

EXECUTIVE FUNCTIONS AN DYSFUNCTIONS©
Don Rosenberg

Brain studies suggest the neurological substrate for Attention Deficit Hyperactivity Disorder is under-functioning of the right frontal lobe. Hence, stimulants which increase activity in the frontal area lead to more normal functioning in that region. So, the **core deficits** in ADHD are in EXECUTIVE FUNCTIONS, those mainly frontal lobe functions. The central problems are thought to be in three areas --

- Working Memory
- Volitional Control of Attention, Focusing of Attention, and Shifting of Attention
- Impaired Inhibition

These three functions do indeed sound like the major manifestations of ADHD. THE MAJOR SYMPTOMS of ADHD include a variety of symptoms of distractibility, distraction-related forgetfulness, inattention, and impulsivity. Each of these symptoms is the behavioral contour of problems in underlying brain-level Executive Dysfunctions. Relating the symptoms to the Executive Functions, we see the major symptoms as

- forgetfulness and often losing objects [Control of Attention and also Working Memory]
- reluctance to do difficult work [Focusing, Managing Frustration, Activation]
- making careless errors [Focus]
- difficulty sustaining attention [Focus, Regulating Alertness]
- difficulty organizing [Organizing]
- and easily distractible [Focus].

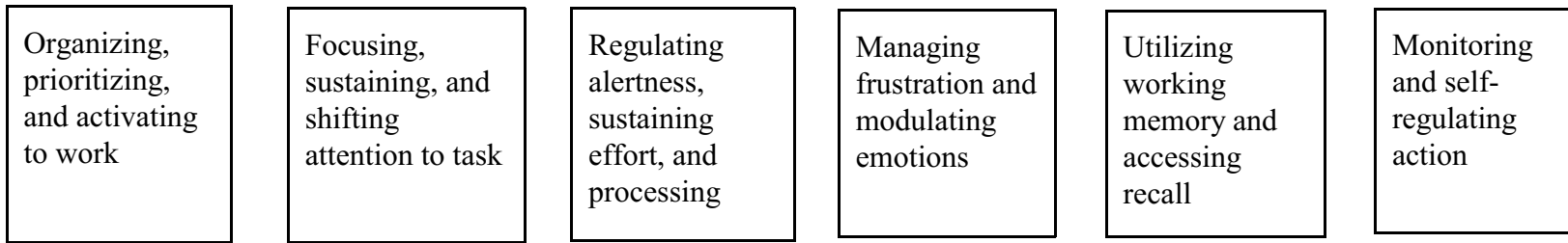
Since some required adaptive behaviors are based upon the successful operation of multiple functions, we can see how these behaviors could be difficult for children to accomplish. Failure in the activity of a single executive function could interfere with effective performance across situations.

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EXECUTIVE FUNCTIONS – mind’s capacity for self-control, goal-directed behavior, and working toward future outcomes.

1. These are mainly frontal lobe functions which are developmentally disordered (immature) or functionally disordered in AD/HD.
2. Under-functioning of the frontal lobe is characteristic of ADHD.
3. ADHD children are functionally uneven – some read very well, some poorly; some are moody, some are mainly cheerful; some can organize their environment in a useful way, some live in disarray. Not all Executive Functions are significantly impaired in any one child.
4. Improvement in one function may or may not affect another. For example, improving Focusing may help with Regulating Alertness and reducing Frustration, but may not fully normalize others functions, for example, Organization and Working Memory.
5. Therefore, it is important to gauge which functions are more difficult for a child, which are aided by medication and which are not, and help with adaptive assistance accordingly in those functions not adequately regulated with medication. **We could design compensatory strategies, exercises, and social system aides which work around the executive dysfunctions of a child.**
6. Academic skills require complex interplay of these 6 functions.

Thomas E Brown PhD model of Executive Functions – Functional ATTENTION is the sum of the interaction of 6 high-level capacities:



<p><u>1. Activation</u> Procrastination & Initiative Can't get started even on important tasks if they seem hard to figure out. Often distracted from essential tasks (pay bills, filing taxes, homework). Can't do tasks based upon their importance/priority, attend to too many details and don't sort them out well. Poor at estimating how long tasks take.</p>	<p><u>2. Focus</u> <i>Distractibility & inattention is a core of ADHD.</i> Can't block out internal noise and external distractions, sounds, movements, etc. (persists into adult ADHD). Can't focus on the essential elements (e.g., the teacher, a test being taken) or sustain focus or shift from one item to another that may be more important but less stimulating of <i>hyperfocus</i> (e.g., conversation, chore, the road ahead, finishing homework vs video game or tv).</p>	<p><u>3. Effort</u> Alertness and speed are not volitionally controlled. Less interesting activities (e.g., reading, long-distance driving) lead to loss of alertness. At time for sleep, may not down-shift alertness to enable good sleep. Slow processing speed, hard to remember sequential steps in a complex coding/processing task (e.g., math, writing). But too hasty and error-prone when care is required.</p>	<p><u>4. Emotion</u> Low threshold for frustration, short fuse, irritable. Emotions flood out attention to other details. Emotional expression may be salient, but tactless.</p>	<p><u>5. Memory</u> <i>Working memory problems are core to ADHD.</i> Can't hold bits of information while taking in or working on new bits. Affects conversation, listening to teacher, note-taking, decoding, reading, comprehension, math sequences, reciprocal interactions. Retrieval from long term memory impaired. Memory problems contribute to slow processing speed.</p>	<p><u>6. Action</u> Volitional action is impaired: act-inhibit, do-not do, go-no go. <i>Poor inhibition is considered a core to ADHD.</i> Fidget, blurt things out, act on impulse, perform unsafe acts. Hard to determine when to assert, aggress, say something, or not to. Poor at determining what others expect or how others are reacting to him/her.</p>
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Executive Function	<p style="text-align: center;">Some of the Behaviors or Problems</p> <p>Note: all these problems use all the functions, so, for teaching purposes, I put them under the what appears to be the most cogent function for each.</p>
<p>Activation, organizing, prioritizing, taking initiative, finishing</p>	<ul style="list-style-type: none"> ✓ know of a required task and forgets to start on it or leave time for it ✓ gets involved in preferred task and has difficulty stopping in order to do less preferred tasks ✓ can't push self to start a task that looks difficult to think out ✓ often distracted from essential tasks (pay bills, filing taxes, homework) or from finishing tasks ✓ can't do tasks based upon their importance/priority ✓ attend to too many details and don't sort them out well ✓ poor at estimating how long tasks take ✓ impulsive decisions without reflecting on consequences or outcomes ✓ leaves a trail of incomplete, unfinished tasks
<p>Focus, sustained attention, resistance to distraction, maintain focus on essential elements, shift focus when necessary</p>	<ul style="list-style-type: none"> ✓ easily distracted ✓ difficulty blocking out internal noise and external distractions, sounds, movements ✓ can't focus on the essential elements (e.g., the teacher, a test being taken) in a situation ✓ difficulty sustaining focus or shifting from one item to another that may be more important but less stimulating ✓ can <i>hyperfocus</i> on preferred, high-stimulus activities, but then can't shift or stop
<p>Effort, maintaining alertness, maintaining effort, shift level of effort to match the situation, processing speed matched to the situation</p>	<ul style="list-style-type: none"> ✓ writing is the most impaired task for AD/HD, holding ideas in mind, acting upon and organizing, maintaining sustained effort ✓ alertness and speed are not volitionally controlled ✓ less interesting activities (e.g., reading, long-distance driving) lead to loss of alert-ness ✓ at time for sleep, may not down-shift alertness to enable good sleep ✓ slow processing speed, can't do timed tasks and tests ✓ hard to maintain attention to sequential steps in a complex coding/processing task (e.g., math, writing) ✓ too hasty and error-prone when care is required
<p>Emotional Control, managing frustration, handling level of emotion</p>	<ul style="list-style-type: none"> ✓ low threshold for frustration, short fuse, irritable ✓ thinks before acting ✓ difficulty curbing excitement and arousal in order to handle the situation more effectively and tactfully ✓ often misperceive the emotional significance of the situation, e.g., finding a situation funny while others become frustrated with the child ✓ moody ✓ shift from positive to negative to positive moods rapidly ✓ emotions flood out attention to other details ✓ emotional expression may be salient (says and shows whatever he or she feels), but often tactless

<p>Working Memory, accessing recall, holding information in mind in order to decode sequences of read or oral information</p>	<ul style="list-style-type: none"> ✓ difficulty remembering and following instructions ✓ difficulty memorizing math facts, spelling words and dates, even had a hard time remembering them when he/she seemed to know them just the day before ✓ difficulty doing mental computation (e.g., arithmetic) in one's head ✓ difficulty remembering one part of a problem while working on others ✓ difficulty paraphrasing or summarizing ✓ one reason for difficulty learning from experience, repeats inappropriate behaviors, needs many reinforcements to finally learn the correct responses ✓ difficulty remembering future events and commitments ✓ difficulty using tracking time, allocating time, getting tasks done in the allotted time ✓ difficulty with self-awareness & introspection, with retaining perception of what he/she has done ✓ difficulty remembering conversation or deciphering oral communications unless they are kept short and simple ✓ difficulty retrieving ideas, quickly retrieving grammar, spelling and punctuation when writing ✓ living in the present, here and now ✓ difficulty preparing for events in the future
<p>Self-Regulating Action, poor inhibition, doing or stopping doing when called to do so, delay of gratification</p>	<ul style="list-style-type: none"> ✓ volitional action is impaired: act-inhibit, do-not do, go-no go – doesn't do or go when supposed to or stop when supposed to ✓ poor inhibition ✓ fidgets, blurt things out, act on impulse, performs unsafe acts ✓ poor at determining what others expect or how others are reacting to him/her ✓ poor delay of gratification ✓ acting without considering consequences ✓ poor motor inhibition ✓ poor sustained inhibition – e.g., when asked to sit still, can do it for just seconds ✓ an incomplete task or an urge which is very salient has to be performed and overcomes inhibition (e.g, asked to stop playing with an object, he/she may for seconds, then go right back to it)

Self-regulatory functions are primarily inhibitory. The brain manages by activating and inhibitory processes. Think of areas of the brain as like switches, turning actions on or off. Effective Executive Functions, therefore, direct behavior. For instance, one function is to inhibit acting upon distracting stimuli which would take us away from the object upon which we are trying to focus. Thus, we can focus on goals, planning, control. We inhibit impulses, mood-driven actions, attention to extraneous stimuli, and actions inappropriate to the situation (unlike hyperactive persons). One way to regulate action effectively is through a guiding APPRAISAL SYSTEM which accumulates our ideas about our environment into cognitions and beliefs; they help us interpret situations and guide our actions. A sub-category of those cognitions are those we consciously use to direct us, SELF-TALK. Even small children direct their behavior by talking aloud to themselves. It is thought people with ADHD do not use Self Talk to direct their behavior – those with hyperactivity are directed by feelings of restlessness, by curiosity, and by distractibility to the extent that self-directing interior conversation does not have the opportunity to operate.

Working memory is those ideas we have in our active mind at any time, including short-term memory – those 7 + or - 2 piece of information we hold in mind briefly – and those thoughts and observations which we have of ourselves right here and now, and those goals which are directing us and our decisions. So working memory is much more than short term memory. Working memory interacts with other functions to inhibit action and direct it. Therefore, if, as some with ADHD say, information goes in one ear and

out the other, or if a distracting stimulus commands attention and causes forgetting of what was just in mind, or if hyperactivity, mood swings, and impulses become the guiding directives of behavior to the exclusion of goals, then impaired working memory is a substantial form of dysfunction in ADHD. This means learning from experience or learning behavior without a large number of repetitions will be much more difficult. A sense of the passing of time is related – another area of deficit in ADHD.

Foresight is related to working memory. Observing patterns and anticipating challenges and gratifications in the future is an essential tool of survival. Without adequate inhibition, and being guided by the impulses and affects of the present moment, people with ADHD are in the present moment and are not conforming behavior effectively towards future goals.

Purposeful Shifting of Attention and Transitions are observed to be difficult for children with ADHD. Using transitions in a broad sense, such as going from Dad's house to Mom's, leaving off watching TV in order to do a chore, concentrating on what Mom is telling you to shift to when you are hyperfocused on a game, shifting into concentration on a task which seems difficult – these are all areas in which the impaired ability to SHIFT ATTENTION will cause difficulties.

Emotional control is also an executive function. Emotional dyscontrol is frequent in ADHD. Frustration and irritation can lead to disregard of facts and reason. When emotions are under control, we can evaluate our emotional reactions. But with limited capacity to filter emotions and impulsive reactions, emotional dyscontrol is common.

Barkley breaks executive functions down into four areas:

Barkley, Russell A., Murphy, Kevin R., Fischer, Mariellen (2008). ADHD in Adults: What the Science Says (pp 171 - 175).

Nonverbal working memory

Internalization of Speech (verbal working memory)

Self-regulation of affect/motivation/arousal

Reconstitution (planning and generativity)

Barkley's model is based on the idea that inability to self-regulate lie at the root of many challenges faced by individuals with ADHD. He puts forth that they are unable to delay responses, thus acting impulsively, and without adequate consideration of future consequences -- beneficial or negative.

REMEDICATION OF EXECUTIVE DYSFUNCTION

AD/HD is a brain disorder involving reduced brain volume, impaired frontal response to dopamine, and impaired functioning in frontal and other areas. Stimulants enhance the use of dopamine.

With regard to students with executive and attentive problems, brain studies have not consistently shown damage in the form of lesions or ventricular blood flow anomalies. On the other hand evidence is beginning to show that cellular dysplasia (a degree of brain cell immaturity) might be involved in not only executive and attention-related disorders but also Autism and Aspergers's syndrome (Rubia, Overmeyer et al 1999), (Ahgren, Baldwin et al 2005). If cellular dysplasia is involved in attention and executive function disorders, then one possible contributing cause of those disorders can be said to be a frontal/inhibitory (internal language) deficiency. Certain trends would be predicted from that, including:

1. Problems with behavioral inhibition (impulsivity) social immaturity (based on poor processing and parsing of social-communicative cues that would normally come with stronger inhibitory capacities.
2. Internal language deficits, manifest as poor working memory leading to variable academic performance.
3. Difficulty with task initiative (due to the lack of internal motivation and regulatory skills that normally facilitate internal language guidance, as well as and planning and judgment skills.

One could conceivably compress what seems to be a complex neuropsychological process into a simple diagnostic premise; specifically that the student with attending or executive problems might lack the ability to covertly talk himself through tasks, and provide the attentive regulation, self reinforcements, start-up prompts and working memory capacities (Petrides, Alivistatos et. al 1993), (Paulescu, Frith et al 1993) that come with a fully mature frontal lobe, and more specifically, with fully developed internal language capacities.

*cannot talk to himself internally in ways that prompt a task focus and submit motivation-sustaining, self-provided feedback

*he is forced to read out loud, needs to receive feedback from his teacher and must utilize outside sources for not having internalized the process.

*coached in how to self-prompt, self-reinforce and self-sustain effort on task as well as in social situations

*practice in overt self-talk guidance (including use of self-reinforcing comments) this could evolve into a covert skill, raising attention, self-regulation and task-initiative to the level of automaticity.

Executive Function	Habilitation and Rehabilitation/Remediation Note: all these problems use all the functions, so, for teaching purposes, I put them under the what appears to be the most cogent function.
Activation, organizing , prioritizing, taking initiative, finishing	
Focus, sustained attention , resistance to distraction, maintain focus on essential elements, shift focus when necessary	
Effort, maintaining alertness, maintaining effort , shift level of effort to match the situation, processing speed matched to the situation	
Emotional Control , managing frustration, handling level of emotion	
Working Memory , accessing recall, holding information in mind in order to decode sequences of read or oral information	
Self-Regulating Action , poor inhibition, doing or stopping doing when called to do so, delay of gratification	

1. Barkley, Russell A., Murphy, Kevin R., Fischer, Mariellen (2008). ADHD in Adults: What the Science Says (pp 171 - 175). New York, Guilford Press.

2. Brown, Thomas E. (2005). Attention Deficit Disorder: The Unfocused Mind in Children and Adults (pp 20 - 58). New Haven, CT, Yale University Press Health and Wellness.

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