Ann & Robert H. Lurie Children's Hospital of Chicago™

The Challenge of Executive Functioning in Spina Bifida

Illinois Spina Bifida Association
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Morton College, Cicero

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Cognitive Strengths and Vulnerabilities

- Average Intelligence
- May suffer from complications such as hydrocephalus, multiple shunt revisions, CNS infections
- Upper spinal cord involvement associated with greater cognitive difficulty

- But intelligence is not the whole picture…

Language

- Strengths of vocabulary, language syntax, phonology
- In preschool often verbally precocious
- With age, inferential reasoning may be challenging
- Pragmatic communication may be a weakness
  - Difficulty suppressing material unrelated to context
  - Get caught up in details that digress from main point

Perceptual-Motor

- Perceptual-motor/sensory-motor activities often hard
- Vulnerability to spatial confusion
- But navigation may be better with landmarks
- Perception of "where" may be weak (spatial localization)
- But perception of "what" better (object/categorical recognition)

Memory/Learning

- Strengths
  - Semantic memory (e.g., vocabulary)
  - Implicit memory (without conscious mediation)
  - Working memory (with low information load)
  - Recognition
- Vulnerabilities
  - Episodic memory (new learning of events, contextual information)
  - Prospective memory (multitasking)
  - Working memory (with high information load)
  - Free Recall

Academics

Reading

- Decoding good
- Comprehension weaker, esp for discourse, and with high information load
- Difficulty suppressing/ignoring material tangential to main point

Math

- Often weak, esp beyond primary years
- Basic enumeration skills intact
- But later difficulties with calculation, estimation, problem-solving
- Spatial math challenging (e.g., geometry)

Writing

- Can be significant challenge, esp expository writing
- Difficulty organizing essential vs nonessential meaning

An Alternate View

- Dennis & Barnes (2010)
  - Key differences in SB depend upon underlying cognitive processes across modalities (verbal/visual)

Associative vs Assembled information processing

- **Associative** – rote, based on literal/concrete associations between events/stimuli (good "fact knowledge") – a strength
- **Assembled** – based on higher-order integration of associations, not just literal associations between stimuli/events, includes appreciation of larger themes and contextual understanding – may be weaker

Developmental Context

- Limitations can emerge in context of development
  - In preschool/kindergarten years, cognitive impact less obvious
  - In primary years (1-2 gr), often attain academic milestones well based on rote, association-based learning and solid basic language skills
  - Beyond third grade, deficits may emerge with demands for inferential reasoning, increased information load (multitasking), speed/efficiency, *contextual* learning
  - Beyond sixth grade, issues with long-term goal-directed behavior/learning become more prominent, difficulties with expository writing have a greater impact

Attention/Executive Functions (EF)

- Reports of inattention common by parents, educators
- But performance on sustained attention tasks often OK
- Not "frontal" pattern of deficits seen in ADHD (e.g., impulsivity)
- Some data suggest deficits of arousal/regulation of attention (incl strategic attention)
- Difficulty regulating behavior towards attainment of long term goals (goal-directed behavior)
- Contextual problem-solving challenging

Executive Functions (EF) – defined

- Allow an individual to regulate thought and behavior in order to attain a goal
- The brain's "CEO" - a central control system coordinating other mental activities

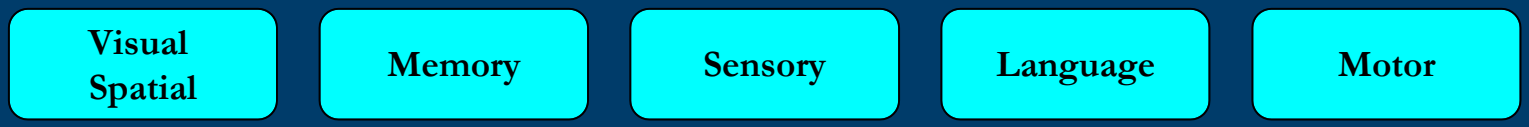
Executive Functions (EF) – Overview

Mediate...

- self-regulation – cognition, behavior, emotion
- response inhibition/delay of gratification
- planning/anticipation of future consequences/events
- ability to approach problems in focused, organized manner
- flexibility - ability to adapt to novel situations, changes in environment
- Ablity to integrate detail vs "big picture" perspectives
- knowledge about knowledge/skills – metacognition

Executive Functions (EF)

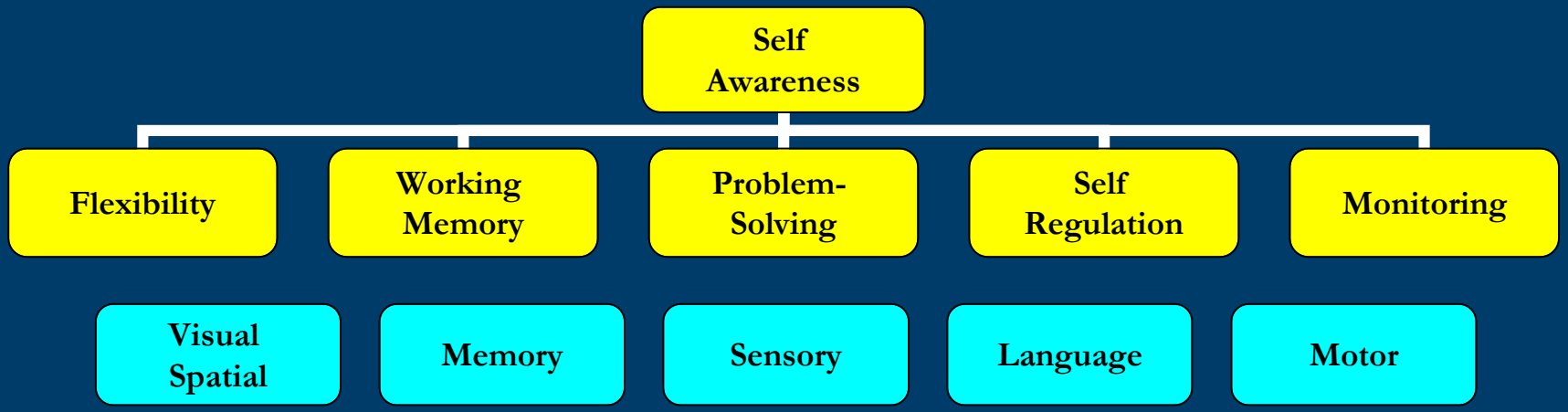
D. Stuss - "Hierarchy of Brain Function"



Executive Functions (EF)

D. Stuss - "Hierarchy of Brain Function"

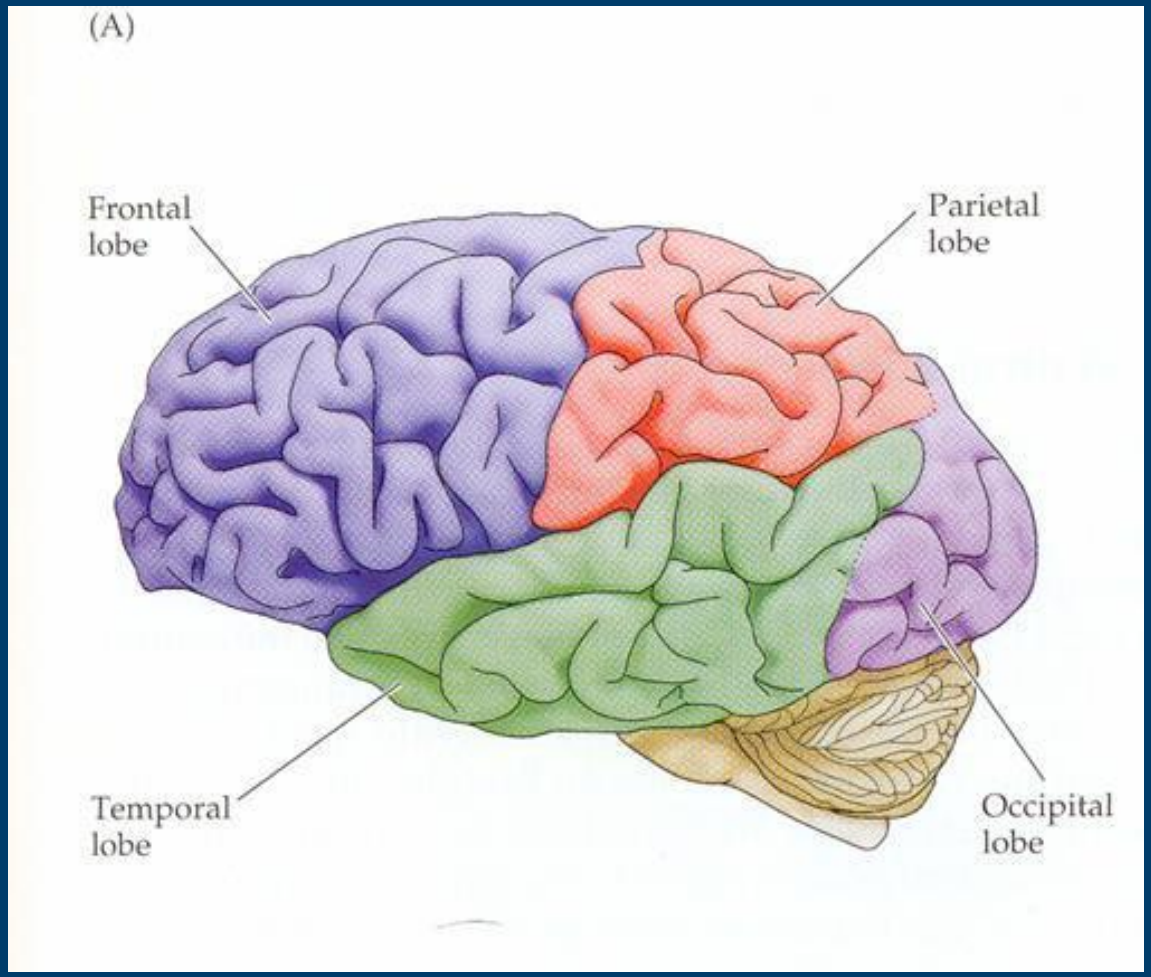
Emphasizes difference between **Executive** brain systems and **Lower** brain systems



Key Feature of EF – Deliberate, Effortful

- Require attention, mental effort
- Contrast with overlearned "automatic" skills
- As a new skill is practiced, it becomes more automatic, requires less effort, and its executive requirements decrease (e.g., learning to drive)

Anatomy of EFs



Anatomy of EFs

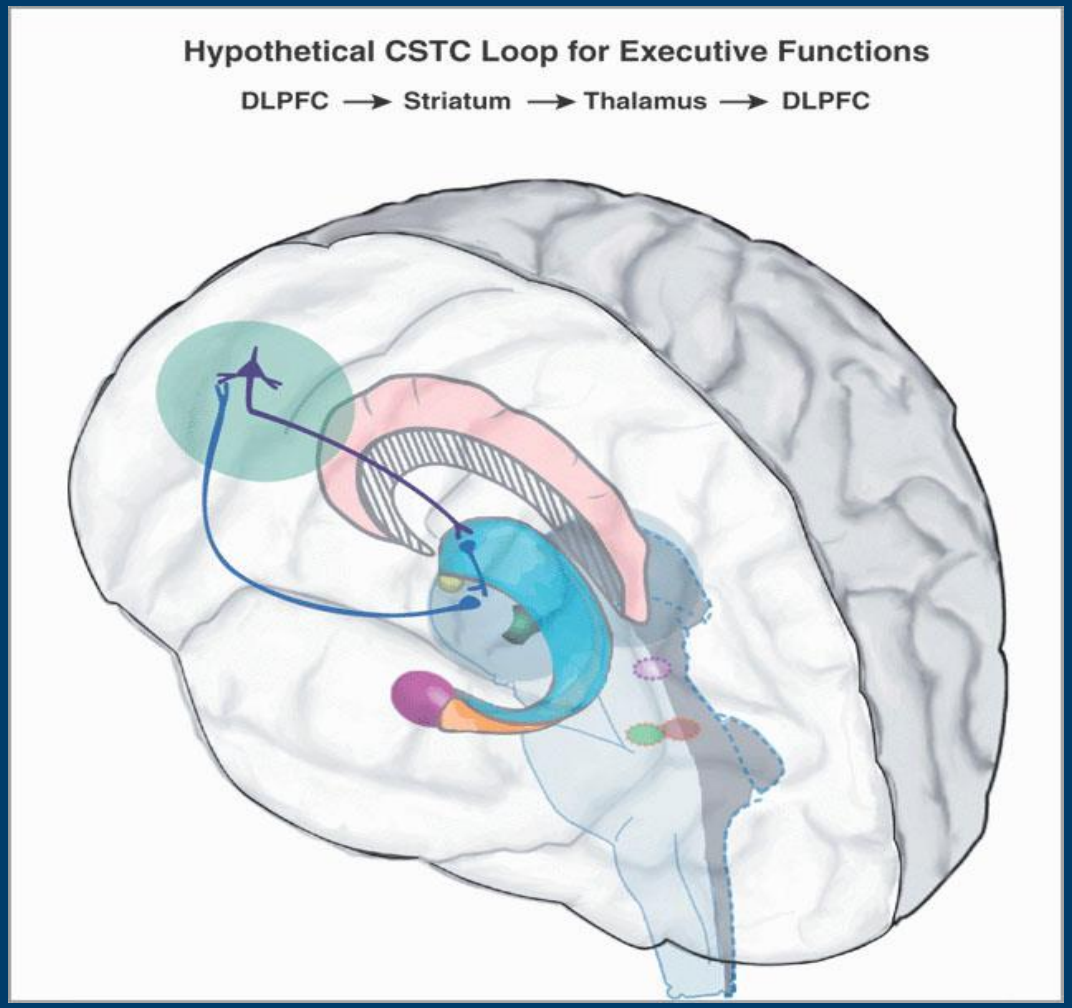
Frontal lobes

- Comprise up to 1/3 of cortex
- Relatively late to mature: Myelination continues through adolescence
- Development influenced by experience: Synaptic density above adult levels at age 1, but decreases via "pruning" till age mid-teen years
- Across species, size of frontal cortex relative to rest of brain is index of adaptability/cognitive sophistication

Anatomy of EFs

…but the Frontal Lobes are not the whole story of EF

- Executive Skills suffer with lesions of other cortical areas (e.g., temporal lobes)
- "Lower" brain centers such as *basal ganglia* have rich connections with frontal lobes and modulate their activity


Hypothetical CSTC Loop for Executive Functions
DLPFC → Striatum → Thalamus → DLPFC

Impact of EF deficits on Academic Functioning

- Disorganization of materials, work environment
- Poor planning
- Ineffective problem-solving
- Reduced work efficiency
- Inconsistent attention/effort
- Inflexible approach to studying, work production
- Difficulty prioritizing information, tasks
- Inadequate monitoring of progress towards goal
- Poor time utilization, test-taking strategies

EF Danger Zones

Independent Work

- Long term projects – procrastination, resulting in heroic "last minute" efforts
- Approach/Avoidance – Tasks seen as monumental and deferred to the future – often eliciting anxiety in approach and also avoidance
- Initiation failure - not knowing how, where to start
- Perseverative behavior - getting "stuck" on a detail and losing sight of the larger task goal

EF Danger Zones

Study Strategies

- Failure to distribute study time – last day "cramming" rather than systematic, nightly review
- Failure to identify most relevant content/skills and prioritize them
- Ineffective note-taking, during lectures and reading (inadequate or compulsive)
- Failure to reflect on ideas, concepts that pull content together

Expository Writing – the "Acid Test" of EF

Requirements:

- Accumulate information
- Define overriding theme of composition
- Define, organize subthemes
- Decide how material will be presented in text – information hierarchy
- At the same time, attend to
  - Paragraph and sentence structure
  - Language syntax
  - Grammar, Spelling, Punctuation, Style…

EF Interventions

How to help student with EF limitations

- Direct instruction/tutoring to remediate skills
- Encourage habits/routines that reduce demands upon EF
- Increase external structure
- Reduce external distraction
- Use language as mediating device
- Address sleep difficulties that may exacerbate poor EF
- Identify mental health issues that may compromise EF (anxiety, depression, ADHD)

EF Interventions

- Take advantage of strengths at associative learning (memorizing scripts for repetitive activities)
- Reduce fine motor demands (use laptop, dictation software)
- Titrate information load during reading, learning (reduce multitasking demands)
- Encourage strategies for self-cuing
  - Focus on essential context and ignore non-critical detail – consider what information is **key**
  - Shift focus of attention from detail to "big picture" and back, away from simple detail "A to B" associations
- Encourage use of landmarks in spatial navigation

EF Interventions

- Books/websites helpful resources – many on Amazon
- For others, work with an EF tutor may be helpful
- In some cases, consultation with mental health specialist may be needed
- Neuropsychological assessment may be helpful

EF Interventions - Books

- *FLIPP the Switch: Strengthen Executive Function Skills* by Sheri Wilkins and Carol Burmeister
- *Smart but Scattered: The Revolutionary "Executive Skills" Approach to Helping Kids Reach Their Potential,* by Peg Dawson and Richard Guare
- *The Organized Student: Teaching Children the Skills for Success in School and Beyond,* by Donna Goldberg and Jennifer Zwiebel
- *The Executive Functioning Workbook for Teens: Help for Unprepared, Late, and Scattered Teens* by Sharon Hansen
- *The Writing Strategies Book: Your Everything Guide to Developing Skilled Writers* by Jennifer Serravallo
- *Promoting Executive Function in the Classroom*, by Lynn Meltzer

EF Interventions

- Websites:
  - Harvard: The Developing Child
  - Child Mind Institute
  - Scholastic.com: Strategies to Build Executive Functioning Skills
  - SMARTS: Online executive function curriculum

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