The Purpose of EF

- Decision making
  - Goal setting
  - Prioritizing
  - Organizing
  - Shifting flexibly
  - Holding and manipulating information

- How we think and how we learn

Executive Functions

- Collection of processes
- Capacity to engage in behaviors that are
  - Independent
  - Purposeful
  - Goal-directed
- Incorporates feedback in order to adjust behavior
Executive Functions

- Allows for self-regulation and self-direction of day-to-day and long-term functioning
- Purposely managing thinking or behavior to attain a goal or desired outcome
- Elements of cognition that allow us to stop and think
  - Restrain
  - Initiate
  - Order
- Executive processes ultimately has to be fluent

## Two Cores Strands of Executive Functions

<table>
<thead>
<tr>
<th>Metacognitive</th>
<th>Social/Emotional</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Goal setting</td>
<td>- Response inhibition - impulse control</td>
</tr>
<tr>
<td>- Planning/strategizing</td>
<td>- Emotional control</td>
</tr>
<tr>
<td>- Organization of materials</td>
<td>- Adaptability</td>
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<tr>
<td>- Time management</td>
<td></td>
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<tr>
<td>- Task initiation</td>
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<tr>
<td>- Goal-directed attention</td>
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<tr>
<td>- Task persistence</td>
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<tr>
<td>- Working memory</td>
<td></td>
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<tr>
<td>- Set shifting</td>
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</tbody>
</table>

EF: Developmental perspective

- Interface between the child and environment
  - The anatomical infrastructure (i.e., white matter) is sensitive to extrinsic factors

- Flexible organization of attention (sensory input) and thought (memory and processing)

- Bidirectional interaction between the control systems and the functions it controls
  - Context matters

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EF: Developmental perspective

- Maturation results from experience
  - Child
    - Self directed learning from activities — problem solving
  - Adult
    - External structure — cues, limits, prompts, scripts
- Critical for success in school
- Leads to self regulation of learning and behavior

Elements Executive Functions

- Attention
- Planning
- Organization
- Initiation
- Monitoring
- Inhibition
- Problem Solving
- Working memory
- Shift
- Emotional control
Attention

- The inability to regulate attention
- Difficulty paying attention
  - To the right thing
  - At the right time
  - For the appropriate amount of time
  - As in depth as needed
Attention

- Alertness
- Awareness/Focus
- Selective attention
- Sustained attention
- Alternating attention

- Awake
- Focal activation — Selecting a stimulus
- Freedom from distractibility — Blocking competitive stimuli
- Vigilance — duration
- Shifting focus
Inhibition

- Delay, wait, stop
  - Leads to planning
    - Anticipation of future events
    - Setting goals
    - Developing plans
    - Impacts time concepts
- Space between thought and action
- Being reflective
- Impulse control
  - Deficits lead to symptoms of ADHD
Working Memory

- Memory for intermediate results that must be held during thinking.¹

- Memory system used for holding and manipulating information while various mental tasks are carried out.²

- A system for temporarily storing and managing the information required to carry out complex cognitive tasks such as learning, reasoning, and comprehension.³

¹ wordnetweb.princeton.edu/perl/webwn; ² homepage.ntlworld.com/vivian.c/Linguistics/LinguisticsGlossary.htm; ³ www.brainrehab.org/NeuropsychTerms.html
Working Memory

- **Executive and attentional** aspect of short-term memory
- Interim integration, processing, disposal, and retrieval of information.
- Active monitoring or manipulation of information or behaviors.¹

¹ [en.wikipedia.org/wiki/Working_memory](en.wikipedia.org/wiki/Working_memory)
Working Memory

- **Requirements**
  - Simultaneous storage and processing of information.
    - Goal orientated
    - Active monitoring or manipulation of information or behaviors
    - In the face of interfering processes and distractions.
Working Memory: Size Matters

Working Memory

- **Four subcomponents:**
  - **Central executive**
    - Attentionally-limited control system
    - Regulates the two other components
  - **Visuospatial sketch pad**
  - **Phonological loop**
    - Necessary for the acquisition of both native and second-language vocabulary.
  - **Episodic Buffer**
    - Integrates visual, spatial and auditory information in a time sequence (e.g., memory of a story or a scene)
Working Memory

Central Executive

Phonological Loop
- Phonological Store
- Articulatory Process

Episodic Buffer

Visuospatial Sketch Pad
- Visual Subsystem
- Spatial Subsystem
Memory: Short, Working, Long-Term

From Children’s Memory Scale [CMS]. Copyright © NCS Pearson, Inc.
Shift

- Cognitive flexibility
- Shifting attention
- Transitioning
The Neurology of Executive Functions
The Anatomy of the brain

- Cranium
- Cortex
- Occipital Lobe
- Basal Ganglia
- Cerebellum
- Dura
- Brain Stem
- Spinal Cord
- Parietal Lobe
- Frontal Lobe
- Temporal Lobe
The Interactions of Frontal Lobe

- Frontal Lobe
  - Action and direction – Output

- Other Lobes
  - Sensory Processing – Input
Frontal Lobe

- Center of self directed action and output
  - Initiate movement
  - Problem solving
  - Goal directed behavior

- Prefrontal Cortex
  - Most specialized for metacognition and self regulation

- Coordinates the sensory input received, process and stored by the other lobes (temporal, parietal and occipital)

Dorsolateral Prefrontal Cortex

- Upper portion of frontal lobe – Work production
- Responsible for metacognitive strand
  - Planning
  - Strategizing
  - Sustained Attention
  - Flexibility
  - Self-Monitoring

- Weaknesses may lead to common ADHD symptoms
  - Inattention
  - Planning and organization problems
  - Limited working memory
Orbital Prefrontal Cortex

- Lower portion of frontal lobe - Behavior
- Responsible for social/emotional regulation strand
  - Impulse Control (Behavioral Inhibition)
  - Emotional Modulation
- Weaknesses may lead to ADHD symptoms
  - High levels of verbal and physical impulsivity
  - Poor emotional control
How the PFC Works

- Top-down regulation of cognition and behavior
- Neural connections guides the flow of activity between
  - Sensory input
  - Internal states
  - Output
- It affects memory
- The PFC is well connected to all the other regions of the brain

The Developmental Web

Putting it all together
The Developmental Web

Developmental Profile

Behavioral Profile

Health

Environmental

Academic–Occupational
Behavioral–Emotional
Social Interaction
Health

Educational &
Developmental

Behavioral &
Cognitive

Medical

Environmental
Developmental Profile

Factors affecting input
Developmental Profile

INPUT

PROCESSING

MEMORY
Short Term
Working
Long Term

OUTPUT

Oral
Written

Central Executive

Short-Term & Working Memory
Visual
Auditory
Tactile-Kinesthetic

Sequential/Simultaneous
Rate
Attention
Cognitive

Short Term & Working Memory

Cognitive
Environmental Factors
Environmental Factors

- Temperament
  - Parenting
  - Stressors

- Teachers
  - Physical Facility
  - Curriculum Demands

- Peers
  - Parents

Diagram image.
Curriculum Demands

- Based on curriculum goals
  - K – 3: Literacy
    - Basic academic skills
      - Reading
      - Writing
      - Arithmetic
  - 4th – 8th: General Education
    - Content
    - Executive Functions
  - 9th – 12th: Preparation for Higher Ed, Vocational Ed, Trade
EF and Reading
EF and the Reading Rope Model

Reading Rope

- **Language Comprehension**
  - Background Knowledge
  - Vocabulary Knowledge
  - Language Structures
  - Verbal Reasoning
  - Literacy Knowledge

- **Word Recognition**
  - Phonological Awareness
  - Decoding (and Spelling)
  - Sight Recognition

**Metacognitive Skills**

- Increasingly Strategic
- Increasingly Automatic

**Skilled Reading:** Fluent execution and coordination of word recognition and text comprehension.

*Reading is a multifaceted skill, gradually acquired over years of instruction and practice.*

Scarborough (2001)
Educational Management

- Educational Therapy
- Speech & Language Therapy
- Occupational Therapy

- Remediation → Weakness (IEP)

- Circumvention → Strengths (504 Plan)
  - Volume
  - Rate
  - Technology
  - Assistance
The Cure for EF Dysfunction

Marry them well!!!