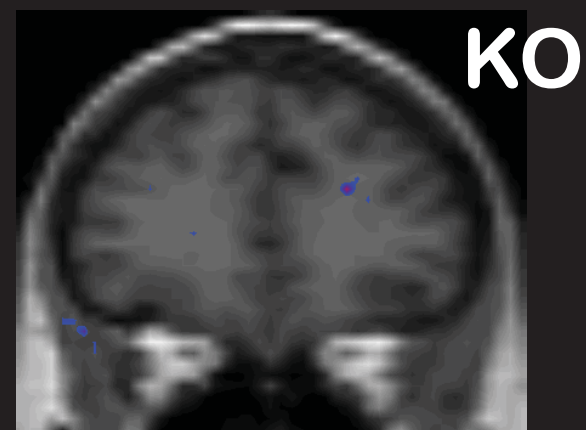
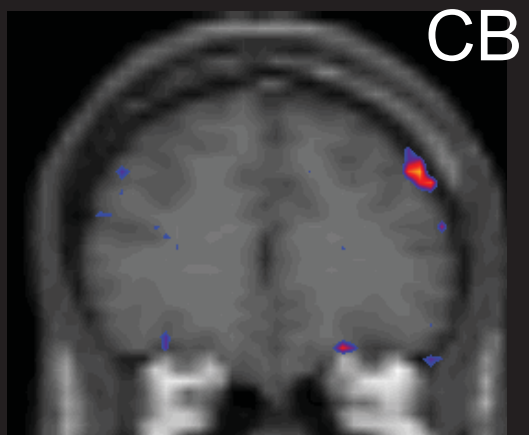
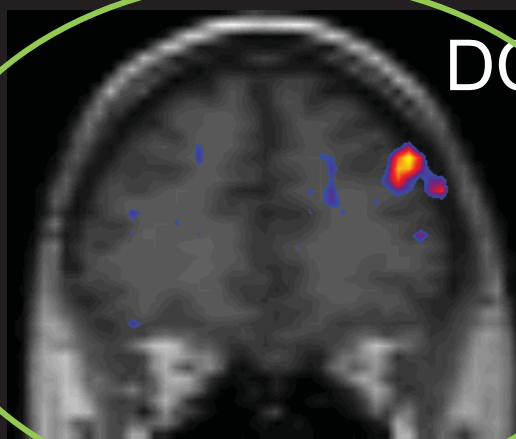
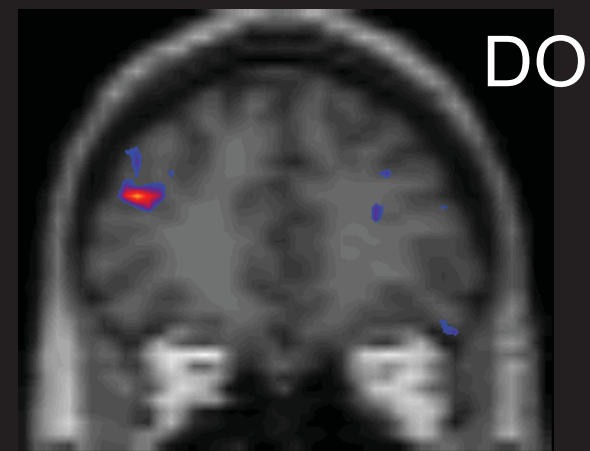
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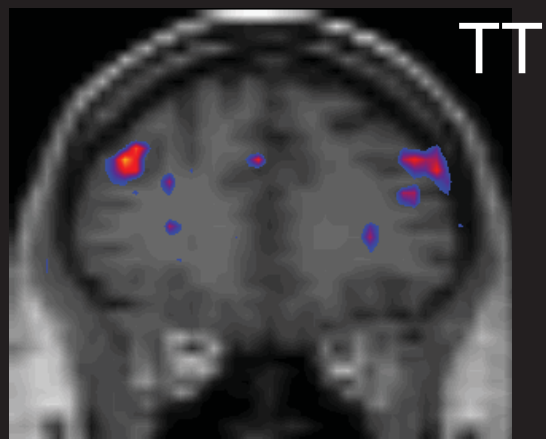
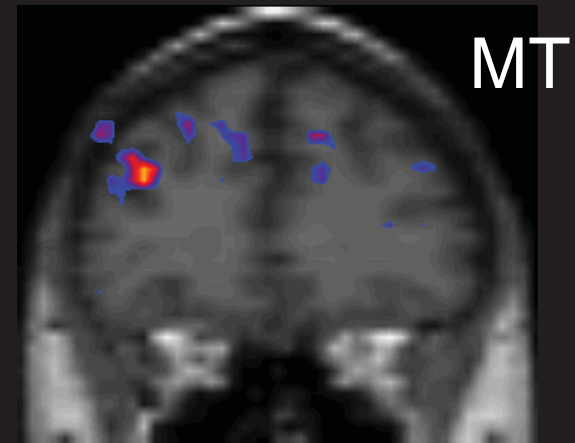
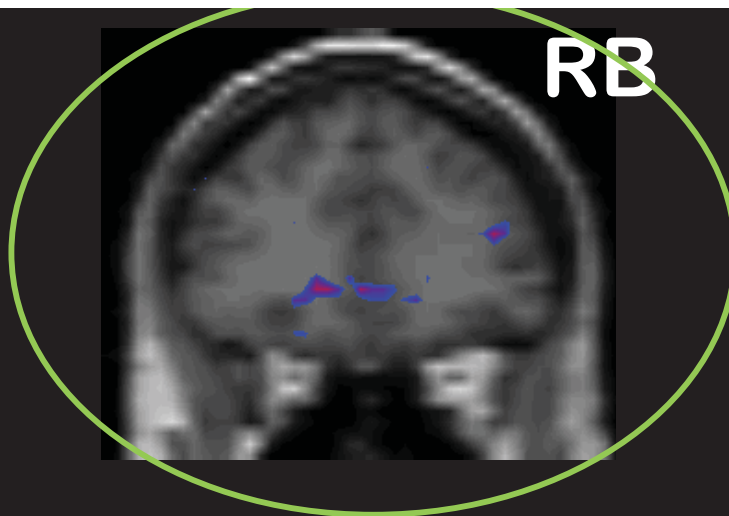
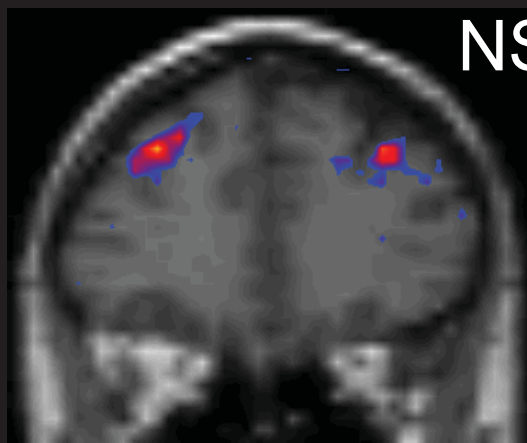




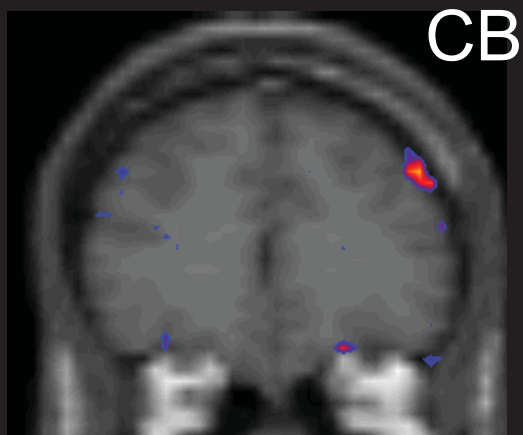
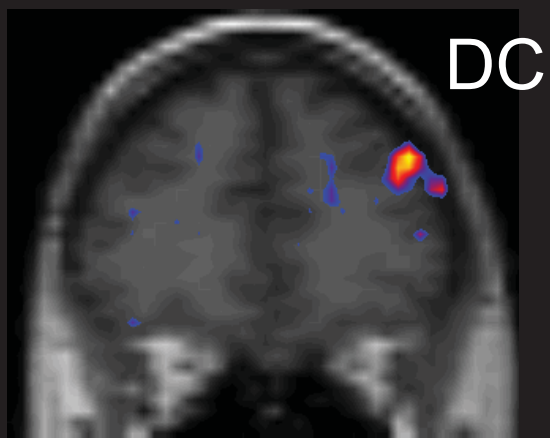
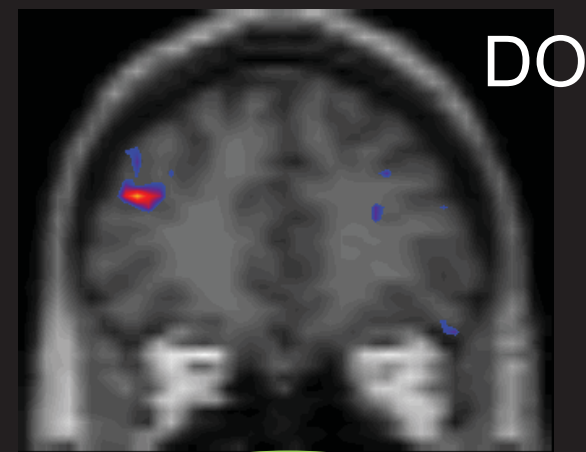


The DLPFC  
Slice for  
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The DLPFC  
Slice for  
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**When something is new, those who recruit PFC most, usually perform best.**

**(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)**

Older brain regions have had far longer to perfect their functioning; they can subserve task performance ever so much more efficiently than can prefrontal cortex (PFC).

A child may know intellectually (at the level of PFC) that he shouldn't hit another, **but in the heat of the moment if that knowledge has not become automatic (passed on from PFC to subcortical regions) the child 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?

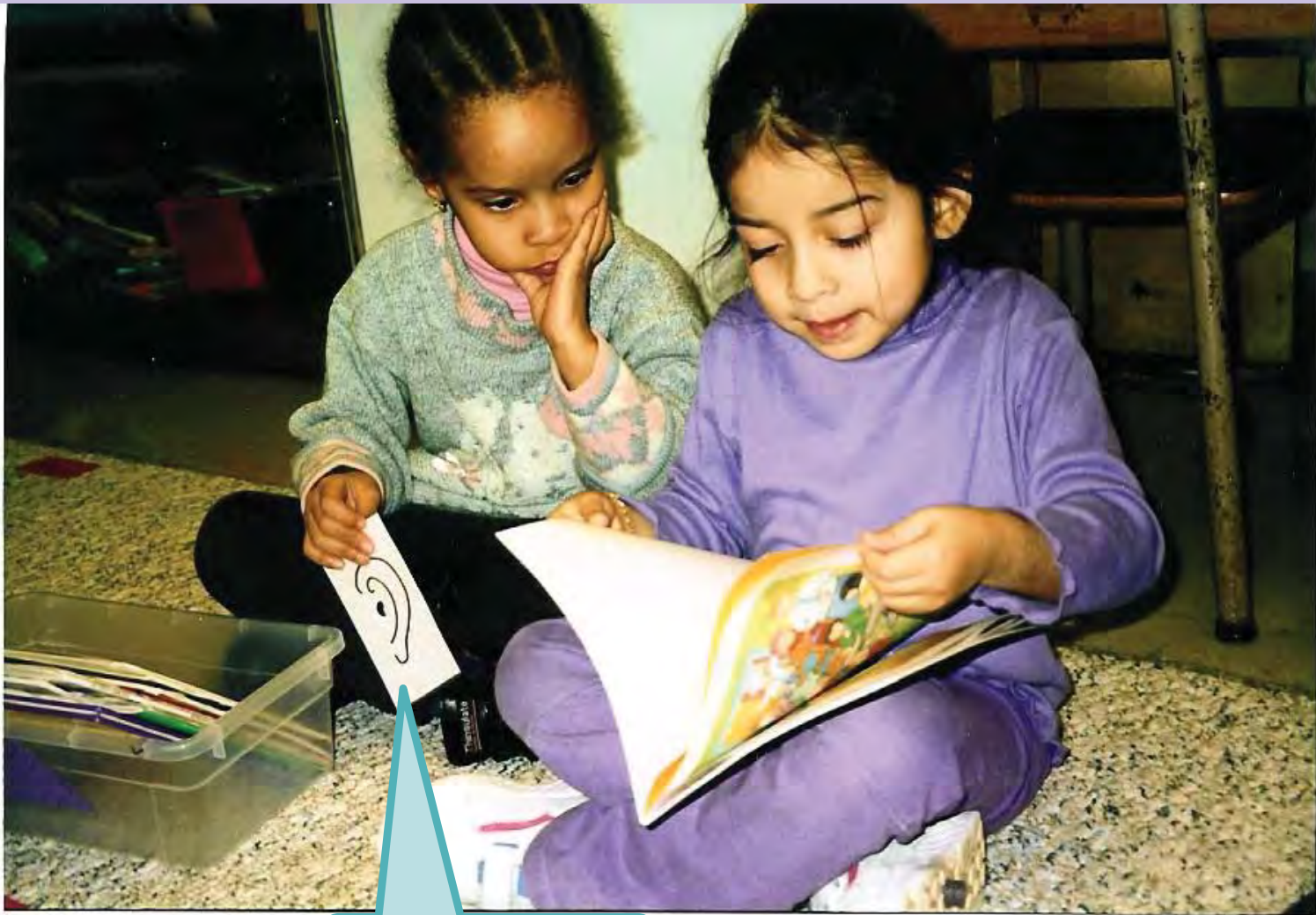
**The answer: Scaffolds**







# Buddy Reading



a scaffold

When their rudimentary EFs are working well **and are scaffolded**, children can work in small groups, pairs, or alone without constant supervision.











# The Importance of ...Action for Learning ...Learn through Doing at any age, but especially for young children



# Hands-on Learning

We evolved to be able to learn to help us act, to help us do what we needed to do.

If information is not relevant for action, we don't pay attention in the same way (hence the difference in route memory for the **driver**, versus the **passenger**, of a car).

You learn something when you **NEED** it for something you want to **DO**.

**(My son teaching me to program  
the VCR)**

**The same is true when we teach  
children in school. They need  
opportunities to concretely  
apply what they are taught.**



**We all know this, so why is so much of schooling still didactic instruction by the teacher, rather than active and hands on?**



When you have hands-on learning,  
when children are able to work on  
their own or in pairs or small groups  
then teachers can then give each  
child individual attention:

to observe, to listen, & to teach  
(provide individual instruction)

And each child can progress at his  
or her own pace.

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The teacher then acts as a scientist,  
testing out hypotheses about

- why is a particular child having difficulty?
- what kind of assistance might be most helpful to that child?
- are any children ready for new challenges?

That's not easy. It is at least as demanding as my scientific work.

It takes training.

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**Training** in Careful Observation,  
**Training** in Generating  
Hypotheses,  
**Training** in Creatively coming up  
with just the Right Touch at the  
Right Time  
**Takes Time.**



But **anyone** can be trained.

The Director of the International Montessori Assoc. has been working in a **Displaced Persons Camp in Kenya**, training the mothers to be the Montessori teachers for their children.

These women were illiterate.

They had no fancy materials. They were taught to make all the teaching materials from scratch from what they could find in the camp.





















In a recent analysis of student  
outcomes worldwide,  
the two countries that  
came out on top were  
Finland & South Korea,  
& that's consistent with what  
other research has also shown



## What do Finland and South Korea have in common?

Not much, but in both countries...

- The standards for getting into teacher training at univ. are extremely high.
- The respect for teachers is enormous.
- Teachers are paid extremely well.

Think about it –

To get the best student outcomes...

We, as a society, need to markedly increase our respect for, and compensation of, teachers - especially presch. & K teachers.

And we need to attract the best and brightest to go into teaching.

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.**



I predict that the activities that will *most successfully* improve EFs will not only work on training and improving EFs but will also *indirectly support* EFs by lessening things that impair EFs and enhancing things that support EFs.

**What things impair  
and what things  
support EFs?**



**PFC is the newest  
area of the brain and  
the most vulnerable**

If you're

- sad or stressed
- lonely
- sleep-deprived, or
- not physically fit

PFC & EFs are the first to suffer,  
& suffer THE MOST.

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

Amy Arnsten, 1998  
The biology of being frazzled  
*Science*

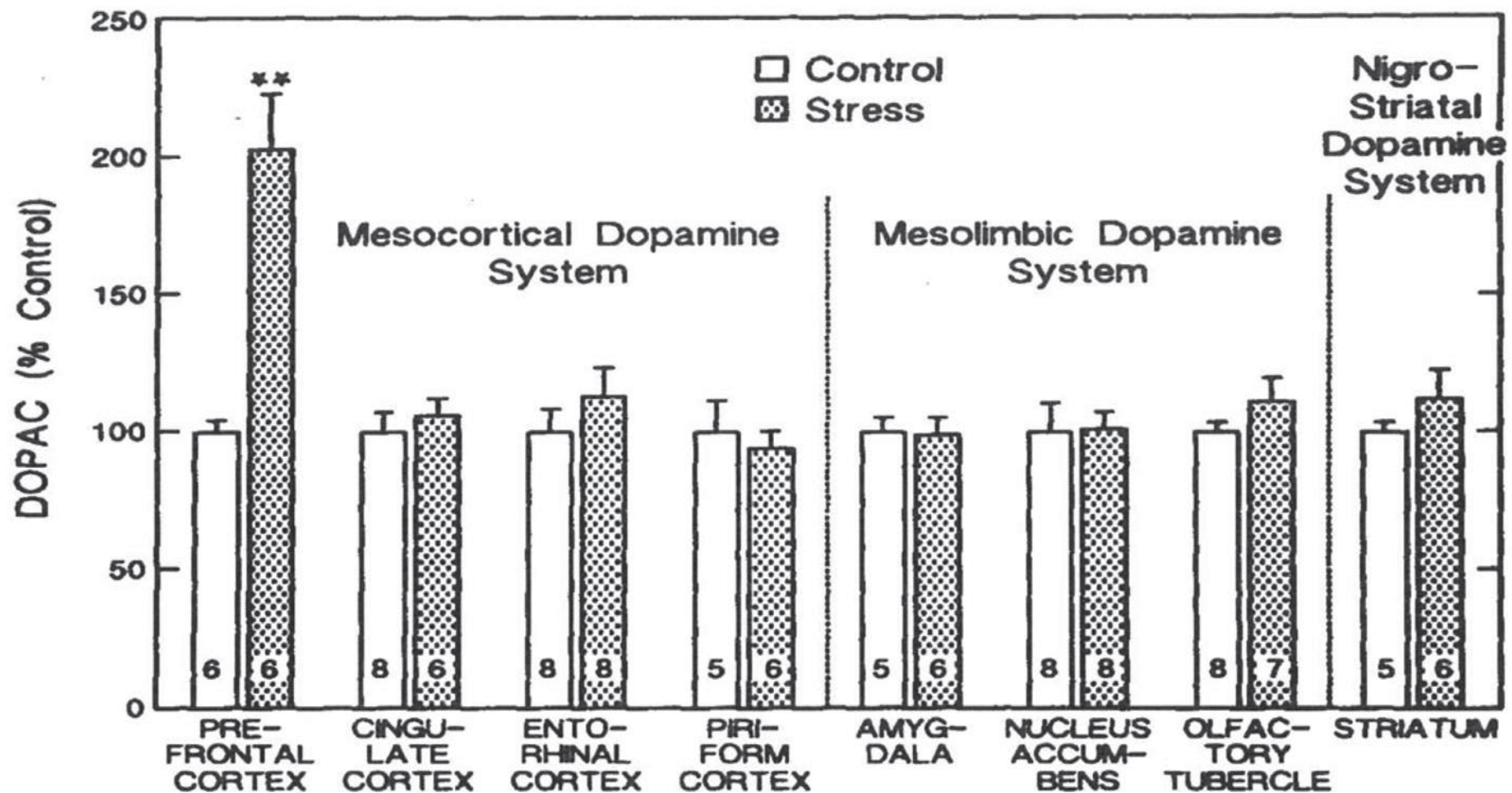
This is *particularly* true for PFC & EFs.



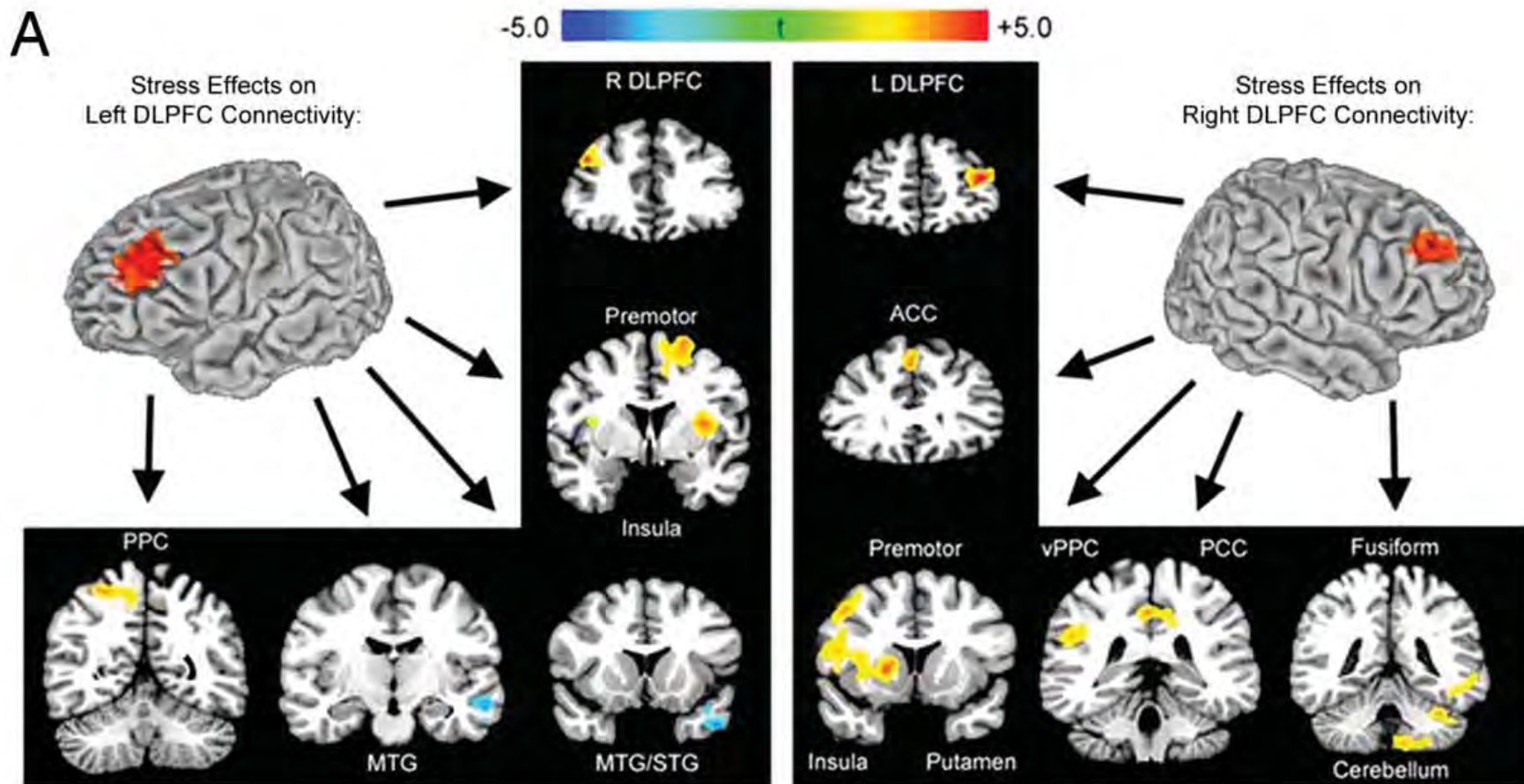
**Stress impairs Executive Functions** and can cause anyone to look as if he or she has an EF impairment (like ADHD) when that's not the case. (You may have noticed that when stressed you cannot think as clearly or exercise as good self-control.)

# Stress and Prefrontal Cortex

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



(Roth et al., 1988)



In college students, one month of stress in preparation for a major exam disrupts prefrontal cortex functional connectivity.

Stress decreases coupling between left DL-PFC and right DL-PFC, and between DL-PFC and premotor cortex, the ACC, the insula, posterior parietal cortex (PPC), and the cerebellum.

**Liston et al. (2009) *PNAS***

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 are 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



**If you're stressed,  
you can't be the  
teacher or parent you  
want to be.**



If you're stressed,  
your children will pick on it.  
It will cause them to feel  
stressed.

And if they're stressed, their  
EFs will suffer & therefore  
their school performance will  
suffer.

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."



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're not perfect.**

**You're going to make  
mistakes.**



I can guarantee 100% that  
worrying about whether you're a  
**good enough parent or teacher**  
will NOT improve your parenting  
or teaching – it will only make it  
worse.



**Imperfect  $\neq$  Worthless**

Even the people  
you most respect  
make mistakes and  
have done things they regret.

**RELAX.**

**EVERYONE makes mistakes.**

**Everyone is imperfect.**

Yet each of us is wonderful in our own  
way – despite being imperfect.

And you can be a TERRIFIC parent even  
though you aren't the perfect parent.

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





**Your caring -- your openness to truly listen; being there for your child when he or she needs you - is more important than your knowledge or skill.**

**Jerome Frank conducted a study comparing many different forms of psychotherapy to.**

**He concluded:**

**Regardless of which form of psychotherapy, the most successful clinical outcomes were achieved by....**

**those who cared deeply about their patients and were able to communicate that caring to the patients**

The best body of work on the relative effectiveness of different forms of psychotherapy can be found in Bruce Wampold's 2001 book:

***The Great Psychotherapy Debate:  
Models, Methods, and Findings***

He concluded that:

**the client-therapist relationship trumps  
technique hands down.**

The British Medical Journal asked  
people what makes a good doctor:

The majority of people responded:

**“A good doctor, is first and  
foremost, a good human being.”**

**The same is true for  
parents and teachers**

# What matters most in Early Childhood Education?

**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)

**Save money** on equipment &  
high tech gadgets

**Spend money** on teacher  
training & teacher salaries







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.

Focus on children's **strengths**, rather than on their weaknesses & failings.

Start with feedback about **what a child got right**, instead of with his or her mistakes.

**Positive feedback** is much more effective than negative feedback.

Children need to feel safe

...to push the limits of what they know,

...to venture into the unknown,

...to take the risk of making a mistake or of being wrong.

The need to know it is okay to make a mistake.

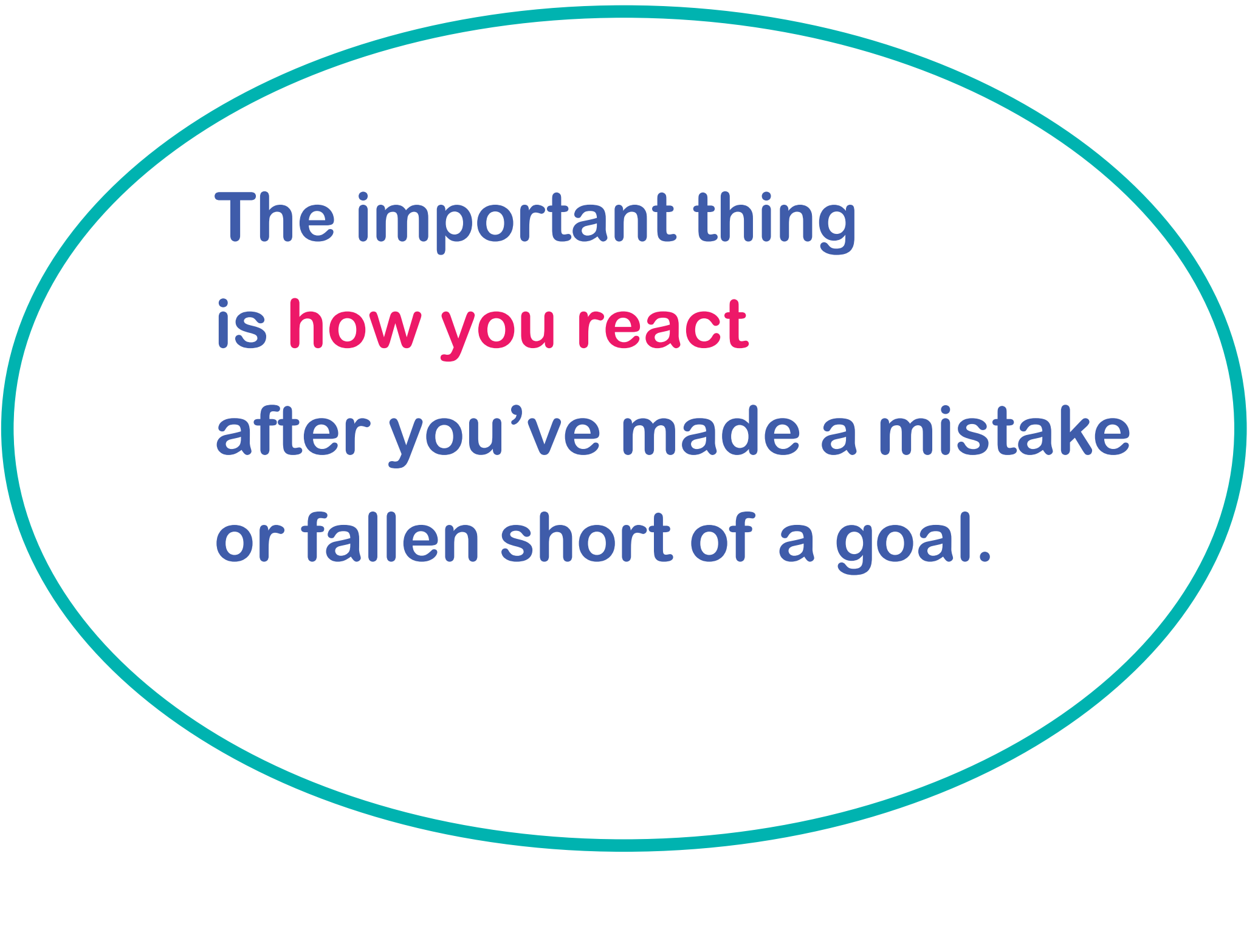
It's extremely important not to  
embarrass a child.

Children can't relax if they're  
worried you might embarrass them.

**Making a mistake is not the worst thing in the world.**

**We need to let children know it's okay to make mistakes; EVERYONE makes mistakes.**

**The only alternative is to stay with what you already know, to stop growing.**



The important thing  
is **how you react**  
after you've made a mistake  
or fallen short of a goal.

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

-- Samuel Proctor Massie



It's never over  
'til it's over

Samuel Proctor Massie was born in the segregated South in the early 1900's. You know he encountered a lot of discrimination, setbacks, and failures. Yet he rose to become one the most highly respected and decorated chemists of the 20<sup>th</sup> century.

**You haven't failed until  
you've stopped trying.**



If children are afraid to try something new, afraid they'll be penalized for a mistake...

We need to show them they'll be rewarded for trying.

If what gets graded is what children see as important, then we need to reward them with an 'A' in a new category -- the courage to try something new, to risk being wrong.

One way programs can reduce stress & aid self-confidence is to communicate loud and clear the faith and expectation that each child will succeed.



When a toddler falls while trying to walk, we would never say, “you get a ‘D’ in walking today”; it would never occur to us to say that.

Instead we say, “Don’t worry; I’m sure you’re going to be able to do this.”

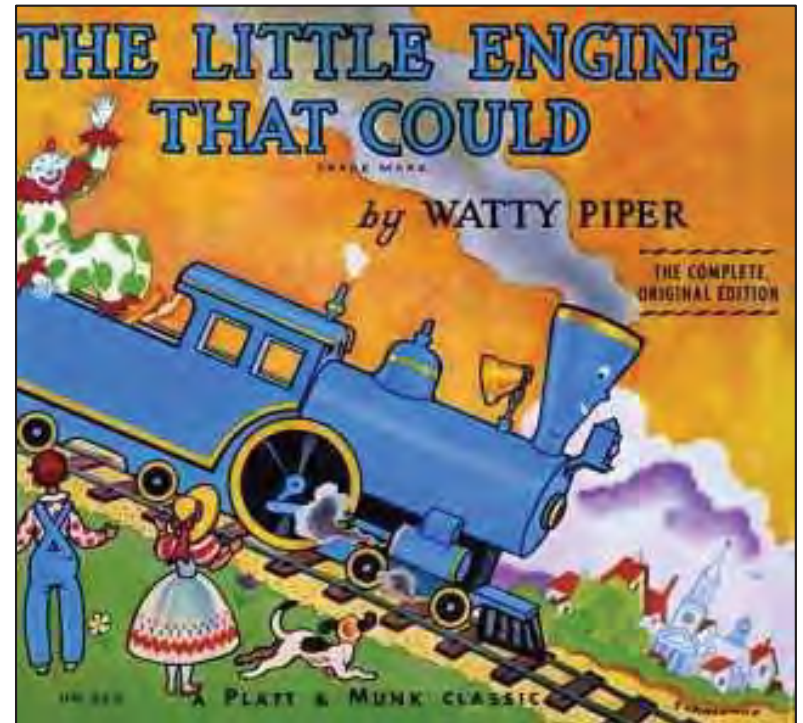
How different is that from what children hear in school. They hear: “You get a D” **instead of** “There’s no question you are going to be able to do this. And we, **together**, are going to figure out a way to make that happen.”

**A school in BC**

**has as its motto:**

**If you can't learn the  
way we teach, we will  
teach the way you learn.**

CHILDREN NEED TO  
BELIEVE IN THEMSELVES.  
THEY NEED TO HAVE SELF-  
CONFIDENCE.  
THEY NEED TO  
BELIEVE THEY  
CAN SUCCEED.



## Two routes to that:

- They need to feel **you believe in them** - that you fully expect them to succeed.

&

- They need **do-able challenges**. They need opportunities to do things that enable **them to see for themselves** that they are capable.



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# 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

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**“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**

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

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

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math exams    Claude Steele

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For ex., there's a stereotype in our culture that men are better in math than women.

And sure enough when a group of researchers went to a univ. & gave a standardized math test, **As a group**, the male students scored higher than the female students.

Then the researchers tested another group of entirely comparable university students on exactly the same test  
– the **ONLY** difference was they **added** one sentence before giving the exam.

They said, “This particular test has been designed to be gender-neutral; on this particular test women score as well as men.”

And what happened? The women scored as well as the men.

It was the **SAME** test as the first group got.

The only difference was whether the women expected themselves to do well or not.

Our expectations for ourselves often become self-fulfilling prophecies

Children need opportunities to do things that enable them *to see for themselves* that they are capable: do-able challenges.

(research studies by Duckworth, 2010; Lewis & Goldberg, 1969; White, 1960)

Pride and self-confidence (and joy) come from seeing yourself succeed **at something that you know is not easy -- even in the youngest infants.**



Another way to show children we believe in them and have faith in them is to give them an important responsibility.

the 'Coca Cola' study

**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.



In one study, researchers told a group of subjects that they'd have close relationships throughout their lives;

- they told another group the opposite; &
- told a third group unrelated bad news.

On simple memorization questions (that don't require EFs) the groups were comparable.

On logical reasoning (that requires EFs), those told to expect that they'll be lonely performed worse.

Other researchers haven't tried to manipulate this, but simply give subjects a survey when they come into the lab

& that includes questions like 'Do you feel socially supported? Do they feel lonely?'

One research group found that  
prefrontal cortex functioned less efficiently in  
those who felt lonely or 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.**



It's not just peers; a close relationship with a caring adult can be huge.



We are not just intellects,  
we have emotions  
we have social needs  
& we have **bodies**







**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



**Motor development and  
cognitive development appear  
to be fundamentally intertwined.**

Diamond, A. (2000)



Close interrelation of  
motor development and cognitive development  
and of the cerebellum and prefrontal cortex.

*Child Development, 71, 44-56*

The different parts of the human being are fundamentally interrelated.

Each part (cognitive, social, emotional, & physical) is affected by, and affects, the other parts.

Diamond, 2000

If we ignore that a child is stressed, lonely, or not healthy because of poor nutrition, lack of sleep or lack of exercise those unmet needs will work against achievement of our academic goals for our children.

To achieve the academic outcomes we all want...

- we need to try to reduce stresses in children's lives & give them better tools to manage stress. Children need to do things that give them JOY.
- no child should feel alone; the classroom, the school community, and the wider community need to be supportive of our children
- we have to care about children's health -- they need good nutrition, sleep, exercise, & time outdoors.

Returning to my prediction:

Those activities that **most**  
**successfully** improve executive  
functions should not only work on  
training and improving executive  
functions  
but also....

indirectly support executive functions by working to reduce things that impair executive functions and working to enhance things that support executive functions.



Key is that the child really  
enjoy the activity and really  
want to do it, so s/he will spend  
a lot of time at it, pushing him-  
or herself to improve.



**What activities directly**  
**train and challenge**  
**executive functions and**  
**indirectly support them by**  
**also addressing our social,**  
**emotional, and physical**  
**needs?**

**Traditional  
Activities that  
have been around  
for millennia.**

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

People in *all* cultures made **music, sang, danced, did sports, and played games**. There are good reasons why those activities have lasted so long and arose everywhere.

Music, dance, circus, theater,  
positive sports, and more 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

---

Because they challenge EFs directly,  
and indirectly support EFs by  
increasing joy,  
a sense of belonging, &  
physical exercise,

I predict they should improve EFs.

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(and we're hoping to get funding to test my prediction for  
El Sistema Orchestra & for social, communal dance)



To repeat: 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.



could be caring for an animal....



# Could be a SERVICE ACTIVITY such as

## Free the Children

### Children Changing the World

More than 1.7 million youth involved in innovative education and development programs in 45 countries.

Educates, engages, and empowers young people to be confident young change-makers and lifelong active citizens.



Educators whose students are engaged in Free the Children report:

**97%** of their students now believe they can make a difference in the world.

**85%** find a greater atmosphere of caring and compassion in the school.

**89%** confirm that their students are more confident in their goal-setting and completion.

**90%** of their students have demonstrated increased leadership among their peers.







# Listening to Stories



Storytelling requires and invites a child's rapt attention for extended periods (sustained, focused attention), and, working memory to hold in mind all that has happened thus far, different characters' identities, and to relate that to the new information being revealed.





You probably think, “Oh what a wonderful scene!”



I would like to suggest that young children also need this: **STORYTELLING**, where only the teller sees the pages in the book.



Without the visual aids of pictures, puppets, or video, children need to work harder to sustain their attention and to remember details of the story like who's who in the story.

I predict that while **Story-reading** is wonderful



**Storytelling**

should tax  
sustained, focused attention more  
and so should improve that more



# Circus Arts



Jackie  
Davis  
→



# Circus

challenges one's executive functions



Have to  
concentrate &  
*stay* focused.

Have to  
quickly think  
on your feet &  
adapt.





# Circus

builds community, learn to cooperate & to trust others not to let you get hurt







**Develop physical skills (e.g.,  
balance, coordination,  
strength, flexibility)**



Last summer, I met a strong, proud African-American man. You would never guess he was born in prison, his father dead before he was born, his mother a couple of years later. At age 15 he was the oldest male in his family still alive and not in prison. He joined Circus Harmony, St. Louis's YCP, at the age of 12 and it transformed his life. Through his circus skills he has won international awards and is currently enrolled in a prestigious circus 'university' in Montreal.



While it may seem logical that if you want to improve academic outcomes you should concentrate on academic outcomes alone, not everything that seems logical is correct.

**Counterintuitively**, the most efficient and effective strategy for advancing academic achievement **is probably not to focus only on academics.**

**We have to care about the whole child (cognitive, social, spiritual, emotional, and physical) if we want improve academic achievement.**

**If we focus only on academics, we are less likely to succeed.**

**What nourishes the  
human spirit may also  
be best for Executive  
Functions.**



Perhaps we can learn something from the traditional practices of people across many cultures & 1,000's of years.

The arts, play, and physical activity may be critical for achieving the outcomes we all want for our children.

*thanks so much 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**.

