

Children with Executive Functioning Deficits

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Objectives

- Define Executive Function
- Neuroanatomy review & identify neuroanatomy related to executive functioning
- Review research literature on EF development
- Discuss assessment techniques
- Interventions
- Case studies
- Questions

What is Executive Functioning (EF)?

- EF is a term used to refer to self-regulatory behaviors necessary to select and sustain actions and guide behaviors within the context of goals or rules. EF involves developing and implementing an approach to performing a task that is not habitually performed. (Mahone et al, 2002)
- Two parts:
 - Working memory & recall
 - Holding facts in mind while manipulating information
 - Accessing facts stored in long-term memory
 - Intention

What is Intention in Executive Functioning?

- Activation/Initiation, arousal, and effort/sustainability
 - Getting started, paying attention, finishing work
- Controlling emotions/Inhibition
 - Ability to tolerate frustration
 - Thinking before acting or speaking
- Internalizing language/Shifting
 - Using “self talk” to control one’s behavior and direct future actions
- Taking an issue apart, analyzing the pieces, reconstituting and organizing it into new ideas (complex problem solving)

From <http://www.chris.dendy.com/executive>

Attention vs EF

- Attention is considered to precede sensory detection/perception
- Intention (remember, EF = working memory + intention) is thought to occur between sensation/perception and action, and involves a state of preparedness to respond.

Denckla, 1996

What difference does it make in Child Psychiatry?

It turns out that if you have executive functioning problems, you are going to have a much more difficult time, no matter what psychiatric problem you might also have.

Executive functioning deficits are not a diagnosis, but they make any other diagnosis much worse.

Neuroanatomy

Executive functions are supported by a distributed neural network with cortical and subcortical components including the frontal cortex and its striatal- thalamic- cerebellar connection.

(Malone & Slovnick, 2007; Dursten, 2003; Royall et al 2002)

Prefrontal Cortical Regions

-Dorsolateral PFC

- associated with cognitive aspects of EF

-Orbitofrontal & Anteromedial PFC

- considered particularly important for emotional & behavioral processes

Cummings, 1993; Mesulam, 1986

Injury

- Medial PFC
 - Lack of initiation
 - A slow behavioral tempo
 - Blunted affect
 - Apathy
- Orbitofrontal
 - Social disinhibition
 - Irritability
 - Aggression
 - Poor impulse control

Linking the frontal-striatal circuit to behavior

- Conceptualize the striatum as acting to gate sensation into two systems:
 - “how” (organization and praxis)
 - “when” (response inhibition).
- This frontal-subcortical network then supports these intentional “how and when” functions that range from the more elementary boredom tolerance to higher-order problem solving functions.

Vulnerability of the Neuroanatomy of EF

The extensive interconnections between the frontal lobes and numerous other subcortical and cortical structures result in an elaborate interplay of neuronal processes. Damage along any of these pathways, or to the structures themselves, can be associated with deficits in executive functioning.

Viewed through a developmental lens, maturation of the frontal lobes, and prefrontal cortex in particular, is the most protracted of any brain region, beginning in infancy and extending into early adulthood, with corresponding improvements in higher-level cognitive functions.

Diamond, 2002

This protracted period of development leaves the frontal systems vulnerable to disruption via a variety of etiologies and is likely why so many children with acquired neurological or neurodevelopmental disorders present with concerns involving executive dysfunction.

Maturational Stages

Developmental trajectories will differ by task but EF functions can be documented in the very young children (if developmentally appropriate test are administered).

- Markers: 6 years, 10 years & early adolescents
- Greatest degree of EF development occurred between 7-9 years, and between 11-12 years. (greater anterior cerebral cortical maturation around those times).

Passler, Isaac et al. 1985. ; Levine, Culhane et all, 1991. Anderson et al, 1996.

Prefrontal brain systems undergo rapid changes during preschool years, including pruning of synaptic connections and subcortical myelination.

Preschool skills

- Particularly important inhibitory control
- Rule use
- Working memory
- Motor persistence

Important for development of socialization and readiness for academic learning.

Preschoolers with lead exposure

- Test poorer in working memory
- Set-shifting
- Planning

Animal study of rats with lead exposure showed reduction of the birth and survival of new neurons (neurogenesis), branching (arborization) (dendrites were shorter and more twisted) and also alters the normal development of newly born neurons in the hippocampus (important for learning & memory)

Canfield, Gendle, Cory- Slechta, 2004; Guilarte et al 2007

School-Age Years

- EF skills are central to successful acquisition and effective use of academic skills (particularly in efforts to overcome learning problems)
- By fourth grade, emphasis on individual acquisition (e.g. learning to read) gives way to new expectation of independent skill utilization (e.g. “reading to learn”)

Problems in motor or procedural learning

- Dependent on basal ganglia and cerebellar function – and a component of nearly all demonstrated academic skill.
- Lead to slow and inefficient behavioral output and the requirement for deliberate, controlled (likely cortically-based) mental effort to perform tasks that are expected to be overlearned or automatic by this age.
- May appear inattentive.
- Mahone & Slomine, 2007.

Adolescence

- Middle school represents a major increase in the demand for organizational skills.
- Issues with spontaneous use of skills, strategic initiation of tasks, and mental flexibility often become more salient as they are required to “remember to remember” to initiate and complete daily activities on a regular schedule, and must manage academic work that is increasingly integrative and longer in length.
- Mahone & Slomine, 2007

Acquired Neurological and neurodevelopmental disorders associated with executive dysfunction

- Traumatic brain injury & hydrocephalus
- Early treated phenylketonuria
- Obstructive sleep apnea
- Chemotherapy & radiation
- ADHD, Dyslexia, OCD, high functioning autism
- Children with Tourette syndrome tend to manifest executive dysfunction only when the disorder coexists with ADHD and/or OCD.

In which disorders are they most severe?

- Most severe: Autistic Spectrum Disorder
- Severe: Fetal Alcohol Syndrome
- Less severe: ADHD & learning problems

In which disorders are they most common?

- Extremely common in Autism & Fetal Alcohol Syndrome.
- If a child has brain damage from slowed growth in the womb or was very premature, they are not too uncommon.
- In brain injured children, infections of the brain, and those with tumors, they are common (along with other rarer diseases).
- They are not as common in Tourettes, ODD, or CD.
- Finnish study: About 15% of children have some problems with executive functioning, but about 50% or so of children and adults with ADHD have problems. (Loo, 2007)

How do executive function deficits manifest themselves?

- Planning
- Prioritizing
- Persistence
- Organizing
- Managing Multiple Task

Four Students with “Memory Problems”

- John has specific deficits in attention; he is not attending to instruction, the information does not enter his awareness to be stored in his memory.
- Susan has specific deficits in language comprehension; she does not understand what the teacher is saying, she cannot process the information for memory.
- Tom has adequate attention and receptive language but his executive deficits impact organizing the information in his memory. Although he can attend to and understand the information, he cannot retrieve specific facts when they are needed.
- Mary has intact attention, language, and executive functioning but her specific memory deficits means she cannot remember the knowledge.

Assessment Options

- Complete neuropsychological testing
 - Advantage: test each one of executive functions plus everything else.
 - Disadvantage: extremely costly, takes hours to test and to review
- Brief assessments of Executive Functioning
 - Advantage: can be done in less than ½ hour and can give you a good idea of the total severity of the problem with executive functioning
 - Disadvantage: not exact nor complete.

Neuropsych Measures

- Intention – Continuous Performance Tasks (CPTs) (both sustained attention and inhibition), Go/NoGo, Stroop Color-Word
- Planning & implicit memory– Tower of London, Tower of Hanoi
- Set-shifting – Wisconsin Card Sorting Task (and cognitive flexibility)
- Organization – Rey Osterreith Complex Figure (and visual spatial organization and visual memory)
- Working memory – Serial Addition Tests, Digit Span Forward/backward

BRIEF

Behavioral Rating Inventory of Executive Function

- These parent and teacher questionnaires assess children (age 5- through 18-years) with neurological conditions' executive function in home and school environments.
- Each BRIEF questionnaire includes 86 items on 8 non-overlapping clinical scales and 2 validity scales and take 10-15 minutes to complete.
- There are also preschool version and self-report.
- Available through online vendors:
 - WPT: <http://portal.wpspublish.com>
 - PAR: <http://www3.parinc.com>
 - <http://depts.washington.edu/dataproj/faqs.html>

Assessment within Developmental Context

- Solid understanding of normal developmental trajectories
- Potential direct and indirect effects of a given neuropsychological disorder, and the ways in which these variables may interact in a given child.
- Age of onset (and duration) must be considered
- Psychosocial milieu of the child which interacts with multiple biological factors.

EF Differences in Autism vs ADHD

- Children with ADHD have shown relative deficits in task that measure inhibition and verbal fluency.
- Individuals with autism show specific difficulty with planning and cognitive flexibility

Geurts et al 2004; Ozonoff & Jensen, 1999

Key Concepts for Pediatric Interventions

- Developmentally appropriate
- Functional
- Individualized
- Longitudinal
- System-based (family, school, community, & healthcare)
- Family-centered
- Transdisciplinary
- Evidence-based

Interventions

- Medications
 - Executive deficits are much less responsive to medications. While hyperactivity and inattentiveness almost always respond to ADHD medications, the executive function deficits often do not.
 - Outside ADHD there is little research on how psychiatric medications might affect executive functioning in children and adolescents

Interventions

- Psychosocial Treatments
 - Use the opportunity to reframe perceptions of the child
 - Academic accommodations
 - Behavioral Interventions
 - Utilizing resources & technology to fit the child's need
 - Relative strengths can be used in developing compensatory strategies to work around areas of weakness.
 - Brain Exercises
 - Little research & all from same organization/company – not recommend at this time

Coaching

- Setting Goals
 - Child's choice
 - Focused & attainable
- Holding regular (often daily) coaching sessions.
 - Identify potential obstacles and outline strategies to overcome them.
 - Written intervention plan created – allowing for shifting and changing goals.
 - Review previous day's plan & goal attainment, develop plan for current day
 - Reward of goal attainment can be written into plan (particularly helpful with younger children).

Rachel can't plan

- Age 16
- Has six subjects in school & part-time job
10 hours per week
- No boyfriend
- After failing last year, not involved in any
other activities

Rachel's Life is One Big Crisis

(partly due to being unable to plan)

- Research paper due in three weeks
 - Rather than work on it a little each day or two, she leaves it to the end.
 - She throws all her energy into that so that she is late for work, overtired, and behind in school
 - Then, when the paper is handed in (late), she has to work extra hard at her part-time job, because her boss has threatened to fire her.

Until her best friend asks her why she never stops by anymore...

How to help Rachel with deficit in activation, arousal, & effort

- Parent training
- Classroom management
- Social skills training
- Academic skills training

Daily Report Card (DRC) – social skills training tool

- Identify behavioral goals
- Select 3-5 target behaviors for DRC
- Define goals in highly specific terms
- Explain DRC to child
- Link DRC with home-based rewards
- Monitor/Modify as needed
- Troubleshoot with parents & teachers as needed

Helping Rachel

- Use “Daily Report Card” [Questions: Starts assignments with ≤ 2 reminders; waits until called upon to give answer; seat work (3 assignments @ 80% accuracy – Pelham & Waschbusch (1999))]
- Introduce use of a day planner
- Parent/teacher help her break down assignments into tasks and assign time to getting that task done
- Time allocated at the beginning of school term and beginning of each week should be used to review projects for week and review at end of day.
- Ask that school assignments be give in writing/e-mailed to be put in calendar
- Color code assignments by priority

Thomas

- Mother drank when pregnant
- Does well at home (no siblings)
- Fairly smart, likes to do things with parents, doesn't lie
- Starts Kindergarten
- “Loses control” when lots of stimulation – does stupid and impulsive acts, gets into trouble, goes into rage, followed by tears

How to help Thomas

- Interventions for deficit in inhibition/controlling emotion
 - Arrive at school 15 minutes after classes begin in morning and leave 15 minutes before end of school day.
 - At assemblies and lunch, wear head phones.
 - Create a spot for him to go to at school that is his “quiet space” (under a tree in the school yard)

Daisy

- 8 years old
- Good at making friends but a hard time keeping them.

Daisy

- Intervention at controlling emotions/poor inhibition of response in her social interactions leading her to be perceived as “rude” or “hurtful” when she blurts out what she is thinking.
- Teach her social norms using games and role play.

Mary is “scattered”

- Good musician and soccer player
- If you heard her debating her teacher, you’d assume she was one of the smartest kids in the class
- Lots of friends
- Unable to succeed in school – dropped out in 10th grade
 - Never able to do two things at once
 - Even think and write, if she did she made all kinds of mistakes

How to help Mary

- Interventions for Working Memory
- Create “working memory in note book”.
- Use books/manuals marking important sections which need to be remembered.
- Add notes to it.
- Keep is close by.

In summary,

- If you ignore Executive Functioning deficits, you will be missing a big cause of disability in children with a variety of psychiatric disorders.
- There are many different kinds of Executive Functioning deficits, and rarely will you find two people with the same profile of deficits.
- Medication will not usually fix this.
- The treatment has to fit the child, their culture, the deficits, and their family.

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