

The game -

- We'll going to have everyone say as many colors from this picture as possible. Each color verbalized needs to be one word
- I'll keep track of the colors that are mentioned
- The last person who says a color in the picture that has not been said before wins!
- We'll do this for 10 minutes max



EXECUTIVE FUNCTIONING – WHY YOUR CHILD NEEDS THESE SKILLS


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During this talk

- What is executive functioning?
 - Why do children need to develop these skills?
 - What kinds of conditions affect executive functioning?
 - What can we do to help nurture executive functioning in our children?
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What is Executive Functioning?

- These are higher types of brain functioning
 - Organizing
 - Being Flexible
 - Inhibition
 - Self-Regulation
 - Strategic Planning
 - Goal-Directed behavior



In a typical day, does your child ever have to...

- Pay attention to something - even if it's totally boring?
- Ignore the things that distract you from the thing you have to pay attention to?
- Hold several pieces of information in your head at the same time?
- Stifle impulses to say or do things that could get you in trouble?
- Change what you're doing in response to a change in circumstances?

How Does It Affect Children?

- Goal-Directed Behavior and Self Regulation are both really essential for Activities of Daily Living:
 - Bathing and teeth-brushing
 - Meals
 - Chores
 - Getting into the car or catching the bus to get to school and other places
- EF facilitates adaptation to complex or new situations

How Does It Affect Children?

- Children need organizing skills, flexibility, and all of the other executive functioning skills for school activities
- Risky behavior can occur with poor inhibition including drug use, violence, sexting, etc.



How Does It Affect Children?

- Without executive functioning:
 - Simplified or confused mental tracking of actions
 - Problems with organizing, and following plans
 - Difficulties with reasoning and decision making
 - Perseveration of speech and action

Cool or Hot EF



- Metacognitive or Cool EF include goal-directed, future-oriented skills such as planning, inhibition, flexibility, set-shifting, and working memory, typically assessed in non-emotional testing conditions.
- Emotional or Hot EF, in turn, operate in contexts that involve emotion, motivation, or reward-based decision making.

Cool or Hot EF

- It has been suggested that metacognitive and emotional EF are closely related and interdependent.

Moreira HS, Costa AS, Castro SL, Lima CF and Vicente SG. Assessing Executive Dysfunction in Neurodegenerative Disorders: A Critical Review of Brief Neuropsychological Tools. *Front. Aging Neurosci.* (2017) 9:369. doi: 10.3389/fnagi.2017.00369

How Do Scientists and Physicians Learn About EF?

- Brain lesions and effects
- Neuropsychological studies in injuries and diseases
- Anatomical and functional neuroimaging
- Experiments in psychology and neurophysiology
- Developmental and life span studies have mapped pathways of cognitive control abilities across the life course, and identified their links to frontal cortex maturation and deterioration

Research is Hopping!

- 1990's - Decade of the Brain
(<http://www.loc.gov/loc/brain/>) -> Human Connectome Project (<http://www.humanconnectomeproject.org/>)
- Projecting into the future with a number of large-scale initiatives such as the
 - United States's Brain Initiative (<http://www.braininitiative.org/>),
 - European Union's Human Brain Project (<https://www.humanbrainproject.eu/en/>),
 - Australian Brain Alliance (<http://www.ausbrain.org.au/>)



What Part of the Brain is Involved?

- Traditionally, frontal lobes, but more recent information -
- Frontal, parietal, and cerebellar lobes were most frequently associated with EF when comparing results from different clinical populations; the occipital lobe was not correlated with EF in any group.

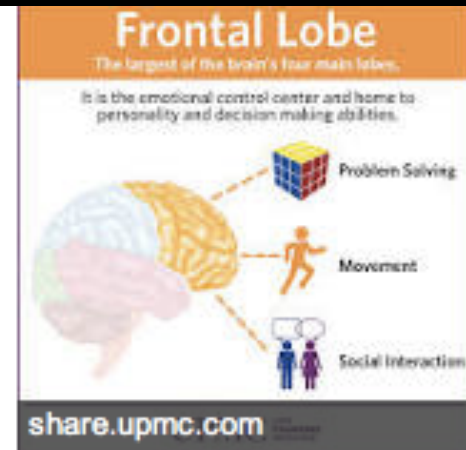
Nowrangi M.A., Lyketsos C., Rao V. Munro C.A. Systematic Review of Neuroimaging Correlates of Executive Functioning: Converging Evidence From Different Clinical Populations. *The Journal of Neuropsychiatry and Clinical Neurosciences* 2014; 26:114–125

Frontal Lobes

There is no other part of the brain where lesions can cause such a wide variety of symptoms (Kolb & Wishaw, 1990). The **frontal lobes** are involved in motor **function**, problem solving, spontaneity, memory, language, initiation, judgement, impulse control, and social and sexual behavior.

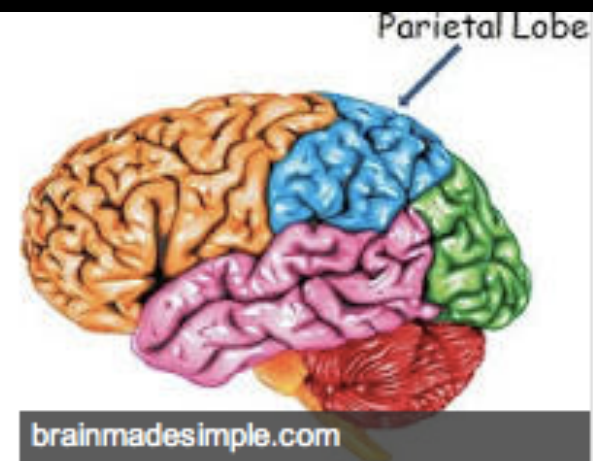
Traumatic Brain Injury Resource Guide - Frontal Lobes

<https://www.neuroskills.com/brain-injury/frontal-lobes.php>



Parietal Lobes

The **parietal lobes** can be divided into two **functional** regions. One involves sensation and perception and the other is concerned with integrating sensory input, primarily with the visual system. The first **function** integrates sensory information to form a single perception (cognition).



Traumatic Brain Injury Resource Guide - Parietal Lobes

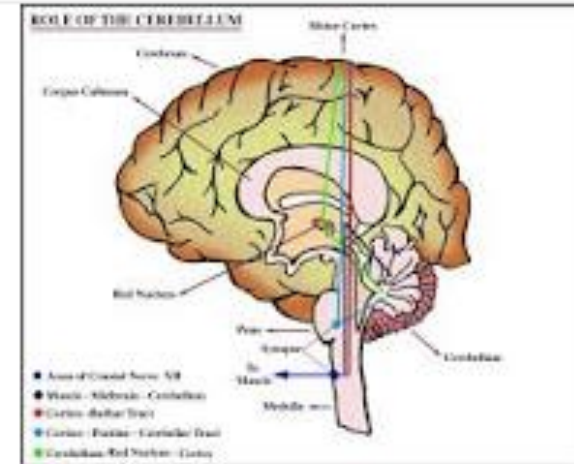
<https://www.neuroskills.com/brain-injury/parietal-lobes.php>

Cerebellar Lobes

It receives proprioceptive input from the spinal cord and controls the anti-gravity muscles of the body, thus regulating posture. The posterior **lobe**, or neocerebellum, is the newest part of the **cerebellum**. It is involved in the coordination of muscle movement via the inhibition of involuntary movement.

The Cerebellum - CSU, Chico

<https://www.csuchico.edu/~pmccaffrey/syllabi/CMSD%20320/362unit7.html>






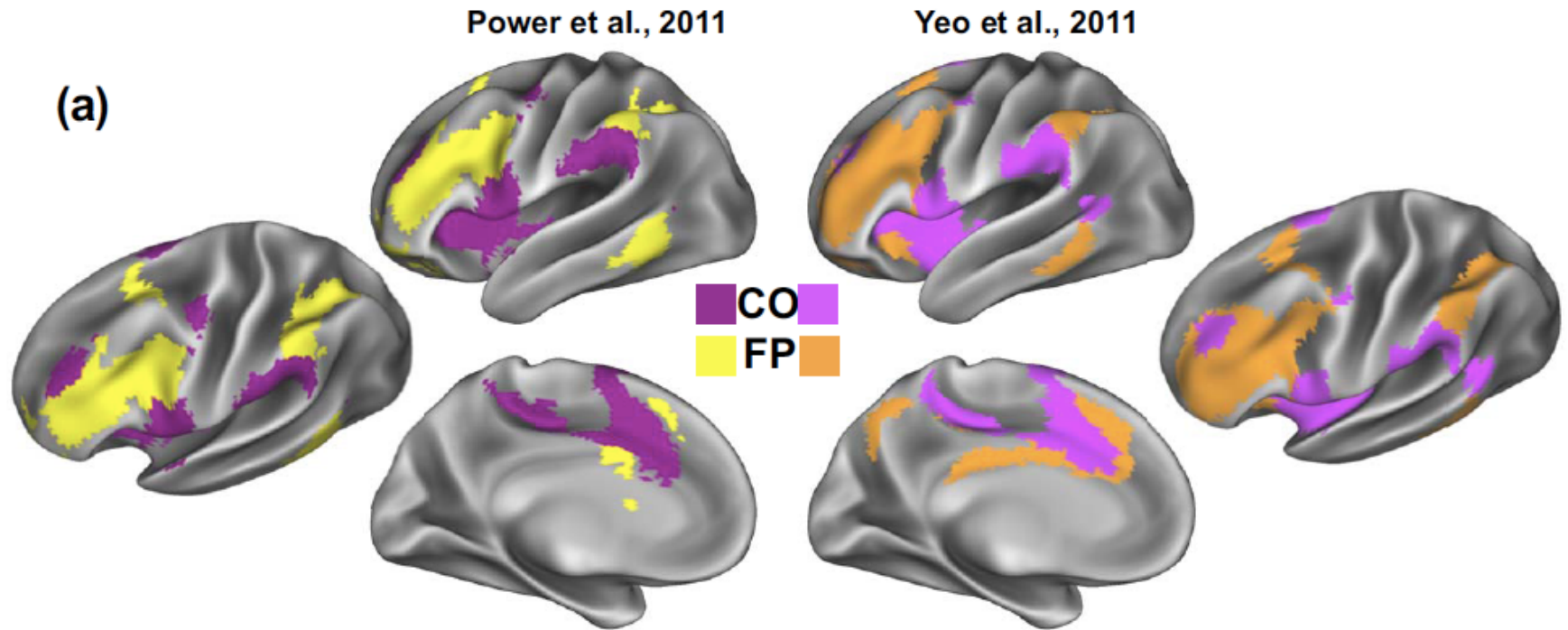
Networks

- Executive control functions are associated with brain regions that interact through distributed large-scale networks

Gratton C., Sun H., Petersen S.E., Control networks and hubs. *Psychophysiology*. 2018;55:e13032.




Cinguloopercular (CO) and Frontoparietal (FP) networks





Summary of Anatomy

- Certain parts of the brain are involved – frontal lobes, parietal lobes, cerebellar lobes
 - Executive Functioning are controlled by networks
 - Injury to any part or interfering with the network can lead to executive functioning problems
- 

What Kinds of Medical Conditions Affect Executive Functioning?

- Premature birth
- Neurodegenerative processes
 - This is particularly in adults around dementia, but children also can have a neurodegenerative condition
- Traumatic brain injury
- Vascular disease including stroke
- Psychiatric disorders such as schizophrenia and depression

Being Poor - Poverty

- Children with lower Socio-Economic Status (SES) show lower levels of EF skill, even taking into account general cognitive skills.
- They also show higher levels of stress and stress hormones, which undermine the use of EF skills and interfere with EF development

Zelazo PD, Forston JL, Masten AS and Carlson SM. Mindfulness Plus Reflection Training: Effects on Executive Function in Early Childhood. 2018. Front. Psychol. 9:208.

Cancer


- Up to 30 percent of patients with cancer exhibit cognitive impairment prior to treatment
- Up to 75 percent have measurable cognitive impairment during treatment
- 35 percent of cancer survivors will continue to exhibit cognitive difficulties in the months to years that follow treatment

Janelains M, Kesler S, Ahles T, Morrow G. Cancer-related cognitive impairment. *Int Rev Psychiatry*. 2014; 26: 102-113.



Cancer

- Attention, memory, and executive functioning are the most frequently identified cognitive domains impacted by cancer.



Pendergrass J.C., Targum S.D., Harrison J.E .
Cognitive Impairment Associated with Cancer: A
Brief Review Innovations in Clinical Neuroscience,
January–February 2018, Volume 15, Number 1–2




Attention Deficit Hyperactivity Disorder

- EF issues with inhibitory control overlap with clinical features of impulsivity and hyperactivity



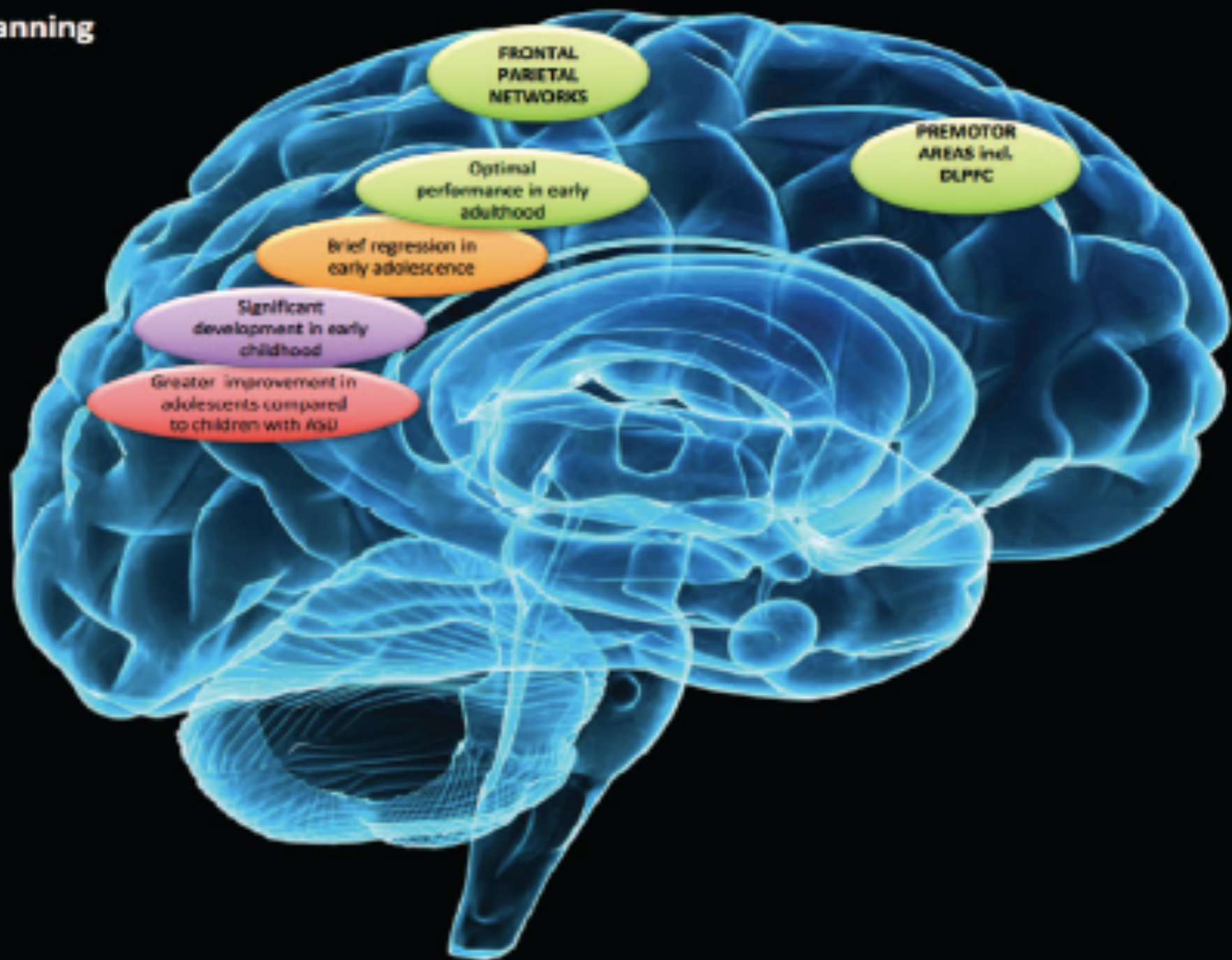
Autism Spectrum Disorder

Next few pictures and information from:

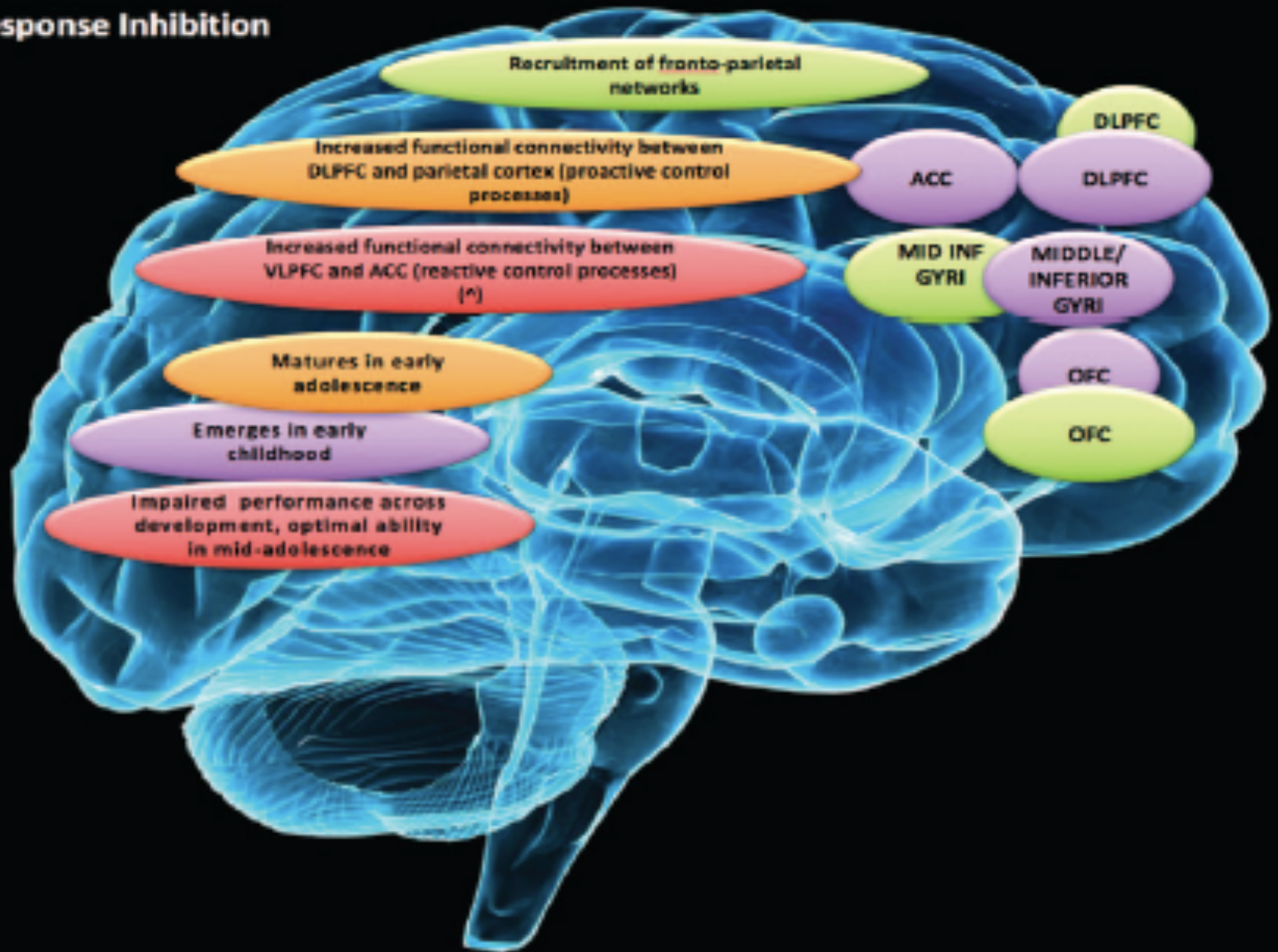


EA Demetriou E.A., et al. Autism spectrum disorders: a meta-analysis of executive function. *Molecular Psychiatry* (2017) 00, 1–7

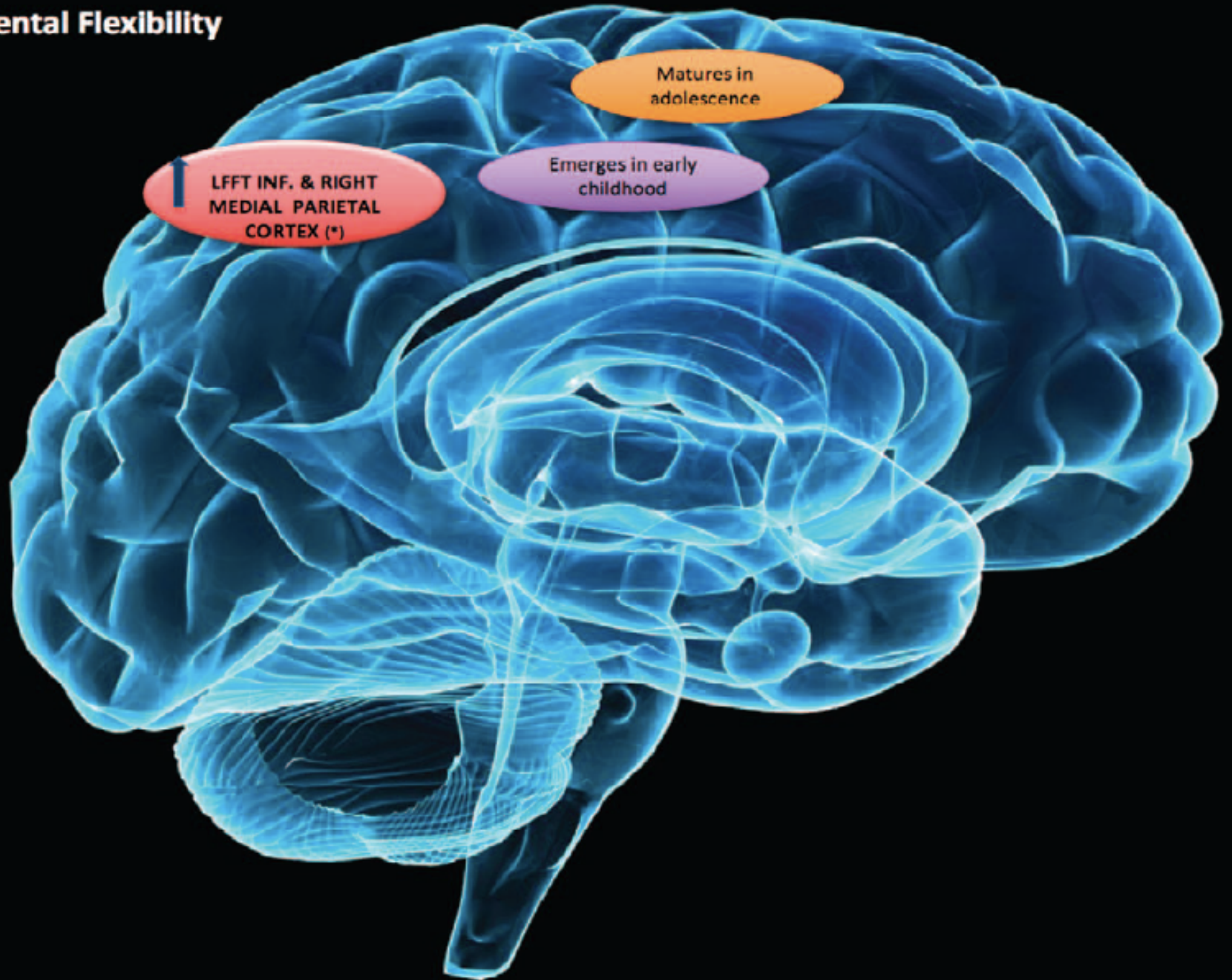
Planning



Response Inhibition





Mental Flexibility





Autism Spectrum Disorder and EF

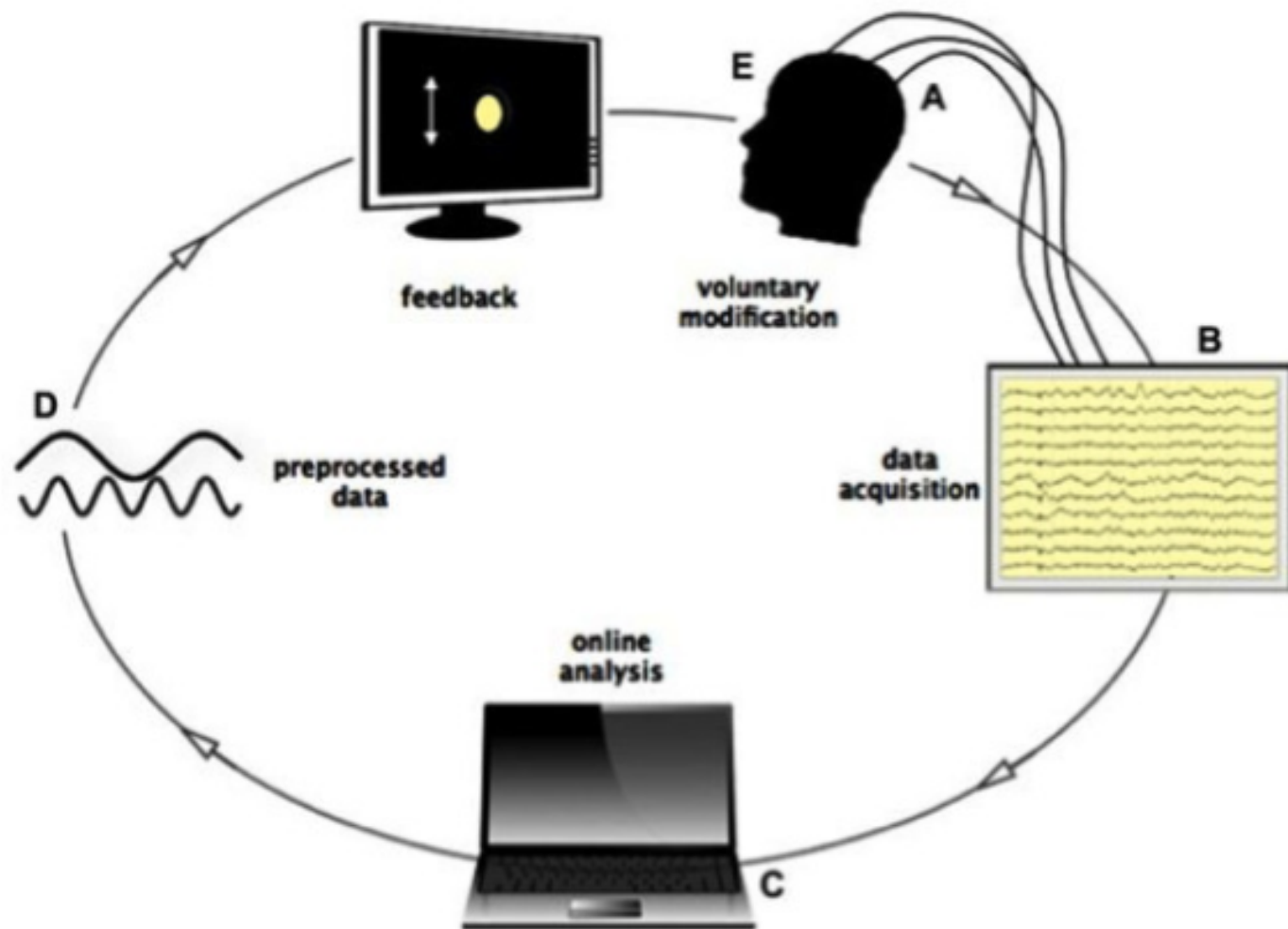
- Individuals with a diagnosis of ASD performed on average significantly worse on EF in comparison with neurotypical controls.
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Strategies to Possibly Improve Executive Functioning Skills


- Physical Activity
- Music Training
- Neurofeedback
- Technological aids
- Mindfulness plus reflection training
- Medication

Figure 1. Neurofeedback intervention loop. This figure is adapted from Bagdasaryan and Le Van Quyen. It depicts a simplified overview of neurofeedback that is delivered via electroencephalography (EEG) (Bagdasaryan 2013). During the neurofeedback session, the individual's brain signal is acquired through the EEG equipment (A, B). The software processes the incoming brain signal and provides information about the degree of alignment between the participant's real-time brain activity and predetermined training goal parameters (C, D). This information is presented to the participant as visual or auditory feedback in real time, to continuously update the participant about modulation of his or her own brain activity (E; Bagdasaryan 2013; Huster 2014).





Technological Aids

- Come in a variety of forms, including:
 - electronic organizers
 - pagers
 - mobile phones
 - web-based scheduling
 - voice recorders
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Example – NeuroPage System

- For example, the NeuroPage system is a reminder system that was developed in California by the father of a young man who suffered a brain injury and the young man's neuropsychologist.






Neuropage

- The Neuropage system utilizes a paging service that sends a reminder or cue to an individual at predetermined points. This system removes the need for the individual to remember to use the device, does not require complicated instructions on its use, and is relatively discrete



Smartphones

- These have the possibility of creating applications (or 'apps') that can target specific cognitive deficits
 - Can be discreetly contained within an attractive and desirable piece of technology (which is good for teenagers)
- 

Shucks

- A review found evidence that interventions employing technological aids did improve executive functions in adolescents with traumatic brain injury (i.e. a brain injury resulting from a road traffic accident, fall, or blow to the head). However, this result was relatively modest and is unlikely to have a clinically important effect on the child.

Linden M, Hawley C, Blackwood B, Evans J, Anderson V, O'Rourke C. Technological aids for the rehabilitation of memory and executive functioning in children and adolescents with acquired brain injury. *Cochrane Database of Systematic Reviews* 2016, Issue 7. Art. No.: CD011020.

Mindfulness and Reflection

- Mindfulness training (e.g., belly breathing; body scan) is expected to help children calm down, regulate stress, become aware of moment-to-moment experience, and sustain attention
- Reflection training in the context of EF games should also help children recognize when they need to “go off autopilot” and instead act deliberately, relying on their EF skills to achieve their goals.

Mindfulness apps

- Apps- Apps are a great tool to use with students, since they typically enjoy using technology. [Headspace](#), [Calm](#), and [Smiling Mind](#) are apps that students have liked.
- Encourage your child to try a few in order to find the best fit. Headspace's guided meditations are 10 minutes each, and Calm has slightly shorter ones. Smiling Mind offers different meditations depending on a child's age. Additionally, Smiling Mind allows greater choice when deciding on the type of meditation to use.

Mindfulness Scripts

- Scripts- There are many activities and scripts available for parents to use with their children when teaching mindfulness. Here are a few that might be helpful:
- Breathing Buddies- Daniel Goleman explains how to teach students mindful breathing using stuffed animals
- Mindful Eating- Many mindfulness programs incorporate the mindful eating of a raisin or chocolate kiss.
- Spiderman Meditation- For superhero fans, this uses a Spiderman script to walk you through teaching your child to become aware of what he/she is sensing with all five senses.

Breathing Buddies



Breathing Buddies



- 1. To practice belly-breathing, ask your child to lie comfortably and place his hands on his belly (if he uses a stuffed animal, he can hold it on top of his belly if he lies down).
- 2. As you count to three, ask him to inhale deeply through his nose. Tell him to fill his belly with air as he inhales; he should feel it get bigger and bigger and bigger throughout the count to three. If his stuffed toy sits atop his belly, he might see it rise as his belly “fills with air”.
- 3. Ask him to exhale to a slow count to four. Tell him he might see his toy fall as he feels his belly shrinking and shrinking throughout the count to four.
- Do five to ten rounds of belly-breathing to get started.

6 Ways to Practice Mindful Eating

Mindless Eating

- 1** Eating past full and ignoring your body's signals
- 2** Eating when emotions tell us to eat (i.e., sad, bored, lonely)
- 3** Eating alone, at random times and places
- 4** Eating foods that are emotionally comforting
- 5** Eating and multitasking
- 6** Considering a meal an end product

Mindful Eating

- Listening to your body and stopping when full
- Eating when our bodies tell us to eat (i.e., stomach growling, energy low)
- Eating with others, at set times and places
- Eating foods that are nutritionally healthy
- When eating, just eating
- Considering where food comes from

Spiderman script

- Right now we are going to learn to activate your super powers to tune into your senses, just like Spider--Man. These are your Spider--Man Super Senses. What it takes is a little practice. Let's start with your sense of hearing.
- First let's sit down. Close your eyes and place your hands on your knees. I am going to ring a bell. When you hear the bell, pay attention to the ring until you can no longer hear the ringing sound, clasp your hands together in your lap. (Repeat 3 times). Like Spiderman, we have activated your super power of ultra hearing! Excellent work!
- Next we are going to activate your super powers of ultra seeing, touching and smelling. I'm going to give each of you a flower. Hold your flower gently in your hand. When I ring the bell, I want you to gently touch the petals. Feel what each petal is like beneath your fingers. Pay attention to if the petal is soft, rough, wet, furry, smooth, or prickly. See what you can feel. Imagine, like Spiderman, your hands have the power to sense very carefully what the flower feels like...



Mindfulness Websites

- Websites- Gonoodle.com and calm.com are resources for parents to use when looking for short mindfulness activities. Headspace also has a website that functions similarly to the app.

Apps, Scripts and websites are those suggested in the website Beyond BookSmart

Medication

- Stimulant
- Non-stimulant
- These are medications that are used in ADHD, which has executive functioning issues





In Adults

- Goal Management Training
 - Cognitive Rehabilitation
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Goal Management Training®

- Goal Management Training®, developed in collaboration is a practical, manualized intervention that addresses cognitive deficits including executive functioning through education, task practice, narrative structure and mindfulness practice

Goal Management Training®

- The GMT procedure encompasses training 5 steps, each emphasizing one important aspect of goal-directed behavior: (1) stop: orient awareness toward the actual state of the situation; (2) define: the goal of the task; (3) list: the task into sub-steps; (4) learn: the steps; (5) check

Goal Management Training®

- GMT is centered on a simple instruction, to “STOP!” the automatic pilot and state one’s goals periodically before and during task execution. The theoretical framework for this intervention is derived from the hypothesis that the brain’s sustained attention network supports executive function. Lapses in sustained attention associated with slips of intention can be avoided through periodic alerting of the sustained attention system.

Goal Management Training®

- The summarised evidence has shown effects on patients with a variety of etiologies (ABI, older adults, substance dependence, MS, cerebrovascular disease (CVD), ADHD and spina bifida).

Stamenova V, Levine B. Effectiveness of goal management training® in improving executive functions: A meta-analysis, *Neuropsychological Rehabilitation*, 2018 DOI: [10.1080/09602011.2018.1438294](https://doi.org/10.1080/09602011.2018.1438294)


Cognitive Rehabilitation

Many possible interventions:

- 1) planning and organisation skills development (e.g. training that begins with tasks with fewer stages building up to more complex tasks);
- 2) problem-solving and strategy formation techniques including goal management training (e.g. training in conscious problem-solving techniques that are intended to become more automatic with practice)



Cognitive Rehabilitation

- 3) self awareness and self regulation of behavior (e.g. pre- and post-task scoring to develop awareness of task performance);
 - 4) initiation of behaviors (e.g. goal-related scheduled tasks to train initiation);
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Cognitive Rehabilitation

- 5) inhibition of prepotent responses (e.g. training tasks designed to elicit conscious responses dependent on inhibiting an automatic response such as sentence completion with words that do not make sense)
- 6) use of written strategies and electronic technology (e.g. using a mobile phone timer to stop one activity and move to another)

Cognitive Rehabilitation

- 7) self instruction techniques (e.g. self talk through the stages of a task to be undertaken)
- 8) feedback methods including mirror and video feedback (e.g. training in the use of self reflection from the person viewing a video recording of their own task performance);



Cognitive Rehabilitation

- 9) systematic problem-solving procedures (e.g. training in the use of self cueing stages including, stop, think through the stages of the task to be undertaken, perform the stages one at a time, review performance).

Cognitive Rehabilitation

- 10) techniques and equipment that compensate for sensorimotor impairment (e.g. developing one-handed dressing techniques, or visually checking on hand grip when pulling trousers up using the weak upper limb)
- 11) the use of written lists and diaries that compensate for impaired organisation and planning skills (e.g. following a shopping list step-by-step, or using a systematic problem-solving procedure during meal preparation).

Shucks

- Researchers identified insufficient high-quality evidence to reach any generalized conclusions about the effect of cognitive rehabilitation on executive function, or other secondary outcome measures.

Chung CSY, Pollock A, Campbell T, Durward BR, Hagen S. Cognitive rehabilitation for executive dysfunction in adults with stroke or other adult non-progressive acquired brain damage. Cochrane Database of Systematic Reviews 2013, Issue 4. Art. No.: CD008391.

The Age When Supports Occur May Make a Difference

- Executive functions develop rapidly during childhood (from about the age of six years) and adolescence
- The growing research in neuroplasticity informs us that integral to the maturation of a child's nervous system are sensitive (but not necessarily critical) periods for development
- During these sensitive periods, the brain is particularly susceptible to change through experience, with potential for diminished remediation in adulthood.



Summary

- A variety of methods may or may not be helpful in improving executive functioning in children
 - Physical Activity
 - Music Training
 - Neurofeedback
 - Technological aids
 - Mindfulness plus reflection training
 - Medication