



New England (HHS Region 1)

MHTTC

Mental Health Technology Transfer Center Network

Funded by Substance Abuse and Mental Health Services Administration

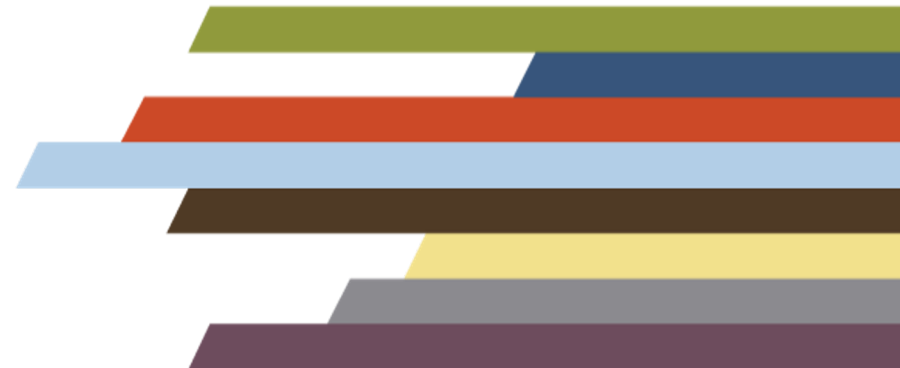
# Neurobiology and Executive Functioning

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Director of Research Operations  
Justice Resource Institute

Presentation Date/Time:

May 16, 2019

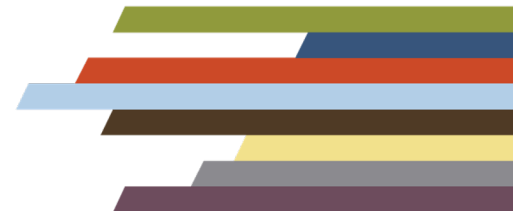
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# Neurobiology and Executive Functioning

## Goals for today:

1. Define executive function
2. Brain areas and EF
3. Impact of trauma
4. Educational outcomes

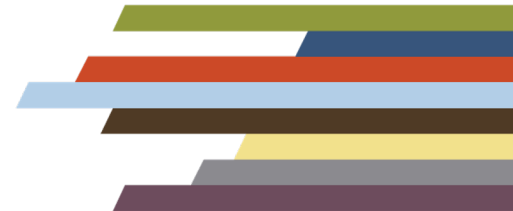


# Executive Function



“Change is the essential process of all existence.”

Photo credit: © 1967 Paramount Pictures

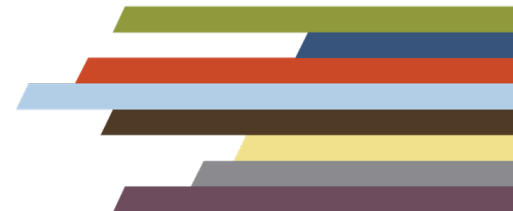


# Executive Functions

Executive functions (EF) are critical in regulation and goal attainment.

Include a number of abilities:

- Attention: Focus the mind
- Inhibition: Stop a prepotent response
- Initiation: Start a new task, “get going” on something.
- Cognitive Flexibility: Mentally switch between tasks
- Working memory: “Hold” information in your mind
- Monitoring: Attend to, take in and use information from your environment.
- Organization and planning
- Decision making: Weigh risk versus reward, consider different courses of action, and think about possible consequences.

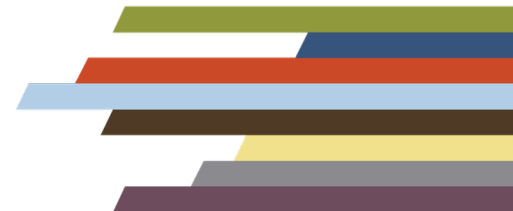




# Executive Functions (cont.)

Disrupted EF associated with volumetric reductions in the prefrontal cortex, striatum and caudate nucleus.

Ultimately, disruptions in EF undermine ability to adapt to changing environmental demands.

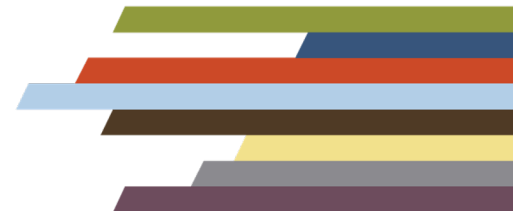


# Polling Question

Do you include in-school/classroom specific activities to improve student:

- a. Memory or Attention
- b. Organizational or Decision making skills
- c. All of the above
- d. None of the above

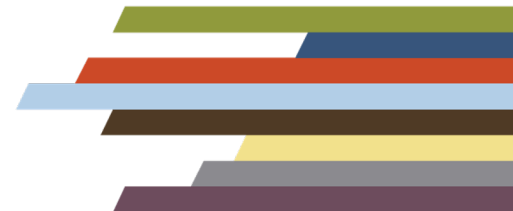
Multiple Choice Options: a,b,c,d



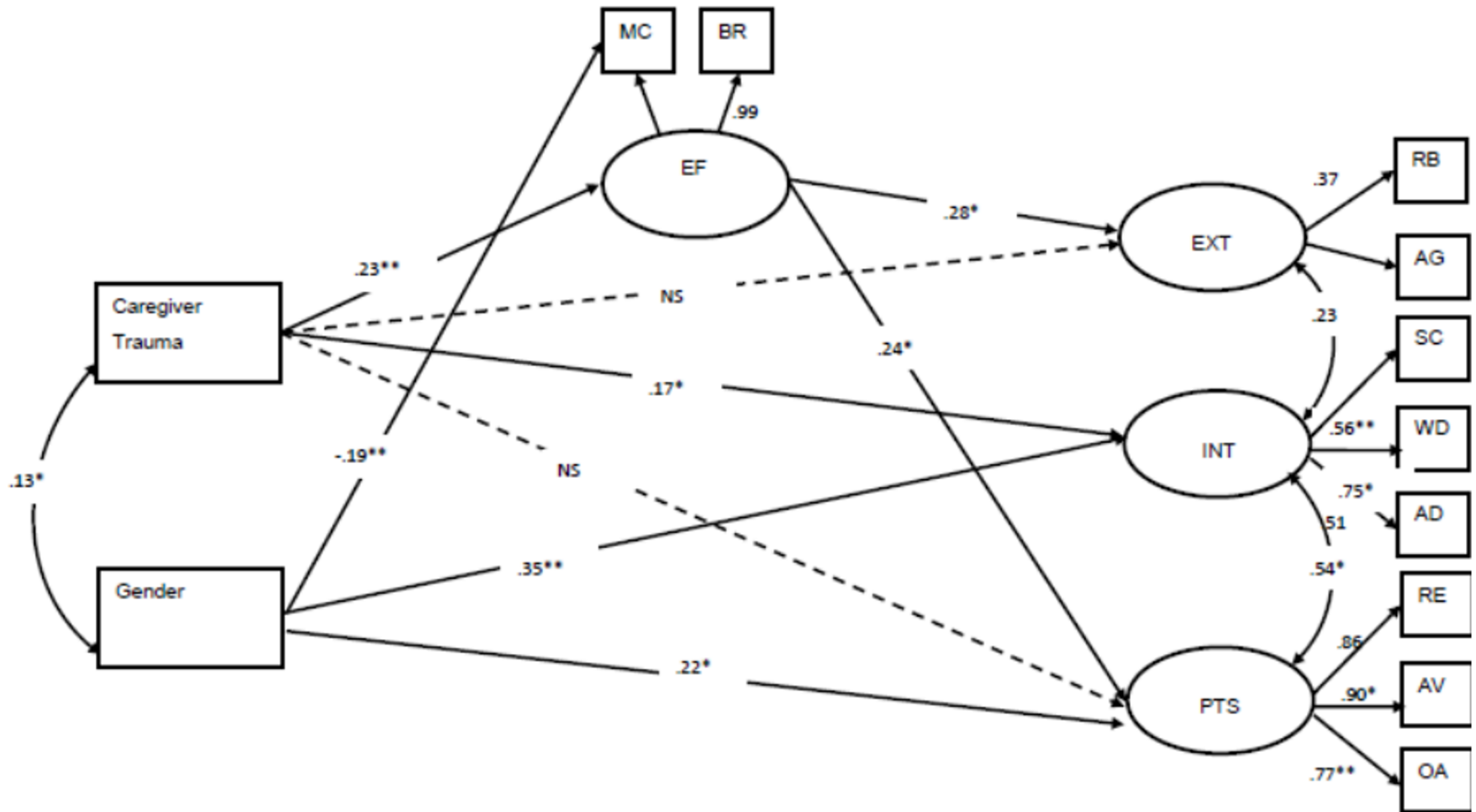
# Executive Function in Action



Video Credit: Special thanks to Watermark Community Church  
(<http://www.Watermark.org>)



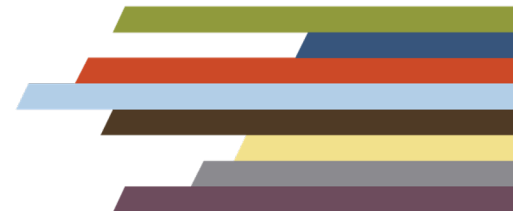
# Transdiagnostic Factor?



273 polyvictimized youth in residential care

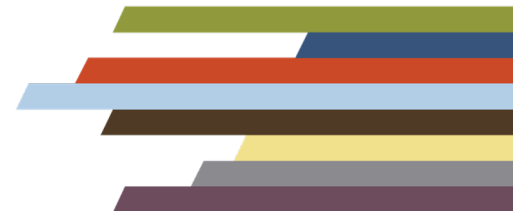
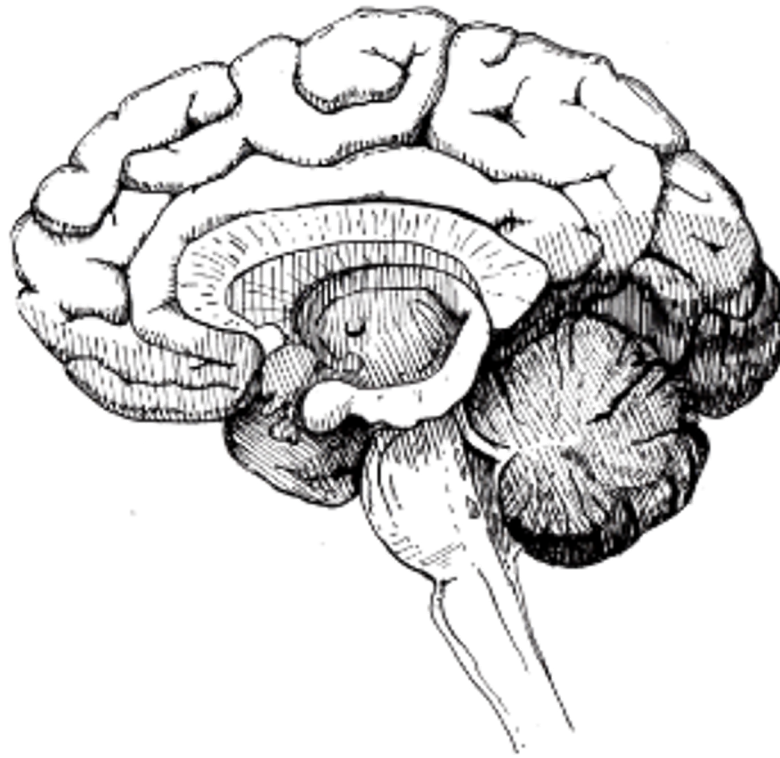
Caregiver trauma = physical, sexual & psychological maltreatment, DV, impaired caregiving, neglect, separation, loss

# Trauma and the Brain Review



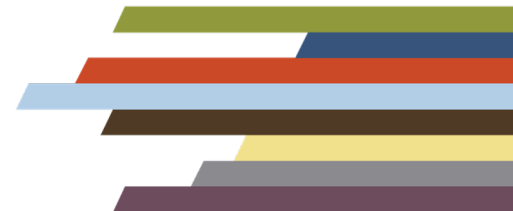
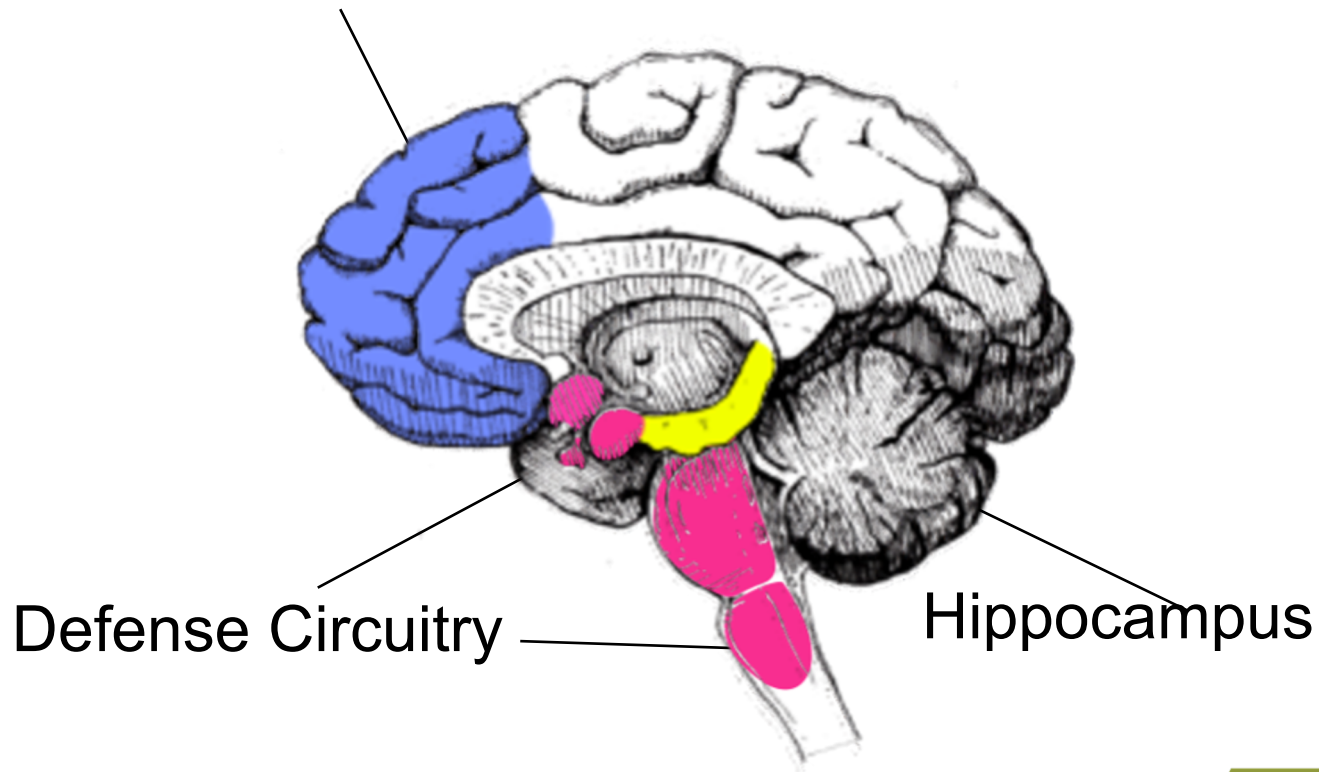
# Role of the Brain

**Make sure the body survives.**



# Brain Fundamentals

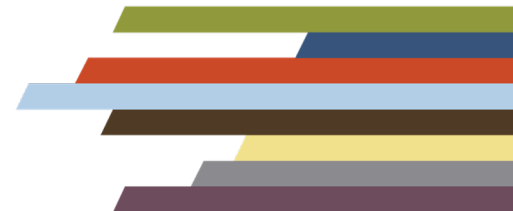
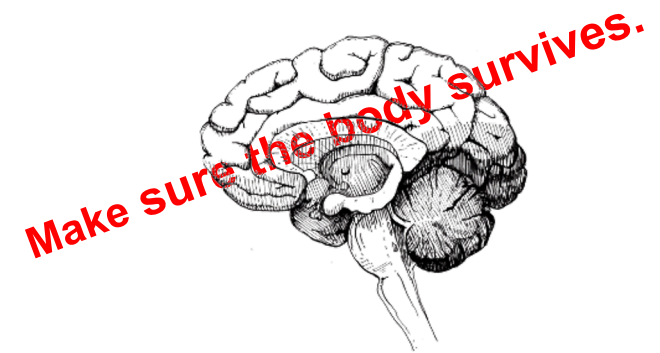
**Prefrontal cortex: Brain  
area central in EF**



# Brain and Body Reactions to Trauma: Survival Response

During traumatic event:

- **Prefrontal cortex** impaired
- Defense circuitry in control
- Brain's **automatic** survival response takes over

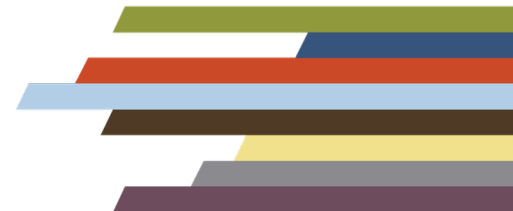




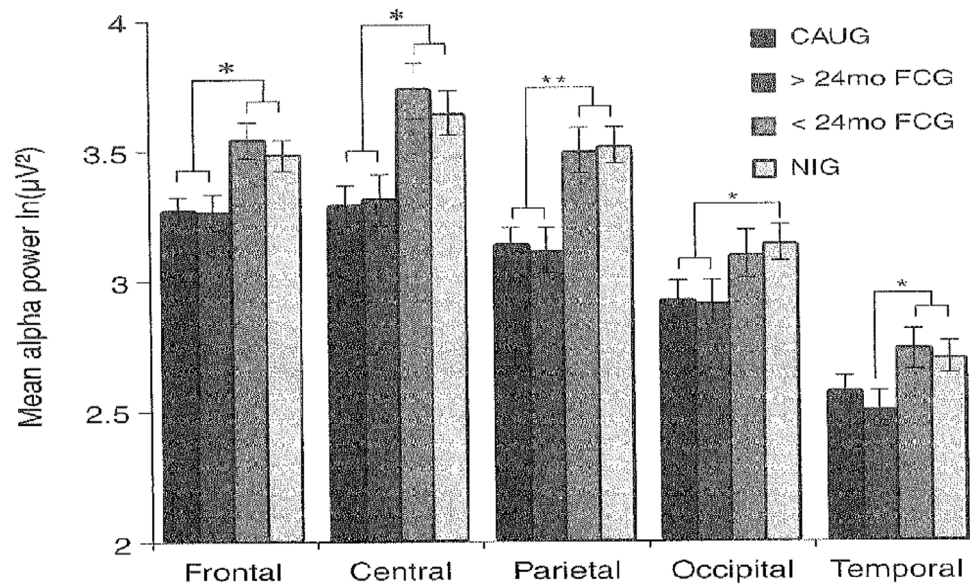
# Impact on Executive Functions



Photo credit: [http://www.cbsnews.com/8301-504763\\_162-57390975-10391704/adhd-more-common-among-youngest-kids-in-class-overdiagnosed/](http://www.cbsnews.com/8301-504763_162-57390975-10391704/adhd-more-common-among-youngest-kids-in-class-overdiagnosed/)



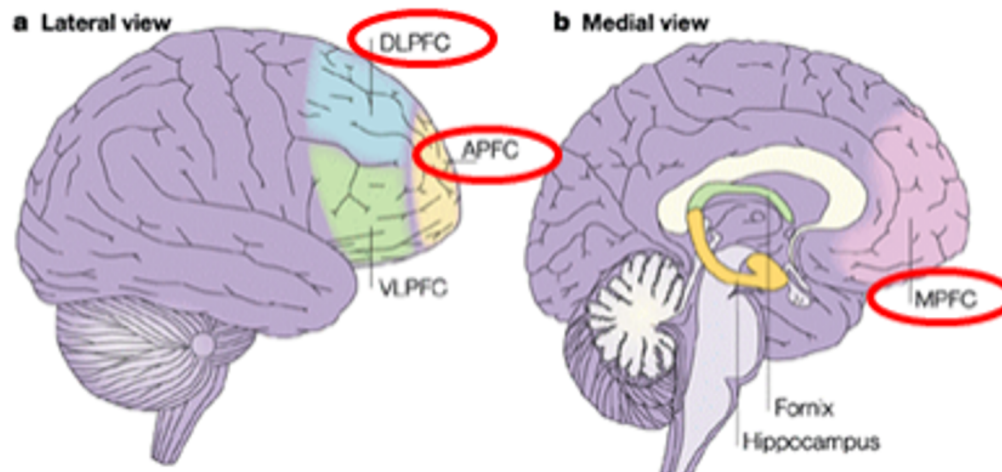
# Institutionalized Children: Cortical Maturity



*Figure 8.3.* Mean alpha power for four groups at eight years of age: children placed into foster care before twenty-four months; children placed in foster care after twenty-four months; children randomized to remain in the institution; and community controls. As can be seen, the children placed into foster care before twenty-four months of age are indistinguishable from community controls.

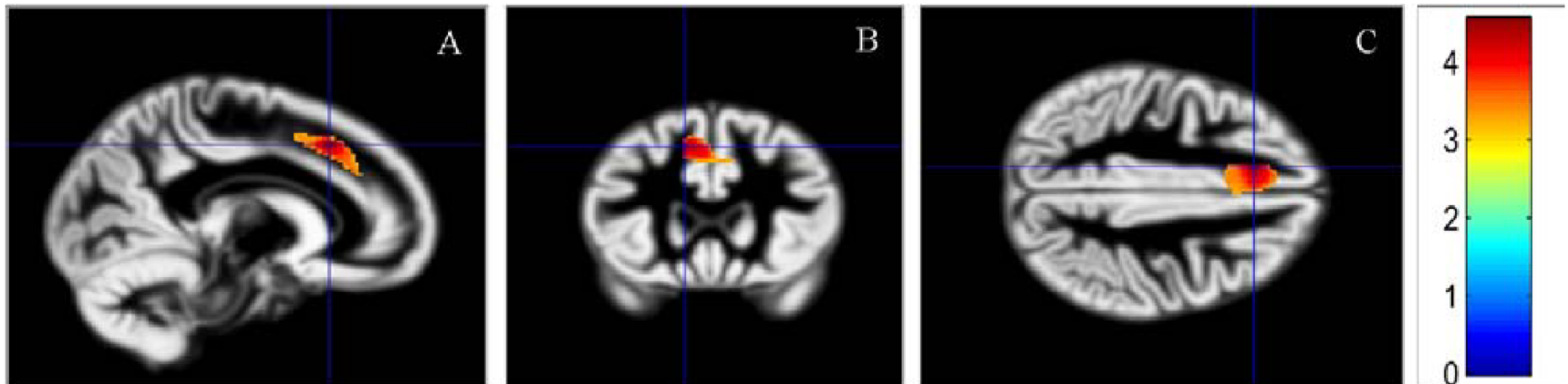
# Prefrontal Cortex

- Dorsolateral PFC (DLPFC):
  - Motor planning, organization, & regulation.
  - Integration of sensory and mnemonic information.
  - Regulation of intellect.
  - Working memory.
  - Reduced size / functioning among maltreated children – related to deficits in inhibitory control (Carrion et al., 2007).



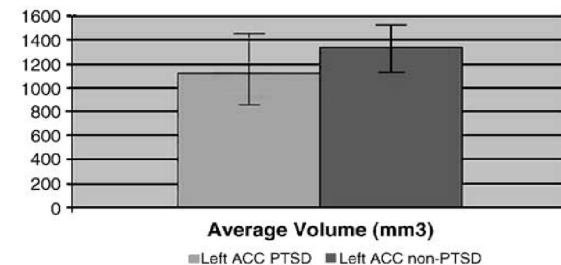
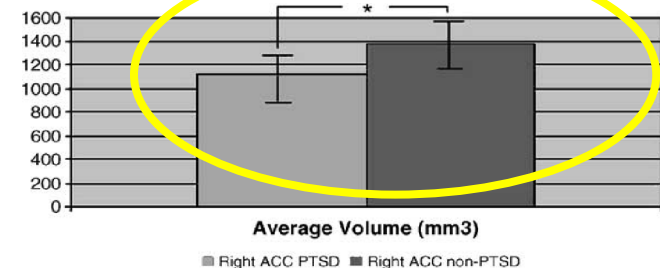
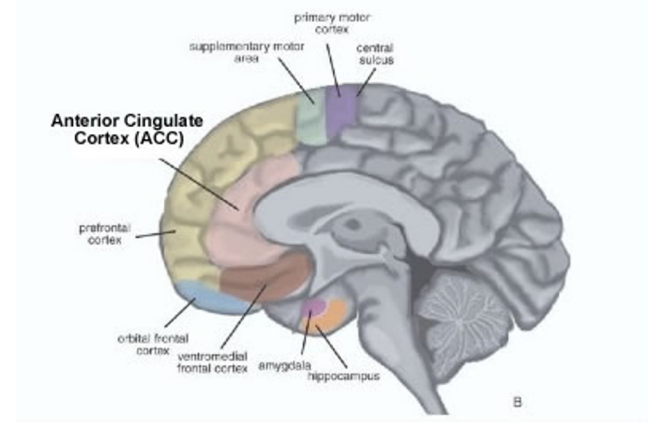
# Medial PFC

- Emotional maltreatment history (no physical / sexual abuse) associated with 7% volume reduction in mPFC.
- Independent of gender or psychiatric diagnosis.
- Impact on ability to regulate, self-reflect and make sound decisions?



# Anterior Cingulate Cortex (ACC)

- Interface between the limbic system and the neocortex.
- Regulates emotion and cognition:
  - Emotional awareness, identification and modulation.
  - Attention, inhibition.
  - Error detection and reward based decision making / learning.
- Reduced size noted in adults w. PTSD related to history of child maltreatment.

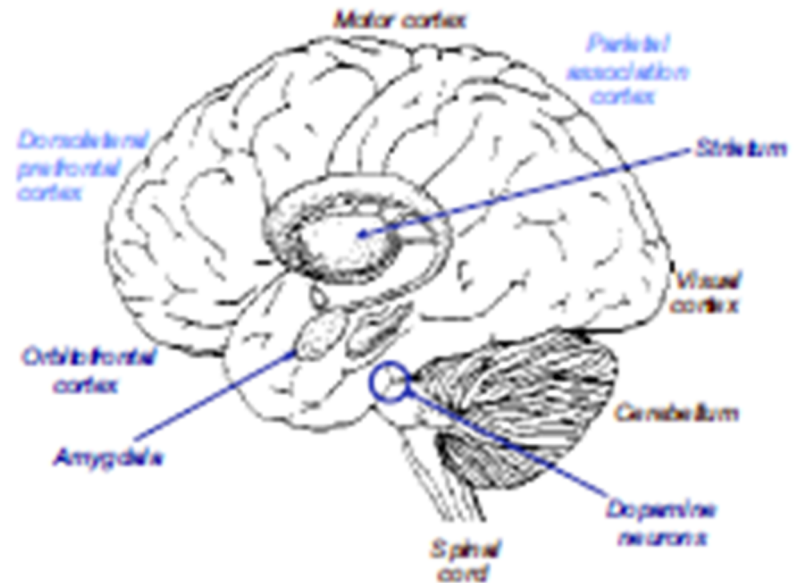


# Disrupted Reward Circuit

Reduced response in striatum:

- Orphans w. early deprivation.
- Children w. RAD
- Maltreated children at risk for depression.
- Adults w. hx of early adversity and / or maltreatment.

- Teicher & Samson, 2016



**FIGURE 3.** Principal brain structures for reward and decision-making. Dark blue: main structures containing various neuronal subpopulations coding reward without sensory stimulus or motor action parameters ("explicit reward signals"). Light blue: structures coding reward in conjunction with sensory stimulus or motor action parameters. Maroon: non-reward structures. Other brain structures with explicit or conjoint reward signals are omitted for clarity.

Figure: Schultz, 2015



# Disrupted Reward Circuit

BUT note – this is in response to a monetary (i.e. abstract) reward...

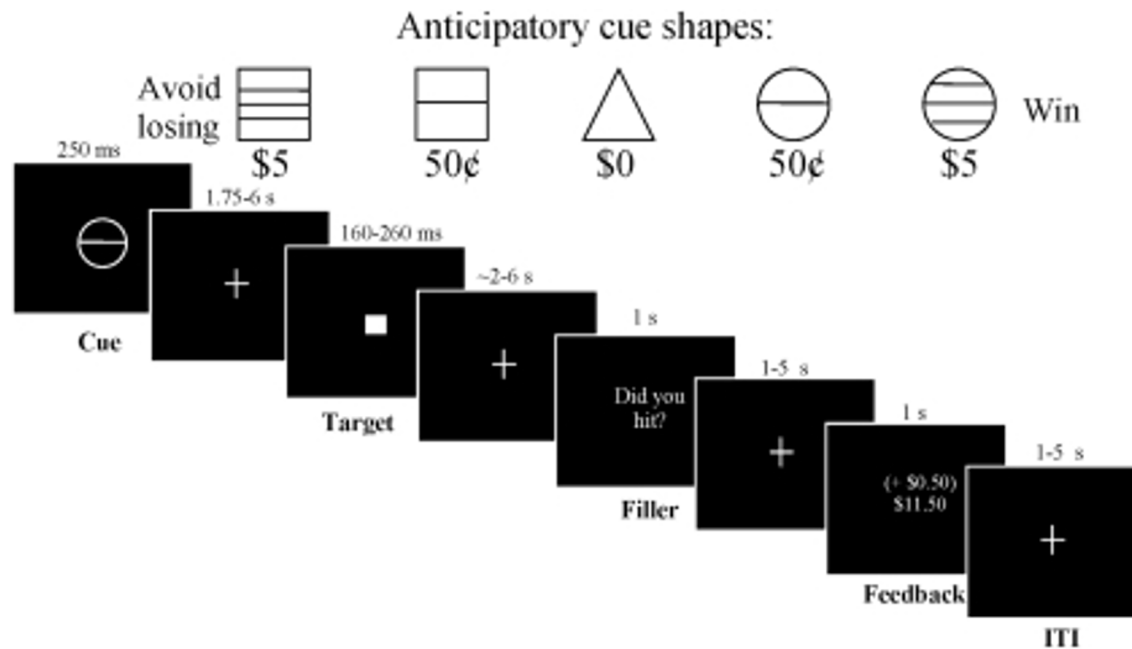
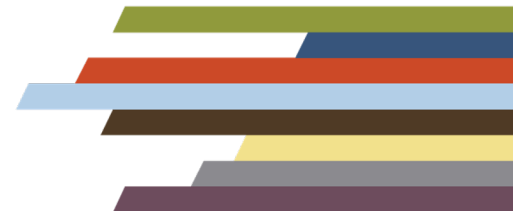


Figure: Schultz, 2015

# Executive Functions

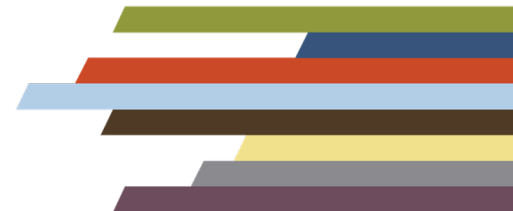
- Attention:
  - Auditory and visual attention deficits across a range of maltreatment exposures (Beers & De Bellis, 2002; De Prince et al., 2009; Nolin & Ethier, 2007).
- Inhibition:
  - Poor inhibitory control consistently found in maltreated children, adolescents and adults (Hart & Rubia, 2012).
- Extreme early deprivation linked to inattentive and hyperactivity symptoms that were greater than observed among “standard” ADHD cases (Sonuga-Barke & Rubia, 2008).





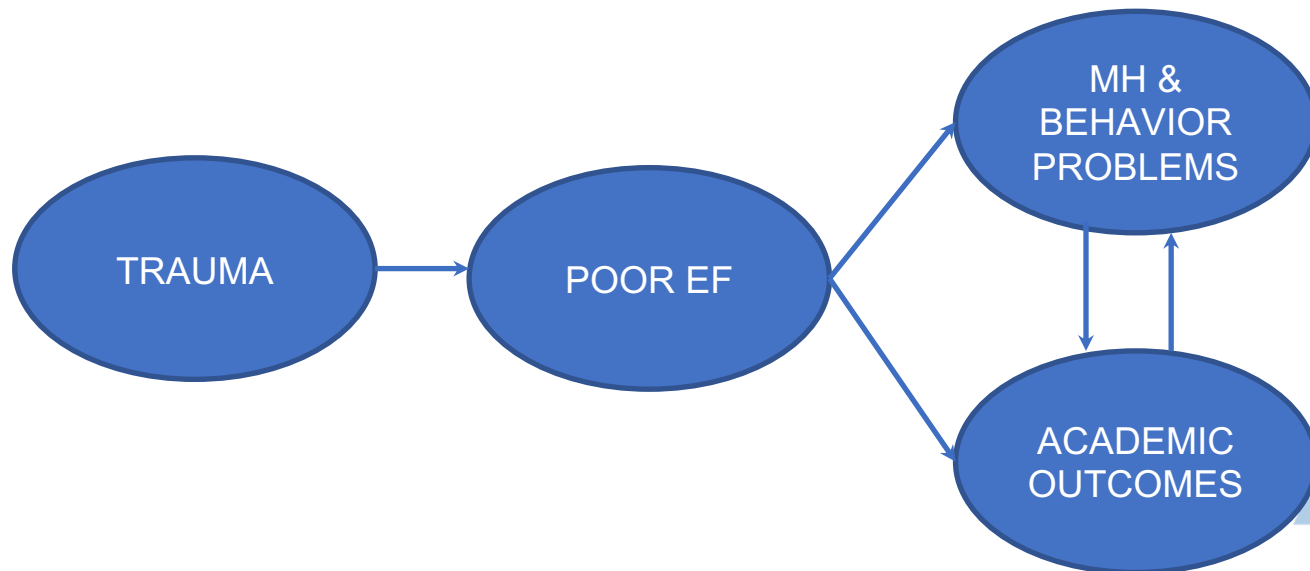
# Educational Impacts of Trauma

- Intelligence (IQ):
  - Lower among children across maltreatment types (Carrey et al., 1995; De Bellis et al., 2009; Prasad et al., 2005; Pollak et al., 2005).
  - “Dose response” – higher severity of maltreatment related to lower IQ.
  - Adult studies suggest IQ may “normalize” with age (i.e. no connection between child maltreatment and adult IQ scores).



# Educational Impacts of Trauma

- **Poorer academic performance** (Kendall-Trackett & Eckenrode, 1996; Loman et al., 2009; Majer et al., 2010; Navalta et al., 2006).
- **Lower educational attainment and greater grade retention** (Bethell et al., 2014; Porche, Costella, & Rosen-Reynoso, 2016).
- **Achievement gaps tend to widen and persist across elementary school** (McClelland, Acock, & Morrison, 2006).

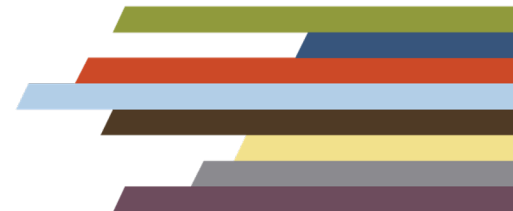


# “Modifiable Resilience Factor”

- EF skills are linked to:
  - School readiness
  - Successful participation in classroom learning – persistence, self-reliance, and motivation.
  - Academic success across a range of outcomes.

“Executive functioning skills are malleable, meaning they can change and are influenced by both positive and negative experiences.” (Zelazo et al., 2016)

Mindfulness interventions have been shown to bolster the development of EF. (Zelazo, Forston, Masten, & Carlson, 2018)

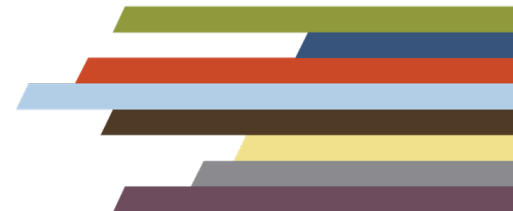


# Polling Question

Interventions to enhance EF include mindfulness, yoga, meditation, protective adults, and predictability (routines, expectations, etc.)

**At your school/in your classroom, to what extent are you implementing any of these kinds of interventions?**

Multiple choice options: 5 = Regularly; 4 = Often; 3 = Sometimes; 2 = A little; 1 = Not at all

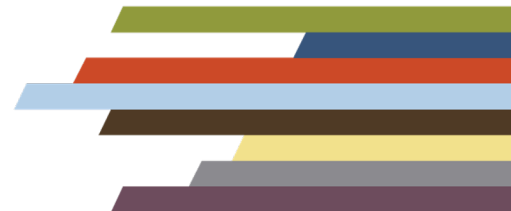


# Polling Question

Interventions to enhance EF include:  
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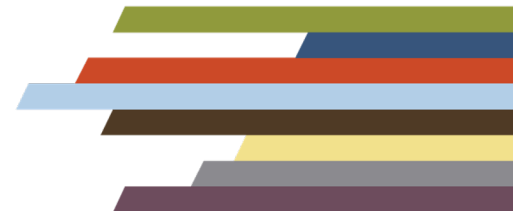
At your school/classroom to what extent are you  
implementing any of the above?

Scale of 1-5, 1 being high



# Summary

- Trauma-impacted children's brains may be less "equipped" to respond effectively to the demands of school.
- Disruptions in executive function contribute to a number of mental health, behavioral, and cognitive challenges that disrupt academic success.
- Interventions focused on building regulation and executive function may help these children engage in school more successfully.





# Thank You

## Contact

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