The Important Role of Executive Functioning and Self-Regulation in ADHD

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Parents and educators dealing with children (or adults) with ADHD are likely to have heard increasing references to the terms "executive functioning" (EF) and "self-regulation" over the past few years. Numerous books on this topic have appeared during that time along with hundreds of scientific papers focusing on the relationship between these constructs, or ideas, and ADHD. One often hears that ADHD is a disorder of EF or that ADHD involves poor self-regulation. But what does this mean? How are these terms related to each other and to ADHD? Does this have some impact on the way in which one should manage the disorder? The purpose of this guest column is to give a brief overview of these terms and what their involvement in ADHD may mean for understanding its nature and also for planning interventions for those who have the disorder.

The most common form of ADHD is now known as the Combined Type. More than 2/3s to 3/4ths of people diagnosed with ADHD will be placed in this type at some time in their childhood or adulthood. This type of ADHD involves significant problems with sustained attention, persistence toward goals, resisting distractions along the way, inhibiting excessive task-irrelevant activity (hyperactivity), and inhibiting actions, words, thoughts, and emotions that are either socially inappropriate for the situation or inconsistent with one's longer term goals and general welfare.

The term "self-regulation" in psychology has a relatively specific definition. While it is often considered the means by which an individual manages themselves in order to attain their goals, it can be thought of as having at least three components. Self-regulation involves (1) any action an individual directs at themselves so as to (2) result in a change in their behavior (from what they might otherwise have done) in order to (3) change the likelihood of a future consequence or attainment of a goal. When you walk into a coffee shop and see a display counter filled with pastries or confections you face a situation that may tempt you to buy these things that are likely to ruin your plans for losing weight this month. To deal with this temptation while you wait for your coffee to be prepared, you may avert your eyes from the counter, walk to a different section of the shop away from the tempting goodies, engage

yourself in mental conversation about why you need to not buy those products, and even visualize an image of the new slenderer version of yourself you expect to achieve in the near future. All of these are self-directed actions you are using to try and alter the likelihood of giving into temptation and therefore increase your chances of meeting your goal of weight loss this month. This situation calls upon a number of distinct yet interacting mental abilities to successfully negotiate the situation. You have to be aware that a dilemma has arisen when you walked into the shop (self-awareness), you have to restrain your urge to order the pastry to go with the coffee you have ordered (inhibition), you re-directed your attention away from the tempting objects (executive attention or attentional management), you spoke to yourself using your mind's voice (verbal self-instruction or working memory), and you visualized an image of your goal and what you would look like when you successfully attain it (nonverbal working memory, or visual imagery). You may also have found yourself thinking about various other ways you could have coped effectively with these temptations (problem-solving), and may have even used words of encouragement toward yourself to enhance the likelihood that you would follow your plan (self-motivation). These and other mental activities are usually included in the modern understanding of human self-regulation.

Since the late 1970s, clinical researchers such as Virginia Douglas, Ph.D. (then working at McGill University), who were studying ADHD have asserted that the disorder likely involves a serious deficiency in the capacity for self-regulation. Why? Because they had already begun documenting through various measures that ADHD was associated with deficits in inhibition, managing one's attention, self-directed speech and rule-following, self-motivation, and eventually even self-awareness. If ADHD involves difficulties in these faculties and these are the human mental abilities that are involved in our regulating our own behavior, then logically ADHD ought to be a disorder of self-regulation. Since then, research has continued to affirm the involvement of deficits in these and other mental abilities that are essential for effective self-regulation in people with ADHD resulting in a tacit acceptance of the idea that ADHD is actually SRDD (self-regulation deficit disorder). While the official name for the disorder will not be changed anytime soon in the official manual that grants names to mental disorders, it is important that people understand this equivalence of ADHD with self-regulation deficits.

Also over the past 30 years, clinical researchers such as myself and many others studying ADHD have increasingly documented deficits on tests and other measures of EF. How do the above ideas about self-regulation problems in ADHD link up with these findings and the term EF itself? To understand this relationship, one has to have a clear definition of EF. Unfortunately, there is no consensus at this time on the meaning of the term EF, despite it being used prolifically in journal articles, presentations, and books about ADHD. A commonly used definition in the field of ADHD has been to refer to EF as "those neuropsychological processes needed to sustain problem-solving toward a goal." Now we can begin to see a potential relationship between EF and self-regulation, because they share a similar if not identical definition. Both involve goal-directed, future-oriented actions. Both involve sustaining actions over time to achieve one's goals. And both include problem-solving as part of those goal-directed actions. Moreover, when we look at a list of the mental processes most often listed as being part of the notion of EF, they include: inhibition, resistance to distraction, self-awareness, working memory, emotional self-control, and even self-motivation. These are the very mental abilities that were already identified as being essential to self-regulation. Initially in 1994, and later in 1997 in a book on ADHD, I argued for just this linkage or relationship between EF and self-regulation. Indeed, I stipulated that each executive function can be considered to be a type or special form of self-regulation – a specific class to actions that people direct at themselves to change their behavior so as to alter a future consequence or likelihood of attaining a goal. In short, an EF is a specific type of action you are directing at yourself for purposes of self-regulation. We can therefore take each EF that researchers have identified and redefine it as a type of self-direct action. Inhibition becomes self-restraint, self-awareness is self-directed attention, verbal working memory is self-speech (talking to yourself, usually using your mind's voice), nonverbal working memory is seeing to yourself, or using visual imagery along with other forms of self-directed sensing (rehearing previous conversations to yourself, re-perceiving odors you previously smelled or flavors you previously tasted, etc.). And problem-solving could be thought of as self-directed play (taking apart and recombining things or ideas to create novel re-arrangements). By adulthood, all of these are largely invisible to others, or mental in form, such that the person engages in them privately, to themselves, in their mind (brain). Working memory and problem-solving in fact are the ways people typically mentally represent and manipulate information that is being held in our mind (using images and words). In short, we use the various EFs for self-regulation to attain goals (alter future consequences): EF = SR. Now we can see that if ADHD is SRDD then SRDD is also EFDD.

They are just inter-changeable names for the same set of problems. People with ADHD have great difficulties with using their EFs for purposes of self-regulation and attaining their goals.

We can now understand that ADHD involves more than just the obvious symptoms of inattention/distractibility and impulsivity/hyperactivity, as listed in the Diagnostic and Statistical Manual for Mental Disorders, 4th Edition (DSM-IV). It is now obvious that the underlying psychological difficulties that are giving rise to these symptoms involve deficits in all of the major EFs, and each of these EFs is a type of self-regulation – a special form of self-directed action. ADHD therefore involves deficits in self-restraint, self-awareness, self-speech, self-sensing and imagery, self-control of emotion, self-motivation, and self-directed play for problem-solving. Because these difficulties are more likely to be delays in the development of these important mental abilities, and not absolute losses of these abilities as might occur after a severe brain injury, what distinguishes someone with ADHD from someone without it is that they appear to be less mature (are age-inappropriate) in their ability to engage in self-regulation (EF) toward specific goals and the future more generally. If one is to help someone with ADHD, they must be helped to either overcome these delays or at least compensate for them (make accommodations to them) if they are to be more effective or successful in managing themselves, getting to their tasks and goals, and preparing for their future more generally.

Disorders of EF or self-regulation, like ADHD, pose great consternation for the mental health and educational arenas of service because they create disorders mainly of performance rather than of knowledge or skills. Mental health and education professionals are more expert at conveying knowledge – how to change; far fewer are expert in ways to engineer environments to facilitate performance – where and when to change. At the core of such problems is the vexing issue of just how one gets people to behave in ways that they know may be good for them yet which they seem unlikely, unable, or unwilling to perform. Conveying more knowledge does not prove as helpful as altering the parameters associated with the performance of that behavior at its appropriate point of performance. Coupled with this is the realization that such changes in behavior are likely to be maintained only so long as those environmental adjustments or accommodations are as well. To expect otherwise would seem to approach the treatment of EF deficits with outdated or misguided assumptions about the essential nature of EF and its impairments.

Some of the principles of EF deficit management that arise from this view of ADHD as a disorder of self-regulation (EF) are:

1. If the process of regulating behavior by internally represented forms of information (working memory or the internalization of behavior) is impaired or delayed in those with EF deficits, then they will be best assisted by "externalizing" those forms of information; the provision of physical representations of that information will be needed in the setting at the point of performance. Since covert or private information is weak as a source of stimulus control, making that information overt and public may assist with strengthening control of behavior by that information.
2. The organization of the individual's behavior both within and across time is one of the ultimate disabilities rendered by the disorder. EF deficits create problems with time, timing, and timeliness of behavior such that they are to time what nearsightedness is to spatial vision; they create a temporal myopia in which the individual's behavior is governed even more than normal by events close to or within the temporal now and immediate context rather than by internal information that pertains to longer term, future events. This helps to understand why adults with EF deficits make the decisions they do, short-sighted as they seem to be to others around them. If one has little regard for future events, than much of one's behavior will be aimed at maximizing the immediate rewards and escaping from immediate hardships or aversive circumstances without concern for the delayed consequences of those actions. Those with deficient EF could be expected to be assisted by making time itself more externally represented, by reducing or eliminating gaps in time among the components of a behavioral contingency (event, response, outcome), and by serving to bridge such temporal gaps related to future events with the assistance of caregivers and others.
3. Given that the model hypothesizes a deficit in internally generated and represented forms of motivation that are needed to drive goal-directed behavior, those with EF deficits will require the provision of externalized sources of motivation. For instance, the provision of artificial rewards, such as tokens, may be needed throughout the performance of a task or other goal-directed behavior when there is otherwise little or no such immediate consequences associated with that performance. Such artificial reward programs become for the person with EF deficits what prosthetic devices such as mechanical limbs are to the physically disabled, allowing them to perform more effectively in some tasks and settings with which they otherwise would have considerable difficulty. The motivational disability created by EF deficits makes such motivational prostheses nearly essential for most children deficient in EF and can be useful with adults having EF deficits as well.

Related to this idea of motivational deficits accompanying EF disorders is the literature on self-regulatory strength and the resource pool of effort (willpower) that are associated with activities of SR. There is an abundant literature on this topic that has been overlooked by neuropsychologists studying

EF yet it has a direct bearing on EF given that EF is viewed as SR here. Research indicates that each implementation of SR (and hence EF) across all types of SR (working memory, inhibition, planning, reasoning, problem-solving, etc.) depletes this limited resource pool temporarily such that protracted SR may greatly deplete the available pool of effort. This results in an individual being less capable of SR in subsequent situations or immediately succeeding time periods and thus more likely to experience problems or fail outright in their efforts at SR and resistance to immediate gratification. Such temporary depletions may be further exacerbated by stress, alcohol or other drug use, illness, or even low levels of blood glucose. Research also indicates what factors may serve to more rapidly replenish the resource pool such as routine physical exercise, taking 10 minute breaks periodically during SR strenuous situations, relaxing or meditating for at least 3 minutes after such SR exerting activities, visualizing the rewards or outcomes while involved in EF/SR tasks, arranging for periodic small rewards throughout the tasks or SR-demanding settings, engaging in self-affirming statements of self-efficacy prior to and during such tasks, experiencing positive emotions, and consuming glucose rich beverages during the task. Some research further suggests that the actual capacity of the resource pool may be boosted by routine physical exercise and by routine practicing tasks involving self-regulation daily for two weeks. From the extended phenotype view of EF as SR, these findings from the psychological literature on SR are directly pertinent to EF and its disorders.

4. Given the above listed considerations, clinicians should likely reject most approaches to intervention for people with EF deficits that do not involve helping patients with an active intervention at the point of performance. The point of performance is that place and time in the natural setting of the person's life where they are failing to use what they know – they are failing to engage effectively in EF (self-regulation). Once per week counseling without efforts to insert accommodations at key points of performance in natural settings is unlikely to succeed with the patient with deficient EF. This is not to say that extensive training or retraining at the instrumental level of EF, as with working memory training, may not have some short-term benefits. Such practice has been shown to increase the likelihood of using EF/SR and of boosting the SR resource pool capacity in normal individuals.

Yet another implication for the management of EF deficits from the self-regulation perspective is that only a treatment that can result in improvement or normalization of the underlying neurological and even genetic substrates of EF is likely to result in an improvement or normalization of the deficits. To

date, the only treatment that exists that has any hope of achieving this end is medication, such as stimulants or the non-stimulants like atomoxetine or guanfacine XR, that improve or normalize the neural substrates in the prefrontal regions and related networks that likely underlie these deficits. Evidence to date suggests that this improvement or normalization in EF may occur as a temporary consequence of active treatment with stimulant medication, yet only during the time course the medication remains within the brain. For instance, research shows that clinical improvement in behavior occurs in as many as 75–92% of those with ADHD and results in normalization of behavior in approximately 50–60% of these cases, on average. The model of EF developed here, then, implies that medication is not only a useful treatment approach for the management of certain EF deficits but may be a predominant treatment approach among those treatments currently available because it is the only treatment known to date to produce such improvement/normalization rates, albeit temporarily.

It also can be reasoned that if EF deficits result in the under-control of behavior by internally represented forms of information (EFs), then that information needs to get "externalized" as much as possible, whenever feasible, at critical points of performance in the natural setting. To "externalize" information is to make it physical outside of the individual. The internal forms of information generated by the executive system, if they have been generated at all, appear to be extraordinarily weak in their ability to control and sustain the behavior of those with EF deficits that impair behavior toward the future. Self-directed visual imagery, audition, and the other covert re-sensing activities that form nonverbal working memory as well as covert self-speech, if they are functional at all at certain times and contexts, are not yielding up information of sufficient power to control behavior in this disorder. That behavior is remaining largely under the control of the salient aspects of the immediate context. The solution to this problem is not to nag those with EF difficulties to simply try harder or to remember what they are supposed to be working on or toward. It is instead to take charge of that immediate context and fill it with forms of physical cues comparable to their internal counterparts that are proving so ineffective. In a sense, clinicians treating those with EF deficits must beat the environment at its own game. Sources of high-appealing distracters that may serve to subvert, pervert, or disrupt task-directed mentally represented information and the behavior it is guiding should be minimized whenever possible. In their place should be cues, prompts, and other forms of information

that are just as salient and appealing yet are directly associated with or are an inherent part of the task to be accomplished. Such externalized information serves to cue the individual to do what they know.

If the rules that are understood to be operating during educational or occupational activities, for instance, do not seem to be controlling the person's behavior, they should be externalized. The rules can be externalized by posting signs about the school or work environment that are related to these rules and having the adult frequently refer to them. Having the adult verbally self-state these rules aloud before and during these individual work performances may also be helpful. One can also tape-record these reminders on a digital recorder that the child or adult listens to through an earphone while working. It is not the intention of this column to articulate the details of the many treatments that can be designed from this model. That is done in my other books. All I wish to do here is simply show the principle that underlies them – put external information around the person and within their sensory fields that may serve to better guide their behavior in more appropriate activities. With the knowledge this model provides and a little ingenuity, many of these forms of internally represented information can be externalized for better management of the child or adult with EF deficits, as seen in ADHD for instance.

Chief among these internally represented forms of information that either need to be externalized or removed entirely from the tasks is that related to time. As stated earlier, time and the future are the enemies of people with EF difficulties when it comes to task accomplishment or performance toward a goal. An obvious solution, then, is to reduce or eliminate these problematic elements of a task when feasible. For instance, rather than assign a behavioral contingency that has large temporal gaps among its elements to someone with and EF disorder, those temporal gaps should be reduced whenever possible. In other words, the elements should be made more contiguous. Rather than tell them that a project must be done over the next month, assist them with doing a step a day toward that eventual goal so that when the deadline arrives, the work has been done but done in small daily work periods with immediate feedback and incentives for doing so.

Yet there is a major caveat to all these implications for externalizing forms of internally represented information. This caveat stems from the component of the model that deals with self-regulation of motivation (and arousal): No matter how much clinicians, educators, and caregivers externalize prompts, cues, and other signals of the internalized forms of information by which they desire the

person with EF deficits to be guided (stimuli, events, rules, images, sounds, etc.), it is likely to prove only partially successful. Even then it will prove only temporarily so. Internal sources of motivation must be augmented with more powerful external forms as well. It is not simply the internally represented information that is weak in those with EF disorders. It is the internally generated sources of motivation associated with them that are weak as well. Those sources of motivation are critical to driving goal-directed behavior toward tasks, the future, and the intended outcome in the absence of external motivation in the immediate context. Addressing one form of internalized information without addressing the other is a sure recipe for ineffectual treatment. Anyone wishing to treat those with deficits in EF has to understand that sources of motivation must also be externalized in those contexts in which tasks are to be performed, rules followed, and goals accomplished. Complaining to these individuals about their lack of motivation (laziness), drive, will power, or self-discipline will not suffice to correct the problem. Pulling back from assisting them to let the natural consequences occur, as if this will teach them a lesson that will correct their behavior, is likewise a recipe for disaster. Instead, artificial means of creating external sources of motivation must be arranged at the point of performance in the context in which the work or behavior is desired.

The methods of behavior modification are particularly well suited to achieving these ends. Many techniques exist within this form of treatment that can be applied to those with children and adults with EF deficits. What first needs to be recognized, as this model of ADHD stipulates, is that (1) internalized, self-generated forms of motivation are weak at initiating and sustaining goal directed behavior; (2) externalized sources of motivation, often artificial, must be arranged within the context at the point of performance; and (3) these compensatory, prosthetic forms of motivation must be sustained for long periods.

To conclude, this column has attempted to show that ADHD is a disorder of self-regulation. Self-regulation requires that a person have intact executive functions (EFs). The EFs are specific types of self-regulation or self-directed actions that people use to manage themselves effectively in order to sustain their actions (and problem-solving) toward their goals and the future. I have tried to show that ADHD is both SRDD (self-regulation deficit disorder) and so is also EFDD. By understanding this relationship among these terms, we can understand the people with ADHD have difficulties using the often mental forms of self-directed actions we all use to manage ourselves effectively so as to attain

our goals and see to our long-term welfare. To deal with the problems ADHD creates, we will need to understand that it involves EF deficits and that such deficits can be compensated for by modifying the environment and making other accommodations so as to both buttress and facilitate the individual's use of their own self-control.

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