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

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1) Self-control

Having the 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
- having the self-control to wait before making up your mind – not jumping to a conclusion or pre-judging

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 dis-assembling those combinations and re-combining 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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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.

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 you want your child to do well in school & in life, help your child 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.

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

…Action for Learning

…Learn through Doing

at any age, but especially for young children

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

If information is not relevant for what we want to do, we don't pay attention in the same way.

We learn something when we NEED it for something we want to DO. It has got to be relevant to our interests!

For ex., who is going to learn the route better – the driver or the passenger in the car? You all know the answer and you all know why.

(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. They need to have an immediate need & use for what they are being taught to do something THEY care about.

We all know this, so why is so much of schooling still NOT active and hands-on BUT instead students sit passively listening (like you guys); while the teacher is up in front, actively using the information, and learning it very well.

This is important because little kids are not built to sit still for any length of time listening to verbal instruction,
esp. little boys.
Trying to force young children do that will cause many children to dread school &
to form long-lasting perceptions of themselves as stupid & unable to learn.

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?

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

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

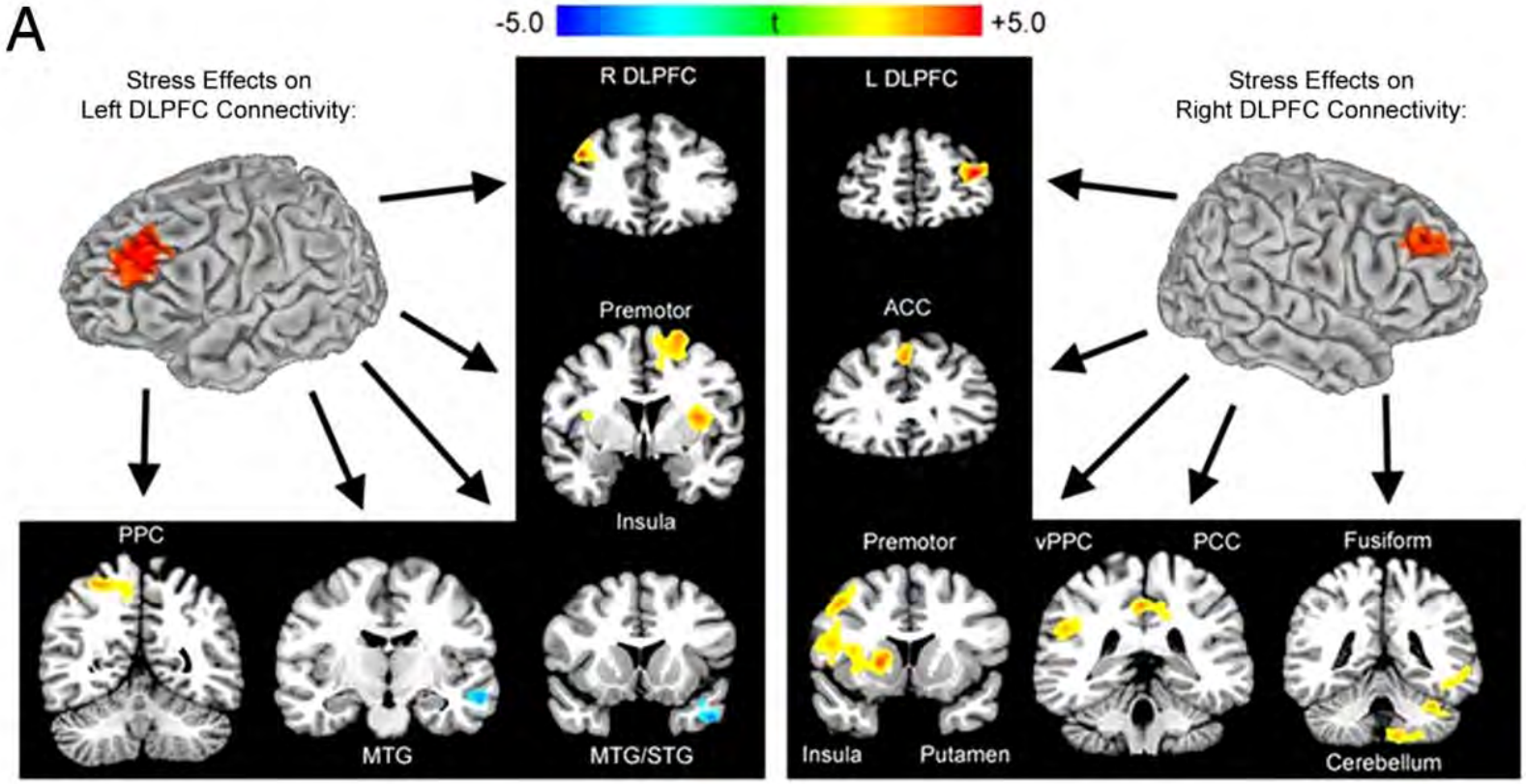
If you're

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

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

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 you're stressed you can't think as clearly or exercise as good self-control.)



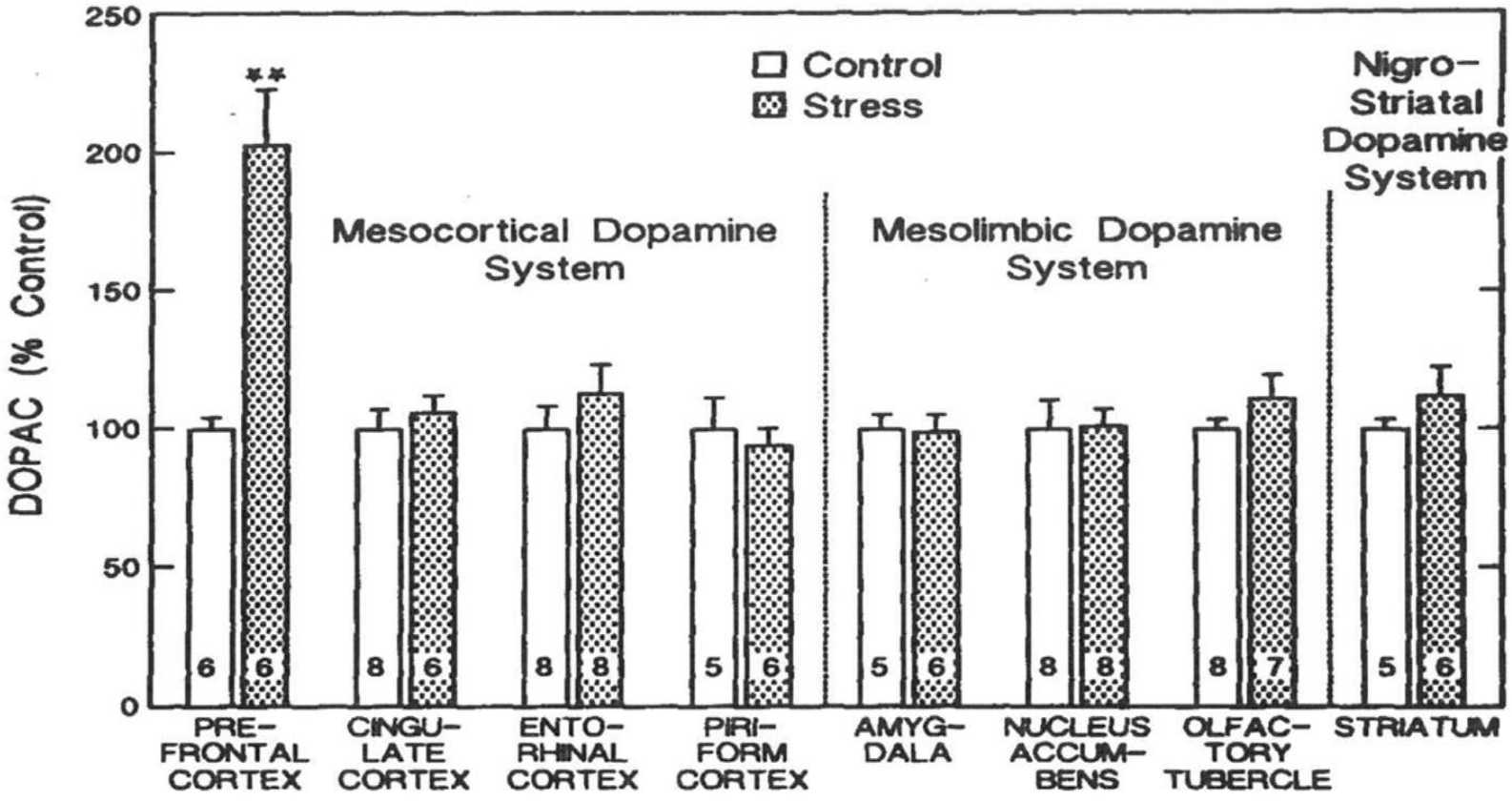
In college students, one month of stress in preparation for a major exam disrupts prefrontal cortex functional connectivity.

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*

Stress and Prefrontal Cortex

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



(Roth et al., 1988)

One way neurons communicate with one another is by one neuron releasing dopamine and the other neuron taking it up with dopamine receptors.

Much of the released dopamine doesn't reach another neuron and needs to be cleared from the space between and around the neurons.

The best mechanism from clearing away released dopamine is by dopamine transporter (DAT) protein.

Dopamine transporter is abundant in the striatum but sparse in prefrontal cortex.

This makes prefrontal cortex more dependent on secondary mechanisms (such as the COMT [catechol-O-methyltransferase] enzyme) for clearing dopamine from extracellular space than are other brain regions, such as the striatum.

COMT Gene

catechol-O-methyltransferase gene

codes for the COMT enzyme, which methylates released dopamine.

It's located on chromosome 22.

A single base pair substitution

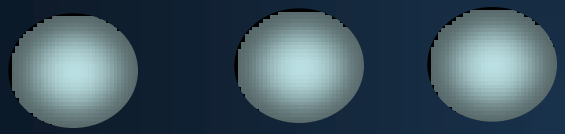
C**G**TG to C**A**TG

translates into a substitution of

Methionine for Valine at codon 158

The Methionine variant of the COMT gene codes for a slower COMT enzyme which leaves more DA around longer in PFC.

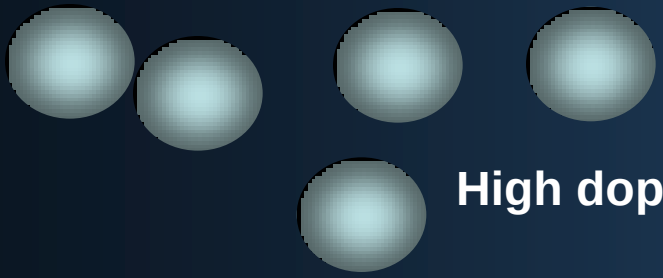
Catechol-O-methyltransferase (COMT) Val158 Met



Low dopamine

High activity enzyme

SYNAPSE



High dopamine

Low activity enzyme

The Methionine variant of the COMT gene is generally associated with better PFC function and better executive functions.

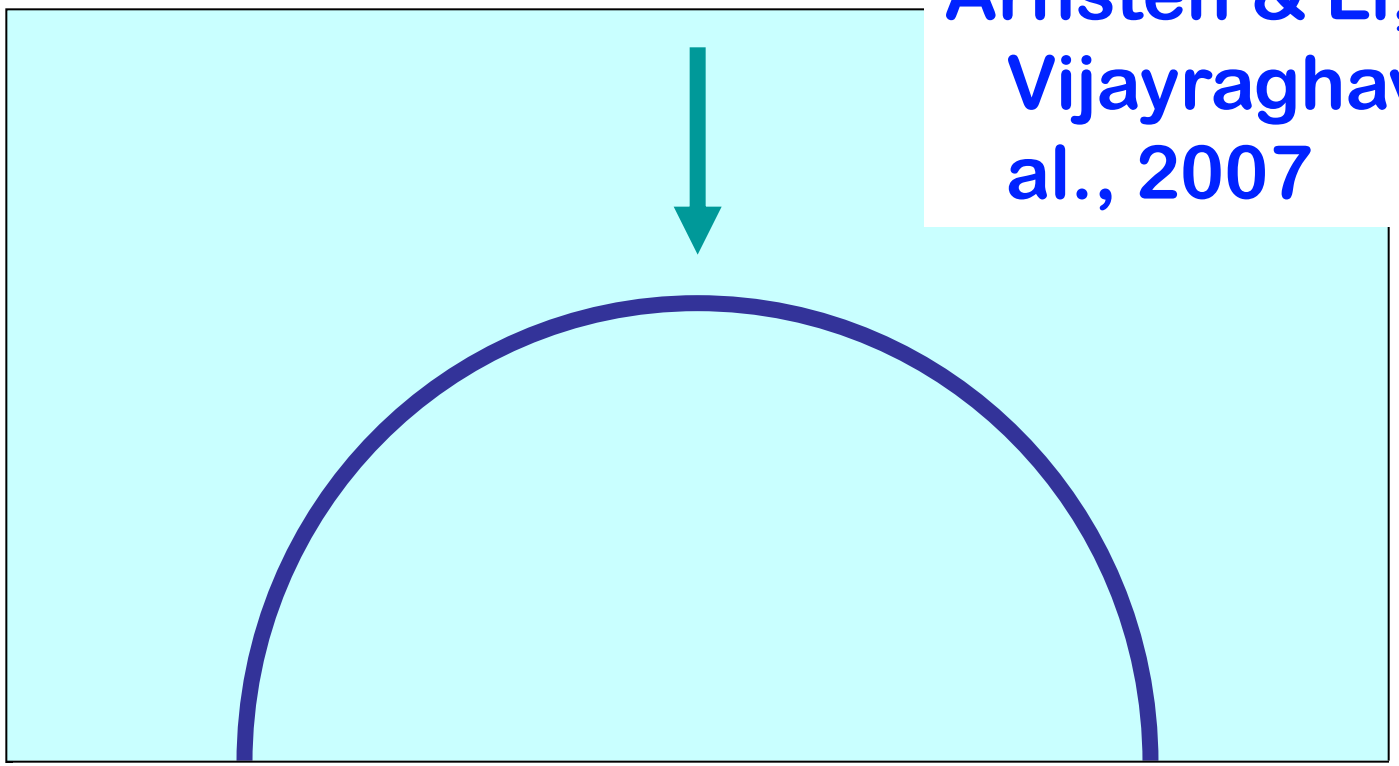
This is specific to EFs:

There is no relation between COMT genotype and IQ or other non-PFC functions.

What's the downside of Met variant of COMT?

The Optimum Level of Dopamine in PFC is an Intermediate Level

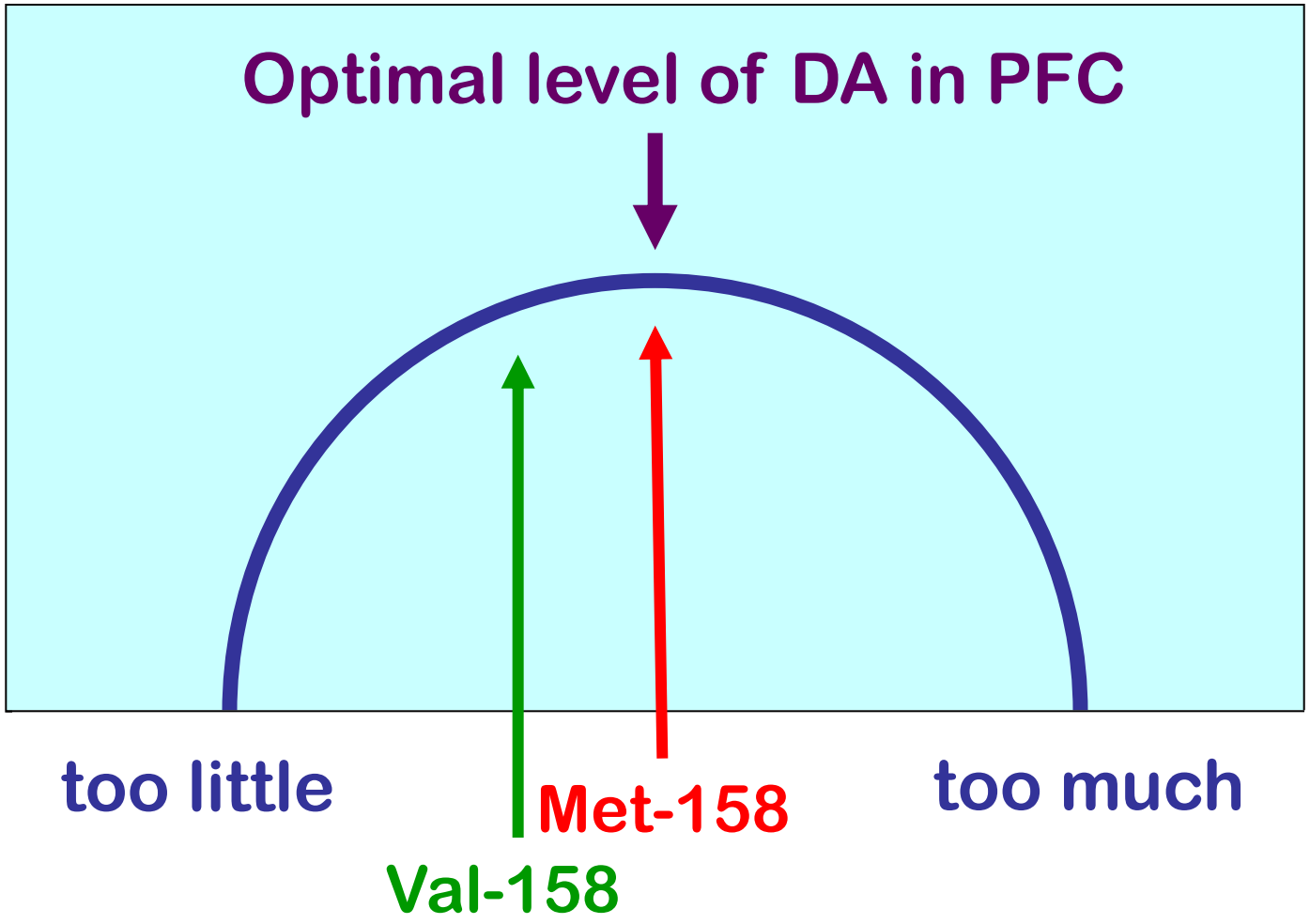
Arnsten & Li, 2005; Vijayraghavan et al., 2007



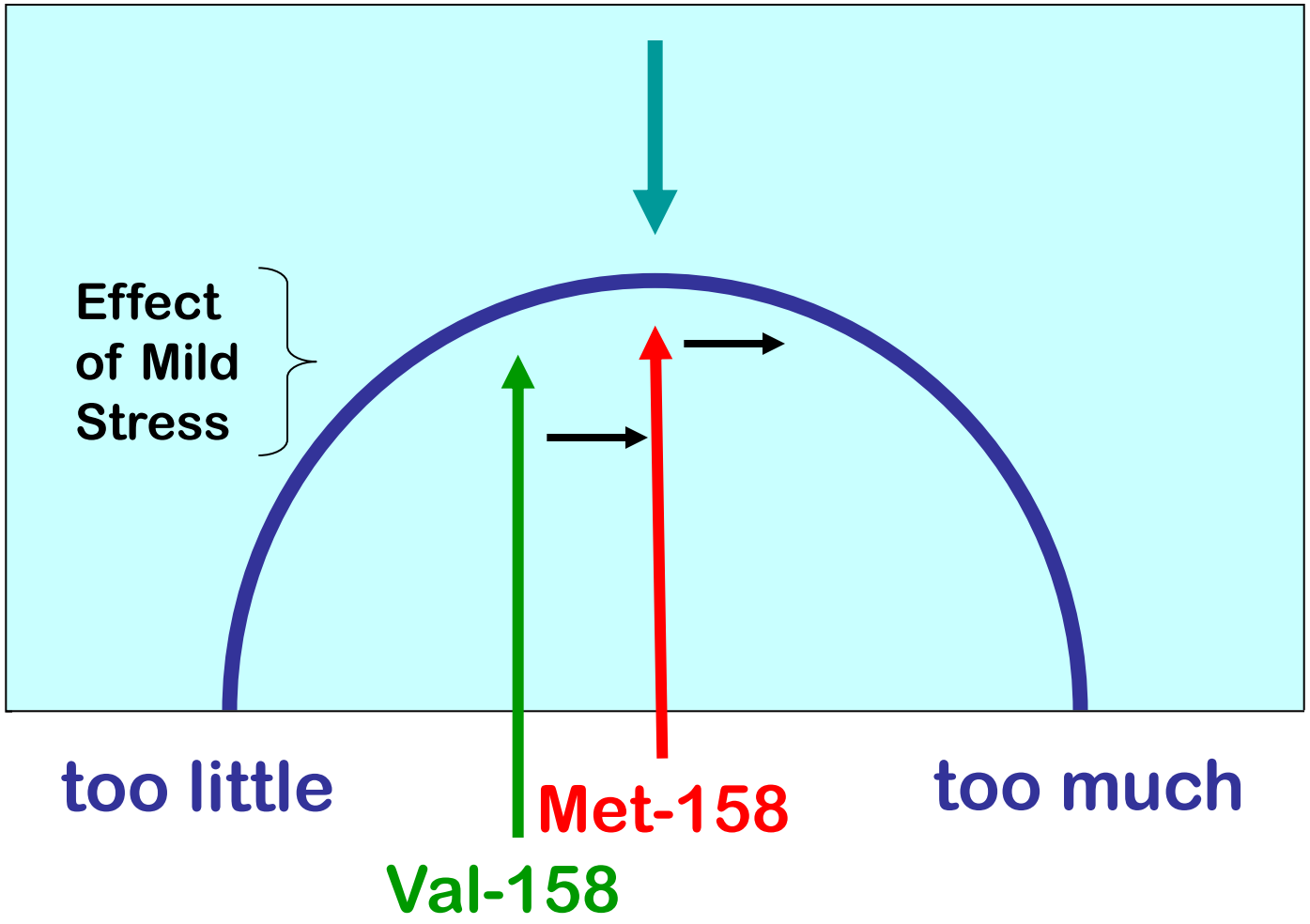
too little

too much

Differences in COMT Genotypic lead to Differences in PFC DA Levels



Genotypic Difference in PFC DA Levels leads to Genotypic Differences in Stress Reactivity



Persons homozygous for COMT-Met^{158} tend to

- be more sensitive to stress

  Buckert et al. 2012; Armbuster et al. 2012

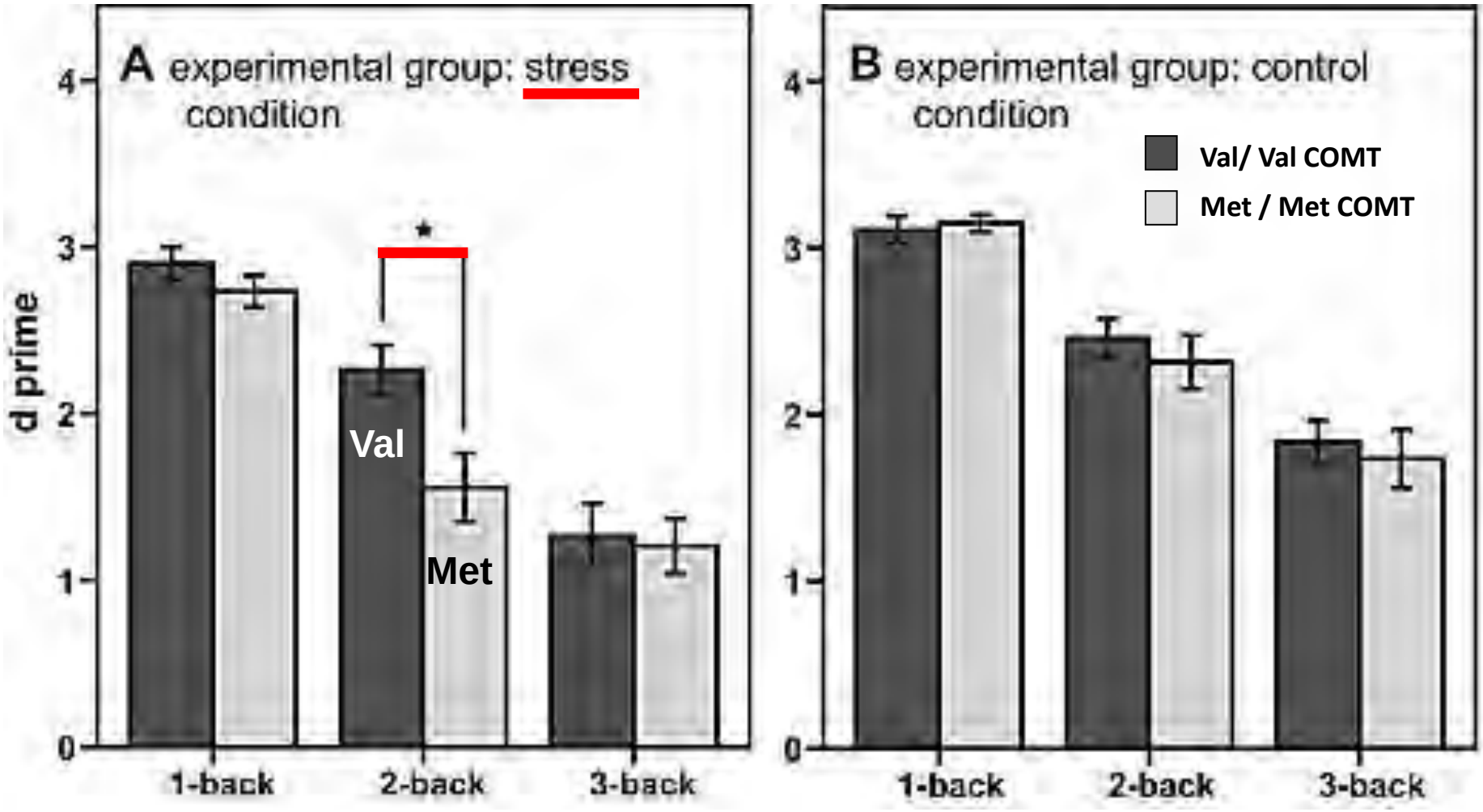
- have higher anxiety

  Olsson et al. 2005

- and have heightened pain stress responses

  Zubieta et al., 2003

  Diatchenko et al., 2005



Buckert et al. (2012): Under stress, young adults homozygous for COMT-Val^{158} showed ***better*** EF performance than young adults homozygous for COMT-Met^{158}

It has long been known that some of the brightest people also have the most fragile personalities and are highly reactive to stress.

Here is a possible mechanism for why the two might go together.

re: dandelion & orchid children

‘Dandelions’ are children who do okay wherever they are planted. They are often seen as models of resilience.

Perhaps children homozygous for COMT-Val^{158} are the dandelions; they’ll do okay even in a stressful environment, but might lack the exquisite fine-tuning of prefrontal cortex needed to achieve the brilliance of which a COMT-Met^{158} child might be capable.

Research shows that some of the children who look the worst when they are in an unsupportive, stressful environment are exactly those who blossom the most when in a good environment.

Perhaps some children homozygous for COMT-Met^{158} are among the orchids -- they might look like a disaster when in a stressful environment, yet might blossom brilliantly in the right environment.

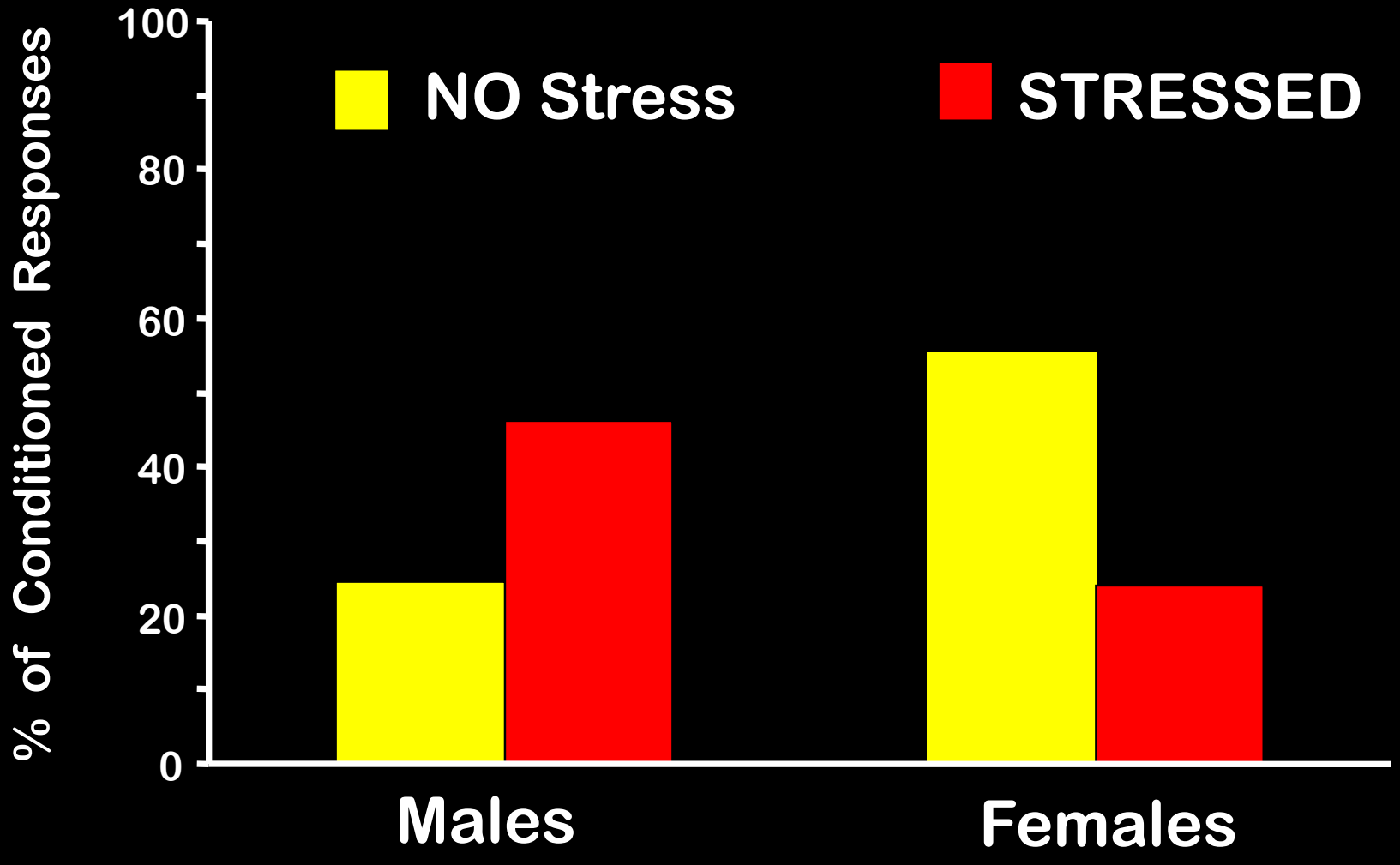
The COMT Met-158 genotype, which confers risk on individuals when they are in adverse, stressful circum-stances, holds out promise of extraordinary potential if only the right fit of circumstances can be found for the individual.

A child who is not doing well in one environment, or with a particular instructional style, might shine in another environment or with a different instructional approach.

Many of us were taught that people perform better on challenging cognitive tasks when they are slightly stressed / a bit on edge, rather than when calm.

That people perform better on challenging cognitive tasks when slightly stressed is NOT true for females.

Effect of Stress on Task Performance in Male and Female Animals



Shors & Leuner, 2003

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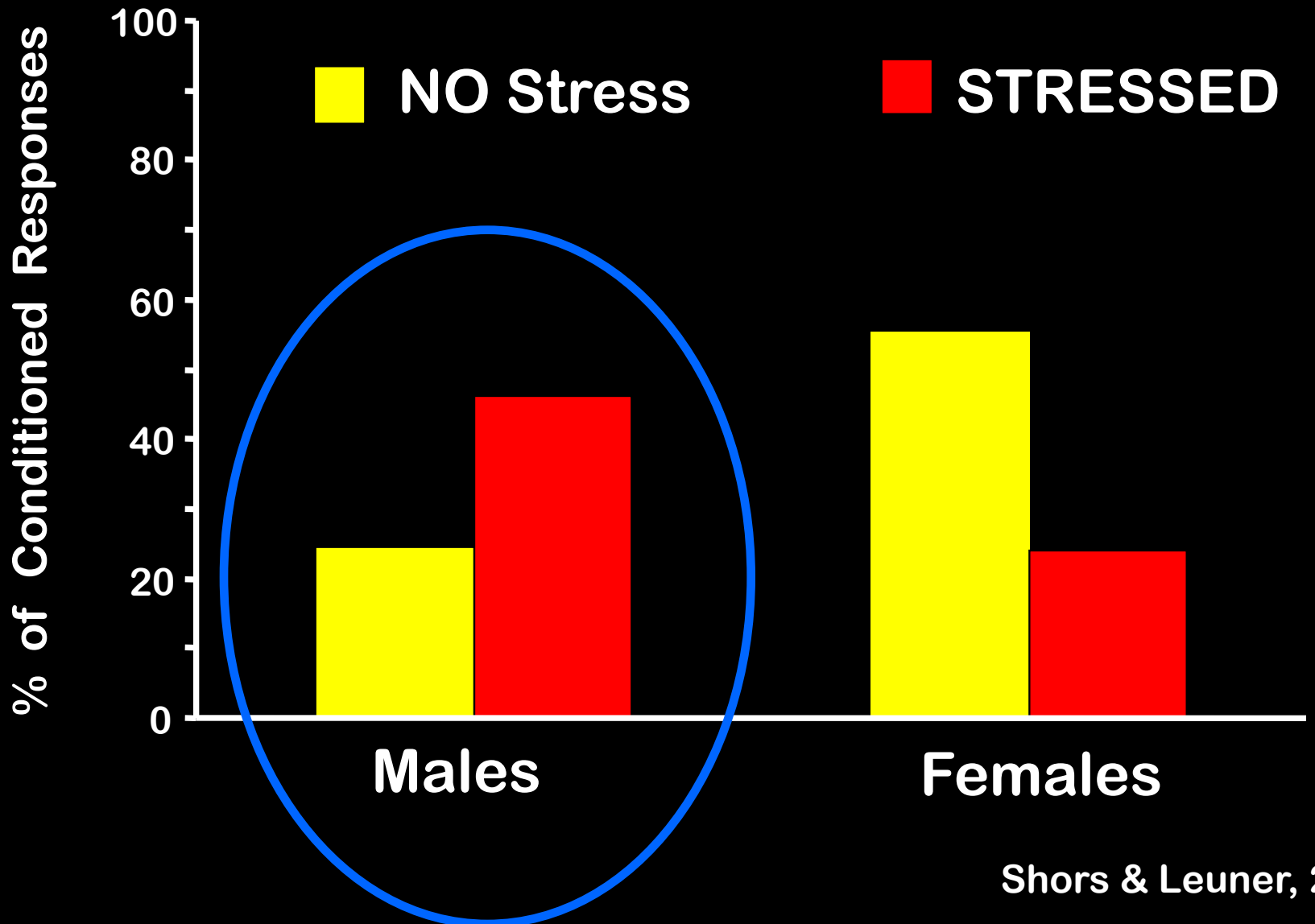

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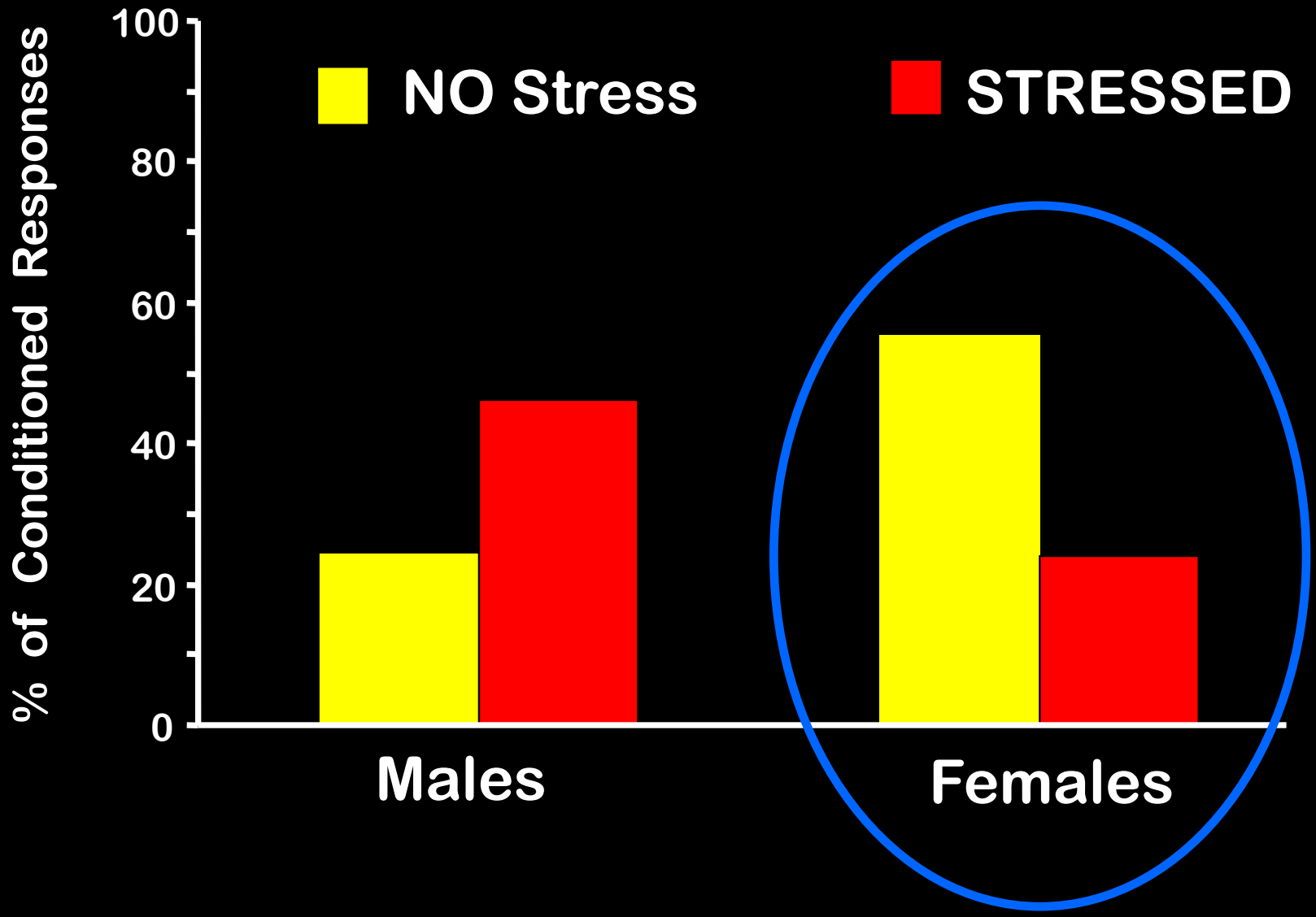
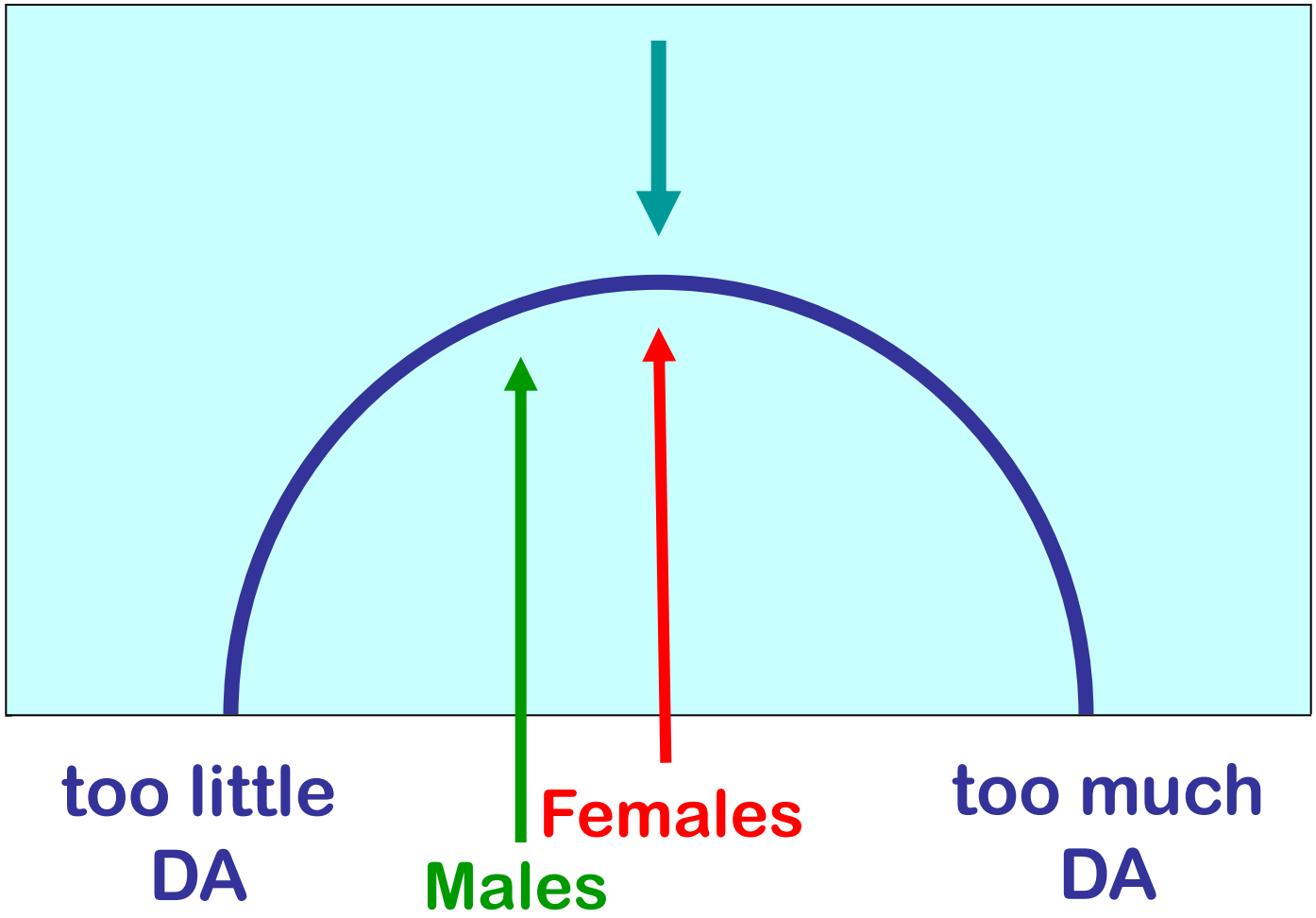


Estrogen down-regulates COMT gene transcription (Ho, 2006).

COMT enzymatic activity is 30% lower in women than men.

Varies with estrus cycle in rats; inverse relation between COMT activity and estrogen levels.

Hypothesis:
Gender Difference in Baseline Level of Dopamine in PFC



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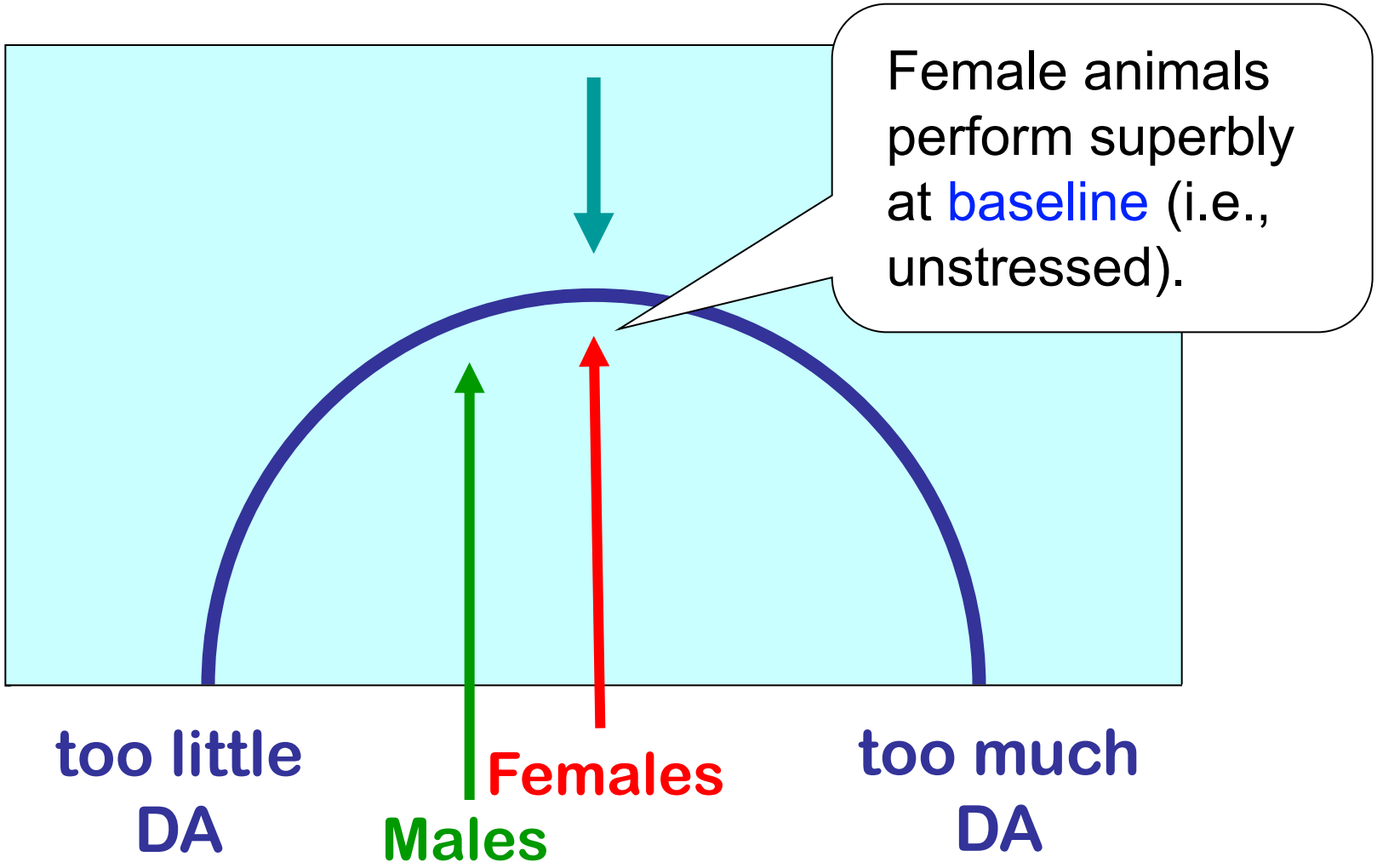
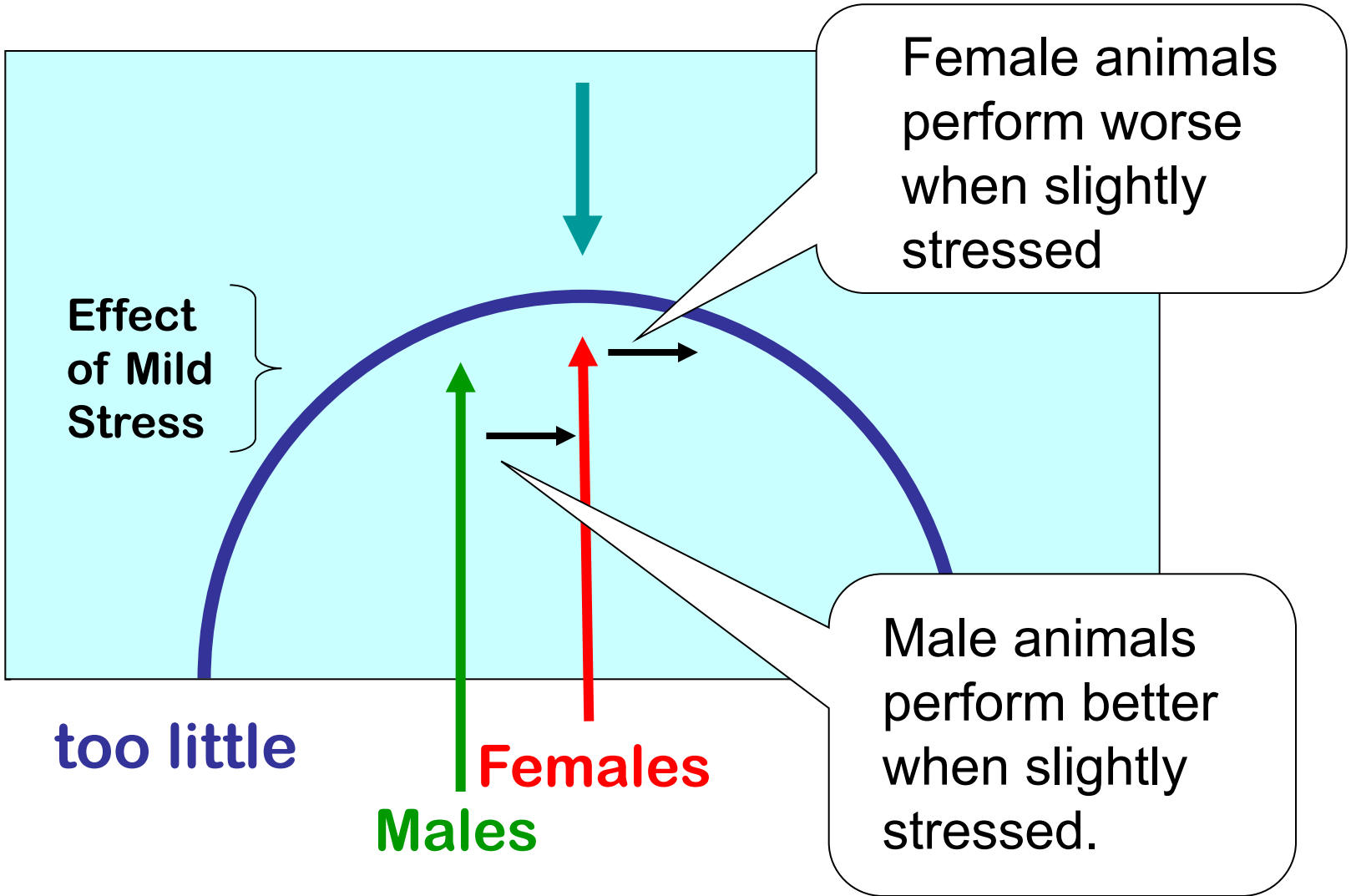
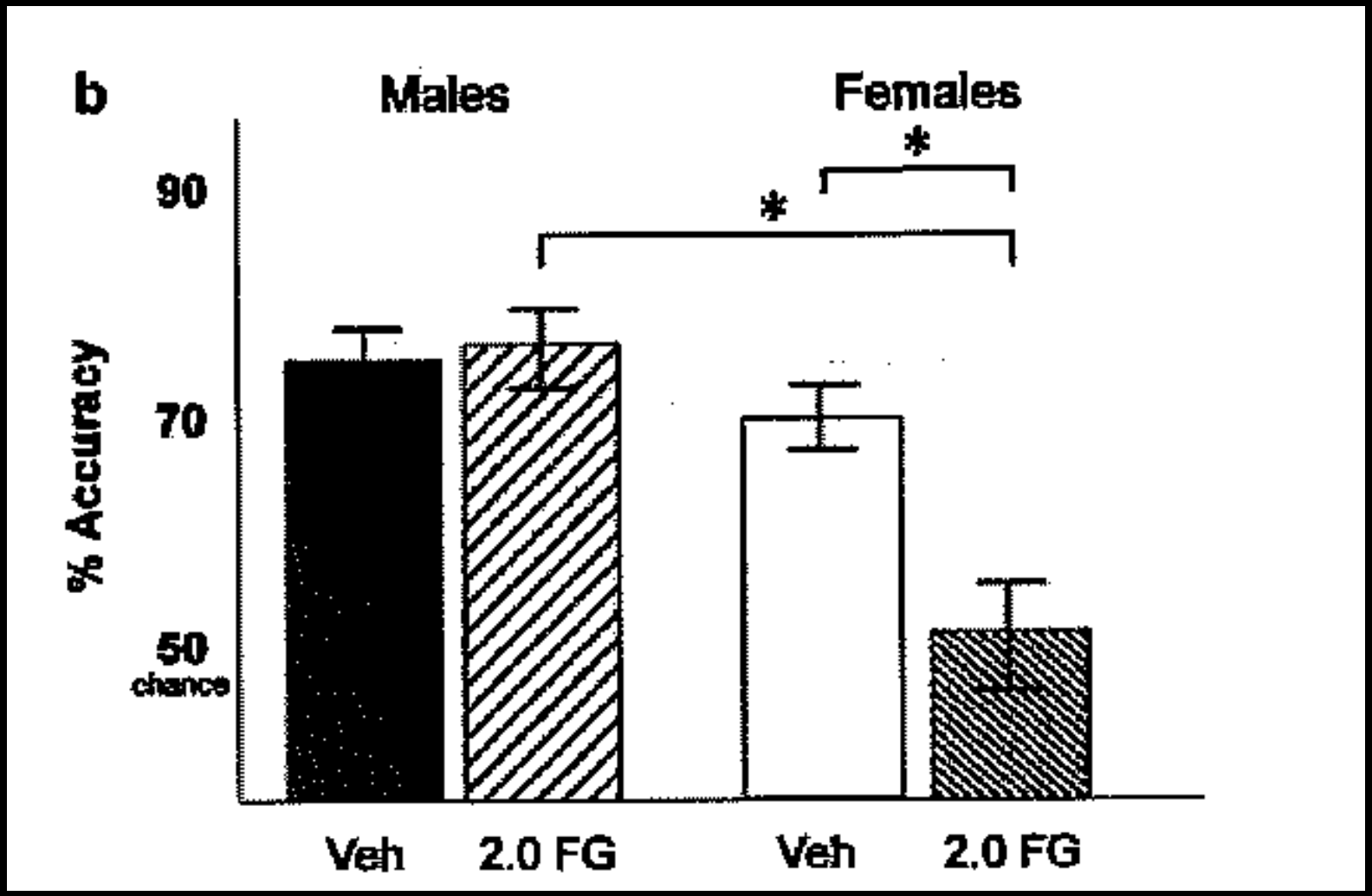


It follows from the Hypothesis of a Gender Difference in Baseline Level of Dopamine in PFC…



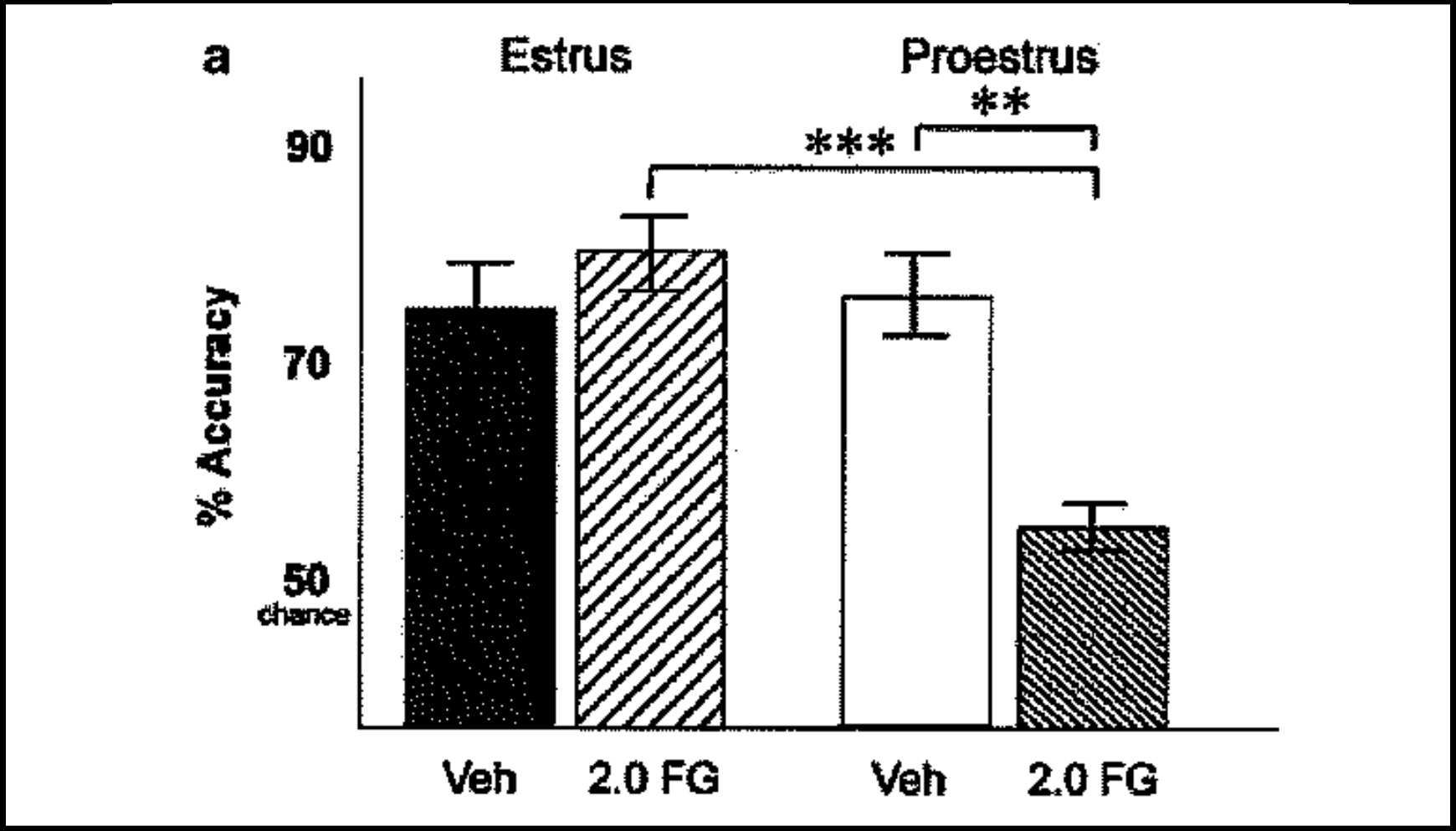
Stress & PFC



Delayed Alternation

(Shansky et al., 2004)

Stress & PFC (Females only)



Delayed Alternation

(Shansky et al., 2004)

Throughout the school years, girls earn higher grades than boys in all subjects at all grade levels.

BUT, boys tend to outperform girls on standardized tests.

Duckworth, A. L., & Seligman, M. E. P. (2006). Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores. Journal of Educational Psychology, 98(1), 198-208.

Standardized tests put girls at a selective disadvantage because, in general, females are more adversely affect by mild stress than are males – and the stress is not only at the exam but in the months leading up to the exam.

Such tests are likely to impair teachers' ability to teach because teachers will be stressed and many teachers are female.

I would like to debunk the idea that students cannot be learning if they are having fun.

Indeed, research shows that we learn more, are more creative, and get more done when we are happy and when our passionate interest is engaged.

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

JOY is NOT the opposite of SERIOUS

Serious business

(like learning) can be

JOYFUL

One way to make school more fun

is to have children

learn through doing,

hands-on learning.

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

You need to be able to **RELAX.**

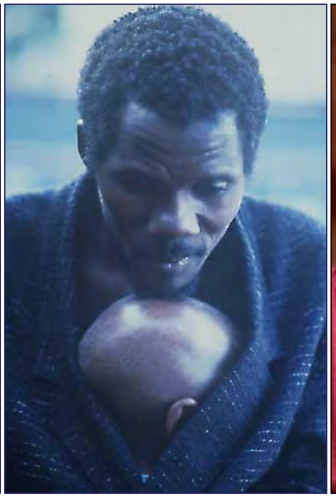
Don't get all stressed and down on yourself because you're not a perfect parent

Remember:

Imperfect ≠ Worthless

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

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 will not have the desired result.

You need to be a Montessori teacher in your heart, or you are not doing real Montessori even if you have perfect technique.

Sometimes being a true Montessori teacher requires *not* adhering exactly to the techniques you were taught.

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

Jerome Frank concluded that:

"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 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)

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.

One major source of stress for many children is feeling that they're not smart enough, that they can't learn, and will never succeed…

It's important to communicate loud and clear the faith and expectation that each child will succeed.

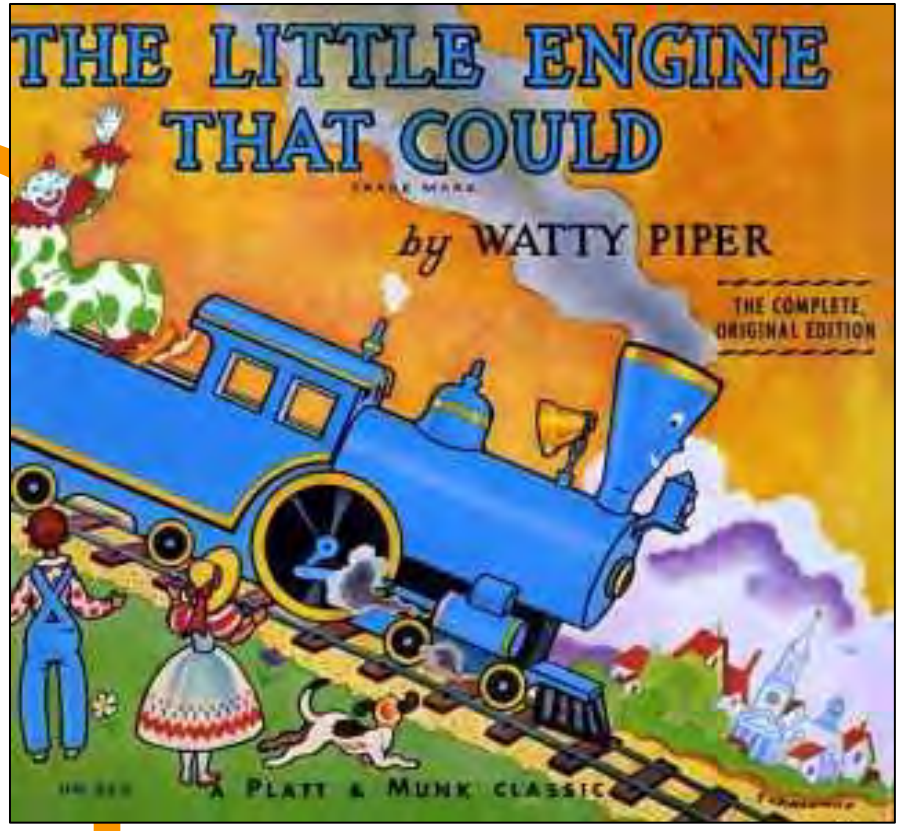
When a toddler falls while trying to walk, we would never say, “you get a ‘D’ in walking today”; it would never occur to us to say that.

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.



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.

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

“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

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

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

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

Many children are so terrified of making a mistake that they're afraid to try anything new.

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

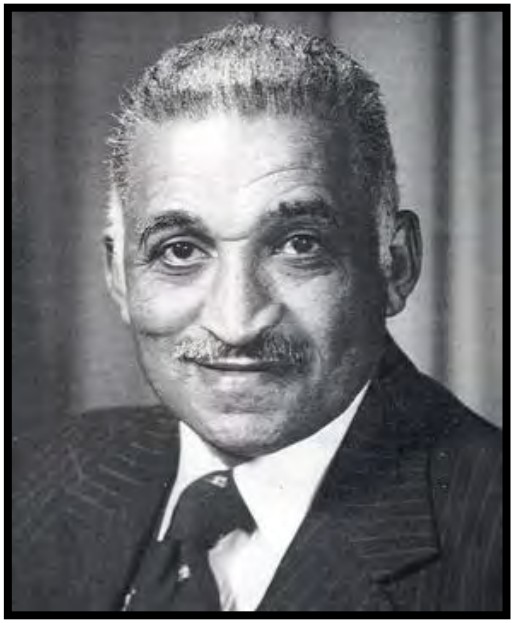
We need to let children know it's okay to make mistakes; EVERYONE makes mistakes.

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 20th century.

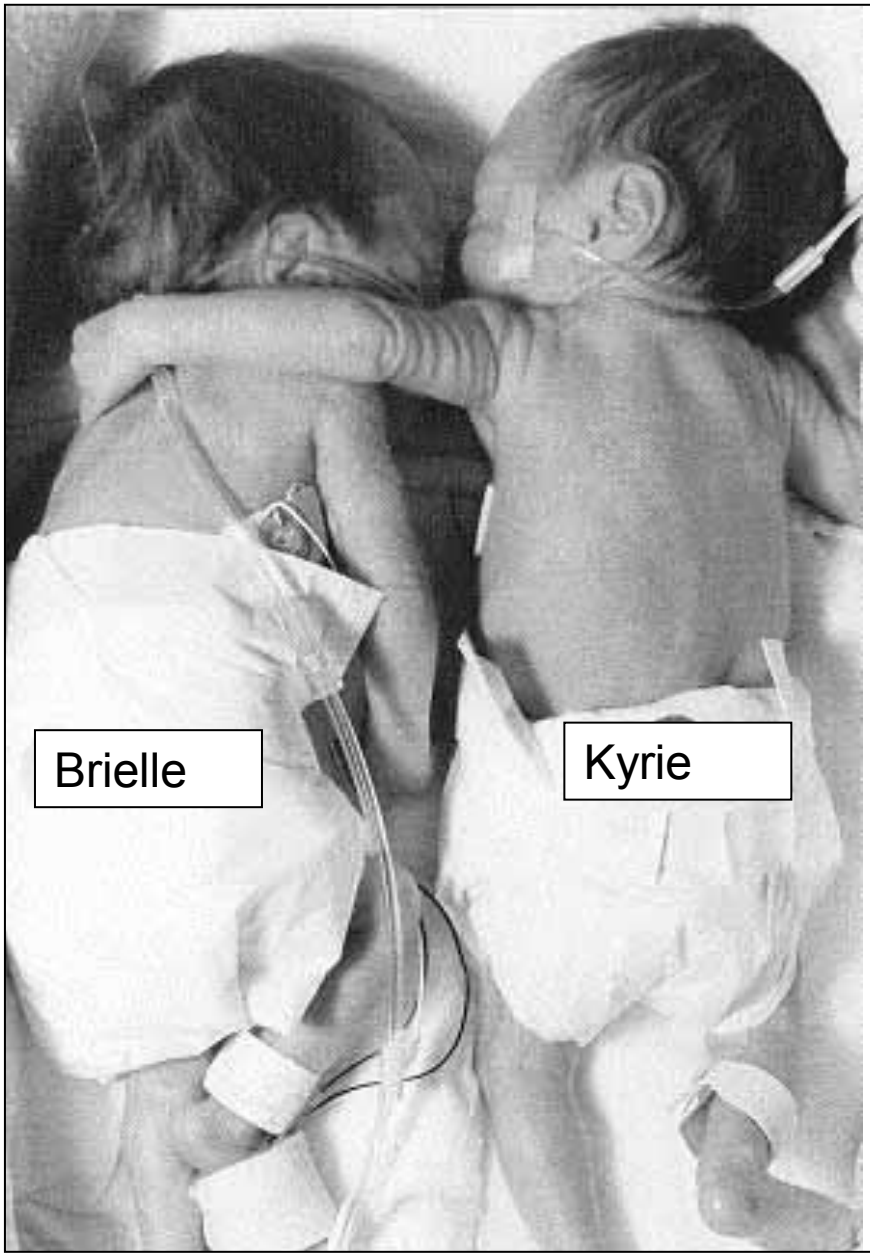
You haven't failed until you've stopped trying.

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.

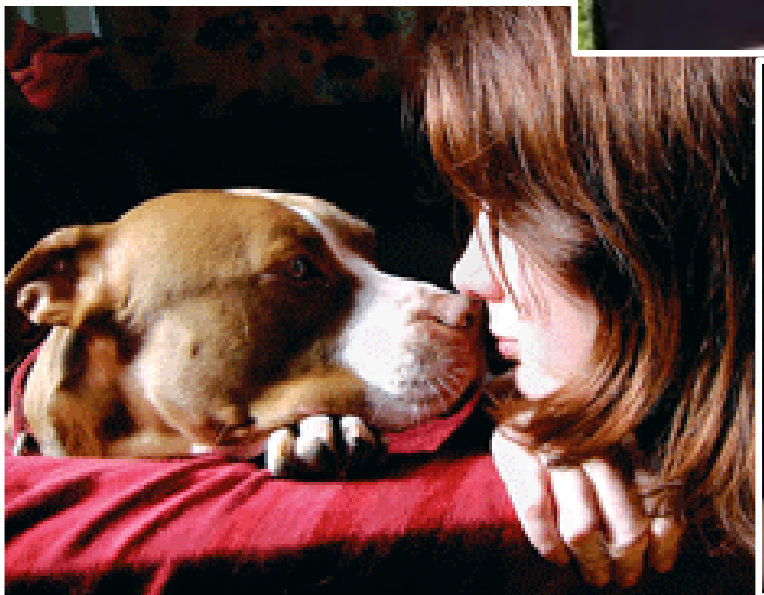
Touch relieves Stress



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

Pets can 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.*

Pets teach us about gentleness, patience, & never holding a grudge

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.

Let's return to what things impair and what things support EFs.

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

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

That 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.

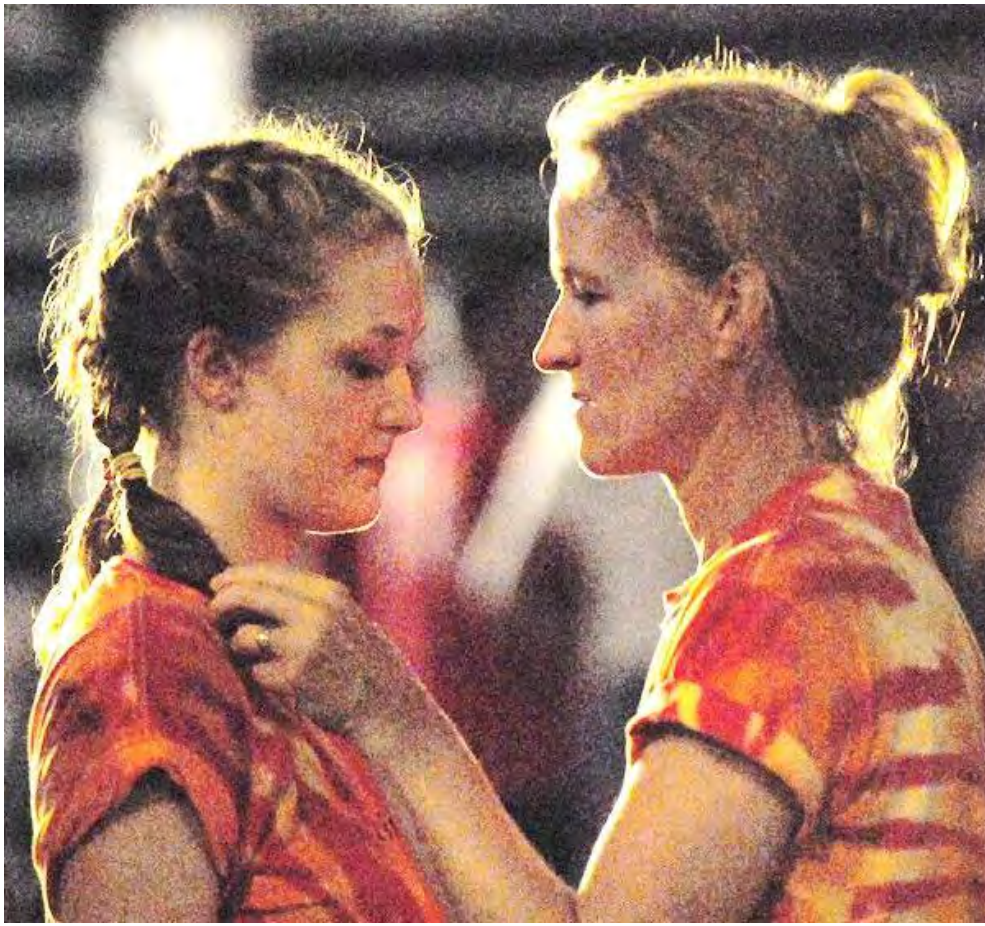
We are fundamentally social.

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're not just intellects,

with emotions

and social needs,

we also 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.

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 area of the brain known as the pre-Supplementary Motor Area (SMA) is important for sequential tasks.

It doesn't matter whether they're sequential motor tasks or sequential cognitive tasks.

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

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 <u>really</u> 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.

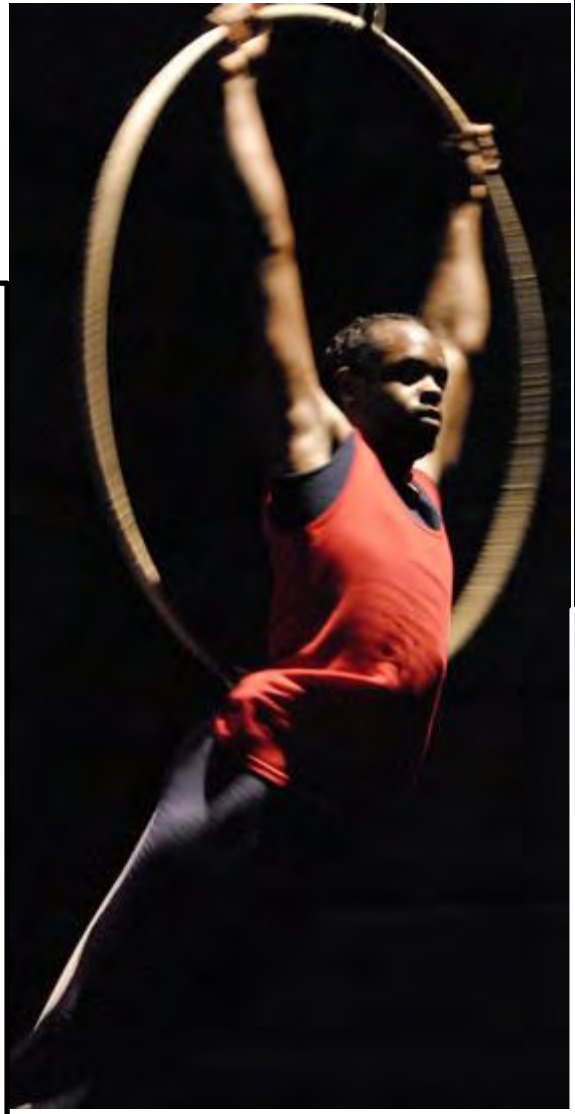
For 10's of 1,000's of years, across ***all*** cultures, storytelling, dance, art, music & play have been part of the human condition.

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.

Certainly they help develop motor skills such as bimanual and eye-hand coordination,

balance,

strength & flexibility



and lung capacity.

These activities also train and challenge our executive functions

VIDEO

http://www.devcogneuro.com/videos/tedx_cognitive_diamond_2014_v2.wmv

They address our social needs, providing feelings of belonging and social support

VIDEO

http://www.devcogneuro.com/videos/tedx_social_diamond_2014_v5.wmv

And they provide joy, building children's feelings of pride and self-confidence

VIDEO

http://www.devcogneuro.com/videos/tedx_self_conf_diamond_2014_v3.wmv

Music, dance, circus, theatre, positive sports and more address our physical, cognitive, emotional, and social needs.

video

http://www.devcogneuro.com/videos/juventas_circus_8min_51sec.wmv

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 a SERVICE ACTIVITY such as

Free the Children

Children Changing the World

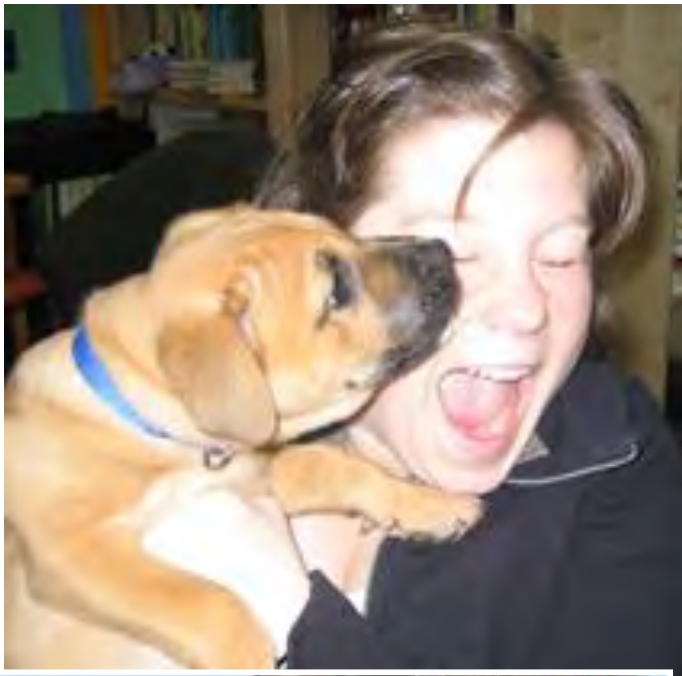
More than 1.7 million youth involved in innovative education and development programs in 45 countries.

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.	89%	confirm that their students are more confident in their goal-setting and completion.
85%	find a greater atmosphere of caring and compassion in the school.	90%	of their students have demonstrated increased leadership among their peers.

could be caring for an animal….



Therefore, I predict they should improve Executive Functions.

It is only a prediction, though, because incredibly there's NO hard scientific evidence on the benefits of any of these activities on Executive Functions.

There's evidence of correlations.

For ex., students in band or sports often do better in school, but we have no way of knowing if they would have done better anyway even if they hadn't been in band or sports.

There's lots of anecdotal data -- testimonials and personal accounts – that these activities have transformed kids' lives.

And there are good theoretical reasons, such as I presented here, derived from solid scientific data that these activities should help.

But the hard sci. evidence is missing.

My grant applications to fund BASIC neuroscience research (like the role of DA in PFC) sail thru scientific review and have been continuously funded by the government for over 25 years.

But when I request funding for solid research on the benefits of dance, music (like el sistema) – or Heaven forbid, youth circus -- reviewers' eyes glaze over. They say: "Study *Dance??* That sounds flaky."

So I'm hoping that people who share my belief that these activities can transform kids' lives might contribute whatever little they can to help fund the needed research.

Crowdsource Funding

Research showing hard data on the benefits of these activities for EFs is sorely needed because these activities -- the arts, physical exercise, and time for play – are being squeezed out of school curricula to make time for more academic instruction.

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 need to care about the whole child (cognitive, social, emotional, and physical) if we want to 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.

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.

thanks so much for your attention

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