

# Executive Functions and Mental Health in Children and Adolescents



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# THE ESSENTIALS OF Executive Functions

## Executive Functions Are



**Executive function (EF)** encompasses a set of higher-order cognitive processes involved in regulating attention, thoughts, and actions (Wiebe & Karbach, 2018). Three key EF skills are:

1. **Impulse Control**
2. **Flexibility (shifting)**
3. **Working Memory**

**EF skills are the  
Command and Control  
Functions  
of the brain**

EF skills begin development early in infancy and continue development throughout early to mid adulthood.

## THE 3 KEY EF Skills

### Impulse Control



The capacity to think before you act. This ability to resist the urge to say or do something allows us the time to evaluate a situation and how our behavior might impact it. (Dawson & Guare, 2016)

### Flexibility



**Cognitive flexibility:** changing perspectives or approaches to a problem, flexibly adjusting to new demands, rules, or priorities (as in switching between tasks) (Diamond, 2013)

### Working Memory



The ability to hold information in mind while performing complex tasks. It incorporates the ability to draw on past learning or experience to apply to the situation at hand or to project into the future. (Dawson & Guare, 2010)

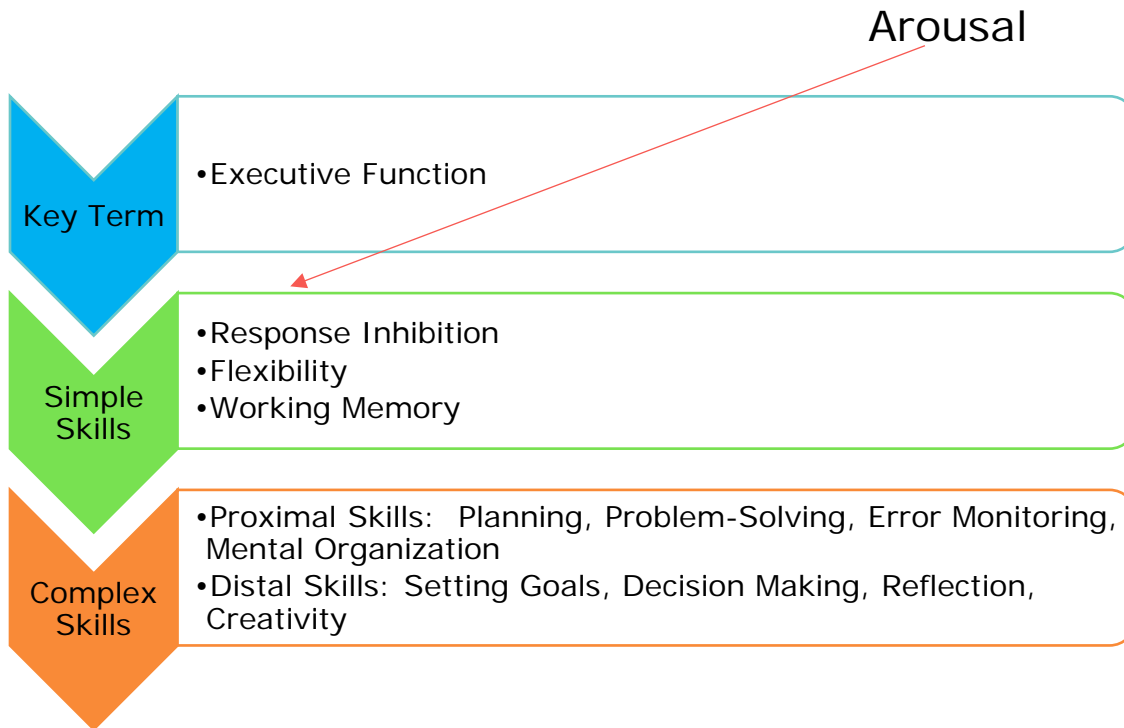
These three simple EF skills are the foundation for more complex skills such as planning, organization, and problem solving.

SOURCE: (Wiebe & Karbach, 2018) (Dawson & Guare, 2016) (Diamond, 2013) (Dawson & Guare, 2010)  
adapted by: Joseph Falkner, MST/CCC-SLP

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## Executive Function Hierarchy



"Executive Function (EF) is defined as a set of mental processes, located in the pre-frontal cortex region of the brain, that are used to carry out goal-directed behavior."

"A simple skill is a basic skill that cannot be broken down into smaller components."

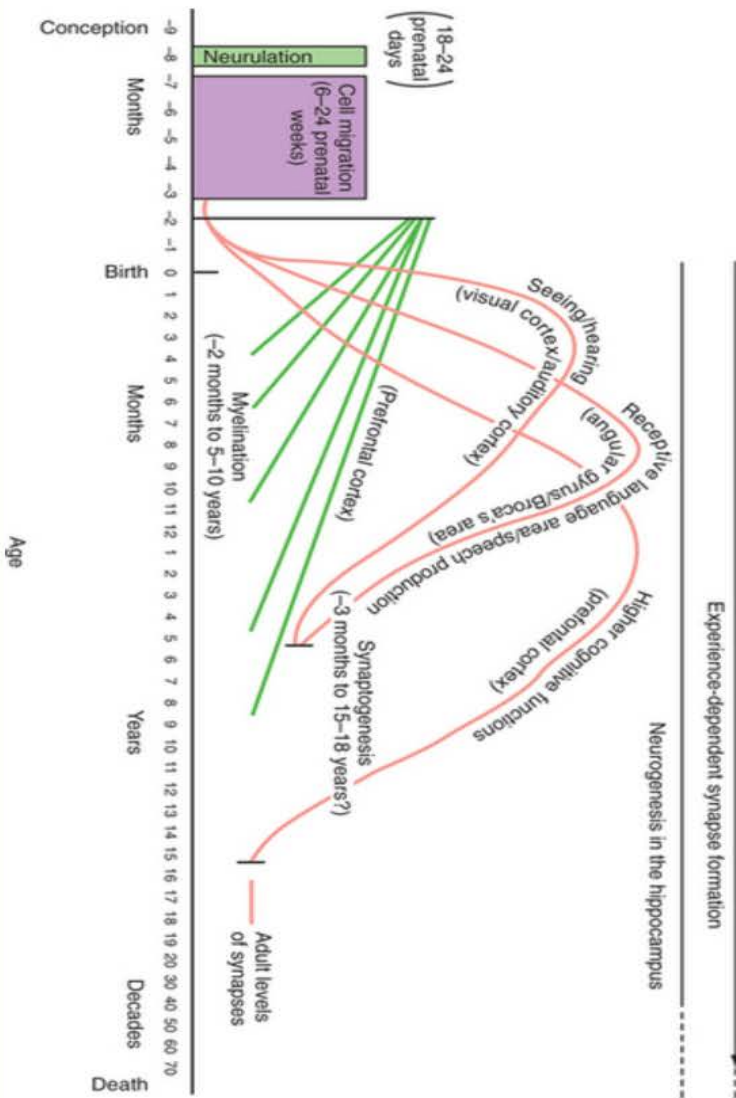
"A complex skill is multi-faceted and involves the coordination of many sub-components or many smaller, simpler skills."

"Proximal skills are more complex than sub-components, and they draw upon them."

"Distal skills are even more complex than proximal skills."

(Jones, Bailey, Barnes, & Partee, 2016)

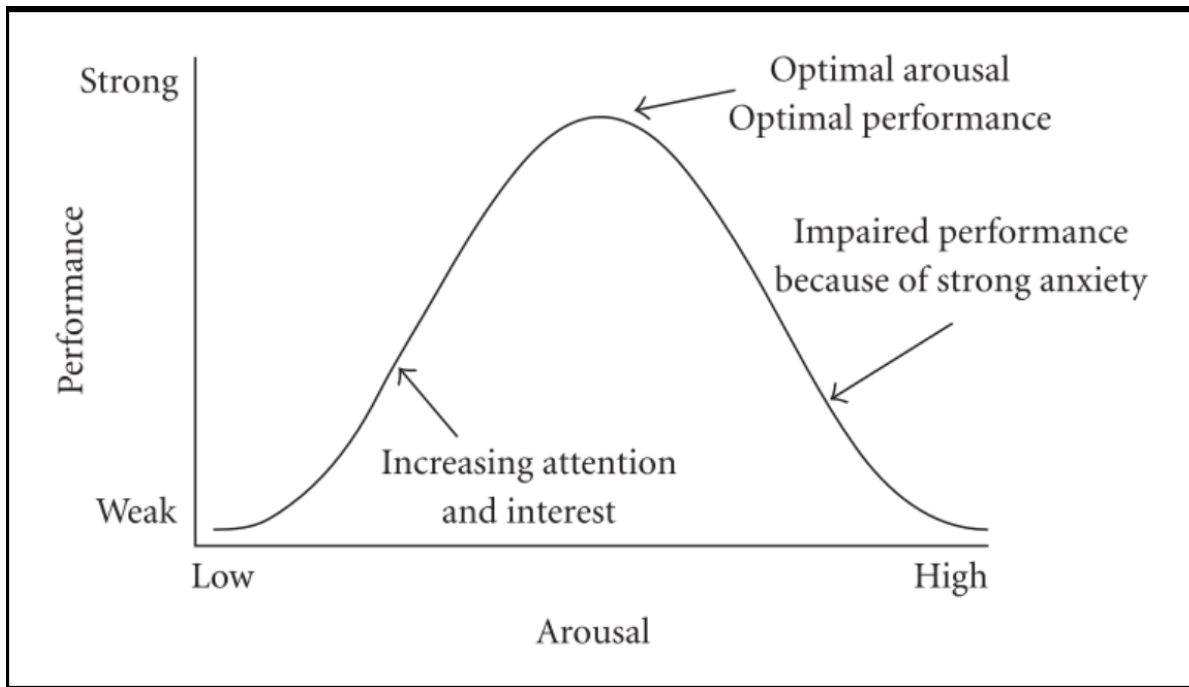
## Development of the Prefrontal Cortex



**Figure 40-1** A depiction of the processes of brain development, including intrauterine neuronal patterning, neurogenesis, cortical migration, gliogenesis, myelination, and experience-dependent synapse modification.

(Thompson & Nelson, 2001)

## Relationship of Arousal and Stress to Executive Functions



(Yerkes-Dodson Law, 2018)

Arousal:

Stress:

Stress Response:

Stress Reactivity:

Autonomic Nervous System:

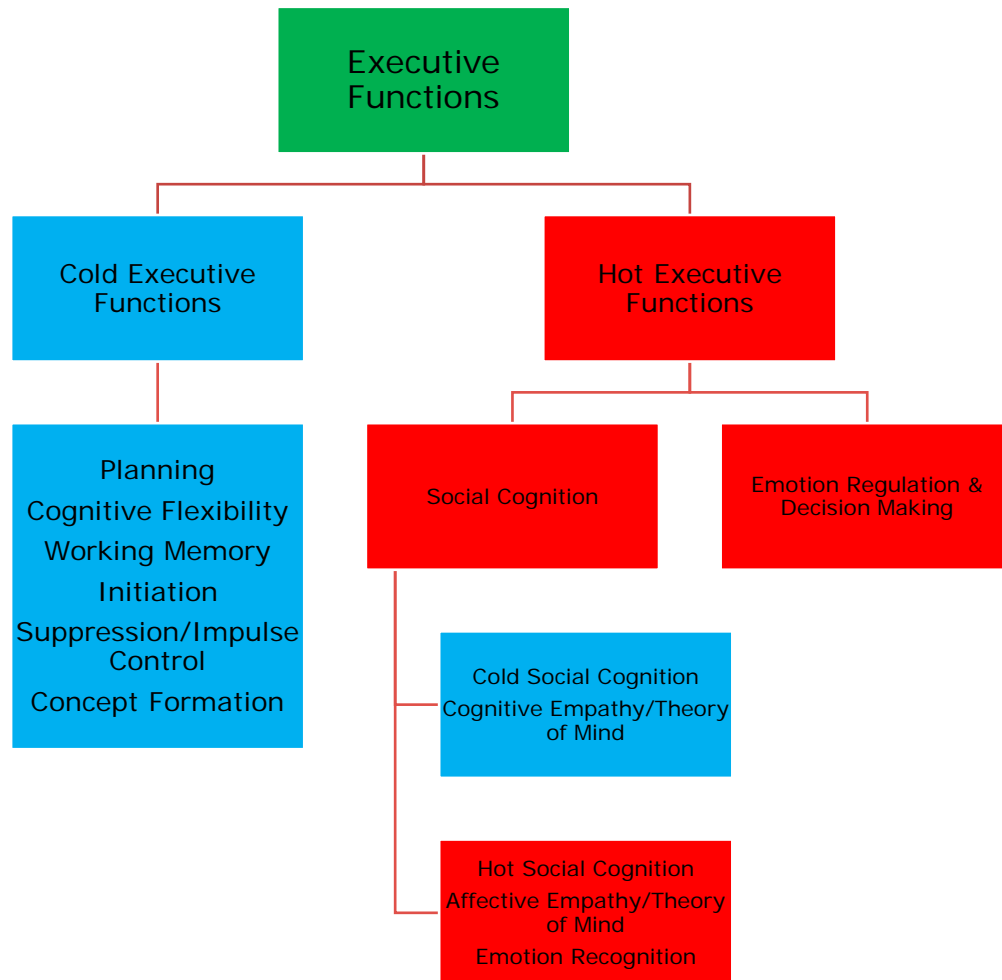
Polyvagal Theory:

HPA Axis:

Stress and the Brain:

## Cold vs. Hot Executive Functions

- Cold “executive functions:
- Hot executive functions:



*Framework of executive function processes, adapted from Chan et al. (2008) and McDonald (2013) in (Zimmerman, Ownsworth, O'Donovan, Roberts, & Gullo, 2016)*

## Impulse Control

Definition: "...refers to one's ability to refrain from doing things that do not contribute to one's intentions or goals." (Yeager & Yeager, 2013)

Three inter-related processes: (Yeager & Yeager, 2013)

1. The ability to refrain from executing one's natural (prepotent) response to a situation
2. The ability to perform "interference control" once a course of action has been initiated, and thus protect the response from disruption by competing events and response
3. The ability to interrupt a response once it has been initiated

Involves three implicit, bottom-up, neurocognitive processes: (Suchy, 2016)

1. Threat Sensitivity: detection and learning from punishing or undesirable outcomes
2. Contingency Updating: updating or reversing learned associations based on context
3. Discrepancy Detection: comparison of environment and actions against goals, plans, etc.

<b>4-5 years</b>	<ul style="list-style-type: none"> <li>• "Reductions in perseveration (persisting with following a rule even when knowing that the rule has changed). Can delay eating a treat; ... can keep an arbitrary rule in mind and follow it to produce a response that differs from their natural instinct" (Center on the Developing Child, 2011)</li> </ul>
<b>6-9 years</b>	<ul style="list-style-type: none"> <li>• Are more internal in thinking and more adept at controlling momentary impulses.</li> </ul>
<b>10-12 years</b>	<ul style="list-style-type: none"> <li>• Become more flexible in thinking and able to switch between a central focus like driving and peripheral stimuli that may need attention, such as pedestrians (Center on the Developing Child, 2011)</li> </ul>
<b>Teens</b>	<ul style="list-style-type: none"> <li>• Increase in risk taking behavior</li> <li>• Increased responsiveness to peer pressure</li> <li>• Increases in "response inhibition" on "cold" EF tasks</li> <li>• Prefrontal cortex and connections to other cortical and subcortical structures involved in inhibition going through significant development</li> </ul>
<b>20's</b>	<ul style="list-style-type: none"> <li>• Decreased risk taking behavior</li> <li>• Better able to inhibit immediate gratification for more long-term goals</li> <li>• Increased connections between emotion centers of brain and prefrontal cortex</li> <li>• Increased awareness when making an inhibition error</li> </ul>
<b>Adult</b>	<ul style="list-style-type: none"> <li>• "Consistent self-control; situationally appropriate responses (e.g., resists saying something socially inappropriate, resists "tit for tat" response)" (Center on the Developing Child, 2011)</li> </ul>

(Blakemore & Robbins, 2012) (Best & Miller, 2010) (Forgan & Richey, 2015)

"Without inhibitory control we would be at the mercy of impulses, old habits of thought or action (conditioned responses), and/or stimuli in the environment that pull us this way or that. Thus, inhibitory control makes it possible for us to change and for us to choose how we react and how we behave rather than being unthinking creatures of habit." (Diamond, Executive Functions, 2013)

## Impulse Control Difficulties

<p>School Age Behaviors</p>	<ul style="list-style-type: none"> <li>• Acting on auto-pilot without reflection</li> <li>• Makes careless mistakes: both verbal and written</li> <li>• Displays hyperactivity</li> <li>• Restlessness—acts wild/"out of control"</li> <li>• Difficulty waiting —delayed gratification is difficult</li> <li>• Interrupts others</li> <li>• Needs immediate feedback</li> <li>• Is a risk-taker or daredevil</li> <li>• Is class clown</li> <li>• Appear disorganized</li> <li>• Perseveration</li> <li>• Dives right into tasks or actions without pausing, reflecting, developing a strategy or game plan             <ul style="list-style-type: none"> <li>• Attempting problem-solving without planning</li> <li>• Starting &amp; stopping tasks repeatedly</li> </ul> </li> <li>• Issues with directions:             <ul style="list-style-type: none"> <li>• Not reading directions</li> <li>• Misreading directions</li> <li>• Misinterpreting directions</li> </ul> </li> <li>• Misinterprets Text</li> <li>• Invading others personal space/Touching things and/or people</li> <li>• Excessive talking</li> <li>• Interrupting conversations</li> <li>• Interrupts and disrupts group activities</li> </ul>
<p>Adolescents and Adults</p>	<ul style="list-style-type: none"> <li>• Distracted driving</li> <li>• Road rage</li> <li>• Substance use and abuse</li> <li>• Gambling</li> <li>• Internet and gaming addiction</li> <li>• Risk-taking behaviors</li> <li>• Angry interactions with significant others</li> <li>• Workplace issues</li> <li>• Money/financial issues—difficulty delaying gratification</li> </ul>

(Axelrod, et al., 2012) (Hutaff & Henry, 2013) (Falkner, 2018)



## Flexibility

Definition: "Mental flexibility allows flexible application of old ideas in new ways, abandoning old ideas that are no longer working in favor of new ideas, or abandoning old issues that have been addressed in favor of new issues that still need addressing. In other words, mental flexibility is the ability to fluidly move from one concept to another, one thought to another, one level of analysis to another, one perspective to another, or one perceptual mode to another. It is also the ability to generalize from the past to the future, or from the concrete to the abstract (Moscovitch & Winocur, 2002; Shimamura, 2002)." (Suchy, 2016)

<b>2-5 years</b>	<ul style="list-style-type: none"> <li>• Can shift actions based on changing rules (e.g. run on the playground but not inside)</li> <li>• Begins to understand turn-taking</li> <li>• Emerging understanding of time</li> <li>• Emotions can still be very intense</li> <li>• Difficulty separating "real" from "imaginary"</li> <li>• May develop fears</li> </ul>
<b>3 years</b>	<ul style="list-style-type: none"> <li>• "Can direct and re-direct their attention to make deliberate choices," mental flexibility (Center on the Developing Child, 2011)</li> </ul>
<b>5 years</b>	<ul style="list-style-type: none"> <li>• Can play cooperatively with several children</li> </ul>
<b>6-9 years</b>	<ul style="list-style-type: none"> <li>• Self-control continues to improve</li> <li>• Internal thinking or self-talk develops</li> <li>• Becomes better able to control negative feelings</li> <li>• Develops awareness of consequences of their actions</li> <li>• Begins to understand difference between "needs" and "wants"</li> <li>• More sophisticated understanding of time</li> <li>• Still egocentric but beginning to understand perspectives of others</li> <li>• Peer competition in sports and the classroom comes to the forefront</li> </ul>
<b>10-12 years</b>	<ul style="list-style-type: none"> <li>• Becomes more flexible according to changing rules</li> <li>• Better able to separate actions and feelings and control negative feelings (Teeter, 1998)</li> <li>• Able to take more responsibility for their actions</li> <li>• Wants independence but still needs guidance</li> <li>• Importance of peer acceptance increasing</li> </ul>
<b>Teens</b>	<ul style="list-style-type: none"> <li>• Increased exploration of "self"</li> <li>• Increased goal flexibility</li> <li>• Continued increases in ability to take the perspective of others</li> <li>• Ability to carry out more tasks at a single time</li> <li>• Increases in "hot" executive function development</li> </ul>
<b>20's</b>	<ul style="list-style-type: none"> <li>• More stable sense of self</li> <li>• More defined "set" of goals for life</li> <li>• Increased resilience to life's stressors</li> <li>• "Able to revise actions and plans in response to changing circumstances" (Center on the Developing Child, 2011)</li> </ul>

(Forgan & Richey, 2015) (Center on the Developing Child, 2011) (Falkner, 2018)

## Flexibility Difficulties

- Difficulty making transitions
- Difficulty starting a new task before the first task is complete
- Difficulty switching gears
- Perseverative behaviors
  - Gives the same answers to different questions
  - Perseverative questioning
  - Perseverating on a topic, idea or activity
- Difficulty switching to a new topic or new subject
- Inflexibility/rigidity
- Difficulty with problem solving and conflict resolution
- Failure to comply with task instructions
- Repeating the same behavior after the task has changed
- Difficulty moving on from an emotional response to a situation
- Difficulty applying different strategies to problems as they arise
- Difficulty attending to differences between two different problems
- Driven by routine and consistency
  - Needing the same seat at table
  - Wearing the same clothes or same color clothes each day
  - Eating the same foods; difficulty with foods touching one another
  - Unable to tolerate changes in schedule
  - Difficulty transitioning - one activity to another, etc.
- Highly emotional—becomes stuck in emotional response
- Ruminative—will repetitively go over a particular thought or problem without coming to a conclusion
  - Worry is involved in rumination
- Unable to adapt to changes or life events

(Axelrod, et al., 2012) (Falkner, 2018)

## Working Memory

Definition: "Working memory involves two different but related skills. The first is the ability to hold information in mind while performing complex tasks." "A related but more complex aspect of working memory gives us the ability to draw on past learning or experience and apply it to the situation at hand or predict future outcomes." (Guare, Dawson, & Guare, 2013)

May have limitations in either storage, processing, or both.

Working Memory Components: (Baddeley A. , 1992) (Baddeley & Logie, 1999)

- Central Executive: the supervisory and control system of working memory (what many consider working memory)
- Episodic Buffer: "The episodic buffer is an entirely new component, described as a 'multimodal' temporary store." "This means that it does not just store information in one modality (e.g. auditory or visual or spatial or kinesthetic) but deals with information from many different modalities." (Henry, 2012)
- Phonologically-Based Store (the phonological loop): the verbal storage and manipulation system
- Visuospatial Store (the visuospatial sketchpad): the visual and spatial storage and manipulation system

<b>7-9 months</b>	<ul style="list-style-type: none"> <li>• "Develops ability to remember that unseen objects are still there; learns to put two actions together in a sequence" (Center on the Developing Child, 2011)</li> </ul>
<b>9-10 months</b>	<ul style="list-style-type: none"> <li>• "Can execute simple means-to-ends tasks and two-step plans; also, able to integrate looking one place and acting (e.g., reaching) at another place." (Center on the Developing Child, 2011)</li> </ul>
<b>3 years</b>	<ul style="list-style-type: none"> <li>• Can keep two rules in mind and act on them</li> </ul>
<b>3.5 years</b>	<ul style="list-style-type: none"> <li>• Can use past knowledge to help them remember (Wellman, Somerville, &amp; Haake, 1979)</li> </ul>
<b>5 years</b>	<ul style="list-style-type: none"> <li>• Begin to recall location of items, such as in a memory game or by finding items in a room</li> </ul>
<b>7 years</b>	<ul style="list-style-type: none"> <li>• Can begin to use simple memory strategies, like organization of material, but usually need prompting (Teeter, 1998)</li> </ul>
<b>10-11 years</b>	<ul style="list-style-type: none"> <li>• May use organizational strategies when instructed to remember information without prompting (Chance &amp; Fischman, 1987)</li> <li>• Begin using rehearsal strategies, such as grouping items together or repeating them in a certain sequence</li> </ul>
<b>12 years</b>	<ul style="list-style-type: none"> <li>• Use more spontaneous elaboration and strategies independently</li> </ul>
<b>Adults</b>	<ul style="list-style-type: none"> <li>• "Can remember multiple tasks, rules, and strategies that may vary by situation" (Center on the Developing Child, 2011)</li> </ul>

(Forgan & Richey, 2015)

## Working Memory Difficulties

School Age Behaviors	<ul style="list-style-type: none"> <li>• Individual gets confused when too much information is presented</li> <li>• Has trouble remembering things (i.e., phone numbers)</li> <li>• Individual may lose track of what they are doing</li> <li>• Individual may forget what they need to retrieve when on an errand</li> <li>• May frequently switch tasks or fail to complete tasks</li> <li>• Difficulty remaining attentive and focused for appropriate length of time</li> <li>• Difficulty following directions</li> <li>• Classroom Related             <ul style="list-style-type: none"> <li>• Difficulty sequencing math word problems</li> <li>• Extreme difficulty solving problems mentally (i.e., mental math)</li> <li>• Poor reading comprehension</li> <li>• Difficulty summarizing</li> <li>• Inconsistent performance</li> <li>• Difficulty keeping up with classroom lessons</li> </ul> </li> <li>• Difficulty keeping up with information to complete a task             <ul style="list-style-type: none"> <li>• May look like poor attention</li> <li>• Misses important pieces of information</li> <li>• Gets confused when too much information is presented at once or too quickly (i.e. information overload)</li> <li>• Poor note taking from lectures</li> </ul> </li> <li>• Extreme difficulty solving problems mentally (i.e. mental math)</li> <li>• Difficulty keeping up with and maintaining conversation</li> <li>• Frequently asking questions</li> <li>• Difficulty sequencing</li> </ul>
Adolescents and Adults	<ul style="list-style-type: none"> <li>• Forgetful of, or misses, appointments</li> <li>• Misses deadlines</li> <li>• Overdue bills</li> <li>• Misses components of projects/work tasks</li> <li>• Requires repeated explanations to be able to complete tasks</li> <li>• Does not complete basic hygiene routines</li> <li>• Does not complete home living routines</li> <li>• Seems absent-minded</li> </ul>

(Axelrod, et al., 2012) (Falkner, 2018)

# Mental Health and Executive Functioning

## Addiction

- Stress Reactivity:
- Executive Function Difficulties:

## Aggression

- Stress Reactivity:
- Executive Function Difficulties:

## Anorexia

- Stress Reactivity:
- Executive Functioning Difficulties:

## Anxiety

- Stress Reactivity:
- Executive Functioning Difficulties:

## ADHD

- Stress Reactivity:
- Executive Functioning Difficulties:

## ASD

- Stress Reactivity:
- Executive Functioning Difficulties:

## Bipolar Disorder

- Stress Reactivity:
- Executive Functioning Difficulty:

### Borderline Personality Disorder

- Stress Reactivity:
- Executive Functioning Difficulties:

### *Concussion and Head Injury*

- *Stress Reactivity:*
- *Executive Functioning Difficulties:*

### Depression

- Stress Reactivity:
- Executive Functioning Difficulties: D

### Maltreatment

- Stress Reactivity:
- Executive Functioning Difficulties:

### Pre-term

- Stress Reactivity:
- Executive Functioning Difficulties:

### Socioeconomic

- Stress Reactivity:
- Executive Functioning Difficulties:

### Disruptive Behavior Disorders

- Stress Reactivity:
- Executive Function Difficulties:

### OCD

- Stress Reactivity:
- Executive Functioning Difficulties:

## PTSD

- Stress Reactivity:
- Executive Functioning Difficulties:

## Schizophrenia

- Stress Reactivity:
- Executive Functioning Difficulties:

## Screen Dependence

- Stress Reactivity:
- Executive Functioning Difficulties:

## Tourette's Syndrome

- Stress Reactivity:
- Executive Functioning Difficulties:

## Principles of Neuroplasticity

1. Use it or Lose It:"
2. Use It and Improve It:
3. Fire Together, Wire Together: re. Repetition is required to link these pathways firmly." (*Raskin, 2011*)
4. Specificity:
5. Repetition Matters:
6. Intensity Matters:
7. Timing Matters:
8. Salience Matters:
9. Transference Matters:
10. Interference Matters:

(Kleim & Jones, 2008)

\*\*\*Important for our discussion today, brains change within the context of experience. Like the grooves of a path that has been walked again and again, our habits become ingrained at a synaptic (and even a genetic level). To make changes (to harness our neuroplasticity), we must walk a new path.



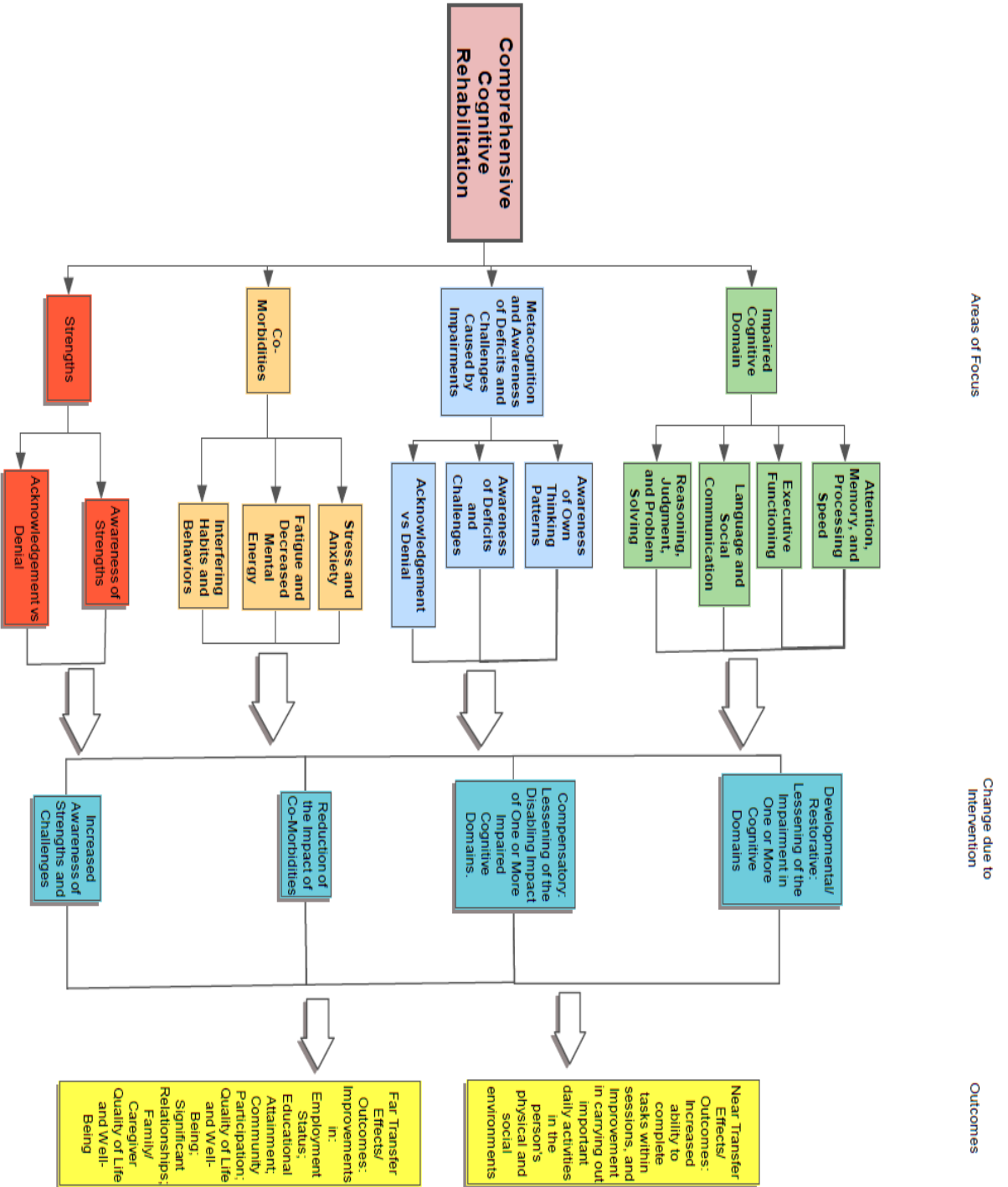
## General Evidence-Based Practices for Addressing Executive Function Difficulties

The following practices have been found to have an evidence-base for addressing executive functions with some populations of individuals. These may not be appropriate for individuals with certain diagnoses.

- Mindfulness Training
- Exercise:
- Computer-based-training:
- Coaching:
- Tools of the Mind:

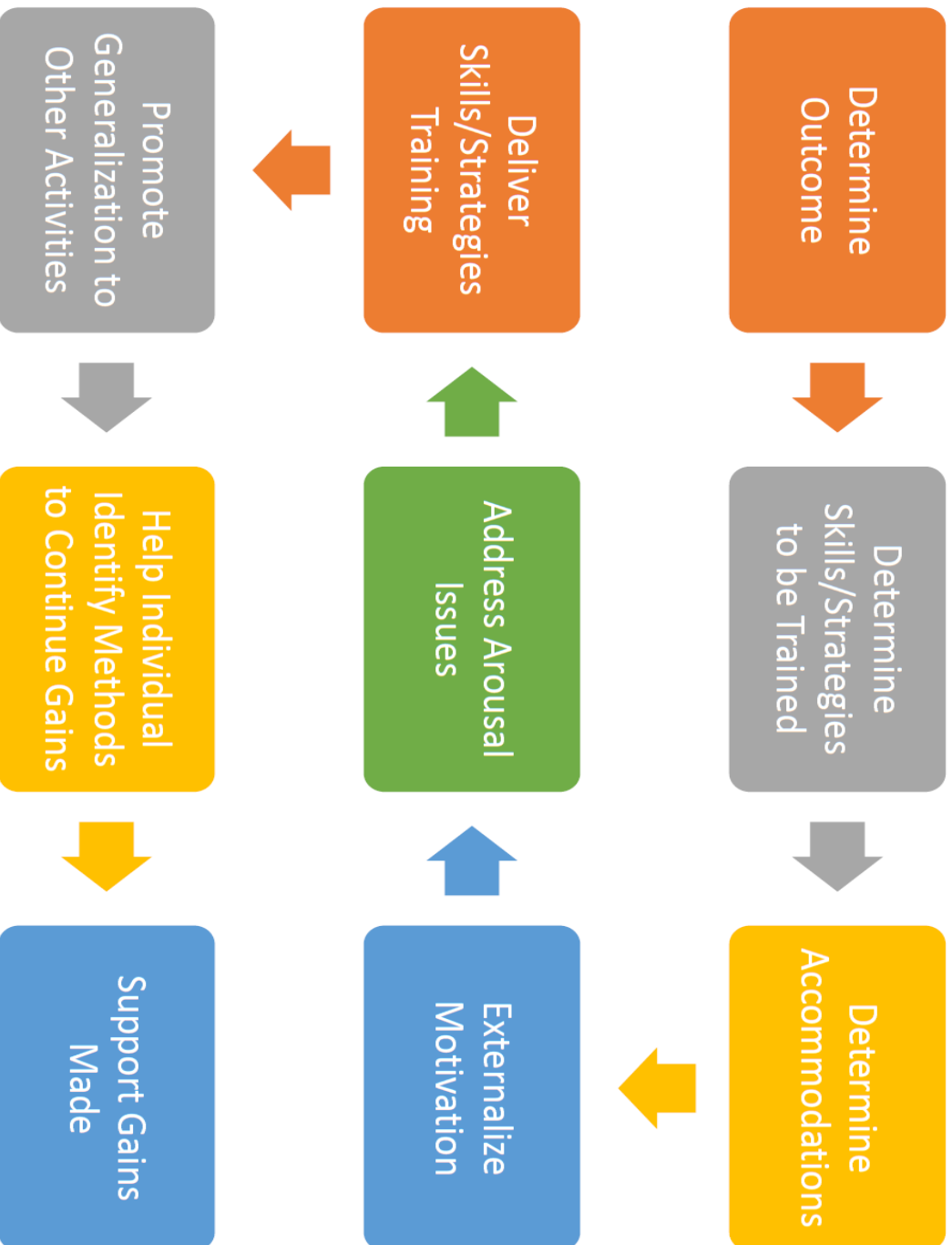
Criticisms of evidence-based executive functioning training: (Diamond & Ling, Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not, 2016)

- “EF training appears to transfer, but the transfer appears to be narrow.”
- “Whether EF gains are seen depends on the amount of time spent practicing.
- “Whether EF gains are seen depends on the way an activity is presented and conducted.”
- “EFs need to be continually challenged to see improvements – not just used but challenged.”
- “Those with the poorest EFs consistently gain the most from any program that improves EFs,
- “Once practice ends, benefits diminish.



Joseph Falkner, MST/CCC-SLP (c), 2017  
 adapted from: Ostergren, 2018

### Addressing Executive Functioning Needs



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adapted from: Barkley, 2012; Haskins, et al., 2014; Dawson & Guare, 2010; Dawson & Guare, 2014; McCloskey, 2016; Naar-King & Suarez, 2011

# A Model of the Art and Science of Addressing Executive Function Needs in Individuals with Mental Health Diagnoses

