

Neurology—Revealed by aMRI and fMRI—Underlying ADHD

- Frontal (and all subdivision!)
- Striatal (emphasis on caudate)
- Cerebellar (most distinctive)
- Underactivated caudate and MPH response of caudate most consistent findings

Shapes of caudate and anteroventral putamen are compressed such that volume is diminished in 8-12 year old boys with ADHD.

Mostofsky/Denckla group

fMRI shows normal sensitivity to rewards in children with ADHD, although conduct disorder (not ADHD) is associated with diminished activation of the reward circuitry of the orbitofrontal cortex.

Rubia et al

Between 12 and 16 years, children with ADHD Rx with stimulants show cortical thickness (for age) closer to typically developing peers than did those not treated.

Shaw et al

“Attention-deficit/hyperactivity disorder is characterized by a delay in cortical maturation.”

- This is the title of the publication by Shaw P, Eckstrand K, Sharp W, Blumenthal J, Lerch JP, Greenstein D, Clasen L, Evans A, Giedd J, Rapoport JL, 2007 PNAS, 104:19649-19654
- Cortical growth-to-max trajectories measured on aMRIs

Multifactorial Cognitive Etiology Model of ADHD

- “Impulsive cognitive style is attributive to an additive or interactive dysfunction in multiple (but probably related) cognitive systems and their closely related mediating neural networks”
(Sergeant et al., 2003; Willcutt et al., 2005)

Compensatory Neural Activity Revealed by fMRI with ADHD

- Caudate activation deficiency implies deficient coding of event probability
- Anomalous activity of right posterior superior temporoparietal region (possible awareness of motor action is compensatory?)
- MPH modulation limited to regional and task specificity, not a “cure-all.”

Non-Pharmacological Rx for ADHD: More Research-based Rationale I

- Cognitive control status is not correlated with symptom severity of ADHD but...
- ADHD symptom severity is *MPH-responsive
- Closely related cognitive control tasks are differently impaired with ADHD

*MPH=methylphenidate

Non-Pharmacological Rx for ADHD: More Research-based Rationale II

- Two closely related cognitive control tasks:
 1. Interference suppression: NOT MPH-responsive
 2. Response inhibition: YES, MPH-responsive
- Rapid naming (fluency measure) is improved but NOT normalized by MPH

EF Popularized As Neuropsychology of ADHD

- Executive Function (EF) is domain of direct interest, implicates “Frontal” circuits
- Barkley’s book explains that all EFs flow (linearly, developmentally) from the primary one, INHIBITION
- Others view INHIBITION and RESPONSE PREPARATION as “two sides of the same coin”
- Add “Sustain,” “Initiate” and “Shift”

Emphasis Shift: Not Just Inhibition is Deficient with ADHD

- Speed of Motor Output
- Timing of Motor Output
- VARIABILITY of Motor Output
- These now “Motor Endophenotype”

Current Concerns About What Sufficiently Characterizes ADHD

- Does the “traditional triad” cover the syndrome?
- Is “hyperactivity” too superficial or redundant?
- Isn’t “inattention” misleading” (better choice “attention mis-allocation”)

Is EDF “diagnostic” of ADHD?

- No! Most with ADHD show EDF but reverse is not true!
- EDF is NOT a diagnosis but a “processing problem” (educators’ terminology)
- EF has “server loops” from other “posteriorly based” systems (also described as “ingredients”)

What Is Seen Clinically As EDF?

- Observations of “I-S-I-S”
- Excess-for-age extraneous overflow
- Poor visual-motor organization
- Lack of strategies or plans of search

How Assess EF/EDF?

- Indirectly in younger children using “neighborhood signs” of motor control/inhibition
- Directly, if at least 8 years old, Delis-Kaplan Executive Function System
- Still need vigilance for “ingredients”

Definitions – “Plain”

- Inhibition (“No-go” side of “Go/No-go”)
- Response Preparation (called “Intention” by neurologists)
- Delayed Responding (made possible by Inhibition)
- Working Memory

Working Memory Analyses

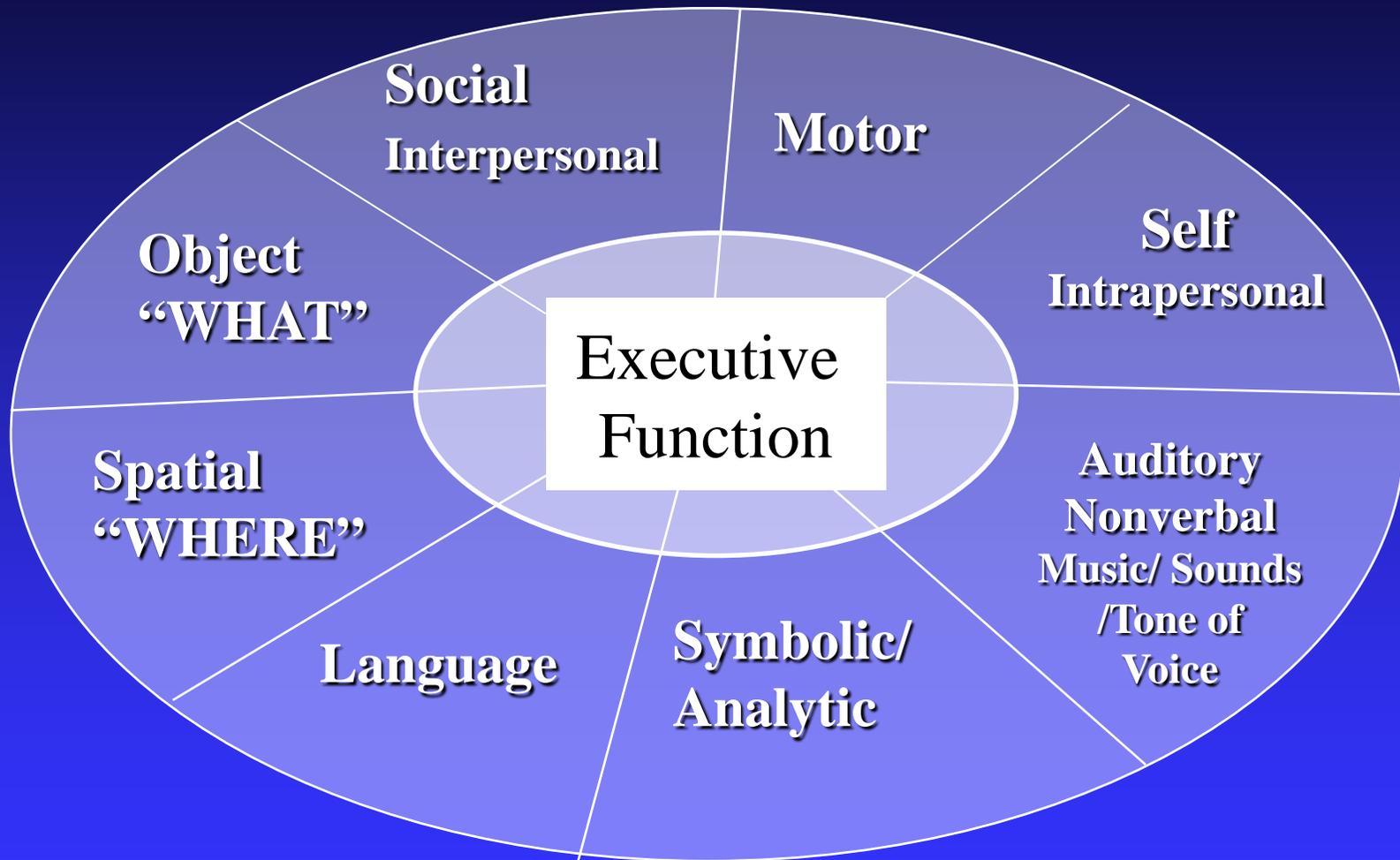
- What fills the delay in the delayed response situation made possible by inhibition of responding
- Working memory in the Central Executive sense must be served by (and mediated through) either a “phonological” (i.e., verbal) loop or a “visuospatial” (i.e., mind’s eye) loop

More Crucial Components of EF

- Sustain and Shift (1/2 of “ISIS”)
- Plan (time-manage, sequence actions)
- Organize (arrange environment, materials, pieces of complex products)
- “Meta” applies to monitor, check, have insight, solve novel problems

Implicit EF Deficits

- Initiation
- Inhibition
- Affect/motivation modulation
- Goal setting
- Planning, (sequencing, spatial and temporal organization, prioritizing)
- Monitor/adjust actions and consequences



TREATMENT IMPLICATIONS

- Stimulants are neither cure nor curse (not so good, not so bad as is said).
- More formulations now exist, use of which involves “the art of medicine.”
- Individualize medication for “target symptoms, target times.”
- MTA conclusions are: stimulants outperform non-drug interventions but combination is best and permits lower drug doses.
- Most medication management doesn't match MTA!

Combined Medical and Behavioral Rx Superior to Medical For

- Oppositional/aggressive
- Internalizing Si
- Social skills
- Reading achievement
- Parent-child relations

TREATMENT DESCRIPTIONS (OTHER THAN STIMULANTS)

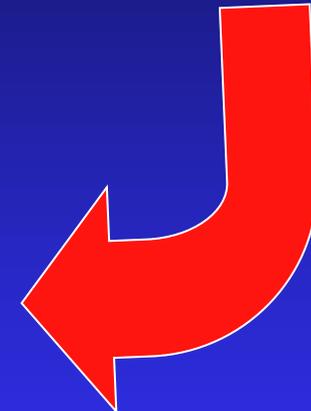
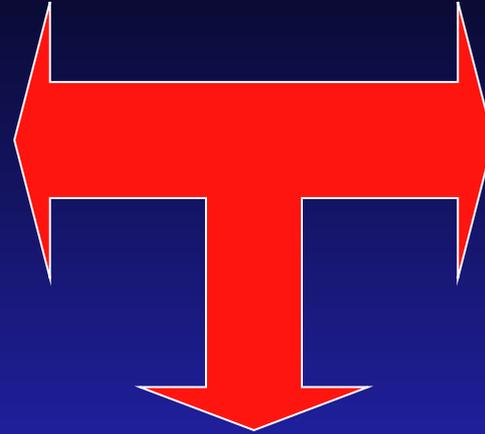
- “ABC” of applied behavior analysis (synonyms: behavior modification, contingency management).
- Valence of contingency should be POSITIVE.
- “A” of ABC stands for “ANTECEDENTS.”

MORE ON TREATMENT OF ADHD (NONPHARMACOLOGIC)

- Antecedents need to be manipulated so that home and school “engineer for success.”
- Tutoring, coaching, motor skills building are examples of Antecedent manipulations (and are cognitive).
- Cognitive, in the psychiatric sense, is not therapeutically effective (e.g., “I must not run”).

Learning
Disability

EF Deficit



**Academic
Difficulty**

Reading Comprehension and ADHD

- Brock & Knapp (1996)
 - 4th, 5th, and 6th graders with and without ADHD
 - All subjects had *normal* decoding skills
 - Both groups had similar word attack, reading speed, and vocabulary skills.
 - BUT...
 - The ADHD group had reading comprehension deficits.

Reading Comprehension and ADHD

- Tannock and colleagues
 - Children with ADHD (without decoding or language problems) have difficulty organizing, sequencing, and self-monitoring retelling of stories they have read
 - Also have difficulty with making inferences from what they have read
 - BUT...can answer factual questions well

What to Do?

Interventions for Reading Comprehension

- FIRST...Evaluate
 - Make sure common lower level skill deficits are not the cause (i.e., decoding)
 - Examine oral language skills (syntax, semantics)
 - Examine EF:
 - Inferential Language
 - Self-monitoring
 - Organizing material
 - Use of strategies

What to Do?

Interventions for Reading Comprehension

- Teaching of strategies, e.g.
 - Comprehension monitoring (“metacognitive awareness”)
 - Graphic organizers
 - Question generation (who, what, why, where)
 - Knowledge of story structure
 - Summarizing
 - Mental imagery
 - Reciprocal teaching (summarize, question, clarification, prediction)
- Teacher first models, then gradually takes away support/modeling

Written Expression

- Heterogeneous; intersection of many skills:
 - Handwriting
 - Spelling
 - Punctuation
 - Expressive Language (Vocabulary, Grammar)
 - Working Memory, Self-Monitoring, Organization, and Planning (Executive Function)

Why is Writing Often Challenging for Children with ADHD?

- Motoric requirements (handwriting)
 - Children with ADHD typically have graphomotor issues
 - Graphomotor/motor substantial predictor of overall written productivity (Berninger et al., 1992)
- Requirements for working memory, self-monitoring, planning and organization
 - Areas of impairment in ADHD

What to Do?

- FIRST, evaluate...exactly which issues is the child having difficulty with?
 - Handwriting
 - Spelling
 - Punctuation
 - Expressive Language
 - Organization/Planning

What to Do?

- Organize and plan—initially be stand-in frontal lobe!
 - Use graphic organizers
 - ◆ Teach use of different graphic organizers for different types of writing
 - Compare/contrast, narrative, description, etc.
 - ◆ Gradual decrease of support
 - *Knowing DOES NOT equal doing*

What to Do?

- Separate out handwriting and writing
 - Dictate
 - Learn keyboarding
- Gradually merge processes so child can organize and write on own.

Roles of ADHD or “false” ADHD (often Anxiety)

- Executive Function (usually but not always impaired with ADHD) is powerful factor in LD of clinical importance
- Anxiety impairs Executive Function (EF) also
- Life is not simple, so BOTH ADHD and Anxiety may undermine EF
- Children with weak EF may “grow into” LDs (written expression and reading comprehension)

Treatment of LD Substantially Determined by ADHD/EdF

- Stimulant meds: neither curse nor cure but reliable only for inhibitory component of EdF (where “d” is for “dys” _____)
- Home and School environment changes are more important but less accessible!
- “A” in ABC of applied behavior analysis needs greater emphasis: proactive antecedents

One Important “anti-A,” the “Inclusion Delusion”

How can in-class special help work when most LD is based upon weak speech-sound processing and/or weak attentional control?

Therapeutic Needs (Nothing New)

- “A” in “ABC” means most importantly cheerful, positive, encouraging adults!
- Special teaching is best done one-on-one (but negative irritable teacher won’t do!)
- Special teaching means flexible, individually “customized” plans, not pre-packaged or scripted “one size fits all.”