

Think of the Brain as a Super Computer:

The brain can be thought of as a super computer that must process *trillions* of bits of information every second. Information is communicated between different regions of the brain and nervous system by electro-chemical transmission. The transmission of information through the brain and nervous system is made possible by both the structure and organization of the cells as well as by the delicate chemical balance that must exist within the brain. How well the brain communicates with itself and the rest of the body is influenced by genetics and the way that the cells are organized during prenatal development (and into early childhood). It is also influenced by the balance of neurochemicals and hormones in the brain. The delicate chemical balance in the brain can be disrupted by anything from illness (Lyme Disease) or injury (concussion perhaps the most familiar) to nutritional deficiencies or traumatic life events.

How does information move around the brain and nervous system?

The individual cells that make up what we can think of as the “hardware” of the brain are called “neurons.” These neurons form a complex “web” in the brain. It is within this web that all of the communication necessary to control every aspect of our body and our functioning as a human being takes place. Typical neurons in the brain “fire” signals of communication to other areas from 5 to 50 times per *second*. Each individual neuron can form thousands of links with other neurons, creating well over 100 trillion connections (“synapses”) in the brain (by some estimates). Imagine all of the information that is being processed in the brain and nervous system every second as the body carries out its essential functions and enables our complex human experiences.

How does the brain make sense of this constant stream of “data” so that we humans can function?

The answer is that some “parts” or functions of the brain are responsible for controlling the brain (which controls the rest of the body and “mind’s” functioning).

Networks in the brain must determine what information to attend to, what information to ignore, what should be allowed in our conscious awareness. Our brain “pulls this off” through the process of “inhibition.” Pathways in the brain must work continually to ignore or suppress the barrage of information coming into the brain and our conscious awareness. In fact, much of the brain’s energy is devoted to what we call the “inhibitory controls.” If the brain had no way to suppress, direct, and organize this ongoing electro-chemical activity (“information”) we would not be able to engage in goal directed behavior and thought.

While we often refer to the Executive Functions as the “Command and Control Center of the brain,” the Executive Functions are not “one thing” and are not in “one place in the brain.” Executive Functioning is a term that was created to explain the brain functions that act in a coordinated way to *cue, direct and control* our thoughts, perceptions, emotions, and actions.

What does Executive Functioning have to do with “ADHD” or other “mental health or

learning” issues?

Executive functioning deficits are at the core of syndromes that we label “ADHD” or “ADD” as well as learning disabilities, and autism spectrum disorders. Current research suggests that executive functioning deficits may be an important factor in **all** “mental or behavioral health” and learning difficulties. For example, when suffering an anxiety disorder or clinical depression, the individual’s brain (and body) cannot ignore or regulate troubling thoughts, emotions, and sometimes behaviors. Self-regulation is a primary component of executive functioning. This makes it crucial that we all understand what we are referring to when we say “Executive Functioning” and have some understanding of what this means or “looks like” in real life.

Is Executive Functioning the Same as Intelligence?

No. The processes of executive functioning are distinctly separate from cognitive abilities (intelligence). However, executive functions interact with our intellectual abilities in very important ways! At the brain level, executive functions help us to **access, manage, and apply** our knowledge, skills, and intelligence. Executive functions are responsible for a person’s ability to engage in purposeful, organized, strategic, self-regulated, goal-directed behavior. Collectively, executive functions *cue* the use of other cognitive capacities including reasoning, language, visual and spatial, and memory capacities.

Because these executive functioning processes *interact* with and control intellectual and academic abilities, difficulties with executive functioning may explain why many bright children—with strong intellectual abilities—may struggle to effectively or consistently *demonstrate* their knowledge or have difficulty following expectation for performance or behavior. It is common for bright, motivated with executive functioning issues to have trouble controlling their emotions or behaviors even though they may be able to explain the rules or expectations for appropriate behaviors and emotional responses in detail when they are calm and not in “in the middle” of the situation.

So you mean that there are different “levels” or “types” of executive functions?

Yes. There are different “levels.” For example, at the most basic level, executive functions cue the brain to “wake up and engage.” This can mean to literally waking up and becoming more alert or it can mean to activate awareness, focus, and control over different types of thinking, perceiving, feeling, or doing. There are different types of executive functions and they can be used somewhat separately or several can be used or needed at one time. For example, some tests of executive function evaluate one or two discrete abilities in isolation, such as the ability to quickly say words that begin with a certain letter. However, most of human functioning requires us to access and use many different executive functions at the same time. Engaging in complex tasks place very heavy demands on higher order integrated executive functioning and self-regulation of cognitive processes.

What are the different types of executive functions?

While there is not yet consensus about the precise number of self-regulation executive functions, current research points to between 22 and 30 distinct functions. Examples are: perceive, initiate, focus/select, modulate, inhibit, gauge, sustain, hold, manipulate, interrupt/stop, shift/flexible, foresee/plan, organize, generate/associate, balance, store, retrieve, pace, time, execute, monitor, and correct. Attachment D provides descriptions of these different executive functions as studied by a leader in the field (McCloskey). Quickly you begin to see how “how much” the brain must do all at once in order to complete routine tasks. In order to improve executive functioning, we must understand precisely which executive functions are problematic for each individual. The following examples help to explain how executive functions involved with *cueing or directing* our behavior and what this “looks like” in daily life:

- Inhibiting reflexive, impulsive responding; (thinking before you speak or act)
- Stopping an activity or shifting to another; (turning off the television in order to begin homework)
- Directing attention and ignoring distraction; this includes the ability to ignore stimulation in the environment (ignoring distracting noises) or to ignore your own thoughts or reactions that interfere with what you are doing (suppress worry thoughts while studying for a test).
- Making judgements about the amount of effort required to complete a task; (figuring out how hard you have to work or focus on an assignment and if you might need help)
- The flexibility to shift between cognitive resources in response to changing demands or outcomes; (changing your approach to a problem if you encounter a road block; not freaking out if things don’t go exactly the way you expected)
- Shifting focus between pattern and detail processing; (Knowing when to focus on the “big picture” and when to concentrate on the details, and when to switch between the two).
- Monitoring and regulating speed of information processing; finding the right combination of speed and accuracy for optimal performance of an activity
- Directing motor output, adjusting performance based on how you are doing during the task
- Enabling self-observation and self-analysis
- Making use of hindsight and foresight in order to make good decisions
- Accurate awareness of the passage of time; the ability to estimate how long tasks will take to complete

Is executive functioning necessary in all areas of functioning?

Absolutely. There are infinite numbers of ways that different executive functions can be or must be combined or integrated in order to complete tasks. There is no guarantee that if one executive function is well-developed, all of them will be well-developed. Any person can have strengths and/or weaknesses in any one or more of the different executive functions at any given point in time. Importantly, executive function capacities can vary in effectiveness depending on the *context* in which they are being used. There are four distinct areas of functioning within which each individual’s executive function capacities can vary greatly:

- ❖ Intrapersonal Domain – executive functions enable us to turn our attention inward in

order to have self-awareness and self-control (of all types) as well as to have control over our own perceptions, emotions, thoughts and actions. Executive functioning deficits within the intrapersonal domain can manifest as problems with self-awareness, self-monitoring, self-discipline, and the ability to set and maintain goals and engage in purposeful, effective behavior. This includes the ability to observe thoughts, emotions, and behaviors and not become caught-up in or “high jacked” by our impulses or reactions.

- ❖ Interpersonal Arena – executive functions govern perception, emotion, cognition, and action in social interactions. Self-awareness and self-control must be turned outward in order to control one’s actions in relation to others. This includes the ability to take the perspective of others and to weigh the benefits of cooperative behavior over self-serving behavior. It also includes the ability to generate a theory of mind, which enables us to understand, infer, and predict the motivations, needs, and desires of others.
- ❖ Environment Arena – executive functions this is the arena direct and monitor perception, emotion, thought, and actions in relation to both the naturally-occurring and the man-made physical world. This includes the ability to avoid “accidents” by anticipating the impact and consequences of one’s own actions in relation to the physical environment. It also includes the ability to manage sensory or emotional stimulation within environments.
- ❖ Symbol System Arena – executive functions direct and enable us to use human-made symbol systems (reading, writing, mathematics, computer use). Executive functions direct our cognitive resources (perception, emotion, cognition and action), mediates learning, and enables us to produce work products. They support our ability to interact with information “media” or “mediums” such as words, numbers, figures, diagrams, schematics, programming codes and other “languages.” Adequate executive functioning and metacognitive controls are necessary to manage the complex attention, organizational, planning, self-regulation, and sequential processing inherent to all academic tasks.

Why are students with executive functioning issues frequently perceived as “lazy” or unmotivated?

A frequently misunderstood executive function is *behavioral activation*. Individuals with ADHD/executive functioning issues can have notable difficulty *activating* the “brain” and executive functions to begin tasks. Neurologically, these individuals struggle to “get the brain in gear,” rally mental energy, and engage requisite executive functions. It can be painfully frustrating to begin tasks that require sustained focus and require integrated executive functioning. This is especially true for tasks that are not preferred or that are challenging or frustrating. This is due, in large part, by the fact that different neural pathways are used when we are engaged in activities that are self-directed, self-motivated, self-generated, or enjoyable than when we are required to do tasks that are assigned or directed by someone else. Negative emotions such as frustration, anxiety, or disappointment exacerbate issues with behavioral activation as well as the ability to sustain focus and mental energy. The struggle to engage cognitive resources and energy frequently manifests as avoidant or distracting behaviors, including “procrastination.” Individuals with this cognitive profile are often perceived as “unmotivated,” or “just preferring” to not to engage in tasks that require attention and effort (particularly academics). It is important to understand that individuals with this type of

neurological profile need help and *cuing* to activate themselves for tasks, particularly non-preferred tasks. The brain needs external support to get started and remain focused. Often, this includes the presence of another person along with encouragement and “cues” to engage. Strategies such as having a distinct time and place to complete work or non-preferred activities or briefly reviewing the goals of a work session with another person at the beginning of the session helps “cue” the brain that it is time to engage. Perceiving or treating problems with cognitive and behavioral activation as “laziness or lack of motivation” is very counterproductive and undermines the ability to implement appropriate, concrete strategies to overcome these difficulties.