Fostering Executive Skills

in Pre-School & School Age Children

Evidence-Based Workshop

Ages 2–5 (Pre-School) • Ages 6–12 (School Age)

A 3-Hour Evidence-Based Professional Workshop

Grounded in peer-reviewed research • Diamond, 2013 • Blair & Razza, 2007 • Zelazo et al., 2016 • Moffitt et al., 2011

SUNSHINE COAST HEALTH CENTRE

GEORGIA STRAIT WOMEN'S CENTRE

Presenter: Dr. Carissa Muth | Date: May 12, 2026

Registered Psychologist • 3 CEU Hours

What Are Executive Functions?

Diamond (2013) — Annu. Rev. Psychol. 64:135–168

Executive Functions (EF) are a family of top-down mental processes needed when automatic or instinctive responses must be overridden.

Prefrontal Cortex Dependent
Processes driving goal-oriented behaviour
Emerge rapidly in early childhood
Continue developing into young adulthood
Predict academic, social & life outcomes
(Moffitt et al., 2011; Blair & Razza, 2007)

Inhibitory Control

Resisting impulses & distractions; filtering irrelevant info

Working Memory

Holding & manipulating info in mind; the mental workspace

Cognitive Flexibility

Switching between tasks, rules, or perspectives

** Higher-order EFs (planning, reasoning, problem-solving) build on these three core EFs (Diamond, 2013)*

Genetics & Environment in EF Development

Gene-by-environment interaction —Gogtay et al., 2024

Variance in EF during adolescence is accounted for 90–100% by genetics — yet environment shapes how that genetic potential is expressed.

Genetic Architecture

- Twin and molecular genetic studies confirm EF is highly heritable, particularly in adolescence. Polygenic influences act on PFC development timelines and dopaminergic signalling efficiency.

Prenatal Risk Factors

- Exposure to prenatal deprivation, malnutrition, and substances of abuse (alcohol, opioids, cannabis) can permanently reduce cognitive ability and EF capacity through disrupted PFC maturation.

Adverse Early Experience

- Violence, abuse, neglect, and environmental deprivation all contribute to worsening EF. ACEs disrupt HPA axis regulation, elevating chronic cortisol that degrades PFC function.

Environmental Variance in Adulthood

- While genetics dominate in adolescence, environmental differences explain the majority of variance in adult EF — highlighting the importance of lifelong, context-sensitive intervention.

Why Executive Function Matters

Long-term outcomes across the lifespan

13×

higher odds of adult income problems with low childhood EF

Moffitt et al., 2011

46%

of variance in school readiness predicted by EF, not IQ

Blair & Razza, 2007

2–4×

greater risk for ADHD, anxiety, depression with EF deficits

Willcutt et al., 2005

3+ yrs

earlier EF intervention = significantly better life outcomes

Diamond & Lee, 2011

The Executive Gap

Why neurodivergent learners fall further behind

What Is the Executive Gap?

Research and clinical observation show that many students — especially neurodivergent learners — have an executive function delay of approximately 3 to 5 years.

Different brain systems mature on different timelines. A child may be chronologically 10 but have EF more consistent with a 6-year-old. Holding them to age-level EF expectations creates ongoing failure.

The Negative Cycle

1. Child struggles to meet expectations
2. Adults interpret as lack of effort
3. Expectations increase (“You can do better”)
4. Stress increases
5. Executive function decreases further
6. Performance worsens

EF Is State-Dependent and Adaptive

Niebaum, Zengilowski, Katz, Shah & Munakata (2025) — Trends in Cognitive Sciences

"Adaptive habits: understanding executive function and its development." — Executive functions are not fixed traits but dynamic, context-sensitive capacities.

State-Dependent Performance

- EF is highly sensitive to the child's momentary state — fatigue, hunger, anxiety, or emotional arousal all temporarily degrade performance. This is not defiance or laziness; it is neurobiology.

Adaptive Function

- EF is not a fixed cognitive muscle to be trained identically in every child. The system adapts based on context, goals, and environment — meaning one-size-fits-all approaches are limited.

Context Matters Clinically

- Assessment results obtained in calm, structured office settings may not reflect the child's real-world EF. Multi-context, multi-informant assessment yields a more ecologically valid picture.

Practical Implication

- Before attributing EF failure to skill deficit, assess the state: Is the child regulated? Is the environment supportive? Optimizing conditions often reveals stronger EF than previously measured.

EF Development Across Childhood

Sensitive periods and developmental milestones (Zelazo et al., 2016; Anderson, 2002)

Key Research Milestones

- Age 3: Emergence of rule-based sorting; basic impulse suppression (Zelazo, 2006)
- Age 5: Dramatic leap in flexible rule application and working memory capacity
- Age 7–9: Working memory reaches near-adult capacity; cognitive flexibility strengthens
- Age 12: Inhibitory control approaches adult levels; EF network matures structurally

The Neuroscience of Executive Function

Prefrontal cortex, dopamine, and neuroplasticity

Prefrontal Cortex (PFC)

- Last brain region to mature; primary seat of EF. Thick myelination continues until mid-20s, enabling increasingly sophisticated EF (Casey et al., 2008). The dorsolateral PFC is central to working memory and impulse control.

Dopamine & Norepinephrine

- Catecholamines modulate PFC function. Optimal — not maximal — levels are required. Dopaminergic signalling in the striatum is strongly implicated in cognitive flexibility. Miederer et al. (2025): dopamine drives adaptation to new information.

Neural Pruning & Synaptogenesis

- Overproduction then experience-dependent pruning of synapses. Pre-school years represent peak synaptogenesis. Environment shapes EF architecture through Hebbian learning mechanisms (Giedd et al., 1999).

Stress & the EF Brain

- Chronic stress (high cortisol) degrades PFC function and dysregulates EF. ACEs directly impair EF development. Autonomic arousal is a key barrier to EF access in children — regulation precedes cognition (Evans & Schamberg, 2009).

Hot vs. Cool Executive Function

Two distinct neural systems — Zelazo & Müller, 2002

Feature	Cold (Cool) EF	Hot EF
Trigger	Logic, data, and neutral tasks	Emotion, social status, and rewards
Brain Region	Dorsolateral Prefrontal Cortex	Ventromedial PFC / Limbic System
Peak Difficulty	Low (tasks are straightforward)	High (requires resisting intense feelings)
Adolescent Ability	Often adult-like by mid-teens	Significantly underdeveloped until mid-20s
Example	Knowing that speeding is dangerous	Speeding because your friends are cheering
Clinical Relevance	Deficits: ADHD, LD, ASD (often)	Deficits: conduct problems, trauma, anxiety, ER

Clinical note: Both systems need targeted development. Hot EF deficits are often more disabling in everyday life but less easily captured by standard cool EF measures.

Factors That Influence EF Development

Modifiable and non-modifiable contributors

⚠ Risk Factors

- Poverty & socioeconomic adversity (Evans & Schamberg, 2009)
- Parental stress, depression, or harsh parenting
- Adverse childhood experiences (ACEs) and trauma
- Prematurity, low birth weight
- Prenatal substance exposure (alcohol, opioids, cannabis)
- ADHD, ASD, or other neurodevelopmental conditions
- Language delays (EF & language are tightly coupled)

✓ Protective Factors

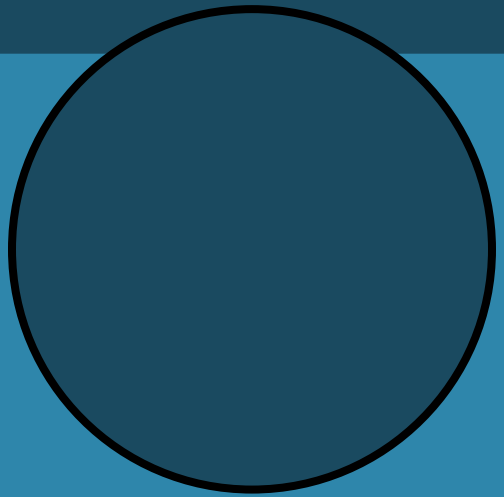
- Warm, responsive caregiving & secure attachment
- Cognitively stimulating home environment
- Bilingualism (Bialystok et al., 2012)
- Physical activity & sleep (Davis et al., 2011)
- Play — especially sociodramatic & pretend play
- Mindfulness training & self-regulation practices
- Music training (Moreno et al., 2011)

Clinical Note: EF deficits are NOT fixed. Neuroplasticity remains high in childhood — intervention works.

BLOCK 2

Pre-School Years

Ages 2–5



Fostering Executive Skills in the Most Sensitive Developmental Window

EF Milestones: Ages 2–5

Normative development and what to watch for (Zelazo, 2006; Hughes, 2011)

Age 2

- Begins inhibiting simple actions on command
- Holds 2 items in working memory
- Rigid rule-following; difficulty switching tasks
- Parallel play; minimal turn-taking EF demands

Age 3

- Passes day–night Stroop task with effort
- 3-item working memory span
- Simple card-sorting (one rule, e.g. color)
- Pretend play scaffolds working memory

Age 4

- Clear inhibitory control during waiting tasks
- Delay of gratification beginning (Mischel et al.)
- Flexible rule-switching emerges
- Metacognitive monitoring begins

Age 5

- DCCS — can sort by shape AND color with rule switch
- 4–5 item working memory span
- Plans 2–3 step sequences independently
- Understands 'false belief' — Theory of Mind milestone

Inhibitory Control: The Foundation

Development trajectory and clinical significance

The developmental trajectory of inhibitory control (IC) begins towards the end of the first year of life and shows prominent, rapid improvement during the toddler and preschool years.

Two Types of Inhibitory Control

- Interference inhibition (blocking distracting info) and response inhibition (stopping a planned action). Both emerge in preschool but follow slightly different developmental courses.

Emotional Sensitivity

- IC is highly sensitive to emotion and stress. When a child is emotionally dysregulated, inhibitory control collapses — this is not defiance, it is state-dependent neurobiology.

Delay of Gratification

- The classic 'marshmallow test' (Mischel et al.) measures IC. Preschool performance predicts adolescent academic achievement, social competence, and BMI decades later.

Clinical Red Flags at Age 4–5

- Still unable to wait turn in structured games; regularly disrupts group activities; cannot stop a movement on command in circle time — these warrant further EF evaluation.

Working Memory: The Mental Workspace

Baddeley model & developmental science (Diamond, 2013)

What Is Working Memory?

- Where thoughts are held and manipulated
- Working = central executive / active processing
- Memory = temporary storage / rehearsal loop
- We can choose what to think about (top-down control)
- Maintained by bouts of neural spiking
- Brain uses multiple mechanisms to maintain WM content
- Many consider attentional control a core WM component
- Memory struggles vs. concentration: clinically distinct

WM and School Success

WM is a stronger predictor of reading and maths achievement than IQ in the early school years. Children with low WM quietly struggle — they rarely disrupt class but fall progressively behind (Gathercole & Alloway, 2008).

WM vs. Attention Deficit

WM deficits and attention problems are often confused clinically. WM failure = forgetting instructions mid-task. Attention failure = never encoding instructions. Assessment differentiates these for treatment planning.

Improving WM: Caveats

Computerized WM training (CogMed, N-Back) improves specific tasks practiced but shows limited transfer to untrained EF domains or real-world functioning (Melby-Lervåg & Hulme, 2013; Sala & Gobet, 2020).

Strategies to Support Working Memory

Cognitive, exercise-based & environmental approaches (Rapport et al., 2013; Sala & Gobet, 2020)

Cognitive Strategies	**Chunking:** Grouping small pieces of data into meaningful units to reduce WM load — e.g., phone numbers, spelling word families. **Mnemonics & Associations:** Linking new information to known anchors: vivid visualization, rhymes, songs, or Memory Palace (Method of Loci). **Active Rehearsal:** Teaching content to someone else or self-quizzing forces active retrieval — stronger than passive re-reading. **Spaced Repetition:** Reviewing in short, increasing intervals rather than massed practice aids transfer from WM to long-term memory.
Cognitive Exercises	**N-Back Tasks:** Recall stimulus from N steps back — directly trains WM maintenance and updating. Moderate evidence for near-transfer. **Mental Math & Sequencing:** Backwards counting, spelling words backward, reciting sequences in reverse — all actively force manipulation of held information. **Strategy Games:** Chess, Sudoku, complex card games (Bridge) require planning ahead and holding conditional scenarios simultaneously.
Lifestyle & Environment	**Quality Sleep:** Essential for memory consolidation; transfers WM-encoded material to long-term storage during slow-wave and REM sleep. **Regular Exercise:** Increases BDNF, cerebral blood flow, and dopamine — supporting neural infrastructure underlying WM. **Mindfulness Practice:** Improves allocation of attentional resources, limiting cognitive distraction and preserving WM capacity. **Reduce Multitasking:** Single-task focus prevents WM system fragmentation. External structure (e.g., to-do lists) offloads WM burden.

Cognitive Flexibility

Dopaminergic mechanisms & developmental trajectory (Miederer et al., 2025)

Cognitive flexibility is the ability to shift and update actions in conjunction with task, goal, and environment — the most complex of the three core EFs.

Dopaminergic Mechanism

- Dopaminergic signalling in the striatum is strongly implicated in cognitive flexibility. Dopamine plays a key role in adapting to new information and switching between mental strategies (Miederer et al., 2025).

Cortical vs. Striatal Dopamine

- Higher cortical dopamine levels are associated with lower striatal dopamine levels — a balance that influences flexibility. This imbalance has been linked to increased self-harm vulnerability in adolescence.

DCCS as Clinical Benchmark

- The Dimensional Change Card Sort (DCCS) is the gold-standard preschool measure of cognitive flexibility. Failure beyond age 5 is a reliable clinical indicator of EF delay warranting further assessment.

How to Build Flexibility

- Sorting games with changing rules, improvisational play, theatre, 'think outside the box' challenges, and exposure to multiple perspectives all directly train the flexible mental set-shifting system.

Play as EF Training

Vygotsky's zone of proximal development & modern neuroscience

"During dramatic play, children perform higher than in individual tasks — play creates a zone of proximal development." — Vygotsky (1978)

Sociodramatic Play

- Children must remember roles, inhibit out-of-character behavior, and flexibly adapt to narrative changes. Strong predictor of EF scores (Thibodeau et al., 2016).

Games with Rules

- Simon Says, Red Light Green Light, Freeze Dance, board games. Require inhibiting dominant responses & rule monitoring. Most direct EF training available to pre-schoolers (Diamond et al., 2007).

Block & Construction

- Planning, goal-setting, working memory for sequences. Predicts EF and mathematics achievement. Children carrying full trays also develops precision and inhibitory control (Wolfgang et al., 2001).

Music & Rhythm

- Keeping beat while doing something else = dual-task working memory + inhibition. Theatre, orchestra, and choir all support EF skill development. Music training improves EF in RCTs (Moreno et al., 2011).

Tools of the Mind & Montessori

Curriculum-embedded EF development in pre-school settings

Tools of the Mind

- Include activities that foster EF through pretend play and waiting your turn
- Scaffolded self-regulation: children create 'play plans' before acting
- Buddy Reading: turns — one child reads, one listens (requires sustained attention and role inhibition)
- The Freeze Game: children dance to music, freeze in matching position when music stops — trains inhibition & self-monitoring
- RCT (Diamond et al., 2007, Science): large effects on inhibitory control & WM; improved reading & math
- Reference: bostonchildrensmuseum.org — Tools of the Mind Curriculum PDF

Montessori Approach

- Walk the Line: children carry an object while walking an oval line, responding to music direction — requires sustained focus, impulse control, distraction resistance
- Silent Game: teacher calls children by name one by one; children must suppress responding to other names, control movement, and stay silent — trains inhibition and sustained attention
- Materials are self-correcting: intrinsic feedback without adult judgment scaffolds planning and error monitoring
- Reference: Montessori Group — 'Fostering Executive Functions the Montessori Way' PDF

Caregiver Scaffolding of EF

How caregiving practices directly shape EF (Bernier et al., 2010; Carlson, 2003)

What the Research Shows

- Maternal mind-mindedness predicts inhibitory control at age 3 (Meins et al., 2003)
- Autonomy-supportive parenting predicts WM & flexibility (Bernier et al., 2010)
- Responsive bedtime routines improve EF via sleep quality (Mindell et al., 2009)

Scaffolded Language

Use 'think-aloud' modeling: 'First I'll get my shoes, then my coat.' Narrating planning models working memory and sequential reasoning.

Consistent Routines

Predictable sequences reduce cognitive load, freeing EF capacity for novel challenges. Visual schedules further offload WM demands (Lucassen et al., 2017).

Warm Limit-Setting

Firm but nurturing limit-setting teaches inhibitory control better than harsh or permissive approaches. The relationship is the intervention.

Allow Tolerable Frustration

Rushing to solve problems for children removes EF practice opportunities. Wait, prompt, then scaffold — avoid rescuing at the first sign of struggle.

Evidence-Based Pre-School Programs

RCT-supported interventions for EF in ages 2–5

Program	Study Design	Key Outcomes	Citation
Tools of the Mind	RCT, 85 pre-K classrooms	Large effects on inhibitory control & WM; improved reading & math	*Diamond et al., 2007 — Science*
Head Start / REDI	Multi-site RCT, low-income	Significant EF gains; reduced behavior problems; school readiness	*Bierman et al., 2008 — Child Dev.*
Chicago School Readiness	Cluster RCT, Head Start centers	EF, language, self-regulation; effects sustained 1+ year post-program	*Raver et al., 2011 — SRCD*
MindUP (Mindfulness)	RCT, ages 4–5	Inhibitory control, attention, peer relationships significantly improved	*Flook et al., 2015 — Dev. Psychology*
Montessori Method	Longitudinal, quasi-experimental	EF, literacy, numeracy, social skills; strongest for disadvantaged children	*Lillard & Else-Quest, 2006 — Science*

EF Activities by Skill Domain

Targeted pre-school activities and their mechanisms

EF Skill	Activities	Key Mechanism
Inhibitory Control	Simon Says, Red Light/Green Light, Freeze Dance, Traditional Martial Arts, carrying a full tray carefully	Override dominant impulse to move/act in favour of a rule-based or appropriate action
Working Memory	Memory/Concentration games, Go Fish, Uno, 'I Went to a Picnic...' verbal game, copying sound sequences	Hold information (rules, lists, prior moves) in mind while simultaneously performing another task
Cognitive Flexibility	Sorting games with changing rules, improvisational play, theatre, 'find new uses for an object' challenges	Switch mental sets quickly; adapt thinking when rules or context change mid-task
All EF Skills	EF coaching, CBT, mindfulness/deep breathing, music performance, team sports	Structured training for organization; self-awareness for emotional regulation underpinning all EF domains

BLOCK 3

School Age Years

Ages 6–12

Consolidating Gains & Building Complex Executive Capacities

EF Milestones: Ages 6–12

What to expect and watch for (Anderson, 2002; Best & Miller, 2010)

6–7

- Sustained attention spans 10–15 min on preferred tasks
- WM expands to ~5 items; double-digit arithmetic
- Improved Stroop performance; less impulsive responding
- Begins using memory strategies unprompted (rehearsal)

8–9

- Planning ahead for multi-step tasks (BRIEF-rated improvement)
- Cognitive flexibility: shift between multiple categories
- Better emotion regulation; reduced tantruming
- Understands rule exceptions and meta-rules

10–11

- Near-adult inhibitory control on standard laboratory tasks
- Strategy shifting: selects most efficient memory strategies
- Sustained attention comparable to adults on structured tasks
- Metacognitive awareness: knows when they don't understand

12

- Full DCCS adult performance; complex rule management
- WM near-ceiling in standard tasks
- Abstract planning; weighs future consequences
- Peer collaboration requires sophisticated social EF

Academic EF Demands

How school tasks load on executive functions (Meltzer, 2010)

Academic Task	Inhibitory Control	Working Memory	Cognitive Flexibility	Planning
Reading Comprehension	•• Ignore distractors	••• Sentence integration	• Track perspectives	–
Mathematics (Arithmetic)	• Suppress algorithms	••• Carry numbers	•• Switch operations	•
Written Composition	•• Stay on topic	••• Manage ideas + syntax	•• Revise plans	••• Outline & organize
Listening & Note-Taking	••• Dual-task filtering	••• Real-time retention	•• Topic shifts	•
Test-Taking	••• Anxiety inhibition	•• Recall under pressure	• Re-examine questions	••• Time management
Social Interaction	••• Turn-taking, impulse	•• Track conversation	••• Perspective-taking	•

••• = high load •• = moderate • = low – = minimal demand

EF and Emotion Regulation

The bidirectional relationship (Zelazo & Cunningham, 2007)

EF and emotion regulation are bidirectionally coupled: strong EF supports regulation, and regulated emotional states support EF performance.

Hot vs. Cool EF (Review)

- Cool EF = abstract cognitive tasks. Hot EF = emotionally significant decisions. Behavior problems reflect hot EF deficits more than cool EF. Both must be developed in childhood.

Self-Regulation & Inhibition

- Inhibitory control is the EF substrate for emotional self-regulation. Children who pass inhibitory tasks at age 4 show fewer externalizing behaviors at age 7 (Olson et al., 2011).

Reappraisal as EF Strategy

- Cognitive reappraisal (reframing a situation) is EF-heavy: requires WM + inhibition + flexibility. Emerges naturally by ~age 9; can be explicitly taught earlier with structured coaching.

Classroom Principle

- Children in emotional states have degraded EF. Teachers who first regulate the child, then teach, achieve better outcomes. Regulate to teach; then teach to regulate (Raver et al., 2007).

Physical Activity as an EF Intervention

Exercise and neurobiological mechanisms (Diamond & Ling, 2016; Davis et al., 2011)

Why Exercise Works

- ↑ BDNF → PFC growth and neuroplasticity
- ↑ Dopamine & norepinephrine → improved PFC signalling
- ↑ Hippocampal neurogenesis → WM enhancement
- ↑ Cerebral blood flow to frontal regions
- ↓ Cortisol / stress response → better EF under load
- Cognitively challenging activities (team sports) are more helpful than non-engaging aerobic exercise alone

PAAS RCT (Davis et al., 2011)

7–11 year olds; 20 min/day aerobic exercise; significant Flanker EF task gains; anterior cingulate cortex activation increased on fMRI.

FITKids RCT (Hillman et al., 2014)

9 months after-school physical activity; WM and attention improvements; brain structure changes documented on MRI.

Type Matters

Chronic physical activity (especially sports) shown to improve EF. Cognitively challenging dual-task exercise > simple cardio for EF transfer

Clinical recommendation: Advocate for physical education & recess. Prescribe family physical activity as an EF intervention.

Sleep: The Overlooked EF Intervention

Sleep as active EF consolidation (Sadeh et al., 2002; Gruber et al., 2010)

A single night of sleep restriction (2 hrs) causes EF impairment equivalent to mild ADHD (Gruber et al., 2010)

PFC Vulnerability

- PFC is particularly sensitive to sleep deprivation. Even subclinical reductions impact EF before other cognitive functions show impairment.

Recommended Hours (6–12)

- 9–11 hours per night (AAP, 2016). Only 30% of school-age children meet this. Screen-based displacement is the leading cause. Sleep is when EF consolidation occurs.

Academic Impact

- Children in the bottom sleep quartile scored 2 grade levels lower on math and literacy than those in the top quartile (Gruber et al., 2012). Sleep is educational intervention.

Clinical Intervention

- Sleep hygiene psychoeducation, consistent bedtimes, screens from bedrooms, CBT-I adapted for children. Parent coaching often needed as primary change agent.

EF Strategies for School Age Children

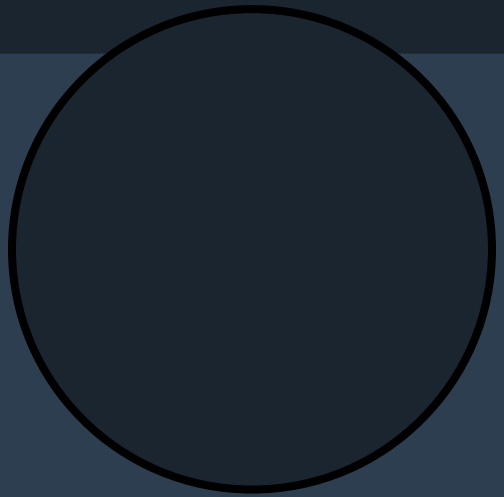
Tools, techniques, and teen-adapted approaches

EF Skill	Tool / Strategy	Description & Goal
Planning & Organization	Digital Organization & Habit Stacking	Apps (Google Calendar, Trello, Evernote) for long-range planning; Habit Stacking links new behaviours to existing routines to reduce initiation failure.
Time Management	Pomodoro Technique + Time-Estimation	Focused work intervals (25 min) + short breaks. Teen first estimates task duration, then tracks actual time — builds metacognition about time blindness.
Working Memory	Active Study Strategies	Self-quizzing, writing summaries without the text, teaching material to someone else — all force active manipulation of WM rather than passive re-reading.
Inhibition & Self-Control	STOPP Method	Stop, Take a breath, Observe, Pull back, Proceed. Practised in calm states so it is available during high-emotion situations. Reduces impulsive social responses.
Cognitive Flexibility	Debate & Perspective-Taking	Argue a position they disagree with; consider viewpoints counter to their own. Directly exercises mental set-shifting and suppression of habitual views.
Goal-Directed Persistence	S.M.A.R.T. Goal Setting	Specific, Measurable, Achievable, Relevant, Time-bound goals. Structures motivation needed for long-term projects and self-directed academic work.
Emotional Regulation	Journaling & Mindfulness	Journaling processes and labels strong emotions. Mindfulness strengthens PFC's ability to observe emotional states without immediately acting on them.

BLOCK 4

Interventions & Clinical Practice

Assessment & Treatment



Assessment, Treatment, and Take-Home Strategies

Assessing Executive Function

A multi-method, multi-informant approach

Rating Scales	• BRIEF-2 (Behavior Rating Inventory of EF, 2nd Ed.) — ages 5–18; parent & teacher forms • BRIEF-P (Preschool) — ages 2–5; gold standard for EF behavior rating in pre-school • Conners 3 — ADHD-focused, includes EF indices across informants • SDQ (Strengths & Difficulties Questionnaire) — brief screening tool
Performance Measures	• NEPSY-II — comprehensive; inhibition, switching, WM, planning subscales • CANTAB / NIH Toolbox — computerized; excellent normed measures from age 3 • DCCS (Dimensional Change Card Sort) — ages 3–5; inhibition & flexibility standard • Corsi Blocks / Digit Span — working memory; embedded in WISC-V, SB5
Functional & Behavioural Assessment	• Clinical interview with child, parent, teacher • Classroom observation: on-task behaviour, transition management • Task-based analogue assessment in natural settings • Review of academic records, teacher comments, work samples

Environmental Modifications for EF

Reducing EF demands through structural design (Dawson & Guare, 2010)

A well-designed environment reduces EF demand — the child does not have to work as hard to regulate, organize, or remember. Modify the environment before modifying the child.

Modification Type	Example	Why It Helps
Visual Externalization	Physical countdown timer (Time Timer)	Don't have to calculate time in the head — just see it. Reduces time-blindness load.
Structural Quiet	Noise-cancelling headphones or privacy carrels	Brain doesn't have to work to filter background noise, preserving inhibitory control capacity.
Cognitive Offloading	To-Do list exactly where work happens	Saves WM from holding the plan — brain energy directed to the task itself.
Environmental Priming	Lay out gym clothes the night before	Removes the morning 'deciding' step, preserving limited morning executive energy.
Sensory Considerations	Remove visual clutter, reduce noise, adjust lighting	Sensory processing demands compete with EF resources; calm environments free cognitive capacity.
Autonomic Regulation	Movement breaks, sensory tools, co-regulation with adult	Arousal state is a prerequisite for EF access. Regulation interventions come before cognitive demands.

Barriers to EF Access

Why children fail to use EF even when they have the skills

Having EF skills does not guarantee using them. State, environment, and experience all serve as barriers. Assessment of barriers is as important as assessment of skills.

Sensory Processing Challenges

- Sensory over- or under-responsivity consumes EF resources before the cognitive task begins. Children with SPD may appear EF-impaired when the primary issue is sensory-driven arousal regulation failure.

Autonomic Arousal Dysregulation

- Fight/flight/freeze activation shuts down PFC function. Children who appear 'not trying' or 'non-compliant' may be in a physiological state that makes EF neurologically inaccessible. Regulation precedes cognition.

Chronic Stress & Toxic Load

- Ongoing adversity, poverty, family conflict, and trauma maintain elevated cortisol, which structurally degrades PFC over time. Interventions ignoring systemic stress will have limited impact on EF.

Emotional State Dependency

- EF is transiently unavailable during strong emotional activation. Children cannot use their EF skills when flooded. Co-regulation and dysregulation prevention are prerequisites, not supplements, to EF intervention.

Computerized EF Training: What the Evidence Says

CogMed and digital interventions (Thorell et al., 2009; Melby-Lervåg & Hulme, 2013)

What Computerized Training CAN Do

- CogMed (WM training): moderately improves the specific skills practiced in the training program
- Short-term memory training improves short-term memory moderately (Rapport et al., 2013)
- N-Back training shows near-transfer gains on similar untrained WM tasks
- Benefits are strongest for children with the lowest baseline WM performance
- Can supplement (not replace) real-world EF intervention and skill practice

What Computerized Training CANNOT Do

- No evidence of WM training effect on typically developing children (Sala & Gobet, 2020)
- No evidence it transfers to other untrained EF domains (e.g., WM training ≠ inhibition gain)
- Questionable whether learned skills can be applied to real-world situations
- Does not address hot EF, emotional regulation, or contextual EF barriers
- Should not be used as a standalone treatment or substitute for environmental intervention

Bottom line: Computerized training is a limited adjunct. Ecological, relationship-based, and activity-based approaches have stronger real-world evidence.

Mindfulness-Based Interventions for EF

Self-regulation, sustained attention, and task switching (Zenner et al., 2014)

Mindfulness teaches children to observe sensations and thoughts without judgment — directly training sustained focus, emotional awareness, and task switching.

What Mindfulness Trains

- Sustained focus (observing breath), cognitive flexibility (returning to focus after distraction), inhibitory control (resist acting on urges), metacognition (awareness of one's own mental states).

Neurobiological Mechanism

- Mindfulness practice thickens the anterior cingulate cortex and strengthens PFC-amygdala connectivity — directly supporting the neural infrastructure of EF and emotion regulation.

School-Based Programs

- MindUP (ages 4–14): 8-week curriculum; RCT evidence for inhibitory control and peer relationship gains. MBSR-C: adapted for school-age children; multiple RCTs with moderate EF effects.

Teaching Key Skills

- Planning before acting (pause-and-plan strategies), body scan for autonomic awareness, 3-breath reset, labelling emotions without reacting — all are teachable, transferable EF micro-skills.

Neurofeedback for EF

Brain-based training

How Neurofeedback Works

EEG electrodes measure brain electrical activity in regions crucial for complex thinking (e.g., dorsolateral PFC, Cz).

EEG readings are fed into a game or visual display the child controls with their brainwaves.

Over many sessions, the brain learns — unconsciously — to reproduce the rewarded electrical patterns associated with focused, regulated states.

Target Brain Regions

Dorsolateral PFC: primary region for WM and impulse control. Theta/beta training (↓ theta, ↑ beta) most commonly used for ADHD EF profiles.

Evidence Base

Moderate evidence for symptom reduction in ADHD; mixed evidence for direct EF domain improvement. Best considered adjunctive to comprehensive treatment.

Theoretical Mechanism

Targets synaptic plasticity (brain's ability to reorganize and form new connections) and may improve blood flow in frontal regions. Influences key neurotransmitter balance.

Clinical Considerations

Resource-intensive (20–40 sessions); costly; access barriers. Discuss realistically with families. Not a replacement for behavioural and environmental intervention.

Evidence-Based School Age Interventions

What works for ages 6–12 (Diamond & Ling, 2016; Cortese et al., 2015)

Cognitive Training (CogMed, N-Back)
RCTs show near-transfer WM gains; limited far-transfer. Best as adjunct. Significant evidence caveats for typical developers (Melby-Lervåg & Hulme, 2013).

Level B

Mindfulness-Based Interventions
MindUP, MBSR-C — multiple RCTs; moderate effects on attention, inhibition, and academic self-regulation. 8–10 week programs; sustainable gains (Zenner et al., 2014).

Level A

Physical Activity Programs
Aerobic exercise 3x/week; FITKids, PAAS trials. Consistent EF gains; neural effects documented. Cognitively challenging > simple aerobic (Hillman et al., 2014).

Level A

Cognitive-Behavioural Therapy
For EF embedded in anxiety, depression, ADHD. Self-instruction training (Meichenbaum); metacognitive therapy. Strong evidence for co-occurring conditions.

Level A

School-Based SEL Programs
PATHS, RULER, Second Step — integrate EF with social-emotional curriculum. 11-percentile academic gain; reduced problem behaviours (Durlak et al., 2011).

Level B

Environmental Training / Games
Circle time games, freeze activities, team sports — found to enhance inhibition, particularly for preschoolers and early school children with below-average IC at entry

Level B

Level A = multiple RCTs. Level B = well-designed non-randomized studies

ADHD as an EF Disorder

Barkley's EF model and clinical implications (Barkley, 2012; Willcutt et al., 2005)

ADHD is best understood as a developmental disorder of EF — not attention per se, but the executive regulation of attention, behavior, emotion, and time (Barkley, 2012)

Inhibitory Core Deficit

Behavioral inhibition is the foundational EF deficit in ADHD, leading to cascading impairments in WM, emotion regulation, and planning (Barkley, 1997). The executive gap is typically 3–5 years.

WM Deficits in ADHD

Children with ADHD score 0.5–1.5 SD below controls on WM measures. This affects complex arithmetic, reading comprehension, and following multi-step instructions.

ADHD vs. Other EF Deficits

Not all EF deficits = ADHD. Anxiety, depression, learning disabilities, trauma all impair EF through different mechanisms. Differential assessment using multi-informant data is essential.

Treatment Hierarchy

Multimodal: medication (stimulants — strongest EF evidence), behavioural interventions, parent training, academic accommodations, EF coaching. No single approach is sufficient (Jensen et al., 2001).

The Psychologist's EF Toolkit

Evidence-based strategies across age groups and settings

Pre-School (2–5)

- Inhibitory control games (Red Light/Green Light, Freeze Dance, Simon Says)
- Encourage sociodramatic play with role-based rules (Tools of the Mind)
- Montessori: Walk the Line, Silent Game
- Scaffolded language routines; think-aloud planning modeling
- Parent coaching: autonomy-supportive, consistent caregiving
- Sleep hygiene and routine psychoeducation

School Age (6–12)

- Self-monitoring & self-talk strategies (Meichenbaum model)
- Visual planners, to-do lists, external WM scaffolds
- Mindfulness attention training (MindUP, 8-week)
- Prescribe aerobic + cognitively challenging exercise 3x/week
- School collaboration: BRIEF-2 guided accommodations
- STOPP method, SMART goals, Pomodoro technique

Family & Systems

- Parent training: PCIT (young), CBT parenting (school age)
- Home routine charts & visual schedules
- Consistent, predictable environments reduce cognitive load
- Sibling/peer play structured for turn-taking & inhibition
- Advocate for physical activity & recess in schools
- Address poverty, stress, ACEs as primary EF intervention targets

School-Home Collaboration for EF Support

Creating consistent, supportive environments (Dawson & Guare, 2010)

School Accommodations

- Extended time on tests (reduces WM bottleneck under time pressure)
- Preferential seating (near teacher, low-distraction zone)
- Task breakdown: written instructions, step-by-step checklists
- Frequent check-ins and self-monitoring prompts during work

Home Strategies

- Visual daily schedule posted in common areas; consistent routine
- Homework routine at same time and place every day
- Break large tasks into sub-goals; reward milestone completion
- Limit screens; protect 9–11 hours of sleep per night

Psychologist's Role in Team

- Translate BRIEF-2 / NEPSY-II data into actionable recommendations
- Write Section 504 / IEP goals targeting specific EF domains
- Consult teachers: environmental modification vs. skills teaching
- Monitor progress with repeat rating scales (6-month interval)

Cultural Considerations in EF Assessment & Intervention

A culturally responsive, equity-informed lens

EF is universal. How it develops, is expressed, and is measured is culturally situated. Assessment must account for systemic inequity as a major EF shaper.

Assessment Bias

- Many EF tasks normed on predominantly White, middle-class samples. Interpreting scores without considering SES, language background, and cultural familiarity risks misdiagnosis (Elbulok-Charcape et al., 2014).

Poverty as Structural Variable

- Poverty-related stressors (noise, crowding, food insecurity, chaos) directly deplete EF. Addressing EF without addressing systemic inequity is an incomplete intervention (Evans & Schamberg, 2009).

Indigenous Perspectives

- Land-based learning, storytelling, and relational practices foster EF in culturally congruent ways. Collaborate with Indigenous communities; avoid pathologizing cultural differences in self-regulation expression.

Culturally Adapted Practice

- Adapt EF interventions to cultural values (collectivism vs. individualism). Community-based delivery models and bilingual services improve reach and efficacy (Yates et al., 2008).

Case Vignette: Pre-School

Discussion Exercise — 10 minutes

Case: Amir, Age 4

Amir is a 4-year-old referred by his daycare for 'aggressive behaviour and inability to follow rules.' His parents report he cannot wait his turn, melts down when transitions occur, and frequently grabs toys from peers. He is verbal and bright. His mother is a single parent, working full-time, reporting high stress. No formal diagnosis. Born 5 weeks premature. Bilingual household (English/Punjabi).

Discussion Questions:

1. Which EF domains appear most impacted? What developmental context is relevant at age 4? Consider the executive gap.
2. What additional assessment information would you gather? BRIEF-P? Observation? Parent interview?
3. What are the most likely causal and maintaining factors? Consider state-dependency, stress, prematurity, and context.
4. Outline a brief intervention plan. What does the evidence suggest? Address both child skills and environmental factors.

Case Vignette: School Age

Discussion Exercise — 10 minutes

Case: Maya, Age 9

Maya is a 9-year-old referred by her teacher for 'poor organization and work completion.' Her parents note she forgets homework, loses track of time during tasks, and gets overwhelmed by multi-step assignments. She is socially well-liked. Reading is at grade level; math is a significant struggle. She cries easily when frustrated. Family history of anxiety in mother. She averages 7.5 hours of sleep per night. Screen time is 4+ hours/day.

Discussion Questions:

1. Which EF domains are most prominent in Maya's profile? How do EF deficits interact with her emotional regulation?
2. What is your differential? ADHD? Anxiety? LD? Combined presentation? What assessment would clarify?
3. What is the significance of 7.5 hours of sleep and 4+ hours screen time? How would you address these?
4. Design a BRIEF-2-informed school accommodation plan and a home EF support strategy for Maya.

Case Vignette: Complex Presentation

Discussion Exercise — 10 minutes

Case: Jordan, Age 11

Jordan is an 11-year-old who has been diagnosed with ADHD-C at age 8 and is on stimulant medication. Despite medication, Jordan struggles significantly with planning, task initiation, and emotional dysregulation. At school, Jordan argues with teachers, refuses to start assignments, and has frequent conflict with peers. Jordan was exposed to domestic violence until age 6 (removed from home). Currently in stable foster care. Low sleep, high arousal baseline. Hot EF appears significantly more impaired than cool EF.

Discussion Questions:

1. How does trauma history interact with Jordan's ADHD/EF profile? What is the role of the executive gap and hot EF?
2. Medication is not fully addressing the problem — why? What additional or alternative interventions are indicated?
3. What environmental modifications should be in place at school and in the foster home?
4. Which intervention approaches (mindfulness, physical activity, CBT, environmental training) take priority and why?

EF Across Ages: Quick Reference Summary

Domain	Pre-School (2–5)	School Age (6–12)	Intervention Priority
Inhibitory Control	Emerges rapidly; games, freeze, Simon Says	Near-adult by 10–12; still sensitive to stress	Preschool: play + environment; School: CBT, mindfulness
Working Memory	2–4 item span; pretend play scaffolds	5–6 items; academic demands peak	Strategies, chunking, routine; exercise supports both
Cognitive Flexibility	Late emerging; rigid at 2–3; flexible by 5	Consolidating; multi-rule switching by 8–9	Sociodramatic play; debate; improvisational activities
Hot EF / Emotion Reg	Highly state-dependent; co-regulation needed	Reappraisal emerges ~9; still fragile	Address regulation before cognition at all ages
Sleep	9–12 hours critical; routines essential	9–11 hours; screen displacement major risk	Psychoeducation, routines, screen limits, CBT-I
Physical Activity	Active play; music; dance	Structured exercise 3x/week; team sports ideal	Prescribe as formal EF intervention

Key Take-Home Messages

01

EF is foundational

Inhibitory control, working memory, and cognitive flexibility underpin academic, social, and life success. These are the skills worth building.

02

Pre-school is the critical window

Ages 2–5 represent peak EF development. Play, routines, and caregiver scaffolding during this window have the highest long-term ROI.

03

EF is state-dependent — not fixed

Stress, arousal, fatigue, and environment all modulate EF access. Regulate first; teach second. Optimize conditions before judging performance.

04

The executive gap is real

Neurodivergent learners often function 3–5 EF years below chronological age. Calibrate expectations; the negative cycle destroys more EF than it builds.

05

EF deficits are transdiagnostic

ADHD, anxiety, depression, ASD, LD, and trauma all present with EF impairments. Assess the profile; don't diagnose by symptom count alone.

06

Evidence-based EF intervention works

Play, mindfulness, physical activity, sleep, and relationship-based intervention all have RCT support. Share this hope clearly with families and schools.

Online Resources & Toolkits

Tools of the Mind Curriculum *bostonchildrensmuseum.org/sites/default/files/pdfs/5-Tools-of-the-Mind-Curriculum.pdf*	Full preschool EF curriculum PDF — freeze games, buddy reading, play plans, and scaffolded activities
Montessori EF Guide *montessori-group.com/wp-content/uploads/2022/01/De-Brouwer_Fostering-Executive-Functions-the-Montessori-Way.pdf*	Walk the Line, Silent Game and full Montessori EF activity rationale
NIH Toolbox Cognition Battery *nihtoolbox.org*	Standardized, computerized EF assessment — normed from age 3; includes working memory, flexibility, inhibition
Harvard Center on the Developing Child *developingchild.harvard.edu*	Free EF science briefs, videos, and intervention resources for practitioners and families
Improving Cognitive Flexibility (Research) *sciencedirect.com/science/article/abs/pii/S2352154625000038*	2025 Miederer et al. article on dopaminergic mechanisms in cognitive flexibility — cited in this workshop
WM Neuroscience Video *youtube.com/watch?v=Ep25ntXtClg*	Working memory neuroscience explainer — suitable for showing in parent consultations or psychoeducation sessions

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Thank you for your commitment to children's development.

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Thank You

Questions & Discussion

Fostering Executive Skills in Pre-School & School Age Children
A 3-Hour Evidence-Based Professional Workshop

Key References: Diamond (2013) • Moffitt et al. (2011) • Blair & Razza (2007) • Niebaum et al. (2025)

Assessment: BRIEF-2 • BRIEF-P • NEPSY-II • CANTAB • NIH Toolbox

Programs: Tools of the Mind • Montessori • FITKids • MindUP • PATHS • CogMed