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New Perspectives on Education Children with ADHD: Contributions of the Executive Functions

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NEW PERSPECTIVES ON EDUCATING CHILDREN WITH ADHD: CONTRIBUTIONS OF THE EXECUTIVE FUNCTIONS

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I. INTRODUCTION

Many children with the diagnosis of Attention-Deficit/Hyperactivity Disorder (ADHD) experience significant adverse effects in their learning and educational performance.[1] Several intervention mechanisms currently exist for assisting students with these needs including informal classroom accommodations, behavior management programming, development and explicit implementation of classroom accommodations via a 504 plan,[2] and identification of an educational handicapping condition (typically "Other Health Impaired") to receive special education services. Effective interventions require full and explicit identification of the child's educationally relevant strengths and weaknesses.[3] With the increasing appreciation and definition of the executive functions as the underlying functional basis of the ADHD symptom clusters,[4] appropriate educational programming

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1. *See infra* Part II.A.

2. 504 plans are written plans that schools may develop when they are faced with educating a student with disabilities to help them comply with the mandates of § 504 of the Rehabilitation Act of 1973. Schools are not required to develop written 504 plans; however, as a practical matter, they usually do to avoid any compliance problems. *See* Catherine D. Anderles, *Helping Schools Make the Grade: Practical Steps for Providing Children with Disabilities a Free, Appropriate Education in Michigan's Public Schools from the U.S. Department of Education's Office for Civil Rights,* 80 MICH. BAR J. 52, 56 (2001); *see also* 34 C.F.R. § 104.33(b)(1)(i), (b)(2) (2001).

Section 504 of the Rehabilitation Act of 1973 provides: "No otherwise qualified handicapped individual in the United States . . . shall, solely by reason of his handicap, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." Rehabilitation Act of 1973, Pub. L. No. 93-112, 87 Stat. 355 (codified at 29 U.S.C. § 794 (1994)).

3. *See infra* Part IV.

4. *See, e.g.*, RUSSELL A. BARKLEY, ADHD AND THE NATURE OF SELF-CONTROL (1997); Russell A. Barkley, *Genetics of Childhood Disorders: XVII. ADHD, Part 1: The Executive Functions and ADHD,* 39 J. AM. ACAD. CHILD & ADOLESCENT PSYCHIATRY 1064, 1065 (2000); Thomas E. Brown, *Does ADHD Diagnosis Require Impulsivity-Hyperactivity?: A Response to Gordon & Barkley,* 7 ADHD Report 1 (1999); Martha Bridge Denckla, *A Theory and Model of Executive Function, in* ATTENTION, MEMORY, AND EXECUTIVE FUNCTION 263 (G. Reid Lyon and Norman A. Krasnegor eds., 1996); Bruce F. Pennington & Sally Ozonoff, *Executive Functions and Developmental Psychopathology,* 37 J. CHILD PSYCHOL. & PSYCHIATRY, 51 (1996).

for students with ADHD necessitates consideration of the inherent executive dysfunction.

The present paper is structured into four sections in developing an argument for explicit recognition and inclusion of executive dysfunction in the educational programming of students diagnosed with ADHD. First, we define the clinical syndrome of ADHD, including a brief review of its evolutionary history. The definition of the disorder, subtypes of the syndrome, severity of its symptoms, and epidemiology are discussed. We then define the construct of executive function, including its behavioral manifestation, neurological underpinnings, and developmental issues. This area of functioning has gained significantly greater definition and recognition in terms of its impact within a host of developmental and acquired neurological disorders including ADHD. Third, the relationship between executive dysfunction and ADHD is explored in terms of current theoretical models and recent work conducted by the authors. The traditional triad of symptoms that comprise the diagnosis of ADHD (i.e., inattention, impulsivity, hyperactivity) is not sufficient to fully describe the treatable symptoms. We demonstrate how executive function adds significantly to the functional description of the disorder. Finally, with the groundwork laid regarding executive function and ADHD, we turn our attention to a model of educational programming including specific strategies and recommendations for addressing various types of executive dysfunction. This intervention model acknowledges the unique aspects of executive function and proposes an approach that necessarily takes the child and his environment into account.

The disorder of ADHD is not a unitary phenomenon. Although a set of common characteristics may exist within the diagnosis, significant variability also exists between individuals. In addition to differing levels of severity and subtypes, a variety of environmental factors may affect the manifestation of the disability in the child and its educational impact. Differing teacher and classroom characteristics may ameliorate or exacerbate functional problems. Different developmental stages, such as the needs of the elementary student as compared to those of the high school student, call for different intervention approaches. Thus, in designing an educational intervention plan, one must consider both the general and the unique characteristics of ADHD for the specific student at hand.

II. AN OVERVIEW OF ADHD

A. Definition of ADHD

ADHD is the most common childhood psychiatric disorder and is one of the most prevalent chronic health conditions affecting school-aged children.[5] The characteristic symptoms include developmentally inappropriate levels of inattention and may include impulsivity and/or hyperactivity.[6] Current diagnostic criteria require that these symptoms begin in childhood (by the age of seven years), occur across settings such as home and school, cause functional impairment, and cannot be attributed primarily to another disorder such as depression or anxiety.[7] Typically, functional difficulties present in school in the form of poor academic performance.[8] ADHD also is implicated in problematic family and peer relationships.[9]

The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) defines three subtypes of ADHD: Predominantly inattentive type (ADHD-I), predominantly hyperactive/impulsive type (ADHD-HI), and combined type (ADHD-C).[10] Each subtype is identified by the number of criteria met within its category. For example, a child who exhibits six of nine possible symptoms of inattention but not six of nine symptoms of hyperactivity and impulsivity would by diagnosed with ADHD-I, a child who exhibits six of nine hyperactive/ impulsive symptoms but not inattentive symptoms would be diagnosed with ADHD-HI, and a child who exhibits six of each symptom category would meet criteria for the combined type of ADHD. The current DSM-IV diagnostic criteria for ADHD and its subtypes are as follows:[11]

> A. Either (1) or (2)
> (1) six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

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5. American Academy of Pediatrics, *Clinical Practice Guideline: Diagnosis and Evaluation of the Child With Attention-Deficit/Hyperactivity Disorder*, 105 PEDIATRICS 1158, 1158 (2000).

6. *Id.*

7. AMERICAN PSYCHIATRIC ASSOCIATION, DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS 78 (4th ed. 1994) [hereinafter DSM-IV].

8. Sydney S. Zentall, *Research on the Educational Implications of Attention Deficit Hyperactivity Disorder* 60 EXCEPTIONAL CHILD 143,143 (1993).

9. *See* Russell Schacher et al., *Changes in Family Functioning and Relationships in Children Who Respond to Methylphenidate*, 26 J. AM. ACAD. OF CHILD ADOLESCENT PSYCHIATRY 728, 729-730 (1987).

10. DSM-IV, *supra* note 9, at 80.

11. *Id.* at 83-85.

Inattention

(a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

(b) often has difficulty sustaining attention in tasks or play activities

(c) often does not seem to listen when spoken to directly

(d) often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

(e) often has difficulty organizing tasks and activities

(f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)

(g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)

(h) is often easily distracted by extraneous stimuli

(i) is often forgetful in daily activities

(2) six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Hyperactivity

(a) often fidgets with hands or feet or squirms in seat

(b) often leaves seat in classroom or in other situations in which remaining seated is expected

(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)

(d) often has difficulty playing or engaging in leisure activities quietly

(e) is often on the go or often acts as if driven by a motor

(f) often talks excessively

Impulsivity

(g) often blurts out answers before questions have been completed

(h) often has difficulty awaiting turn

(i) often interrupts or intrudes on others (e.g., butts into conversations or games)

B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years.

C. Some impairment from the symptoms is present in 2 or more settings (e.g., at school or work and at home).

D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning.

E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder).
Code based on type:
314.01 *Attention-Deficit/Hyperactivity Disorder, Combined Type:* If both criteria A1 and A2 are met for the past 6 months
314.00 *Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type:* If criterion A1 is met but criterion A2 is not met for the past 6 months
314.01 *Attention-Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulse Type:* If criterion A2 is met but criterion A1 is not met for the past 6 months

B. Epidemiology

Although estimates vary from a low of 2% to a high of some 10% to 12% of the population, the generally accepted incidence rate of ADHD is 3% to 5%.[12] Differences in estimates are thought to reflect different methodologies across studies, the changing diagnostic criteria for ADHD, and various sampling methods (e.g., clinically referred samples versus non-referred samples).[13] More boys than girls are identified as meeting the diagnostic criteria for ADHD, with an approximate 6 to 1 ratio in clinically referred samples and an approximate 3 to 1 ratio in non-referred samples.[14] ADHD is frequently seen along with other disorders, including Oppositional Defiant Disorder (ODD), Conduct Disorder (CD), anxiety disorders, depression, learning disabilities (LD), and speech and language disorders.[15] Among children diagnosed with ADHD, 40% to 70 % are also diagnosed with either ODD or CD, 15% to 20 % with mood disorders (e.g., Bipolar Affective Disorder, depressive disorders), 20% to 25 % with anxiety disorders, and 6% to 20% with LD.[16] ADHD is also seen frequently in the context of Tourette's disorder and major developmental disabilities, such as Mental Retardation and Autism.[17]

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12. *Id.* at 82; American Academy of Pediatrics, *supra* note 5, at 1159.
13. Jose J. Bauermeister et al., *Epidemiology of Disruptive Behavior Disorders*, 3 CHILD AND ADOLESCENT PSYCHIATRIC CLINICS OF NORTH AMERICA 177, 178 (1994).
14. Julie B. Schweitzer et al., *Attention-Deficit/Hyperactivity Disorder*, 85 ADVANCES IN THE PATHOPHYSIOLOGY & TREATMENT OF PSYCHIATRIC DISORDERS: IMPLICATIONS FOR INTERNAL MED. 757, 758 (2001).
15. *See* Vansheep Sharma et al., *Attention-Deficit and Disruptive Behavior Disorders, in* PSYCHIATRY 667, 669 (Harold Alan Pincus et al. eds., 1997).
16. *Id.* at 669-670.
17. *Id.* at 670.

C. *An Historical Perspective*

The clinical picture currently labeled ADHD has been described for a century, with the earliest systematic study in 1902.[18] There, Still described a group of children, that today would likely meet criteria for ADHD, as having a "defect in moral control" and a "deficit in volitional inhibition," referring to an inhibitory control deficit resulting in an inability to regulate behavior.[19] Later, a behavioral similarity to children with brain injury resulted in the diagnostic label "minimal brain damage."[20] The label was changed in the 1950's and 1960's to "minimal brain dysfunction," reflecting the presumption of a neurologically-based deficit in the face of limited or no evidence of brain damage in most cases.[21] The increasing recognition of hyperactivity as a symptom of "minimal brain dysfunction" in the 1960's again altered the diagnostic label to "hyperkinetic reaction of childhood" which included the first diagnostic consideration of inattention, hyperactivity and distractibility.[22] With the publication of DSM-III, the label "Attention Deficit Disorder" was coined and subtyping became possible. Clinicians could indicate a diagnosis of ADD with or without hyperactivity.[23] With the first revision of DSM-III, the subtyping distinction was eliminated and the diagnostic label changed to the current ADHD.[24] Finally, in 1994 with the publication of DSM-IV, the label remained the same but subtypes were again included in the diagnostic scheme to reflect the broad variation in children with attentional disorders.[25]

D. *A Current Perspective*

A recent National Institutes of Health Consensus Development Conference reviewed the extant literature on ADHD and offered several impressions: (1) ADHD is a commonly diagnosed behavioral disorder of childhood that represents a major public health problem with far reaching and profound effects; (2) despite progress in the

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18. *See* George F. Still, *Some Abnormal Psychical Conditions in Children*, 1 LANCET 1008 (1902).

19. *Id.* at 1008.

20. BARKLEY, *supra* note 4, at 5; *see also* ALFRED A. STRAUSS & LAURA E. LEHTINEN, PSYCHOPATHOLOGY AND EDUCATION OF THE BRAIN-INJURED CHILD 112-113 (1951).

21. *See* BARKLEY, *supra* note 4, at 5.

22. *See* AMERICAN PSYCHIATRIC ASSOCIATION, DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS 50 (2d ed. 1968).

23. AMERICAN PSYCHIATRIC ASSOCIATION, DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS 41 (3d ed. 1980).

24. *Id.*

25. DSM-IV, *supra* note 7, at 80.

assessment, diagnosis, and treatment of ADHD, the disorder and its treatment have remained controversial in many public and private sectors; (3) the validity of ADHD as a disorder is supported, although there is no "test" of ADHD; (4) cost barriers, inadequate diagnosis and treatment of ADHD, and the lack of integration of medical and educational services represent considerable long-term costs for society.[26] Finally, the conference participants lamented that the causes of ADHD remain speculative and that no strategies for prevention exist.[27]

III. DEFINING THE EXECUTIVE FUNCTIONS

Although the construct of executive function has gained a central position in neuropsychology over the past 15-20 years,[28] its understanding and inclusion within the field of education has lagged behind. In a recent survey, psychologists in school and clinical settings were asked about their knowledge of executive function and associated practice methods.[29] School psychologists reported being less familiar with the concept of executive function than psychologists in clinical settings and less ready to define executive function.[30] Furthermore, they tend to assess and treat executive function to a lesser degree than their clinical psychologist colleagues.[31] Both groups, however, overwhelmingly cite a need for more training in the concepts, assessment and treatment of executive functions, as well as the need for additional normative measures of executive function.[32] DeBonis and colleagues further report school psychologists' infrequent use of intervention methods to address executive dysfunction in students with ADHD.[33] They also found few references to the executive functions in common educational curriculum materials for students with ADHD.[34] Thus, educational personnel are in need of

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26. *National Institutes of Health Consensus Development Conference Statement: Diagnosis and Treatment of Attention-Deficit/Hyperactivity Disorder (ADHD)*, 39 J. AM. ACAD. OF CHILD AND ADOLESCENT PSYCHIATRY 182, 187 (2000).

27. *Id.* at 188.

28. *See generally* G. REID LYON & NORMAN A. KRASNEGOR, ATTENTION, MEMORY AND EXECUTIVE FUNCTION (1996).

29. Gerard A. Gioia et al., *Survey of Knowledge and Practice of Executive Function with Children*, 5 PEDIATRIC INTEREST GROUP NEWSLETTER 6 (2001).

30. *Id.*

31. *Id.*

32. *Id.*

33. David A. DeBonis et al., *The Relationship Between ADHD Theory and Practice: A Preliminary Investigation*, 4 J. Attention Disorders 161, 167 (2000).

34. *Id.* at 168.

further training in the concepts and methods to address the needs of students with executive dysfunction.

The executive functions play a fundamental role in a child's cognitive, behavioral, and social-emotional development with substantial implications for everyday academic and social functioning.[35] It is crucial that the educational system fully understands the concepts of the executive functions as well as develops skills for assessing and intervening when the student demonstrates deficiencies. Different profiles of executive dysfunction are found in a variety of clinical conditions associated with vulnerable brain development and/or brain injury. Although the syndrome of ADHD is the focus of this paper, the executive functions are equally applicable to children with other neurologic impairments including those with developmental origins (e.g., learning disabilities, autism/pervasive developmental disorder, mental retardation) and acquired etiologies (e.g., traumatic, infectious, toxic, metabolic, neoplastic encephalopathies).

The term "executive control" has been attributed to the cognitive psychologist, Neisser,[36] who described it as the "orchestration of basic cognitive processes during goal-oriented problem-solving."[37] This early definition is important because it articulates the differentiation of "basic" cognitive functions from the "executive" or "orchestrative" cognitive control functions. Welsh and Pennington characterized the early development of the executive functions in terms of "the ability to maintain an appropriate problem-solving set for attainment of a future goal."[38] Denckla defined the critical features of the executive functions for active problem-solving as follows: providing for delayed responding, future-oriented, strategic action selection, intentionality, anticipatory set, freedom from interference, and the ability to sequence behavioral outputs.[39] Although various authors have discussed different aspects of the executive functions, most would agree that the term is an umbrella construct for a collection of interrelated functions that are responsible for purposeful, goal-directed, problem-

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35. *See* Mark Ylvisaker & David DeBonis, *Executive Function Impairment in Adolesence: TBI and ADHD*, 20 TOPICS IN LANGUAGE DISORDERS 29, (2000).

36. ULRIC NEISSER, COGNITIVE PSYCHOLOGY 292-97 (1967).

37. Marilyn C. Welsh & Bruce F. Pennington, *Assessing Frontal Lobe Functioning in Children: Views From Developmental Psychology*, 4 DEVELOPMENTAL NEUROPSYCHOLOGY 199, 202 (1988).

38. *Id.* at 201.

39. Martha Bridge Denckla, *Measurement of Executive Function*, *in* FRAMES OF REFERENCE FOR THE ASSESSMENT OF LEARNING DISABILITIES: NEW VIEWS ON MEASUREMENT ISSUES 117, 117-18 (G. Reid Lyon, Ph.D. ed., 1994).

solving behavior.[40] An accepted metaphor conceptualizes the executive functions as the conductor of an orchestra where the component "instruments" of the orchestra are the "basic" domain-specific functions (e.g., language, visuospatial functions, memory, motor skills). The conductor directs – making intentional decisions regarding the final output of the music and recruiting the necessary components in reaching the intended goal. The executive functions are defined as the control or self-regulatory functions that organize and direct all cognitive activity, emotional response, and overt behavior.[41] In cognitive and educational psychology, the executive functions are also described in terms of metacognition, the domain-general functions that serve an oversight role.[42]

A. Subdomains of Executive Function

Although not fully inclusive, we present specific behaviorally-referenced subdomains that make up this collection of regulatory or management functions including the ability to: initiate behavior, inhibit competing actions or stimuli, select relevant task goals, plan and organize a means to solve complex problems, shift problem-solving strategies flexibly when necessary, and monitor and evaluate behavior.[43] The working memory capacity to hold information actively "online" in the service of problem-solving is also described within this domain of functioning.[44] Finally, the executive functions are not exclusive to cognition; emotional control is also relevant to effective problem-solving activity.[45] More specific definitions of these subdomains of executive function follow.[46]

The ability to initiate is described as beginning a task or activity, or the process of generating responses or problem-solving strategies. Caregivers often report that children with initiation difficulties have trouble getting started on homework or chores, and require prompts

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40. *See* Vicki Anderson, *Assessing Executive Functions in Children: Biological, Psychological, and Developmental Considerations*, 8 NEUROPSYCHOLOGICAL REHABILITATION 319, 319 (1998).

41. *See* Linda Ewing-Cobbs et al., *Neuropsychological Sequelae after Pediatric Traumatic Brain Injury: Advances since 1985*, *in* TRAUMATIC BRAIN INJURY REHABILITATION: CHILDREN AND ADOLESCENTS 18-20 (2d ed. 1998).

42. *Id.* at 19.

43. Gerard A. Gioia et al., *Assessment of Executive Functions in Children with Neurological Impairment in* PSYCHOLOGICAL AND DEVELOPMENTAL ASSESSMENT: CHILDREN WITH DISABILITIES AND CHRONIC CONDITIONS 317, 321 (Rune J. Simeonsson & Susan L. Rosenthal eds., 2001).

44. *Id.*

45. *Id.*

46. *See id.* (providing a detailed description of the following subdomains of executive function).

or cues in order to begin. It is important to emphasize that problems with initiation are not the result of non-compliance or disinterest in the task. The child typically has an interest in the task or activity and wants to succeed but cannot get started.

The ability to inhibit is a critical trait for success in school and home. Measures to assess this subdomain examine the ability not to act on (inhibit or resist) an impulse and to appropriately stop one's own activity at the proper time. The ability to inhibit is also readily observed in daily activities with common examples of disinhibition including: acting without thinking, being easily distracted, and being unable to sit still. Parents and teachers typically possess a wealth of information about a child's ability to inhibit his/her responses, and rating scales are effective means of gathering information about this subdomain.

The ability to shift one's problem-solving strategy during complex tasks is a key aspect of executive function. Thinking flexibly and being able to switch or alternate attention are essential components of novel problem solving. In their day-to-day lives, children who are rigid or inflexible may exhibit problems transitioning from one situation, activity, or aspect of a problem to another as the situation demands. Caregivers often describe these children as "getting stuck" on a topic or as being highly preservative.

The ability to plan involves anticipating future events, setting goals, and developing appropriate steps ahead of time to carry out an associated task or action. Planning involves imagining or developing a goal, and then strategically determining the most effective method or steps to attain that goal. Planning often involves the sequencing and stringing together of steps in order to most efficiently achieve an end state. The ability to plan had previously been considered as a skill of later development, but research has illustrated its active use in preschool children. Parents and teachers may complain about the child's lack of planning ability, tendency to start assignments at the last minute, or failure to anticipate possible problems.

The ability to organize complex amounts of information is a subdomain that becomes increasingly important as demands for independent functioning increase. Organization involves establishing and maintaining order within an activity or carrying out a task in a systematic manner. The way in which information is strategically organized can play a critical role in how it is learned, remembered and re-

trieved.[47] Common reports from caregivers, which suggest disorganization, describe the child as "scattered," easily overwhelmed by large tasks or assignments, or having difficulties organizing personal belongings.

The ability to self monitor is typically not assessed via a discrete performance measure but rather by direct examiner observation and caregiver reports. The ability to self monitor includes checking on one's own actions during or shortly after finishing a task to assure appropriate attainment of a goal. Children who do not self monitor often rush through assignments without checking their work for mistakes. Additionally, such children may be unaware of how their actions affect others in a social context.

Emotional control is another manifestation of the executive functions. It is closely associated with the ability to inhibit and modulate responses. Emotional control is readily observed at home, at school, and during assessment. The inability to modulate one's own emotional response may manifest as overblown emotional reactions or a general affective reactivity. Such children are often described as "explosive."

Working memory is the process of holding information in mind for the purpose of completing a specific and related task. Working memory is essential in order to follow complex instructions, complete mental arithmetic, or perform tasks with more than one step. A common observation made by parents is that their child often has trouble remembering things for even a few minutes, or when sent to get something, forgets what s/he was supposed to get.

B. Brain Basis for the Executive Functions

The developmental course of the executive functions parallels the protracted course of neurological development, particularly with respect to the prefrontal regions of the brain.[48] A commonly held view of the neuroanatomic organization of the executive functions, however, is that they are seated solely in the prefrontal region of the brain (i.e., the part of the brain that is furthest forward).[49] This position is an oversimplification of the complex organization of the brain. Although damage to the frontal lobes can result in significant dysfunc-

47. *See generally* WOLFGANG SCHNEIDER AND MICHAEL PRESSLEY, MEMORY DEVELOPMENT BETWEEN 2 AND 20, 33-77 (1989) (discussing the encoding and retrieval strategies in memory development).

48. Gioia et al., *supra* note 43, at 322.

49. *Id.*

tion of various executive subdomains,[50] the executive functions do not simply reside in the frontal lobes.[51] Nevertheless, an understanding of this phylogenetically unique neuroanatomic region is important in any discussion of the executive functions. The neuroanatomical essence of the frontal lobes is their dense connectivity with other cortical and subcortical regions of the brain. The prefrontal system is highly and reciprocally interconnected through bi-directional connections with the limbic (motivational) system, reticular activating (arousal) system, posterior association cortex (perceptual/cognitive processes and knowledge base), and the motor (action) regions of the frontal lobes.[52] This central neuroanatomic position underlies the regulatory control that the frontal systems exert over the perceptual coding and conceptual processes of the posterior cortex, attentional, and emotional functions subserved by the subcortical systems.[53]

C. *Developmental Issues*

The developmental course of the executive functions across childhood reveals a protracted ontogenetic course in comparison with other cognitive functions - paralleling the prolonged pattern of neurodevelopment of the prefrontal regions of the brain.[54] Although earlier views of the executive functions argued for their emergence in early adolescence, studies in developmental psychology suggest a much earlier trajectory.[55] The development of attentional control, future-oriented intentional problem-solving, and self-regulation of emotion and behavior can be observed beginning in infancy and continuing through the preschool and school-age years.[56] Examples

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50. *See* Anderson, *supra* note 40; Jack M. Fletcher et al., *Behavioral Changes After Closed Head Injury in Children*, 58 J. CONSULTING AND CLINICAL PSYCHOL. 93, 97 (1990); P.J. Eslinger et al., *Perspectives on the Developmental Consequences of Early Frontal Lobe Damage: Introduction*, 7 DEVELOPMENTAL NEUROPSYCHOLOGY 257 (1991).

51. Gioia et al., *supra* note 43, at 322.

52. *See* Thomas N. Johnson et al., *Projections from Behaviorally Defined Sectors of the Prefrontal Cortex to the Basal Ganglia, Septum, and Diencephalons of the Monkey*, 21 EXPERIMENTAL NEUROLOGY 20, 21 (1968); Linda J. Porrino & Patricia S. Goldman-Rakic, *Brainstem Innervation of Prefrontal and Anterior Cingulated Cortex in the Rhesus Monkey Revealed by Retrograde Transport of HRP*, 205 J. COMP. NEUROLOGY 63-76 (1982).

53. Welsh & Pennington, *supra* note 37, at 199-230.

54. *See* M.A. Passler et al., *Neuropsychological Development of Behavior Attributed to Frontal Lobe Functioning in Children*, 1 DEVELOPMENTAL NEUROPSYCHOLOGY 349 (1985); H.S. Levin et al., *Developmental Changes on Performance Tests of Purported Frontal Lobe Functioning*, 7 DEVELOPMENTAL NEUROPSYCHOLOGY 377 (1991).

55. Charles J. Golden, *The Luria-Nebraska Children's Battery: Theory and Formulation*, *in* NEUROPSYCHOLOGICAL ASSESSMENT AND THE SCHOOL AGE CHILD 277, 292 (G.W. Hynd & J.E. Obrzut eds., 1981).

56. Welsh & Pennington, *supra* note 37, at 210.

of this work include studies of the development of goal-directed, problem-solving behaviors in 12-month-old infants using an object permanence and object retrieval paradigm.[57] Eighteen-month-old children exhibit the self-control abilities to maintain an intentional behavior and inhibit behavior incompatible with attaining a goal.[58] These examples demonstrate the utilization of early intentional self-control behaviors by infants and toddlers for the purpose of goal-directed problem-solving. The executive self-control at these early ages is, however, variable, fragile, and bound to the external stimulus situation, whereas increasing stability is gained between 18-30 months of age.[59] Developmental studies of children through adolescence demonstrate a time-related course of development for specific subdomains of executive function, including inhibitory control,[60] flexible problem-solving,[61] and planning.[62] As is the case with most dimensions of psychological and neuropsychological development, the emergence of executive control functions during development can vary across individuals in terms of when specific subdomains emerge and to what ultimate degree.[63]

Regarding the clinical manifestation of executive dysfunction, it is important to acknowledge and emphasize that there is no singular, core disorder of executive function. Pennington and colleagues point out that disorders with different neuroanatomical bases can present with similar broad manifestations of executive function deficits (for example, treated PKU, ADHD, Autism, and Fragile X in women).[64] On the other hand, a single clinical syndrome such as ADHD may reflect different executive function deficits, such as disinhibition and impaired working memory.[65] Unlike a domain-specific function such as language where a commonality of deficits is seen in a clinical syn-

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57. *See, e.g.*, A. Diamond & P.S. Goldman-Rakic, *Comparison of Human Infants and Rhesus Monkeys on Piaget's AB Task: Evidence for Dependence on Dorsolateral Prefrontal Cortex*, 74 EXPERIMENTAL BRAIN RESEARCH 24 (1989).

58. Brian E. Vaughn et al., *The Emergence and Consolidation of Self Control from Eighteen to Thirty Months of Age: Normative Trends and Individual Differences*, 55 CHILD DEVELOPMENT 990, 1001 (1984).

59. *Id.*

60. Passler et al., *supra* note 54, at 366.

61. *See* G.J. Chelune & R.L. Baer, *Developmental Norms for the Wisconsin Card Sorting Test*, 8 J. CLINICAL AND EXPERIMENTAL NEUROPSYCHOLOGY 210, 225 (1986).

62. *See* David Klahr & Mitchell Robinson, *Formal Assessment of Problem-solving and Planning Processes in Preschool Children*, 13 COGNITIVE PSYCHOLOGY 113-48 (1981).

63. Vaughn et al., *supra* note 58, at 991.

64. Pennington & Ozonoff, *supra* note 4, at 57.

65. Gioia et al., *supra* note 43, at 324.

drome, executive function deficits can present differently within a syndrome or similarly across syndromes.[66]

D. Defining the Child's Profile of Executive Function

Before intervening with the executive functions, it is necessary to define the student's profile of executive function strengths and weaknesses. This can be conducted by a number of skilled professionals given proper training. Depending on the complexity of the student's issues, the assessment of their executive function can be conducted by a school psychologist, neuropsychologist, or clinical psychologist.[67] Teaching staff must play an active role in the process as well.[68] Given the directive, dynamic, fluid, and multi-form nature of the executive functions, assessing them with standard tests is challenging.[69] Any assumption that the executive functions are a static set of abilities simply amenable to traditional testing is false. The fluid, strategic, goal-oriented problem-solving involved in the executive functions is not as amenable to paper-and-pencil assessment as are the more domain-specific functions such as language, memory, motor, and visual/nonverbal abilities.[70] Furthermore, the structured nature of the typical testing situation often does not place a high demand on the executive functions, reducing the opportunity for observing this important domain.[71] In considering whether or not a child has difficulty in the executive domain, the examiner must appreciate the structure, organization, guidance, and planning, as well as the cueing and monitoring they provide to promote optimal performance by the child.[72] The examiner serves, in essence, as the child's external executive control.[73] A child with significant executive dysfunction can perform appropriately on well-structured tasks of knowledge where the examiner is allowed to cue and probe for more information, thus relieving the child

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66. *Id.*

67. *See* Shirley F. Szekeres & Nancy F. Meserve, *Educational Intervention After Traumatic Brain Injury, in* TRAUMATIC BRAIN INJURY REHABILITATION: CHILDREN AND ADOLESCENTS, *supra* note 41, at 391.

68. *Id.*

69. Anderson, *supra* note 40, at 328.

70. Gioia et al., *supra* note 43, at 337-38.

71. Jane Holmes-Bernstein & Deborah P. Waber, *Developmental Neuropsychological Assessment: The Systemic Approach, in* NEUROMETHODS: VOL. 17 NEUROPSYCHOLOGY (T. Boll & B.K. Bryant eds., 1990).

72. *Id.*

73. *Id.*; *see* Edith Kaplan, *A Process Approach to Neuropsychological Assessment, in* CLINICAL NEUROPSYCHOLOGY AND BRAIN FUNCTION: RESEARCH, MEASUREMENT AND PRACTICE 125 (Thomas Boll & Brenda K. Bryant eds., 1988).

of the need to be strategic and goal-directed.[74] A full definition of the child's profile of executive function should include information gathered from testing, focused observations, standardized behavioral ratings, and clinical interview.[75]

A paradox exists in the assessment of the executive functions. Some individuals with significant deficits in specific executive function subdomains may, in fact, perform appropriately on general intelligence tests and on many purported "tests of executive function" yet have significant problems making simple real-life decisions.[76] All tests are multi-factorial, with greater or lesser degrees of domain-specific content knowledge and thereby demanding of varying degrees of organization, planning, inhibitory control, or flexibility.[77] For example, a child may be able to perform appropriately on the Wisconsin Card Sorting Test, which requires flexibility in problem-solving, yet fail miserably in strategically modifying his/her approach to completing a set of math problems in the classroom or solving social problems.[78] The behavioral observations and formal test findings obtained in a formal testing situation may not comprise a complete data set documenting strengths and weaknesses in the array of executive functions.

Assessment of the executive functions requires a multi-modal approach to characterize fully the child's profile.[79] The examiner must (1) obtain systematic observations of ways the child manages task demands within the context of the assessment situation, (2) recruit reliable reports of critical problem-solving behaviors in the child's "real world," and (3) provide psychometrically and developmentally appropriate tests for direct observation of executive problem-solving performance.[80]

Recognizing the different stimulus conditions which are provided within the comfort of the controlled setting of testing (which may be very necessary to identify the child's knowledge and abilities) versus those existing within the child's "real" day-to-day world is critically important. Frequently, the more novel and/or complex the task, the greater the demand for the executive functions.[81] The more familiar,

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74. Gioia et al., *supra* note 43, at 338.

75. *See* Berstein & Waber, *supra* note 71.

76. Donald T. Stuss & Leslie Buckle, *Traumatic Brain Injury: Neuropsychological Deficits and Evaluation at Different Stages of Recovery and in Different Pathologic Subtypes*, 7 J. HEAD TRAUMA REHABILITATION 40-49 (1992).

77. Gioia et al., *supra* note 43, at 338.

78. *Id.*

79. *Id.* at 339.

80. *Id.*

81. *Id.* at 338.

automatic, and simple the task, the less the child needs to recruit their executive functions.[82] What may be a complex, novel task for one child may be relatively familiar and automatic for another; thus, children recruit vastly different degrees of executive control functions toward solving a particular problem.[83] The ultimate application of assessment data to formulating credible, practical recommendations and intervention strategies demands a clear understanding of this issue. Assessing the child's behavior and responses under greater and lesser degrees of examiner-determined control and structure can help clarify the child's executive competence. This point stresses the importance of an intra-individual approach to assessment, as opposed to a (simple) normative model. Teasing apart executive functions from domain-specific functions is part of the challenge of their assessment and definition. Returning to the orchestral metaphor, the conductor (executive function) must have players (cognitive processes) to direct in order to make "cognitive" music.

IV. THE ROLE OF EXECUTIVE FUNCTION IN ADHD

Three aspects of disordered functioning including sustained attention, impulsivity, and high activity level have traditionally defined the syndrome of (ADHD).[84] The definition of ADHD has been evolving over the last thirty years.[85] More recently, the nature of the disorder has been re-examined and is undergoing further redefinition in terms of a disorder of the executive functions.[86] Various authors have argued that the syndrome of ADHD might better be viewed in terms of the construct of executive function than the traditional triad of symptoms reflected in current diagnostic criteria.[87] Many agree that ADHD is not a unitary disorder, and that difficulties with sustained attention, impulsivity and hyperactivity are not the sole characteristics or areas of difficulty.[88] A model of ADHD defined by executive function may be both more specific and more inclusive in identifying problematic areas of functioning. Further, viewing the behavioral symptoms of ADHD as ramifications of deficits in executive function

82. *Id.*

83. *Id.*

84. DSM IV, *supra* note 7, at 78.

85. *See* BARKLEY, *supra* note 4, at 4; Russell A. Barkley, *Genetics of Childhood Disorders: XVII. ADHD, Part 1: The Executive Functions and ADHD*, 39 J. AM. ACAD. CHILD AND ADOLESCENT PSYCHIATRY 1064, 1065 (2000); Denckla, *supra* note 4, 264; Pennington & Ozonoff, *supra* note 4, at 63.

86. BARKLEY, *supra* note 4, at 235-311.

87. *E.g., id.* at 260-311.

88. *See e.g.*, Barkley, *supra* note 86, at 1065.

provides a useful neuropsychological model, as executive functions are one step closer to neural substrate than the ADHD diagnosis and provide a more functional framework for research.[89] As can be presumed from the nature of executive function, there is a close link with attentional functioning.[90] Theoretically, working memory deficits contribute substantially to the Predominantly Inattentive subtype of ADHD, while inhibitory control deficits account for the cluster of symptoms comprising the hyperactive/impulsive subtype.[91]

Clinically, beyond the symptoms of inattention ("doesn't pay attention to lectures. . ."), impulsivity ("doesn't think before he/she acts. . ."), and hyperactivity ("is constantly on the move. . ."), parents and teachers are also frequently reporting significant problems with disorganization ("can't organize thoughts or belongings. . ."), poor planning ("always starts projects at the last minute and without the correct materials. . ."), deficient working memory ("can't remember or follow a 3-step direction. . ."), poor self-monitoring ("never checks work. . ."), inflexible problem-solving ("gets stuck on only one way to solve a problem. . ."), and an overemotional response ("has frequent outbursts that are out of proportion. . ."). We would argue that these additional symptoms are the manifestation of the executive dysfunction that is inherent in the syndrome of ADHD. Although the traditional triad of symptoms clearly must be a focus of treatment and educational support, intervention strategies to address the executive dysfunction must also be included. That is, bringing the impulsive behavior and hyperactivity under control is a critical and fundamental aspect of treatment, but does not directly address the poor organizational skills, monitoring of performance and behavior, or inflexible problem-solving approach. In fact, treatment of the poor inhibitory control is likely an important precursor to metacognitive (e.g., organizational) intervention, but is not sufficient in developing the necessary organizational and monitoring skills for managing complex tasks.

V. MODELS OF EXECUTIVE FUNCTION IN ADHD

A comprehensive understanding of ADHD requires explicit inclusion of the executive functions in clinical assessment and intervention, as well as in research. Several authors have examined ADHD in terms

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89. *Id.*

90. *See* BARKLEY, *supra* note 4; Allan F. Mirsky, *The Neuropsychology of Attention: Elements of a Complex Behavior, in* INTEGRATING THEORY AND PRACTICE IN CLINICAL NEUROPSYCHOLOGY 75-91 (Ellen Perecman ed., 1989).

91. Russell A. Barkley, *Linkages Between Attention and Executive Functions, in* ATTENTION, MEMORY AND EXECUTIVE FUNCTION 307-26 (G.R. Lyon & N.A. Krasnegor eds., 1996).

of various executive functions. Pennington & Ozonoff describe the "frontal metaphor" when defining ADHD, with specific reference to the deficits in the executive function domains of inhibition and working memory.[92] Bayliss and Roodenrys also discuss an underlying executive function deficit in ADHD in terms of a supervisory attentional system, which reflects largely the inhibitory capacity of the child.[93] The most comprehensive examination of ADHD in terms of a model of executive function has been well articulated by Russell Barkley.[94] Using Bronowski's conceptualization of language and the executive functions as the basis of his model, Barkley views inhibition as the fundamental, core executive function in his model.[95] Several other dimensions play crucial roles in the child's ability to exhibit appropriate self-control, including nonverbal working memory (visual imagery and private audition and internalized resensing), verbal working memory (covert language that controls self; rule-governed behavior), internalized emotion/ motivation (covert affective states, source of intrinsic motivation that drives future behavior), and reconstitution (analysis combining with synthesis, allowing manipulation to synthesize new responses; allows flexible, fluent, inventive goal-directed behaviors).[96] Children with ADHD have fundamental deficits in behavioral inhibition, which result in a variety of other executive function deficits, including poor verbal and nonverbal working memory, difficulties regulating their affect, motivation and arousal, and poor goal-directed analytic and synthetic problem-solving abilities.[97] The outcome for the child with ADHD is disinhibited and task-irrelevant responses, impaired execution of goal-directed responses, insensitivity to feedback regarding their behavior, inflexible problem-solving behavior, and behavior that is poorly controlled by internal cognitive states.[98]

To further empirically examine the role of the executive functions in children with ADHD, we conducted two studies of the relationship between the multiple domains of executive function and

92. Pennington & Ozonoff, *supra* note 4, at 51-53.

93. Donna M. Bayliss & Steven Roodenrys, *Executive Processing and Attention Deficit Hyperactivity Disorder: An Application of the Supervisory Attentional System*, 17 DEVELOPMENTAL NEUROPSYCHOLOGY 161 (2000); Donald A. Norman & Tim Shallice, *Attention to Action: Willed and Automatic Control of Behavior*, *in* 4 CONSCIOUSNESS AND SELF-REGULATION 1-18 (Richard J. Davidson et al. eds., 1986).

94. BARKLEY, *supra* note 4, at 235-59.

95. JACOB BRONOWSKI, *Human and Animal Languages*, *in* A SENSE OF THE FUTURE, 104-31 (1977).

96. BARKLEY, *supra* note 4, at 154.

97. *Id.* at 310-11.

98. *Id.* at 9-14.

critical aspects of ADHD.[99] Specifically, we showed (1) how two key aspects of executive function, working memory and inhibition, can predict ADHD subtypes, and (2) the intimate overall relationship between a larger set of executive function domains and the traditional symptomatology of ADHD.[100]

A. *Study I: Working Memory and Inhibition as Predictors of ADHD Subtypes*

We asked parents and teachers of children who met DSM-IV criteria for either ADHD, Predominantly Inattentive Type (ADHD-I) or ADHD Combined Type (ADHD-C) but not other comorbid diagnoses (e.g., Conduct Disorder, Oppositional Defiant Disorder, and Reading Disorder) to complete observational measures of executive function. Parents and teachers of children without identified attentional, learning, or behavioral concerns and matched for age, gender, ethnicity and parental education to the children with ADHD also completed the measure to serve as controls. The Parent and Teacher Forms of the Behavior Rating Inventory of Executive Function (BRIEF), an 86-item questionnaire designed to assess executive functions via ratings of children's everyday behaviors, served as the measure of executive function.[101] In particular, we were interested in two of the eight non-overlapping BRIEF scales - Working Memory and Inhibit.

Parents and teachers rated children with either Inattentive or Combined types of ADHD significantly, indeed substantially, higher than children without an ADHD diagnosis on the BRIEF Working Memory scale.[102] Parents and teachers also rated children with the Combined Type of ADHD significantly higher on the Inhibit scale than children with the Inattentive Type of ADHD, who were in turn rated higher on the same scale than children with no diagnosis.[103] Logistic regression analyses revealed that, for both teacher and parent ratings, the BRIEF Working Memory scale predicted ADHD-I diagnosis in 81% (parent) to 83% (teacher) of the cases.[104] The Inhibit scale

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99. Gerard A. Gioia & Peter K. Isquith, *Executive Function and ADHD: Exploration Through Children's Everyday Behaviors*, CLINICAL NEUROPSYCHOLOGICAL ASSESSMENT, (forthcoming 2001).

100. *Id.*

101. Gerard A. Gioia et al., *Behavior Rating Inventory of Executive Function* http://www.parinc.com/product.cfm?ProductID=456 (on file with the Journal of Health Care Law & Policy).

102. Gioia & Isquith, *supra* note 99 (manuscript at 15, on file with the Journal of Health Care Law & Policy).

103. *Id.*

104. *Id.* (manuscript at 16, on file with the Journal of Health Care Law & Policy).

predicted ADHD-C diagnosis in 85% (parent) and 79% (teacher) of the cases.[105] Although the Working Memory scale did not distinguish between subtypes of ADHD (i.e., this was a significant problem in both subtypes), the Inhibit scale distinguished 65% to 68% of cases (i.e., it was a more prominent problem in ADHD-C).[106]

This study supports the notion that deficits in domains of executive function underlie the behavioral symptom clusters that characterize the diagnosis of ADHD. Specifically, working memory deficits are characteristic of attention problems in both subtypes of ADHD, while failure of inhibitory control was a stronger contributor to the hyperactive/impulsive symptoms of ADHD, Combined Type.

B. Study II: Relationship Between ADHD and Executive Function

Next, we examined the relationship between the broader neuropsychological construct of executive function and aspects of the clinical syndrome of ADHD by comparing all eight BRIEF scales with a published measure of ADHD symptoms based on the DSM-IV diagnostic criteria and the ADHD Rating Scale-IV.[107] We predicted that difficulties with sustained attention and performance would be associated with difficulties initiating problem-solving activity, organization, planning, and working memory. These metacognitive functions would, therefore, associate more with the "cognitive"/ inattention symptoms than the impulsive and hyperactive symptoms of ADHD. In contrast, we predicted that hyperactive/ impulsive behaviors would be associated with greater difficulties regulating behavior including inhibiting and shifting behavior, as well as emotional control and self-monitoring.

For this study, parents of 81 (51 boys, 30 girls) clinically referred children with diagnoses of ADHD completed the BRIEF along with the ADHD Rating Scale-IV. Fifty children met criteria for ADHD-I and 31 met criteria for ADHD-C. Correlations among the eight BRIEF scales and the two scales of the ADHD Rating Scale-IV (Inattentive symptoms, Hyperactive/Impulsive symptoms) were submitted to exploratory principal factor analysis (PFA) with oblique rotation, a method that allows for exploration of complex relationships among the variables while seeking groups of variables, or factors, that summarize the data. A two-factor solution was the most parsimonious. The five BRIEF Metacognition scales (Initiate, Plan/Organize, Working

105. *Id.*

106. *Id.* (manuscript at 17, on file with the Journal of Health Care Law & Policy).

107. *See* GEORGE J. DUPAUL ET AL., ADHD RATING SCALE-IV: CHECKLISTS, NORMS AND CLINICAL INTERPRETATION (1998).

Memory, Organization of Materials, and Monitor) along with the ADHD Rating Scale-IV Inattention scale defined Factor 1 whereas the three BRIEF Behavioral Regulation scales (Emotional Control, Inhibit, and Shift) loading with the ADHD Rating Scale-IV Hyperactive/ Impulsivity scale defined Factor 2.

These findings highlight the relationship between eight subdomains of executive function and the symptom clusters of the ADHD syndrome. The inattentive characteristics of ADHD were highly related to the metacognitive domains of task initiation, organization and planning, working memory, monitoring, and organizing one's materials.[108] The hyperactive/ impulsive characteristics of ADHD were more highly related to the behavioral regulation aspects of executive function including inhibitory control, emotional control, and problem-solving flexibility.[109] These findings extend the viewpoint of executive function as the underlying neuropsychological functions that characterize ADHD symptoms. Further, the underlying functional elements of the Inattention subtype of ADHD include not simply inattention in the narrow sense, but also the executive ability to initiate, organize, plan, and monitor an action sequence and to maintain this problem-solving set in active working memory. Similarly, the behaviors within the ADHD Combined subtype would include the executive function subdomain of inhibit, consistent with Barkley's model[110] as well as the ability to flexibly shift problem-solving set, and maintain appropriate emotional control.

Taken together, these two studies provide evidence for the strong relationship between the neuropsychological construct of executive function and the clinical diagnosis of Attention-Deficit/Hyperactivity Disorder, consistent with the viewpoints expressed by a number of authors.[111] We concur that executive function is a more useful framework for understanding the behavioral characteristics captured as the triad of ADHD symptoms.[112] The multi-dimensional construct of executive function is both more specific in highlighting the multiple functional components within the subtypes of ADHD and more com-

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108. Gioia & Isquith, *supra* note 99 (manuscript at 21, on file with the Journal of Health Care Law & Policy).

109. *Id.*

110. BARKLEY, *supra* note 4, at 154.

111. *See generally id.* at 1064; Thomas E. Brown, *Does ADHD Diagnosis Require Impulsivity-Hyperactivity?: A Response to Gordon & Barkley*, 7 ADHD REPORT 1 (1999); M.B. Denckla, *A Theory and Model of Executive Function: A Neuropsychological Perspective, in* ATTENTION, MEMORY AND EXECUTIVE FUNCTION, 263-278 (G.R. Lyon & N.A. Krasnegor, eds., 1996).

112. *See* Gioia & Isquith, *supra* note 99.

prehensive in expanding the critical behavioral symptoms beyond the traditional triad.[113]

The first study highlights the relevance and utility of the specific executive function behaviors of inhibitory control and working memory in the diagnosis of the subtypes of ADHD. These two executive function domains are good indicators of the ADHD subtypes of Predominantly Inattentive Type and Combined Type. The second study supports the "redefinition" of the ADHD diagnostic components within an executive function framework. Barkley and others have long held inhibitory self-control as the fundamental symptom of ADHD.[114] Redefining the critical diagnostic behaviors in terms of the neuropsychological construct of inhibition is supported. The construct of working memory has also been proposed as a possible underlying element of ADHD.[115] In fact, the "attention" in ADHD has been questioned as a discriminating aspect of ADHD, and instead is suggested as the secondary consequence of other more primary underlying functions (e.g., inhibition).[116] Thus, the present redefinition of attention in the ADHD symptom complex in terms of executive function has prior support.

Not only do specific components of executive function serve to redefine the diagnosis of ADHD, but the broader metacognitive and behavioral/emotional regulatory aspects of executive function must be considered as well. We believe this inclusive application of the executive function construct to ADHD has clinical support when one considers the types of everyday problems that are often reported by parents and teachers. Although "not paying attention" and "not thinking before he acts" are frequent concerns, reports of "disorganized thinking and performance," "poor planning," "not checking his work," and "difficulty accepting other strategies" are also expressed quite frequently. The formal assessment of these critical aspects of executive function is necessary in functional diagnosis and treatment planning for children with ADHD symptoms. Articulating the particu-

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113. *See id.*

114. *See generally* Russell A. Barkley, *Impaired Delayed Responding: A Unified Theory of Attention Deficit Hyperactivity Disorder, in* DISRUPTIVE BEHAVIOR DISORDERS IN CHILDHOOD, 11-57 (Donald K. Routh ed., 1994); 7 C. KEITH CONNERS & KAREN C. WELLS, HYPERKINETIC CHILDREN: A NEUROPSYCHOSOCIAL APPROACH (1986); Virginia I. Douglas, *Cognitive Control Processes in Attention-Deficit/Hyperactivity Disorder, in* HANDBOOK OF DISRUPTIVE BEHAVIOR DISORDERS, 105-138 (Herbert C. Quay & Anne E. Hogan eds., 1999).

115. *See* BARKLEY, *supra* note 4, at 265-285 (summarizing the author's proposal that there is evidence of working memory deficits in children diagnosed with ADHD).

116. MICHAEL GORDON, HOW TO OPERATE AN ADHD CLINIC OR SUBSPECIALTY PRACTICE 1-18 to 1-20 (1995).

lar behavioral subdomains of executive function allows for a more specific targeting of behavioral and cognitive/academic treatment methods toward those deficient areas. Following an executive function rubric, the clinician would not only ask questions about the child's inattention but would also formally inquire about the child's ability to initiate, plan, organize, and monitor task and social behavior, as well as to hold information actively in working memory. Furthermore, rather than pursuing information primarily in terms of overactive or impulsive behavior, assessment questions regarding the broader aspects of inhibitory control (including cognitive inhibition), as well as problem-solving flexibility and control of emotional responses would be addressed. Finally, the redefinition and refinement of our understanding of ADHD may promote better clinical treatment of individuals with this disorder. A more specific executive function model of ADHD would be useful for targeting appropriate cognitive, academic, social, and behavioral treatments.

VI. EXECUTIVE SYSTEM INTERVENTIONS

Given the general theoretical discussion regarding the integral role of executive function within the diagnosis of ADHD together with the empirical evidence of executive function as both interwoven with ADHD symptomatology and predictive of clinical subtypes, we believe adequate support exists for consideration of executive function behaviors within an educational intervention model. Furthermore, the reports of clinical and educational problems by teachers and parents also implicate the central role of executive dysfunction. For example, teachers and parents frequently bemoan the significant disorganization in the student's general approach to tasks as well as their maintenance of their materials.[117] Difficulties following multi-step directions or completion of long-term projects are also common complaints.[118]

Following an appropriate assessment and definition of the student's specific executive dysfunction, educational intervention planning can begin. Given the unique nature of the executive functions in playing a "command" role in terms of guiding and regulating thought and behavior, the approach to intervention must be considered globally. First, one must consider the end-goal or outcome of "good" executive function for the child. We propose the following educational executive outcomes for children:

- Purposeful, goal-directed task and social activity

117. BARKLEY, *supra* note 4, at 10.
118. *Id.*

- Active educational problem solving approach
- Self-control within social and academic tasks
- Maximal independence in task completion
- Reliable and consistent behavior and thinking
- Positive self-efficacy as a learner
- Internal locus of control
- Accurate awareness of one's own strengths and weaknesses

The general principles of an educational executive function intervention model are based largely on the work of Mark Ylvisaker and colleagues who advocate an ongoing, contextualized (i.e., in the child's real world), collaborative (i.e., together with the child, parents, teachers, peers), hypothesis-testing (i.e., generating and implementing testable methods) assessment and treatment approach.[119] The ultimate goal of executive function intervention in the school setting is to establish regular behavioral and cognitive *routines* to maximize independent, goal-oriented educational problem-solving and performance. A critical feature of any educational intervention is to establish external environmental pre-conditions that will enable the child to learn maximally, and, ideally, establish automatic educational problem-solving routines. Bernstein and Waber further articulate this "Brain-World" interactional model of neuropsychological function whereby the child's adaptation is an ongoing fluid process of their own resources in the context of the environmental demands at the time.[120] Both aspects of this interaction must therefore be explicitly considered in the intervention system.

For individuals just starting to learn executive control behaviors, young children, or individuals with extreme executive dysfunction, the focus of intervention may need to be more externalized or environmental (i.e., to organize and structure the external environment and to organize and cue strategies and behavioral routines).[121] Many such individuals do not have the internal resources available to initiate behaviors without significant individualized structuring, cueing, and reinforcement.[122] They often need help to know when and how to apply the appropriate problem-solving behavioral routine.[123] Direct rewards and positive incentives are often necessary to motivate the

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119. MARK YLVISAKER & TIMOTHY J. FEENEY, COLLABORATIVE BRAIN INJURY INTERVENTION: POSITIVE EVERYDAY ROUTINES (1998); Mark Ylvisaker & David DeBonis, *Executive Function Impairment in Adolescence: TBI and ADHD*, 20 TOPICS IN LANGUAGE DISORDERS 29-57 (2000).

120. Jane Holmes-Bernstein & Deborah P. Waber, *Developmental Neuropsychological Assessment: The Systemic Approach*, 17 NEUROMETHODS: NEUROPSYCHOLOGY 311-371 (1990).

121. *See* YLVISAKER & FEENEY, *supra* note 119, at 106.

122. *See id.*

123. *See id.*

child to attend to and practice new behavioral routines. Because of the nature of the child's executive dysfunction, many children and adolescents may initially experience these organizational routines as quite stressful. Establishing such routines may require, therefore, explicit rewards. Once behavioral routines have become established, positive cueing becomes the crucial factor; cueing can then be faded, as a function of the child's increasing autonomy.

An executive system intervention focus is possible in most daily activities involving more than one step for completion, including classroom, therapy, social/recreational, and activities of daily living at home.[124] For example, any of these activities can include:

- Goal-setting: an initial decision about or choice of a goal to pursue (What do I need to accomplish?)[125]
- Self-Awareness of strengths/weaknesses: recognition of one's stronger and weaker abilities, and a decision about how easy or difficult it will be to accomplish the goal (How easy or difficult is this task/goal? Have I done this type of task before?)[126]
- Organization/Planning: development of an organized plan (what materials do we need? Who will do what? In what order do we need to do these things? How long will it take?)[127]
- Flexibility/strategy use: As complications or obstructions arise, planned (e.g., staff ensure that problems arise) or unplanned coaching of the students in flexible problem solving/strategic thinking (When/if a problem arises, what other ways should I think about to reach the goal? Should I ask for assistance?)[128]
- Monitoring: a review of the goal, plan, and accomplishments at the end (How did I do?)[129]
- Summarizing: what worked and what didn't work; what was easy and what was difficult – and why[130]

An executive function intervention model includes at the outset an appropriate assessment. This includes defining the relevant profile of executive strengths and weaknesses, associated domain-specific abilities or deficits, and an analysis of the everyday person, task, and situa-

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124. *See* Ylvisaker & DeBonis, *supra* note 119, at 39.
125. *Id.* at 55.
126. *Id.* at 54-55.
127. *Id.* at 55.
128. *Id.* at 57-58.
129. *Id.* at 57.
130. *Id.*

tional demands that increase or decrease appropriate executive functioning. Determination of the developmental level of child and the age-appropriate expectations for executive function are also necessary.

Several basic tenets are also advocated, including:[131]

1. Teaching a *goal-directed* problem-solving *process*
2. Implementing the process within positive, meaningful everyday academic routines
3. Real-world *relevance* and application of strategies and routines
4. Involving everyday people (parents, teachers, peers) as models and "coaches"
5. Including the child in the design of the intervention as much as possible
6. Most individuals with executive dysfunction do not yet possess the age-appropriate internalized skills for well-regulated problem-solving. Therefore, intervention often begins from an "external support" position with active and directive modeling, coaching and guidance by important everyday people, which proceeds over time to an "internal" process of fading and cueing as follows:
   a. External modeling of multi-step problem-solving (i.e., executive) routines
   b. External guidance to develop and implement everyday executive routines
   c. Practice application/ use of executive routines in everyday situations
   d. Fade external support and cue internal generation and use of executive routines
   e. Support internal control in generation and use of specific problem-solving routine(s)
   f. With external guidance, promote generalization to new situation(s)
   g. Accumulate experience, examine conditions for selective use of various executive routines
   h. Provide feedback (external and internal) throughout the process

In structuring an executive function intervention program, we advocate the use of everyday executive routines within the context of a general approach to executive problem-solving as opposed to merely teaching specific skills out of context. In addition, given the difficulties that many individuals with executive dysfunction possess with

131. *See id.* at 99-130.

working memory, the use of a "hard copy" of the active multi-step executive routine is often necessary. The child should become increasingly more active in formulating and carrying out the plans and reviewing his/ her performance (thus promoting "internal" executive control). The goal of executive function intervention is maximal independence and self-sufficiency, which necessitates active involvement of the child. The challenge in conducting an effective executive function intervention is in the "delivery system," that is, the means by which the teacher implements the collaborative program. A fine balance exists between too little and too much teacher support for the student. This can be a challenge because too little support for the student can be overwhelming as he/she does not yet have the competence to manage the critical executive routines to self-manage their learning. Too much support, on the other hand, can create continued dependence and a lack of growth in the critical executive, self-management functions. Thus, the challenge is not to shift responsibility for the executive routines too suddenly onto the student but instead in a gradual manner with mentoring, modeling, and guided practice.[132] This gradual transfer of responsibility for the executive function routines occurs with increasing competency of the student. This approach also requires the teacher/ mentor to know the student well enough to deliver the intervention in a sensitive, yet empirical (i.e., based on the student's actual performance) manner. This approach is akin to a mentoring or coaching process.

In developing interventions for the executive functions, it is important to appreciate what they are not. They are not:

- Specific, isolated sets of skills or information that are unidirectionally taught *to* the child.
- A mere list of steps that is taped to the child's desk or bedroom door.
- Simple behavior modification to increase motivation in the absence of critical antecedent conditions (setting variables, problem-solving routines).
- A "student thing" - listing treatment/ IEP goals without attention to the "how, who, where, when" of the intervention delivery system.

Within the context of a collaborative, contextualized problem-solving model utilizing the everyday routines of the child and delivered within a method such as the Goal-Plan-Do-Review system,[133] examples of specific recommendations for interventions and

132. Mark Ylvisaker & David Debonis, *Executive Function Impairment in Adolescence: TBI and ADHD*, 20 TOPICS IN LANGUAGE DISORDER 29 (2000).

133. YLVISAKER & FEENEY, *supra* note 119.

accommodations are offered in Appendix A according to area of functioning. We hope the majority of these interventions are somewhat familiar to the intervention team. We have classified them in terms of the relevant executive functions to which they apply. These recommendations are general and are intended here as suggestions or ideas that may be tailored to suit the student's individual needs. As with any intervention, clinical judgment is paramount. In following with the model of combined external and internal foci to intervention, the recommendations are organized in terms of these two categories with the expectation that a combination of both is typically necessary to promote the full implementation of an executive problem-solving routine.

A. Goal-Plan-Do-Review (GPDR) Routine

The use of a general executive problem-solving routine that promotes systematic goal definition, planning, action, self-monitoring/evaluating, and flexible, strategic adjustment of plans and actions may serve as a central framework or vehicle within which specific executive function intervention methods and strategies can be incorporated. The Goal-Plan-Do-Review method is one such system.[134] The complexity of the problem-solving routine should be adapted to the competency level of the child.[135] The executive problem-solving routine is structured such that these questions are asked (ultimately by the student although initial modeling and guidance by the teacher is necessary):[136]

1. GOAL: What do I want to accomplish?
2. PLAN: How am I going to accomplish my goal? What materials and/or equipment will I need? What steps and/or assignments do I need to plan out to accomplish my goal?
3. PREDICTION: How well will I do? How much will I get done?
4. DO: Act on the plan. Am I encountering any problems? If so, I will generate possible solutions to those problems and try them.
5. REVIEW: How did I do? How does my performance compare with my prediction? What worked? What didn't work? What will I try differently next time?

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134. *Id.* at 106.
135. *See id.* at 106-19.
136. *See id.* at 108-09.

VII. APPLICATION OF EXECUTIVE FUNCTION INTERVENTIONS TO THE IEP/504 PROCESS

For educational purposes, the goals for promoting executive system functioning are interrelated with all of the academic subjects and social/communication situations if they meet the following conditions (as most will) of: novel learning or processing tasks necessitating goal-oriented performance requiring a delayed response and involving multiple steps over a period of time. Therefore, for the student with executive/organizational deficits, the executive/organizational strategies are important to *link directly* with each academic content area (reading, writing, math, science, etc.).

One's executive/organizational skills are increasingly in demand as the curriculum in the higher grades becomes more complex.[137] The relationship between these two factors is quite direct, i.e., greater complexity of learning necessitates greater use of efficient executive skills.[138] The curriculum in the later elementary and into middle/high school requires the student to derive information from increasingly complex text, reproduce this information in appropriately organized written form, and do so in an increasingly independent manner.[139] Thus, tasks for which students may have difficulty are those that: (1) are long-term (requiring planning); (2) require organization of lots of detailed information (e.g., a specific multi-step task), and; (3) that are to be completed in a certain time frame (requiring time management).

In addition to recommendations provided in Appendix A, translation of executive function interventions into the language and context of the Individualized Education Plan or the 504 Plan is necessary. A set of sample IEP/504 Plan goals and objectives are provided below. Importantly, rather than specific academic curriculum "content", these goals focus on the development of a learning and/or problem-solving "process" designed to enhance the efficient learning and memory of academic information. Implementation of the methods to achieve these unique, non-traditional "learning process" goals will likely require additional training and guidance of school personnel. The emphasis of support should be on teaching, modeling, and cueing an approach to self-management of learning through active planning, organization, and monitoring of work.

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137. Shirley F. Szekeres & Nancy F. Meserve, *Educational Intervention after Traumatic Brain Injury, in* TRAUMATIC BRAIN INJURY REHABILITATION: CHILDREN AND ADOLESCENTS, *supra* note 41, at 394.

138. *Id.*

139. *Id.*

In the IEP, we recommend the overarching, long-term goal for the student with executive dysfunction be stated as follows: "The student will independently employ a systematic learning/ problem-solving method (e.g., Goal-Plan-Do-Review - GPDR) for all academic tasks and activities that involve multiple steps and/or require long-term planning." Domain-specific goals and objectives can then be articulated. For students who are younger or with more severe executive dysfunction, the objectives might be prefaced with: "With directed assistance, the student will. . ."[140]

1. Goal Setting:
   a. The student will participate with teachers in setting instructional goals (e.g., "I want to be able to read this book, write this paragraph, etc.").
   b. The student will accurately predict how effectively he/ she will accomplish a task. For example, he/ she will accurately predict whether or not he/ she will be able to complete a task; predict how many (of something) he/ she can finish; predict his/ her grade on tests; etc.
2. Self-Initiating:
   a. When the student does not know what to do, he/ she will ask the teacher.
   b. With regular/minimal prompting from the teacher, assistant or parent, the student will begin his/her assigned tasks, initiate work on his/her plan, etc.
3. Planning:
   a. Given a routine (e.g., complete sheet of math problems, write a paragraph), the student will indicate what steps or items are needed and the order of the events.
   b. Given a selection of 3 actions necessary for an instructional session, the student will indicate their order, create a plan on paper, and follow the plan.
   c. Having failed to achieve a predicted grade on a test, the student will create a plan for improving performance for the next test.
4. Organizing:
   a. The student will follow/create a system for organizing personal items in his/her locker.
   b. The student will select and use a system to organize his/her assignments and other schoolwork.

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140. Interview with Mark Ylvisaker, Ph.D., Assistant Professor of Communication Disorders, College of St. Rose, in Albany, NY (1996).

c. The student will prepare an organized outline before proceeding with writing projects.

5. Self-Monitoring, Self-Evaluating:
   a. The student will keep a journal in which he/she records his/her plans and predictions for success and also records his/her actual level of performance and its relation to his/her predictions.
   b. The student will identify errors in his/her work without teacher assistance.
6. Self-Awareness:
   a. The student will accurately identify tasks that are easy/difficult for him/her.
   b. The student will accurately identify his/her strengths and weaknesses.

VIII. CONCLUSION

Given the incidence of ADHD and its potential for adverse impact on the student's educational progress and success, one must consider an active plan of intervention. When organizing a comprehensive set of educationally-relevant interventions, in addition to the traditional behavior modification programs and psychopharmacologic approaches, we argue that the understanding of ADHD is entering the era of the executive functions, with greater reference to the underlying brain bases to this disorder. Several theoretical models have been proposed for the inclusion of the executive functions within the description of ADHD. Our own work supports these theoretical models by demonstrating the integral role of the executive functions within the diagnosis and functional description of ADHD. The traditional triad of symptoms, inattention, impulsivity, and hyperactivity, are not the only significant functional issues associated with ADHD. We believe the various domains of executive function are highly relevant for consideration and inclusion in an appropriate educational intervention. These problems are the very essence of what parents and teachers describe in their list of concerns.

We further advocate for educational intervention teams to become familiar with the concepts and methods for proper comprehensive assessment of the student's profile of executive dysfunction, thus enabling intervention planning and implementation of the relevant interventions. Several surveys of school personnel, particularly school psychologists, indicate a need for more training in the concepts, assessment and intervention methods with respect to the executive functions. We review the unique aspects that executive function brings to learning as well as the distinctive ways that the interventions must be

conceptualized. Returning to our metaphor involving the conductor of the orchestra, we believe one would approach the intervention process differently if a poor musical product was the result of deficient orchestra players versus a faulty leader/conductor. The same principle applies to educational interventions when executive dysfunction plays a primary role in the student's learning or social-behavioral difficulties. Simple, skill-based treatments that are taught *to* the student and are to be carried out solely by the student, without regard to the process of his/her learning and the environmental conditions that support that performance, are often doomed to fail. These intervention methods are complex as they are meant to provide the student with meaningful, functional routines that are geared toward effective "online" problem-solving. Ylvisaker and colleagues skillfully illustrate this collaborative process between the student and his/her educational "caretakers."[141]

In addition to a conceptual background to the executive functions, we provide a model and sample illustrations of intervention plans that can assist professionals in developing appropriate process-oriented, collaborative educational problem-solving routines within meaningful everyday contexts. We understand that the language of the Individualized Education Plan (IEP) is not fully compatible with goals and objectives that address the student's cognitive problem-solving process but we also believe that these "process routines" are, in fact, appropriate educational outcomes amenable to objective definition and monitoring. Creative school teams are challenged to articulate these goals in meaningful ways. As our understanding of their needs continues to increase, students with ADHD are entitled to a comprehensive program of educational supports based on this latest knowledge. Given the integral nature of executive dysfunction within the everyday manifestation of ADHD, the explicit inclusion of a systematic and comprehensive program of educational intervention strategies is essential.

141. Mark Ylvisaker & David DeBonis *Executive Function Impairment in Adolescence: TBI and ADHD*, 20 TOPICS IN LANGUAGE DISORDERS 29 (2000).

APPENDIX A

Examples of Domain-Specific External and Student-Focused Executive Function Interventions[142]

Inhibit

Students with inhibitory control difficulties often require additional structure in the environment at the outset in order to maintain more appropriately controlled behavior. It is important to appreciate that, by definition, children with inhibitory control problems do not anticipate consequences of their actions. Thus, controlling antecedents to their behavior, or environmental stimuli that may lead to impulsive behavior, is essential. Distractions need to be limited, and tasks often need to be kept more focused and time limited. Social difficulties often become apparent for children with inhibitory control difficulties. Children who behave impulsively with peers may say or do inappropriate things and peers will learn to keep their distance. It is important to intervene early to avert social difficulties and the negative effects on the student's self-esteem.

External structure. (1) Provide more explicit, extensive and/or clear set of rules and expectations, and reviewed with student regularly. (2) Limit distractions, including visual and auditory distracters, as well as other students or activities that can pull attention away from a task. (3) Reduced homework requirements to within the student's capabilities, with stepwise increases as he/she demonstrates success.

Student-based interventions. (1) Teach response delay techniques, such as counting before responding. (2) "Stop and think" methods teach students to inhibit their initial response, to consider potential consequences, and to further develop a plan of approach to a situation. (3) Frequent, brief breaks with motor activity can be a reward for work completed. The student might complete a small amount of work before bringing it to the teacher for review. (4) Use cross-age tutoring or mentoring with an older student who can model appropriate social behaviors. (5) More focused and well-controlled peers can serve as role models in small group activities with adult guidance. (6) Guided observations of peer interactions may help the student learn more appropriate social skills. (7) Limit time in unstructured activities. The student might join an activity with a pre-arranged expectation that he/she will take a break after a set period of time and review successes and any areas of difficulty.

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142. *See* M. YLVISAKER & TIMOTHY J. FEENEY, COLLABORATIVE BRAIN INJURY INTERVENTION: POSITIVE EVERYDAY ROUTINES (1998).

Shift

Remaining consistent is an important aspect of structured, systematic teaching, and promotes learning and generalization across settings and time. Consistency in teaching and management does not imply rigidity, but rather a systematic form of teaching and dependable, predictable environments. Increased consistency is often necessary at the outset for children with difficulties shifting or adjusting to changes in routine, schedule, or activity. This may include the use of teaching and behavioral strategies that remain the same across time, environments, and people. Often a child's preference for sameness or insistence on routines and sameness reflect the degree of anxiety and distress he/she experiences with change. While respecting the student's need for the comfort which his/her routines may provide, the learning and home environments can gradually and incrementally introduce minor changes, one at a time.

External structure. (1) Develop a set of positive routines and a set of alternative routines. The day can be viewed as a sequence of routines, such as a morning routine, school routine, and evening routine. These can be further broken down into several sub-routines, such as brushing teeth, washing up, getting dressed, and packing a backpack for school. The student may then be able to learn alternative sub-routines, such as different ways to get to school, that can be practiced and swapped in and out of the larger routines. This can build in the appearance of flexibility. (2) Use external prompting to shift attention, behavior, or cognitive set from one activity or focus to the next.

Student-based interventions. (1) One of the most effective strategies is the "two minute warning." Teachers and parents can alert the student that one activity is about to end and another will begin. (2) Allowing a few minutes of "down time" or leisure activity between the end of one activity and the next can facilitate transitions. (3) Make the change in activity another form of routine. (4) Changes in scheduled activities, persons, or events can be placed on a schedule and called to attention with advance notice. This provides more time to adjust to the change. (5) Set time limits for each task before a shift to the next task is required. Use of a timer can facilitate adjustment to change in activity.

Emotional Control

Children with executive difficulties, particularly with fragile inhibitory control and/or difficulties adapting to change in their home and school environments, may express their feelings more strongly and more directly than most children. This can make them seem more

angry, irritable, sad, or silly than their peers. Such emotional expression should prompt evaluation to rule out mood or affective difficulties. When difficulties with modulation of affect occur in the context of other self-regulatory problems, management of the child's executive difficulties may be helpful.

External structure. (1) Manage stimuli or antecedents that appear to produce emotional changes or outbursts. Some situations, peers, or tasks may need to be initially avoided or limited until the student experiences more success in managing emotional expression. (2) The student's parents and teachers can model appropriate emotional modulation. They might talk aloud through a situation that provokes feelings of anger or sadness, and explain how they will deal with their feelings. (3) If the student responds with emotional outbursts to school work, it may be helpful to return to mastery or success levels and to adjust academic demands.

Student-based interventions. (1) Difficulties with emotional control can often be viewed as one expression of disinhibition. Techniques for supporting inhibitory control and reducing impulsivity may be helpful. (2) Provide opportunities to discuss upcoming situations or events that may provoke an emotional outburst. (3) Teach a concrete, simple metaphor to help increase emotional monitoring and increase the likelihood of a more appropriate response. For example, the student might work in therapy to develop a "thermometer" or "speedometer" metaphor for measuring anger or distress. He/She might label each temperature or speed to reflect degrees of anger, such as "10 = normal, 20 = irritated, 30 = getting mad . . . . 100 = out of control." Each level can then be tied to a specific concrete behavior, such as counting to delay responses, terminating the conversation, seeking adult intervention, or immediately leaving the situation. (4) Increase the student's awareness of potential for emotional reactivity and likely consequences.

Initiate

It may be helpful to appreciate that children with initiation difficulties have trouble "getting going" or starting. This can be exhibited behaviorally, such that they cannot get started on physical activities such as getting up, socially such that they have difficulty calling friends or going out to be with friends, academically such that they have trouble getting started on homework or assignments, or cognitively, such that they have difficulty coming up with ideas or generating plans. Deficits in "primary" initiation are relatively rare and are often associated with significant neurological disorders (e.g., traumatic brain injury, anoxia,

radiation). More commonly, initiation deficits are the secondary consequence of other executive problems (e.g., disorganization) or emotional disorders (e.g., depression, paralyzing anxiety). Basic tenets of intervention include providing additional external structure, prompting and cueing, and helping organize and plan.

External structure. (1) Increased structure in the environment or in an activity can help with initiation difficulties. Building in routines for everyday activities is often important, as routine tasks and their completion become more automatic, reducing the need for independent initiation. For example, the morning routine can be broken down into a sequence of steps, and these steps can be written down on index cards or a simple list. The student might then follow the list of steps each day with supervision as needed until the routine becomes automatic. The student can learn to use such lists as prompts. (2) External prompting may be necessary to help the student get started. The student's teacher might stop by his/her desk at the outset of each task and prompt him/her to start his/her work, or perhaps demonstrate the first problem of a worksheet. At home, his/her parents might need to similarly prompt him/her to get started on homework, chores, or to go out with friends.

Student-based interventions. (1) Children who demonstrate difficulties thinking of ideas may benefit from learning a structured, systematic approach to idea generation. They can be taught idea generation strategies to help develop ideas for topics, activities, or ways to approach a problem. (2) Providing "to do" lists on paper or index cards can be a method of developing automatic routines and can serve as external cues to begin an activity. Some children benefit from keeping a binder or "cookbook" with lists of steps for each activity. They can look up a page with steps for completing a specific task, and use the list to guide their activity. (3) As with any executive difficulty, it can be helpful to increase the student's awareness of his/her difficulty initiating. As he/she becomes metacognitively aware of his/her own difficulties getting started, he/she can participate actively in using strategies.

Working Memory

External structure. (1) Pre-teaching the general framework of new information and guiding attention to important points to listen for can be an essential tool for circumventing working memory difficulties when they interfere with ability to capture new material. The student might meet with a resource teacher or aide at the outset of each day and preview the gist of what will be learned that day. (2) The rate of

presentation for new material may need to be altered for the student. He/She may need additional processing time or time to rehearse the information. (3) Children with working memory difficulties often need tasks or information broken down into smaller steps or chunks. (4) Children with working memory difficulties can benefit from learning compensatory skills to apply independently.

Student-based interventions. (1) Many children demonstrate a natural tendency to use "self-talk," or verbal mediation in order to guide their own problem solving and to direct their attention. Such verbal medication strategies might be encouraged or taught directly. (2) Providing a written checklist of steps required to complete a task can serve as an external memory support and alleviate some of the burden on working memory. (3) The student can learn how to actively listen, such as stopping what he/she is doing at the time, focus his/her attention, ask questions, restate the information or question, or take notes. (4) Mnemonic devices (i.e., memory strategies) are important tools to help children with working memory difficulties learn, and later recall, basic skills and facts. (5) Teach the student to "chunk" information to help increase the amount that he/she can learn or capture at one time. (6) Use rehearsal to increase the amount of information encoded into memory. The student might need to practice a series of steps for solving a problem, memorizing a list of key facts, or completing an everyday activity in order to accommodate his/ her more limited working memory at the outset. (7) Have the student repeat or paraphrase what he/she has heard or understood in order to check for accuracy and to provide an opportunity for rehearsal. Ultimately, teaching self-initiated "comprehension checking" strategies (e.g., the child asking for repetition of instructions) helps to promote independent management of working memory weaknesses.

Planning

External structure. (1) It is often helpful to provide examples of how students might plan differently to complete the same task, so that the student can see options for alternative methods. (2) Children with difficulties planning may benefit from having a binder or "cookbook" of steps for common routines or assignments. They might have a section for approaches to specific types of math problems, writing assignments, or reading materials and can reference the plans as needed. (3) Children with difficulties planning may benefit from having a binder or "cookbook" of steps for common routines or assignments. They might have a section for approaches to specific types of math problems, writing assignments, or reading materials and can refer-

ence the plans as needed. (4) Teacher/Parent modeling is an important means of teaching good planning skills. The student's parents can discuss plans for the day at the breakfast table, or verbalize their thinking about how to approach a series of errands. The use of the child's planning guide for the parent's multi-step activities may serve as a good model. Developing an overall plan for the day, week, month and year with a calendar can also serve as a useful exercise.

Student-based interventions. (1) Involve the student maximally in setting a goal for the activity or task. Encourage him/her to generate a prediction regarding how well he/she expects to do in completing the task/activity. Structure planning and organization efforts around the stated goal. (2) Active, maximal involvement of the child in the development of plans is important. The use of a planning guide may be necessary to reduce the organizational and working memory demands of this multi-step process. (3) Have the student verbalize a plan of approach at the outset for any given task, whether an everyday chore or routine or academic activity. The plan can be broken down into a series of steps, arranged in sequential order, and written down as a bullet list. The plan can be guided interactively with his/ her parent or teacher to achieve sufficient detail and increase likelihood of success.

Organization

External structure. (1) Present information in well-organized manner at the outset. Children with difficulties grasping new concepts or the gist or framework of new material often do best when the material is presented in a structured fashion. Teachers that offer a higher degree of structure in their courses may be a better fit for the student. (2) Keeping an extra set at books at home can be a powerful tool for helping children with organizational difficulties, as it alleviates a need to remember what books to bring back and forth and provides ready access to materials at school and at home. (3) Given the particular difficulty managing complex, long-term assignments, students with organizational difficulties often benefit from working on only one task, or one step of a larger task, at a time. Tasks may need to be broken down into smaller steps in order to facilitate organization and planning. Long-term assignments, such as term papers or projects, are often insurmountable for children with organization and planning difficulties.

Student-based interventions. (1) Call to the student's attention the structure of new information at the outset of a lesson or lecture. (2) Previewing the organizational framework of new material to be

learned in bulleted or outline form may increase appreciation of the structure and enhance the student's ability to learn associated details. (3) It may be helpful to provide an outline or list of major points prior to the lesson. (4) Having the student restate the overall concept and structure of the information or task following a lecture will provide an opportunity to ensure accurate understanding as well as an opportunity to correct any misunderstanding. (5) As the student becomes more aware of difficulties grasping organization of new information, he/she may be able to learn to search for the organizational frameworks inherent in novel material. (6) Students with difficulties keeping track of their assignments may benefit from learning to use an organizational system, schedule book or daily planner. Use of such as system is a useful tool for many aspects of organization and planning, but requires effort on the part of the student, parents, and teachers. (7) Specific, strategic approaches for reading (e.g., SQR3) can be taught to facilitate the student's efficiency in learning new material. For example, the student might learn to first examine the chapter outline or list of headings, then read the chapter summary and focus questions before approaching the body of the text.

Organization of Materials

External structure. (1) Children with difficulty maintaining reasonable organization of their environment and materials may benefit from increased external structure for organization and from developing good organizational routines in general. (2) Having an extra set of books at home can be a simple yet effective means of ensuring that the student has the required materials at home and in school for completing his/her school and homework. (3) Some children can benefit from having a checklist of needed materials to review on a daily basis before leaving home for school, and/or at the end of the school day.
Student-based interventions. (1) The student may need help from his/her parents and his/her teachers in reviewing materials needed prior to a given task or at the beginning and/or end of the day. To facilitate development of good organizational habits, the student might review with his/her parents each morning his/her plans for the day, the associated materials to accomplish his/her goals, and the organization of the materials in his/her backpack or desk. Similarly, he/she might have some "organization time" at the end of the school day to arrange his/her materials.

Self-Monitoring

External Structure. (1) Provide the student with opportunities for self-monitoring his/her task performance and social behavior. Provide cues, as subtly as possible, if necessary. (2) Often, children with difficulties monitoring their output do not recognize their own errors. It may be helpful to build in editing or reviewing as an integral part of every task in order to increase error recognition and correction. (3) Setting goals for accuracy rather than speed can help increase attention to errors. Rewarding the student for accuracy may support continued focus on monitoring his/her work.

Student-based interventions. (1) Ask the student to predict how well he/she will do on a particular task, then compare prediction with outcome in order to increase his/her awareness of his/her strengths and weaknesses. Encourage charting of performance and/or behavior in order to provide a tangible record of activity for ongoing monitoring. (2) It may be helpful to videotape an activity or situation then review together. This allows the student to see himself from others' perspective. Discussion of the videotape with an adult, such as a guidance counselor or therapist, is essential. This method should be considered carefully, and approached collaboratively with the student's, parents', and other participants' consent. While videotaping can be a powerful tool, there is also potential for emotional consequences and negative effects on self-esteem. (3) Verbal mediation can be a useful tool for helping children direct focus to their own behavior or work. The student might benefit from talking through a task, as this can increase attention to the task and, secondarily, increase error recognition. Model, cue, and encourage the use of the phrases "What works?" and "What doesn't work?" as self-monitoring tools.