



## *Afterword (2005)*

It is most gratifying to see the excellent reception that this book has received in the 8 years since its initial publication. More than a hundred studies have been published on the neuropsychology of ADHD since this theory appeared in *Psychological Bulletin* in 1997 and later that year in the first printing of this book. Many of these studies' authors have cited this theory; some have used it as the main rationale for their research. A theory is a time-limited tool that serves to initiate and guide a program of research. From that standpoint, this theory remains alive and well as a tool for generating testable hypotheses about ADHD. That is not to say that all of these studies have supported all of the predictions that were being tested, but many of them did so.

In particular, readers should consult three recent meta-analyses of neuropsychological studies of children and adults with ADHD (Frazier, Demareem, & Youngstrom, 2004; Hervey, Epstein, & Curry, 2004; Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005) that document the various neuropsychological deficits associated with the disorder, particularly in behavioral inhibition and working memory. And the excellent conceptual review by Nigg (2001) concluded that there is now little doubt that deficits in behavioral inhibition occur as a central feature of ADHD, especially that aspect he termed "volitional" or "executive" inhibition. Undoubtedly more work needs to be done to further clarify the nature of these deficits.

What made this theory unique among prior theories of ADHD was that it did not simply assert that ADHD was a disorder of inhibition or just delay aversion, as earlier theorists had done. Helpful as

these ideas were at the time in focusing more research attention on the nature of inhibition and attention deficits in ADHD, they did not explain many of the other cognitive, developmental, or neuropsychological deficits associated with ADHD nor make more than a few testable predictions apart from those already inherent in their basic theoretical premises. To be truly useful, however, theories must not only better explain current findings but also make predictions about conditional relationships that were not previously considered. This permits the theory to be falsifiable and also to drive research forward into new areas. The present theory did so by arguing that *if* ADHD is a disorder of behavioral inhibition and *if* such inhibition is essential to the effective performance of the executive functions and self-regulation, *then* other impairments should be evident in those executive functions and the larger realm of self-regulation that they provide. More specifically, it asserted that working memory (both verbal and nonverbal), emotional self-control (and the intrinsic motivation it can provide), as well as reconstitution (planning, problem solving, and goal-directed innovation) and the motor (behavioral) control they provide will not function effectively if deficits in inhibition exist—because these executive functions depend on inhibition.

Just as important, this theory defined its terms operationally. And it showed how inhibition, self-control, and executive functioning are related to each other if carefully defined. *Inhibition* serves to suppress immediate responses to immediate events in the sensory fields. *Self-control* is the directing of responses or actions toward oneself to change one's own behavior in order to make *future* consequences more or less likely to occur. It cannot occur if individuals have not stopped responding to events around them, so they can direct their actions toward themselves. The *executive functions* are the more specific classes of actions we direct at ourselves to engage in self-regulation. They are types of self-control and can be defined from their contemporary neuropsychological labels (verbal and nonverbal working memory, planning, etc.) into a more Vygotskian view of actions to the self, such as self-directed sensory–motor actions and especially visual imagery and rehearing (nonverbal working memory), self-directed speech (verbal working memory), self-directed emotion (emotional self-control), and self-directed play or analysis and synthesis (planning and goal-directed innovation). That is, we see and hear ourselves (among other self-directed senses), talk to ourselves, motivate ourselves, and play with information to change ourselves for the sake of improving our future consequences.

Also important is that these actions, which in early development (and human evolution) were overt or more publicly observable, be-

come with developmental maturation more covert, private, and unobservable in form (what Vygotsky called “internalization”). Individuals with ADHD are less able to direct actions back at themselves for the sake of self-improvement to maximize their future consequences. And when they do so, they are more overt or public (i.e., less mature) in form rather than covert (or internalized/privatized) in form and prove less effective as forms of self-regulation. I believe this concept is what makes this particular theory of self-control (executive functioning) especially useful. It places its bets. If these theoretical definitions and premises and their conditional relationships prove wrong, then the theory is dead as both an explanatory and a predictive tool. The generic and crucially important process of how humans redirect behavioral actions back at themselves and then gradually privatize them during development to form private (mental or cognitive) means of self-directed activities for self-change is the very heart of this theory. It is little studied save for the more extensive research in developmental psychology that has been done on Vygotsky’s theory of self-directed and internalized speech, even though it likely constitutes the origin of thinking (effortful cognitive action to the self).

### *PREDICTIONS FROM THE THEORY*

For the sake of driving further research initiatives in ADHD, it is worth setting forth a number, though by no means all, of the specific predictions about self-control and ADHD that arise from this theory. Children and adults with ADHD—combined type should manifest the following deficits, with some depending upon the age at which they are studied (i.e., if a process described below is not yet developed or proficient in typical children, it cannot be found to be deficient in children with ADHD). Also, if typical children have been proficient at a task for many years, it is likely at a certain point that children with ADHD will eventually attain some proficiency because the disorder is a *delay* in development, not a total *loss* of ability. If such a task is either too easy or too hard for both groups, no group difference would be expected in the results, even if those with ADHD are delayed in the larger developmental domain being tested.

#### *Behavioral Inhibition*

ADHD involves deficits in three aspects of behavioral inhibition:

- Inhibiting the prepotent response (the urge to act on the moment).

- Inhibiting ongoing responses that are proving ineffective—being sensitive to errors and thereby discovering and shifting to more effective responses.
- Inhibiting responses to task-irrelevant events (distractibility), known as “interference control.”

*Sensing toward the Self*

The deficits noted above will interfere with the development of self-directed actions (sensory–motor action), and especially the use of visual imagery and private audition (rehearing), as means of regulating behavior.

- This interference arises because inhibition is needed to delay the response to the temporal now (immediate and compelling events) as well as to begin privatizing (suppressing) the publicly observable or overt aspects of those self-directed actions the individual will use to self-regulate. Why self-directed actions need to become private or internalized in form is an interesting question for evolutionary psychology. But here the point is that if private self-directed behavior is a form of thinking—as Skinner, Vygotsky, and Bronowski believed it to be—then children with ADHD are thinking out loud more than others when they should be engaging in private action or thought like others of their age.

- The capacities for social exchange (often delayed across time) and for joining with others to accomplish larger goals require an evolved mental mechanism. If these are functions of the working memory system, then children with ADHD will demonstrate deficits related to reciprocal altruism (social exchange), sharing, and cooperation in these activities. This may help us to understand their substantial problems with peer relationships. Sharing and cooperation depend on a capacity to wait and to sense the future implications of what a person does with others; if some individuals cannot stop and think (see the probable future) before they act, they are far less likely to share, cooperate, keep promises, exchange goods and services, and otherwise engage in social reciprocity and the non-zero-sum interactions that are the heart of human social groups. Conscious cooperation, and especially conscious altruism and its inherent delay in social exchange, require a sense of the social future. ADHD would impair that sense, thereby impairing the social behavior dependent on that sense.

- When one has a capacity for holding an image (or sound) in mind, many of those images will be of the behavior of others in the

social group. Here, I believe, arises the capacity for imitative learning. Copying the behavior of another, it seems to me, requires the ability to hold an image of that behavior in mind and sustain its existence mentally for a sufficient period of time to permit it to be duplicated. The image is therefore the template from which the imitative response will be constructed. No imagery, no imitation.

- If such images can then be stored in long-term memory for later recall, then a further capacity for delayed imitation can arise, so that what is witnessed at one time in a given social context can be duplicated later and in another social context. Imitation is doing what others do. Vicarious learning is a broader capacity that involves imitation, as well as sometimes doing the opposite of what others do. For instance, if Peter observes Paul engaging in a behavior that leads to Paul's being punished or injured, Peter's image of this contingency arrangement can subsequently be used to suppress that same behavior in his own repertoire. Peter can learn from Paul's mistakes. And so develops the capacity to use the behavior and learning of others for self-change and improvement. In doing so, Paul has saved himself the exceptional amount of time and effort required for trial-and-error (operant) learning. I have argued above that this capacity to retain images of the actions of others to be used, now or later, for imitation or vicarious learning depends on the nonverbal working memory system. To the extent that ADHD adversely affects this system, children with ADHD should be less capable of imitating the behavior of others (particularly complex sequences that will tax working memory capacity), and they will be less capable of self-improvement through the larger capacity of vicarious learning.

- Hindsight arises when one is capable of reactivating images of past experience. And when those images can be held in mind and studied for recurrent patterns, those patterns can be carried forward to serve as a best guess of the future—an expectation. Hindsight has now generated foresight, or an ability to anticipate the likely future. Such images and associated expectations can then generate a capacity for anticipatory preparation to act when the time arrives. This too seems to arise from the nonverbal working memory system. And again, to the extent that ADHD disrupts that system, we should find that those with the disorder act without due regard to hindsight and foresight. In short, they are less likely to stop and think before they act, the thinking here being hindsight–foresight.

- The problem with hindsight for those with ADHD should be evident as well in the content of their speech with others and their interactions with them, as well as in how they elect to spend their time and energies. They do not stop and consider (much less verbally refer

to) their past experience and its associated images, in order to consider and discuss the future when it is essential to do so. It is not that they *cannot* do so at all when they are asked about their past or even their future; it is that they do not do so at the crucial junctures in the stream of their ongoing activities when it would be wise to do so. This is a point that needs to be made repeatedly: The problem is not so much with knowing as with doing or using. This issue appears in regard to all of the executive functions discussed here.

- The images we are capable of holding in mind constitute our own individual history and include images of ourselves and our past behavior. By frequently referring to such images, we develop auto-noetic awareness, or a sense of ourselves across time. This is self-awareness within a temporal sense. Once again, to the degree that ADHD interferes with the capacity to review past experiences in mind, it also interferes with awareness of self across time. Is this the origin of the positive illusory bias so well established now in children with ADHD—people’s inability to appreciate how poorly they may actually perform certain activities, relative to their typical peers?

- Holding images and other information in mind from the past and projecting them forward in time to anticipate the future probably contributes to the conscious sense of time itself—and, just as important, to the capacity to use that sense of time in order to govern behavior, make it more timely, and make preparations to act on future events in a timely manner. Might not this be the origin of the time reproduction problems so consistently evident in children, teens, and adults with ADHD? This is, in its largest scope, time management, or the management of oneself relative to the sense of time. And it too should be impaired in those with ADHD. Complaints of procrastination, lack of punctuality, and a failure to give due regard for the time, timing, and timeliness of their actions should be rife about those with the disorder.

- If individuals do not consider time and the future before taking action, as I argue that those with ADHD are less likely to do, then they will not place greater value on larger, later future rewards over the more obvious, immediate, and usually smaller ones. The value of future consequences should be more steeply discounted than is the case with typical peers. Some suggestion of this differential discounting of future consequences has already been evident in studies of children and teens with ADHD, but it deserves far greater research attention than it has received.

- If individuals do not think about and utilize their sense of time, we could easily predict that they will be less likely to talk about time in their general conversations with others, and that they will be

later in doing so in their development than when typical children first begin to make verbal references to past, future, and time in general.

### *Speech to the Self*

As noted above, speech to the self progresses from being directed at others in early childhood, to being self-directed yet still overt by ages 3–5 years, and eventually to covert self-speech in middle to late childhood. With this progressive privatization comes a shift from description to include self-instruction, as well as an increasing power of language to guide motor behavior. We should (and do!) find that just as children with ADHD may be delayed in nonverbal working memory, particularly its temporal–sequential aspects, so too are they delayed in their privatization of self-speech. Although such a delay in a fascinating developmental progression is interesting in its own right, it also suggests a delay in the power of self-regulation that self-directed speech probably evolved to provide.

- Children with ADHD will be deficient in the capacity of language generally and self-directed speech particularly to guide motor behavior. Rule-governed behavior should prove problematic for these individuals.
- Children with ADHD will engage in greater public speech (excessive talking) and less private speech, given that they are thinking out loud, as noted earlier, when others are thinking covertly.
- Self-speech also provides a source of problem solving, because it permits typical individuals to interrogate or question themselves to better elicit useful information from their memory and experiences. Self-questioning in problem solving should be less proficient in those with ADHD.
- One somewhat unexpected prediction about this delay in self-directed speech (verbal working memory) in those with ADHD is that it should also be associated with a progressive deficit in reading, viewing, and listening comprehension. Take reading, for instance. Silent reading requires self-directed covert speech, but it also requires that what is said (read) to the self be held in mind or online to extract its meaning. Words as arbitrary utterances derive their meanings, directly or indirectly, from the images and actions that they symbolically represent. What is read must be held in mind to more fully appreciate the nonverbal semantic content it was intended to convey. Because ADHD interferes with working memory (both verbal and nonverbal), those with the disorder should have greater difficulty holding in mind

the content of what is read, and therefore should be less proficient in understanding what is read. As many clinical patients with ADHD will describe, when reading they often forget what was read at the top portion of the page by the time they have reached the lower portion of the page, and therefore must return to the top to read it once again. We should also find that they retain only the most obvious and concrete aspects of the story, while being less proficient at understanding and retaining the more complex and subtle features of plot and sequence. Given that this is a working memory problem, it should affect not just reading, but listening to story narratives and even viewing televised content. Although there is growing evidence that this is indeed the case, what this theory provides is the reason it would be expected to be found in the first place in those with the disorder—another testable prediction.

- Also unexpected (at first) is the prediction that such a disorder of internalized speech and verbal working memory should lead to a delay in moral development and the capacity to be socialized into the rules of the group or larger culture. If speech is not being internalized well, then the rules it conveys will not be internalized well. Part of moral development springs from the sense of the social future and the social consciousness it affords—“Do unto others as you would have them do unto you.” But part of moral development is also internalizing codified rules of conduct that instruct right from wrong. The difficulties with internalizing speech and using rules to guide behavior predicted to be associated with ADHD should also be expected to create some adverse impact on moral conduct in those with the disorder.

- Consider also that if those with ADHD are less able to consider the future consequences of their actions before they act, and are less capable of remembering and of following through on rules, instructions, and advice generally, they would also be less able to follow through on promises and commitments made to others, even if these were sincerely made at the outset.

#### *Self-Regulation of Emotion/Motivation*

Given the foregoing discussion of how emotional self-regulation may arise, and with it motivational self-regulation, one can predict that children with ADHD will have difficulties in moderating and self-regulating emotional states, thereby displaying raw and impulsive emotions more than typical children do.

- They will also have difficulties in creating and sustaining self-motivation. Self-motivation provides the drive, determination,

stick-to-it-tiveness, persistence, and willpower to “stay the course” toward future goals in the absence of externally provided reinforcement or punishment. Those with ADHD will not be as capable of these actions, and so will not be as capable of sustaining effortful behavior toward goals in the absence of external consequences for doing so.

- The corollary of this prediction is that those with ADHD are more dependent than others on such externally provided consequences for their drive states and persistence toward tasks and goals than are typical children or adults. In part, then, ADHD is “MDD”—motivation deficit disorder. I believe this predicts and explains why those with ADHD can sustain their attention and activity toward tasks (e.g., video games) that provide frequent external consequences or that the individuals find enjoyable to do, yet cannot sustain their attention and activity toward tasks such as homework or chores, which provide no such frequent schedule of consequences.

- Emotion equals more than just a motivational state; it also comprises a dimension of arousal. If those with ADHD cannot regulate emotional states, then almost by definition they cannot self-regulate states of arousal as well as others of their age. Self-arousal and self-activation toward goals and tasks will be less successful in those with ADHD.

#### *Self-Directed Play (Planning and Generativity)*

I believe that the fourth executive function represents the internalization of play, or analysis and synthesis. The capacity to take things apart and recombine them into novel sequences and structures applies not just to objects, but, more importantly, to our own behavioral sequences and hierarchical structures. We don’t just play with objects (or words); we play with the behaviors that so affect and create them. Typical children will progress from overt physical or manual as well as verbal play to covert forms of these self-directed actions. They will come to be able to manipulate the nonverbal and verbal contents of working memory, taking apart and recombining them into novel recombinations. Many of these products will be useless or nonsensical, but a few will be exceptionally creative, innovative, and useful new ideas that can be put into play for problem solving, goal attainment, and their associated social effectiveness.

- Those with ADHD should show a delay in the progressive privatizing of overt manual and verbal play to their covert forms. They will have a greater need than typical children to manipulate material manually or play with language publicly in their task performance and problem solving.

- When mental problem solving, planning, or fluency (defined as generating a diversity of responses on demand) is required, those with ADHD will be less proficient at doing so than are their peers. One can easily see the probable adverse impacts of this on mental arithmetic, digit span backward, verbal and design fluency, and planning tasks, all of which require manipulating the content of working memory for successful performance.

- The executive system provides for effective problem solving, particularly when obstacles are encountered in pursuit of goals. It affords one the ability to rapidly construct and mentally test out various behavioral options for resolving the problem (planning) before selecting that which seems to address the problem most effectively. Those with ADHD should be less proficient at such problem solving than typical individuals.

- When typical individuals are recombining the parts of the world or their own behavioral units into new sequences, a syntax will prove essential to doing so effectively; order and timing are crucial in many aspects of our actions. This theory predicts that those with ADHD will have greater problems with such a syntax, showing greater errors in these recombinatorial activities having to do with sequence and timing, and hence the utility of these new ideas. Here then may arise the organizational difficulties so apparent in the drawing, writing, speech, actions, general task performance, and social functioning of those with ADHD.

- This executive unit is not just for planning and goal-directed behavioral innovation. It is also likely to be the source of critical thinking—the mechanism by which competing forms of information, response options, and their consequences are weighed for their likely long-term benefits (or, more technically, risk–benefit trade-offs). Such critical thinking is not merely an activity of science or the academic life, but an essential part of daily social life for all of us. It is a means of social self-defense in which we can respond to and defend against the efforts of others trying to influence us for their own self-interests. Without such critical means of considering the proposals, advice, instructions, sales pitches, or other means of social persuasion (or even coercion) to which we are subjected on a daily basis, we would be inherently gullible—easy prey for the charlatans, shysters, cranks, and other social predators we encounter. This should mean that those with ADHD are less capable of such social self-defense and hence more suggestible, gullible, and pliable to others' self-interests and social ends. And they should be least capable of defending themselves in this way when it is most useful to do so.

Here then are some of the many testable predictions that such a model provides for understanding the development of self-regulation and of ADHD. Others, as they pertain to the clinical understanding and management of the disorder, were set forth in Chapter 11. No other contemporary theory or hypothesis about the nature of ADHD can afford such an extensive blueprint for programmatic research, relying on deeper insight into the likely nature of this disorder. And, as I show, this theory supports proposals for interventions for the management of the disorder. Imperfect as this theory is, one cannot fault its utility. And that is really all one can ask of a theory in its often all-too-brief conceptual life.

#### *POTENTIAL FLAWS IN THE THEORY*

No theory is perfect when initially proposed, and this one is hardly an exception. But since we ask not for perfection, but utility, we seek to build a ship that can be floated to be tested and revised, enabling us to build an even better ship that can be floated, tested, revised, and so on. Theories, like all accumulated information, are Darwinian in nature (Campbell, 1960), evolving as their conceptual feet are held to empirical fires of experimentation, falsifiability, and revision. With the benefit of years of research since this book was first published, I would say that there may be a few potential flaws to this theory.

Chief among these possible errors may be that, at its core, ADHD may involve not just a problem with inhibition, as I originally asserted here, and that the executive deficits that ensue are secondary effects stemming from that impairment. It may well be that deficits in working memory develop later, yet are just as central to ADHD as is inhibition. As clinical conceptualizations of ADHD have long recognized, this disorder involves symptoms of both poor inhibition and deficient attention. The deficits in attention actually now appear to be, as was claimed here earlier, deficits in executive functioning and, in particular, working memory. The attention (working memory) problems may arise at a later time in development than the inhibitory ones, but may be primary, not secondary. This is not a theoretical retreat but an acknowledgment that although the inhibition and working memory (executive) deficits are semirelated or partially coupled, the latter deficits may not arise simply as a function of the former inhibitory problems. Time, and especially more experimentation, will tell.

A second potential problem with this theory—acknowledged when this book was first published, but worth reiterating here—is

that the construct or fourth executive function of reconstitution (planning and generativity) may not be a single unit but separated into its verbal and nonverbal forms, just as working memory can be so usefully divided. The means by which conscious cognitive information held in working memory is manipulated (reconstituted) in the processes of analysis and synthesis may be distinguished in verbal relative to nonverbal domains. This too remains to be seen, and I reiterate my uncertainty here.

In closing, let me direct readers to an earlier paper (Barkley, 2001) on the possible evolutionary purpose of the executive system for further speculations on the adaptive problems that the executive functions may have evolved to solve in human social functioning. These should also generate additional theoretical predictions about the nature of social functioning in those with ADHD as well. And let me also express my thanks to the many students and researchers who have elected to further study this theory and its implications for self-control and for ADHD.

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