Executive Functions Assessment and Interventions

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Workshop Topics

1. What are Executive Functions (EFs)
2. EFs and Academics
3. Assessment Strategies
4. The MEFS approach
5. Case study
6. Interventions
Executive Functions

1. A complex construct
2. There are many different EFs
3. Different theories
4. Different from intelligence (correlate .2 - .3)
5. Cues and controls cognition, emotion, social functioning, and behavior
6. Have a neurological basis
7. Conscious and unconscious
8. Important for learning and production
EF Definitions

1. Directive capacities
2. Supervisory system with multiple parts
3. Cue the use of other mental capacities but are not those capacities themselves; do not do those processes
4. “Purposeful, organized, strategic, self-regulated, goal-directed processing of emotions, thoughts, and actions”
More EF Definitions

1. “A range of cognitive processes that controlled by the prefrontal cortex” (Eslinger)
2. “Those capacities that enable a person to engage successfully in independent, purposive, self-serving behavior” (Lezak et al.)
3. Self-awareness and self-regulation
4. There is no consensus definition
5. Difficult to separate executive from cognitive
6. Difficult to operationalize
7. With parents and children, “control tower” helps
Working Memory (WM) Example

1. The executive dimension of WM supervises short-term memory (a cognitive process)
2. The executive aspect of WM inhibits, shifts, and updates
3. The executive aspect of WM interacts with cognitive processes such as reasoning
4. The executive aspect of WM cues the use of an executive skill/strategy, such as rehearsal
Is There a “g” of EF?

1. Factor analysis does not prove that EF is one “thing” in the brain or one function
2. Rather, “Co-conductors” that collaborate
3. Thus, the development of EF’s can vary; can be strengths and weaknesses within
4. Domain’s have their own EFs; e.g. language
5. Saying that EF in general is weak is not especially helpful in understanding the problem, child, or developing an intervention
Self-Regulation EFs

1. These are what are typically considered EFs
2. Cue and direct how we feel, think, and act
3. Can self-regulate without being consciously aware
4. McCloskey theory and McCloskey Executive Functions Scale (MEFS) has 31 specific self-regulation EFs
McCloskey Self-Regulation EFs

- Perceiving
- Focusing
- Sustaining
- Initiating
- Energizing
- Inhibiting
- Stopping
- Pausing
- Being Flexible
- Shifting
- Monitoring
- Modulating
- Correcting
- Balancing
- Sensing Time
- Pacing

- Using Routines
- Sequencing
- Holding/Working
- Storing/Retrieving
- Gauging
- Anticipating
- Estimating Time
- Analyzing
- Evaluating
- Generating
- Associating
- Organizing
- Planning
- Prioritizing
- Deciding
- Link to Examples
McCloskey (MEFS) Self-Regulation Clusters

1. Attention
2. Engagement (initiating, inhibiting, flexible)
3. Optimization (monitoring, correcting)
4. Efficiency (pacing, using routines)
5. Memory (holding/working, storing/retrieving)
6. Inquiry (anticipating, analyzing)
7. Solution (organizing, planning, deciding)
Higher Level EFs (McCloskey)

1. These develop later
2. Have lower correlations with self-regulation
3. Self-Realization is a sense of self and others
   1. Same as metacognition
   2. Theory of mind
   3. Self-awareness
   4. Sense of personal strengths and weaknesses
   5. Can enhance self-regulation, but not always
4. Self-Determination
   1. Goal setting and long-term planning
Arenas of Involvement (McCloskey)

1. EF’s vary greatly by situation, environment, and domain of functioning
2. Intrapersonal (internal processes) and Interpersonal (social) (these two combined on MEFS)
   1. Autism has deficits in this arena
3. Academic (symbol system)
   1. Language and academic learning
   2. LD often deficient in this arena
Neurological Basis of EF

1. Control center in prefrontal cortex
2. Each EF has its own pathway through the frontal lobes and with other parts of brain
3. Connectivity is important for EFs functioning
Prefrontal Cortex Image
Development of EFs

1. Begin to develop in early infancy
   1. E.g., choosing where to look
   2. Control of actions
2. The different EFs are on different developmental tracks and rates
3. Major developmental advances in adolescence
4. Development is not under the child’s control
Development of EFs

1. Initially cued by external demand
2. Then become more internally driven
3. Complying with external EF demands requires more mental effort and greater control capacity than internal (ADHD)
4. Females more advanced than males (see MEFS study)
EF Deficits in ADHD Population

1. Weak self-regulation EFs, especially inhibiting, focusing, sustaining
2. Also: holding, planning, sensing time
3. Self-realization and self-determination
4. Not all individuals with EF deficits are ADHD
EFs and Other Disorders

1. Executive deficits are evident in every neuropsychiatric disorder (does not mean they are the cause)
2. Examples: Anxiety, ODD, CD, autism
3. Can have executive deficits without having a disorder
EF and Academic Learning

1. EFs are good predictors of achievement
2. EF deficits are more evident in production problems than acquiring academic skills
   1. May be that teacher provides more executive controls during skill learning
   2. Production deficit: has the academic skills, but does not demonstrate/apply them
3. Especially homework and projects
4. EF demands increase in middle & high school
5. A mismatch between demands and students EF levels
The Big 6 Efs for Academics (Meltzer)

1. Goal-Setting
2. Flexibly Shifting
3. Prioritizing
4. Organizing
5. Working Memory
6. Self-Monitoring
EFs and Misattributions

1. Misattributions: Laziness, apathy, irresponsible, lack of motivation, lack of respect for authority
2. Poor study skills
3. Low intelligence
EF and Reading Comprehension

1. Important EFs: Focusing, Sustaining, Organizing, Planning, Shifting, Inhibiting, Monitoring, Holding/Working, Generating, Associating, Storing/Retrieving, Balancing
EF and Math

1. EFs needed for math computation include: Focusing, inhibiting, storing/retrieving, monitoring, and correcting
EFs and Written Expression

1. Of all academic skills, is the most impacted by EF difficulties

2. EFs needed to integrate the various processes, abilities, and skills when writing. Such EFs include: Sustaining, gauging, holding/working, organizing, planning, balancing, monitoring, correcting, generating, associating
EF Assessment Challenges

1. Assessments focus primarily on EF with symbolic material (academic learning arena)
2. Direct assessments provide much EF support
3. Each scale structures the EFs differently
4. Scales don’t assess for different arenas
5. Rating items are general, not specific
   1. E.g., the BRIEF Working Memory subscale has other EFs: Focus, Select, Modulate, Organize, Monitor, Execute, Direct
Problem with Direct Standardized Testing of EFs

1. Standardized tests provide structure, focus, short intervals; reduce need for EF functions
2. May lack validity for the individual. Typically, overestimate the EF abilities and skills
3. Some tests designed for those with strokes and brain injuries
4. Multiple EFs are required by each task
5. The tasks also require cognitive processes
Test Performance When EFs Vary

1. EF deficits are indicated when performance declines as EF demands are increased
   1. Arithmetic subtest on WISC-IV Integrated improves as EF demands are reduced

2. Still need to determine the specific EFs that are deficient
Direct Assessment Examples

1. NEPSY-II
2. D-KEFS
3. BADS-C
4. WCST
5. RCFT
Interviews

1. See CD in McCloskey, Perkins, and Van Divner (2009)

Examples
Classroom Observations

1. See CD in McCloskey, Perkins, and Van Divner (2009)
   Examples
FBA-Like Analysis

1. Do an FBA from an EF perspective
2. With this, the Antecedents are miscuing or lack of cuing of appropriate EF skills
   1. Example: complex directions, can’t hold or organize, then noncompliance, then consequence
3. Child’s negative behavior may not be conscious misbehavior but rather inadequate cuing and activation of EFs necessary for regulating behavior
MEFS Standardization and Norming

1. 254 Teacher raters, 167 cities, 29 states
2. Ages 5-19; N = 1,000; 5 age groups
3. Matches U.S. demographics well
4. 17% of norming sample: disability/disorder
5. Online data collection
6. 110 Items
7. <15 minutes to complete
MEFS Goals

1. Identify EF strengths and weaknesses
2. Identify more specific EF strengths and weaknesses than other scales
3. Identify EF “production deficiencies”: has the executive skill but the skill is not being cued internally
4. Facilitate intervention planning
MEFS Structure

1. 7 Self-Regulation Clusters
2. 31 Self-Regulation EFs
3. Also, Self-Realization and Self-Determination
4. Two arenas: Academic and Self/Social
5. Identifies strengths and deficits across self-regulation EFs by arena
6. Individual item analysis
Directive EFs vs EF Skills

1. Directive EFs: Becoming aware of the need to cue and then cuing and directing its executive skill counterpart, such as awareness of the need to plan

2. Expressive Executive Skills: The actual expression of the EF skill, such as planning

3. Having the EF skill, but not expressing it because it has not been cued is an “EF production deficit”
Working Memory (WM) Example

1. WM Directive Cues
   1. Noticing you just forgot something
   2. Recognizing it will be difficult to remember

2. EF Skills
   1. Review your previous thoughts
   2. Write it down
   3. Rehearsal
   4. Chunking
   5. Visualizing
Unique Rating Structure Identifies Different Types of EF Deficits

<table>
<thead>
<tr>
<th>Rating Description</th>
<th>Strengths or Deficits</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 – Almost always does on own without prompting</td>
<td>5 and 4 – Executive Function Strength (has both directive function and expressive skill)</td>
</tr>
<tr>
<td>4 – Frequently does on own without prompting</td>
<td>3 and 2 – Executive Function Deficit (directive EF lacking but has expressive skill)</td>
</tr>
<tr>
<td>3 – Seldom does it on own without prompting</td>
<td>1 and 0 Executive Skill Deficit (the executive skill is lacking; can’t do even when cued)</td>
</tr>
<tr>
<td>2 – Does it, but only after prompting</td>
<td></td>
</tr>
<tr>
<td>1 – Only does it with direct assistance</td>
<td></td>
</tr>
<tr>
<td>0 – Unable to do even with assistance</td>
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</tbody>
</table>
Gender Differences

1. At all age levels, females significantly better EFs on Engagement and Optimization clusters
2. Ages 5-6, females better on all self-regulation clusters except Memory
3. Ages 7-8, females better only on Engagement and Optimization
4. Ages 9-10, females better on all except Efficiency and Memory
5. Ages 11-18, females better on all clusters
EF Correlation with Academic Skills

1. Teachers rated student’s overall academic skill level
2. Below average students had the lowest MEFS scores, and above average the highest
3. Significant differences by academic skill level for all MEFS clusters, regardless of disability status
Suggestion for Using the MEFS with African-Americans

1. The MEFS does not have a composite score that is like “g” or equates with intelligence

2. When MEFS cluster scores are all average or higher, can argue that there is a specific learning deficit in an individual who would otherwise achieve at an average or higher level
Validity Studies: BRIEF

1. The majority of correlations between MEFS cluster scores and BRIEF Metacognitive scores were significant.
2. The majority of correlations between MEFS cluster scores and BRIEF Behavior Regulation scores were not significant.
3. MEFS Self-Realization and Self-Determination were mostly not significant.
4. The MEFS and BRIEF are measuring different EFs or measuring them in different ways.
Validity Studies: NEPSY-II EF Tests

1. Nearly all correlations between MEFS cluster scores and NEPSY-II EF scores were not significant

2. Only the NEPSY-II Word List Repetition had significant correlations with several MEFS Self-Regulation clusters

3. The MEFS and NEPSY-II are measuring different EFs or measuring them in different ways
Autism Profile

1. Autism sample had significantly lower scores on all MEFS clusters in both academic and self/social arenas

2. The majority of the differences were around one standard deviation
ADHD Profile

1. ADHD sample had significantly lower scores on MEFS clusters in both academic and self/social arenas, except for the Memory cluster and Self-Realization

2. The majority of the differences were around one half of a standard deviation

3. Those on medication did not have significant differences on Memory, Efficiency, and Self-Realization and self/social under Solution
Case Study

1. 12 year old, 6\textsuperscript{th} grade female
2. WJ IV GIA of 71; ST WM a strength (95)
3. Academic skills 2\textsuperscript{nd} to 4\textsuperscript{th} grade level
4. She is in unstructured charter school project-based regular ed. class; performance is poor
5. No interest in learning
6. Can shut down and become noncompliant
7. Can be socially appropriate when she chooses to
Case Study MEFS Results

1. MEFS completed by classroom teacher
2. All cluster scores 1\textsuperscript{st} % ile except Memory
3. No EF strengths
4. EF Deficits and Executive Skills Deficits are fairly even, meaning she can perform the EF when prompted and thus has the capacity/skill
5. Has more EF deficits under academic than self/social, consistent with underachievement indicators on the WJ IV
6. NEPSY-II EF scales scores are 7-12, majority around 9

1. Why?
EF Intervention Considerations

1. There is minimal evidence-based literature
2. Don’t assume the child has conscious control over the EFs in question
3. Rewards and punishments may not be appropriate for those with undeveloped EFs
4. Directive EF deficits or an EF skills deficit?
   1. If directive, then needs external cuing at first
   2. If skills, then skills need to be taught
5. Some EFs will improve with time/maturation
EF Intervention Guidelines

1. Model effective EF use (think aloud)
2. Initially assume EF capacity is there; it just needs to be activated
3. Focus on making child aware of the EF’s needed to accomplish a task
4. Begin with external control when there are directive EF deficits
5. Gains may be minimal and progress slow
6. Have reasonable expectations
7. Teach specific executive functions as skills routines
8. The end goal is the internalization of directive capacities and skills that can be accessed
Intervention Programs that Improve EF

1. Cognitive Behavior Therapy
2. I Can Problem Solve
3. Skill-Streaming
4. Social Skills Training
5. Cognitive Strategy Training
6. Working Memory Training
7. Study Skills
8. Programs for ADHD
Metacognitive (Awareness) Emphasis

1. “Thinking about thinking”
2. Applies to all EF interventions
3. Teach child how EF works
4. Inform child of strengths and weaknesses
5. Teach how to control, apply, use the EF skill
6. Emphasize personal efficacy of intervention
7. Includes strategy knowledge and application
8. Teach conditional strategy knowledge: how, when, where, why
EF Strategies for the Whole Class (Meltzer): Metacognitive Instruction

1. Recognize the purpose of a strategy
2. Recognize the benefits of a strategy
3. Teach conditional strategy knowledge: how, when, where, why to use the strategy
4. When students understand the above, they personalize and generalize strategies and persist at using them
Help Teachers Understand

1. The extent of the EF demands they make on students and how these overwhelm students with slower EF development
2. How EF deficits contribute to academic production problems
3. Encourage them to have an EF focused class
   1. Similar to mnemonic classroom
EF Strategies for the Whole Class (Meltzer): Goal Setting

1. Short-Term and Long-Term goals
2. Makes students more motivated
3. Identify the steps involved
   1. Breaking tasks into manageable parts
4. Identify the strategies needed
5. Includes planning and time management
EF Strategies for the Whole Class (Meltzer): Flexibility and Shifting

1. Shifting examples: from one approach to another, from one process to another, from the main ideas to the details, from writing to editing, from reading to computing

2. Flexibility examples: interpreting information in different ways, solving math problem in different ways, studying differently for different kinds of tests
EF Strategies for the Whole Class (Meltzer): Organizing and Prioritizing

1. Prioritize based on level of importance
   1. Allocate time based on priority
2. Teach them to impose their own structure on the task
3. Organize concepts, such as semantically
4. Organize materials and work space
5. Graphic organizers
6. Following a rubric for writing
EF Strategies for the Whole Class (Meltzer): Working Memory

1. Learn how to manage cognitive load
2. Using rehearsal
3. Chunking and visualizing
4. Using long-term memory mnemonics, such as keyword
EF Strategies for the Whole Class (Meltzer): Self-Monitoring & Checking

1. Review progress towards goals
2. Reflect on strategy use
3. Develop and use personalized checklists
4. Use self-cuing
Strategies for External Control

1. Structure the environment to reduce self-regulation demands
2. Structuring time (schedules, timers, etc.)
3. External prompting (providing list of steps)
4. Cue/prompt specific self-regulation EF skills when they directive EFs are deficient
5. Providing feedback and reinforcement
Using Verbal Mediation

1. Using self-talk to increase self-control
2. Generating internalized language is a very effective tool for improving self-regulation EFs
3. First, model it by talking through it aloud
4. Then have child say it aloud
5. Then whisper
6. Then say it internally
Attention Self-Monitoring

1. Research documents efficacy of this method
2. Works because it increases the EF Directive (self-cuing) aspect
3. Increasing self-monitoring increases on-task behavior, extends sustaining attention
4. Assumes the EF skill is adequate
Attention: Self-Monitoring

1. Teacher, or device carried by student, cues student at variable intervals, 1 - 5 minutes
2. When cued, student marks monitoring sheet regarding behavior when cue occurred or behavior since last cue
3. When teacher is cueing, she also provides her rating alongside student’s; student receives bonus point when ratings match
4. Set a points goal that student is working for, easy at first, then keep adjusting upward
5. Reinforcement system is necessary
Sensing Time

1. Having difficulty estimating how much time a task will require

See sheet
Executive Functioning: Planning

1. Developing planning improves math performance (Naglieri’s study; ATI)
2. Discuss benefits of plans
3. Develop plans
4. Verbalize them
5. Implement them and evaluate
Problem-Solving Steps

1. Define the problem
2. Brainstorm solutions
3. Pick a solution
4. Implement the solution
5. Review the results
N-Back Exercise

1. Used as a working memory exercise
2. Found to promote growth of white matter in brain
3. Remember stimulus n-items bac
4. *n-back task*
5. What strategy would you teach for this?
6. It can strengthen these EFs:
   1. Sustaining
   2. Inhibiting
   3. Shifting
   4. Holding/Working
Interventions: Case I

1. A five-year old with ADHD and severe impulsiveness (risky behaviors)
2. Consult with parents to structure home environment to make it safer
3. Teach child the language of self-regulation
4. Cue him to stop and plan
5. Cue him to pay attention to what is going on in his environment
6. Cue him to modulate his activity level
7. Cue him to gauge the activity level needed for the task
8. Cue him to inhibit his actions and make a better choice
9. Cue him to correct his motor actions that led to an incident
10. Help him think about potential consequences of his actions
Intervention Case II

1. An adolescent male with difficulties in nearly all of the 32 self-regulation EFs
2. Has difficulties in both the self/social arena and the academic arena (he is struggling academically)
3. Has many EF deficits (is not self-cuing)
4. Is aware of many of his EF deficits
5. Has adequate social skills & good communication
6. Is a concrete thinker
7. Has appropriate long-term goals (a hands-on trade)
Intervention Case II Academics

1. Weak academic skills in all areas
2. Unexcused absences
3. Temper outbursts in classes
4. Lack of engagement during class
5. Does not complete assignments
6. Failing grades
7. At-risk of dropping out
Interventions for Case II

1. Work experience
2. Specially designed instruction in academics
3. Removal of antecedents leading to temper outbursts
4. Help him identify realistic goals
5. Discuss the kind of EFs he would need to achieve his goals
6. Modeling by a “coping” model on the work site
7. Providing a structured work site
Interventions for Case II

7. Self-administered rewards

8. Strategies for maintaining external control
   1. Structure the environment
   2. Structure his schedule to maximize effective use of time
   3. Teachers were taught how to cue him in a positive manner

9. External feedback and rewards

10. Aligning school program with his internal desires