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THE SCHOOL NEUROPSYCHOLOGY OF ADHD: THEORY, ASSESSMENT, AND INTERVENTION

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Although the five-part diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders Fourth Edition, Text Revision* (DSM-IV-TR) for attention-deficit/hyperactivity disorder (ADHD) are behavioral and descriptive in nature, this condition has increasingly been defined as a disorder resulting from impaired behavioral inhibition leading to executive function deficits. Recent research, particularly involving the Planning, Attention, Simultaneous, Successive (PASS) theory offers an understanding of the intellectual and neuropsychological processes implicated in ADHD. We provide an overview of ADHD as a neuropsychological condition; reviews of research on the PASS theory, which provide a process-based understanding of ADHD; and recommendations for assessment and intervention. The research base summarized here provides support that ADHD have a distinctive profile of PASS processes that is consistent with the cognitive nature of their disorder and that researchers have shown increased academic performance when children are taught to better use planning processes when completing academic tasks. © 2008 Wiley Periodicals, Inc.

Billy enters the classroom with his usual flair and high level of energy. He yells, "I'm here!" only to be told by his teacher that he needs to put his belongings away and be seated without disrupting the class. Billy begins to unload his backpack then sees his friend reading a new comic book across the room. As his teacher begins to take attendance, she notices that Billy's backpack is on the floor with crumpled papers spilling out. Billy is out of his seat reading the comic book with his friend. When the teacher reminds Billy again that he is not following the morning routine, he quickly tries to organize his belongings and get to his seat. A few minutes later, Billy talks out of turn in the middle of the teacher's morning announcements to inform the class that he has a new puppy. Even though Billy is enthusiastic about being part of the classroom, he has a difficult time controlling his energy and planning his actions. Why does Billy act this way? Billy has attention-deficit/hyperactivity disorder (ADHD). Despite how much Billy wants to, it is difficult for him to follow classroom rules. But beyond the diagnosis of ADHD and the description that Billy is impulsive, inattentive and hyperactive, what specific intellectual process does he struggle with leading to this pattern of behavior?

INTRODUCTION

In May 1968, the American Psychiatric Association (APA) published the second edition of their *Diagnostic and Statistical Manual of Mental Disorders* (DSM-II). Under the category of Behavior Disorders of Childhood and Adolescence, a condition referred to as Hyperkinetic Reaction of Childhood (or adolescence) was described as a problem "characterized by over activity, restlessness, distractibility and short attention span, especially in young children; the behavior usually diminishes in adolescence" (p. 50). The manual notes that these conditions "are more stable, internalized and resistant to treatment than transient situational disturbances but less so than psychoses, neuroses and

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personality disorders" (p. 50). It was assumed that, when these characteristics were described by parents and/or observed, a diagnosis was made.

Thirty-two years later, the *Diagnostic and Statistical Manual of Mental Disorders Fourth Edition, Text Revision* (DSM-IV-TR) of the APA was published. In the interim, the diagnostic manual grew from 134 to 943 pages. The diagnosis of Hyperkinetic Reaction of Childhood evolved to be referred to as ADHD. The original description of eight lines for this condition grew to a set of diagnostic criteria and accompanying descriptions of eight pages. Yet the diagnostic process remained unchanged.

The essential feature of this condition is currently described as a "persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development" (p. 85). The current diagnostic criteria contain five parts (A through E). Part A contains the often cited 18 diagnostic symptoms; Part B requires that symptoms must cause impairment before age 7; C that impairment must be present in two or more settings; D that there is clear evidence "of clinically significant impairment in social, academic or occupational function" (p. 93); and finally, E requires that symptoms should not occur exclusively during the course of other conditions or be better accounted for by other mental disorders. ADHD grew from a simple description to a set of diagnostic criteria based on an effort to provide empirical, statistically valid, and reliable descriptors (Mcburnett, Pfiffner, Willcutt, et.al., 1999).

Although a citation is made in the DSM that persons with ADHD may demonstrate variability in IQ, the diagnostic criteria continue to reflect behavioral rather than cognitive or neuropsychological manifestations. The quest to discover a specific cognitive profile for children with ADHD has been elusive; however, we believe that there is emerging research (Naglieri, 2005) that suggests that cognitive processes could be added to the DSM-V diagnostic criteria for ADHD.

Through the mid-1980s and into the 1990s, many children and adolescents affected with ADHD went unreferred, undiagnosed, and untreated, and rarely were neuropsychological deficits proposed as explanatory factors of the condition or related impairments. The rate of referral for ADHD and neuropsychological research on the condition has steadily increased in the past 10 years as has treatment with medication, the primary intervention (Castle, Aubert, Verbrugge, Khalid, & Epstein, 2007; Safer, Zito, & Fine, 1996). Concurrently questions and criticisms have increased concerning not just the prevalence of the condition; treatment as well is debated (Diller, 2006; Diller & Goldstein, 2006). Despite these criticisms and questions, the rates of diagnosis and treatment continue to increase with the greatest increases noted during the adult years (Castle et al., 2007; Medco, 2005). Converging lines of evidence reflect the significant adverse outcome of adults with ADHD (Biederman, Monuteaux, Mick, et al., 2006; Kessler, Adler, Barkley, et al., 2006) and estimated incidence rates of 4% to 5% of the adult population (Kessler et al., 2006). Yet it is still the case that the children have a complex set of problems that are often affected by a variety of social and nonsocial factors. Evaluation is complicated by the fact that there continues to be no critical diagnostic test for ADHD. This phenomenon is not the result of a lack of effort on the part of researchers but reflects the complex interaction of ADHD symptoms with the environment.

It continues to be the case that there are few exclusionary developmental criteria and no unequivocal, positive, developmental, or neuropsychological markers for the diagnosis of ADHD. ADHD appears to be distinct from other psychiatric and developmental conditions because of its intensity and persistence as well as the clustering of symptoms rather than the simple presence or absence of symptoms that drives impairment and ultimately confirms the diagnosis. This phenomenon was first observed by Ross and Ross in 1982 and continues to be the case today (Goldstein & Naglieri, 2006). In many ways, ADHD reflects an exaggeration of what is normal behavior, either too much or not enough of what is expected in certain settings. The high rate of comorbid conditions makes differential diagnosis and treatment a complex process.

Symptoms considered characteristic of ADHD confront all school psychologists. Opinions about ADHD as a diagnostic entity distinct from other neuropsychological conditions often reflect a broad diversity of beliefs among neuropsychologists. Most if not all agree that, on a biological basis, there are individuals who struggle from a young age to manage impulses, control movement, sustain attention, and engage in self-disciplined behavior. Yet controversy continues around the biological cause and neuropsychological impairments of this symptom profile and, not surprisingly, the solution. The increasing rate of diagnosis and treatment for ADHD, particularly in the adult years, is most likely a reflection of the greater community, professional, and parental awareness of the symptoms of the condition as well as a broadening of the diagnostic criteria to include additional subgroups. Thus, more individuals are referred, diagnosed, and treated.

Although it is true that many symptoms of ADHD share common ground with other psychiatric and developmental conditions (Jiron, Sherrill, & Chiodo, 1995), a solid body of scientific evidence demonstrates that the cluster of symptomatic problems currently used to define ADHD clinically represents a disorder distinct from other conditions (Biederman, Faraone, Milberger, Jetton, et al., 1996). Multiple physical and biological differences have been identified (Dickstein, Garvey, Pradella, et al., 2005; Pliszka, 2005; Unnever and Cornell, 2003) as well as genetic differences (Fisher, Francks, McCracken, et al., 2002). Since the 1970s, however, research has increasingly suggested that the core problem for ADHD is not excessive activity but deficits in executive functions (Douglas & Peters, 1979; for review, see Barkley, 1997, 2006). Although the current DSM-IV-TR diagnostic criteria continue to weigh heavily upon symptoms of inattention, the emerging literature across the life span provides strong contrary evidence that deficits in self-regulation and executive functioning offer a better explanation of this condition and its impairments (Barkley & Murphy, 2006). Yet the change in focus to problems of poor self-regulation and executive dysfunction, both likely driven by impulsivity as the core symptom of ADHD causing the most serious impairments, has not come easily. Just as the lay public begins to accept that inattentiveness is a problem for some, the preponderance of the research literature in the past 10 years suggests that in laboratory settings the problem is not that these individuals cannot pay attention but that they do not pay attention efficiently or effectively. Their inconsistent attention occurs in repetitive, effortful situations in which inhibition, planning, and working memory are required. Converging lines of evidence including measures of physiological functioning, laboratory tests, and neuroimaging studies increasingly support disinhibition as a core deficit in ADHD (for review see Barkley, 2006; Harrier & DeOrnellas, 2005; Wellington, Semrud-Clikeman, Gregory, et al., 2006).

Barkley suggests that "ADHD represents a profound disturbance in self-regulation and organization behavior across time" (1997, p. vii). These functions are subserved by prefrontal, mid-brain, and cerebellar regions in the human brain (Fuster, 1989). ADHD appears to be a condition that affects the organism's ability to organize behavior over time and meet demands for present and future performance, and may be best captured by the measurement of real life behavior. As Barkley (1997) notes, pervasive impairments caused by ADHD are driven by problems (a) fixing on and sustaining mental images that relate to external events, (b) imagining hypothetical futures that might result from those events, (c) establishing goals and plans of actions to implement them, (d) avoiding reacting to distracting stimuli, (e) using internal speech during self-regulation, (f) regulation of affect and motivation, and (g) analyzing and synthesizing information.

Thus, ADHD, a problem occurring at the point of performance, well defines a disorder of executive functioning. It is a problem that results from being capable of learning from experiences but incapable of acting efficiently on that learning at the point of performance (Ingersoll & Goldstein, 1993). It is thus a disorder of inadequate response inhibition, a problem of performance (not skills) and of inconsistency (not inability). We propose that these behaviors of ADHD should be assessed using a variety of measures and procedures but that psychometrically sound measures of

basic psychological processes must be included. Assessment of the basic psychological processes addresses issues such as the role of executive functions in ADHD-Hyperactive (ADHD-H), the selective attention problems of persons with ADHD-Inattentive (ADHD-I), differential diagnosis of children with ADHD-H and ADHD-I as well as of those with learning disabilities, as well as the design of effective educational and behavioral treatment planning.

A Neuropsychological Definition of ADHD

Based on the work of Douglas & Peters (1979) and Douglas (1985), Goldstein & Goldstein (1990) first proposed a four-part practical definition of ADHD that was later expanded to five parts (1998). This definition, modified for this article, provides a neuropsychological perspective of the condition. It is offered as a way to facilitate understanding, measure impairment, and design effective treatment. As Douglas (1985) noted, those with ADHD experience a constitutional predisposition to struggle with attention, effort, inhibitory control, and fully modulated arousal, and have a need to seek stimulation. They struggle with the executive processes well defined by Barkley (2006). The five components of this definition include:

1. *Impulsivity and planning.* This group of individuals experiences difficulty with inhibition leading to problems in planning. Planning is a mental process by which an individual determines, selects, supplies, and evaluates solutions to problems (Naglieri & Das, 1997). Planning requires the efficient choice of strategies and the ability to self-monitor, self-correct, flexibly shift, and adjust to feedback. These individuals often know what to do but do not do what they know, have difficulty weighing the consequences of their actions, do not consider the consequences of their past behavior, and struggle with rule-governed behavior (Barkley, 1981). These individuals are often repeat offenders, a pattern that frustrates parents, teachers, friends, and spouses.

   Scholnick (1995) reviewed an extensive literature of nearly 11,000 references concerning the development and implementation of planning. Planning requires an internal process of problem solving that precedes the external strategic action; requires the capacity to inhibit action while thinking through the best ways to obtain goals; and involves multiple stages, each of which is critical in designing, choosing, and following through with the problem-solving approach regardless of the nature of the task. Planning is an active process that requires selective inhibition or impulse control and relies on working memory to construct and anticipate a plan and monitor its execution. This requires prolongation, self-directed speech, and reconstitution at the very least (Barkley, 1997). For example, if an individual is unable to anticipate future consequences of his actions or reflect while acting, he is likely to be accident prone. Adept planners make fast computations and think ahead several steps through the use of working memory. This skillful allocation of resources requires that attention be divided simultaneously between active construction and utilization of a plan. Planning is also likely influenced by long-term memory, motivation, personal attributes, and belief about personal capacities. Planning deficits have been repeatedly found to significantly discriminate youth with ADHD from those with other conditions and controls (Naglieri, Goldstein, Iseman & Schwebach, 2003; Naglieri, Salter & Edwards, 2004; Paolitto, 1999).
2. *Inattention.* Individuals with ADHD have difficulty sustaining effort and functioning efficiently relative to their peers and ability. In new or novel settings and in those settings that are less repetitive and effortful, the individuals appear to function better, suggesting that the fault lies not in failure to know what to do but an inefficiency in action. Thus to reinforce an important point, ADHD represents an exaggeration on a dimensional basis of normal problems such as too much restlessness or an inadequate investment in tasks that must be completed.

On a dimensional basis the behavior of these individuals represents the extreme of what is expected.

3. *Hyperactivity.* Individuals with ADHD tend to be excessively restless and overactive, and struggle in particular to control body movements when staying still is at a premium. Interestingly, even youth diagnosed with the inattentive type of ADHD demonstrate more restless, fidgety behavior than controls do (Lahey, Pelham, Loney, et al., 2005).
4. *Problems modulating gratification.* Individuals with ADHD often appear driven toward immediate, frequent, predictable, and meaningful consequences. They demonstrate less sensitivity to changing parameters of reinforcement rate, which may be secondary to problems sustaining attention and/or faulty inhibition (Kollins, Lane, & Shapiro, 1997). These individuals demonstrate an excess or exaggeration in comparison to normal individuals with regard to these variables. They experience greater difficulty working toward a long-term goal. They often require brief repeated payoffs rather than a single long-term reward. Individuals with ADHD also do not appear to respond to rewards in a manner similar to others (Haenelin & Caul, 1987). Rewards do not appear to be effective in changing their behavior on a long-term basis. They are quick to regress after the reward paradigm is removed. Impulsivity drives their behavior to remain consequentially bound. However, it also appears that, given a sufficient number of trials and opportunities for generalization, their behavior, which is the capacity to do consistently what they know, is shaped in a way similar to that of unaffected individuals (Shure & Aberson, 2004). With regard to consequences and behavior development, for persons with ADHD the issue is not so much behavior modification as behavior management. The provision of a sufficient number of supervised, structured, and reinforced trials for everything from daily habits to social, academic, and work skills is essential.

   This group of individuals also receives significantly more negative reinforcement than do other groups. Their interactions with others are often shaped by an effort to avoid aversive consequences. Negative reinforcement offers a plausible, experiential explanation for the diverse problems that individuals with ADHD develop. Efforts of helpers tend to reinforce passivity and helplessness. Over time the avoidance of aversive consequences tends to exert greater influence over their behavior than does the seeking of positive consequences. Individuals with ADHD, children and adults alike, learn to respond to demands placed on them by the environment when an aversive stimulus is removed contingent on performance rather than for the promise of a positive future reward.
5. *Emotional regulation.* Individuals with ADHD appear to become aroused more quickly. Whether happy or sad, the speed and intensity at which they move to the extremes of emotion is much greater than those of peers. This problem appears to reflect an impulsive inability to separate thought from emotion. They often appear to be on a roller coaster ride of emotions. When happy, they tend to be so happy that people are disrupted. When unhappy, they tend to be so unhappy that people are equally disrupted. A combination of these qualities – feedback when received for emotionality, lack of ability to develop the skills necessary to control emotions, and the disruption in relationships across the life span – exerts a significant influence on a sense of psychological well-being, locus of control, and personality style.

Problems with ADHD typically cause significant and pervasive impairment in day-to-day interaction in the environment across the life span. Familial, social, academic, and vocational demands of a fast paced culture require a consistent, predictable, independent, and efficient approach to life. Failure to develop, maintain, and use these abilities efficiently leads to uneven and unpredictable behavior, characteristically a function of knowing what to do but being unable to do it in a consistent, predictable manner.

ADHD and Cognition

Children with ADHD-Combined Type (ADHD-C) and ADHD-Hyperactive/Impulsive Type (ADHD-HI) are characterized as having poor behavioral inhibition (Barkley, 1997). Their symptoms include, for example, problems with inhibition of prepotent responses, which limits control of behavior. The symptoms also lead to poor planning and anticipation; reduced sensitivity to errors; poor organization; impaired verbal problem solving and self-directed speech; poor rule-governed behavior and self-regulation of emotion; problems developing, using, and monitoring organizational strategies; and self-regulation and inhibition problems (Barkley, 2003). These children are sometimes described as showing difficulty with executive functions or meta-cognition, which has been associated with the prefrontal lobes (Roth & Saykin, 2004; Seidman, Doyle, Fried, Valera, Crum, & Matthews, 2004). If ADHD-C and ADHD-HI are conceptualized as a failure of self-control within the context of prefrontal lobe functions (see Goldberg, 2001), then a connection between the disorder and the conceptualization of ability as basic psychological processes such as those described by Naglieri & Das (2005), which in turn is based on the seminal work of A. R. Luria, can be made.

Luria (1980) described three "functional units" of the brain. The function of the first unit is regulation of cortical arousal and attention; the second codes information using simultaneous and successive processes; and the third provides for strategy development and use, self-monitoring, and control of cognitive activities. It is the third functional unit that is relevant to ADHD-C and ADHD-HI. This functional unit is associated with the prefrontal areas of the frontal lobes of the brain. Luria (1980) stated that "the frontal lobes synthesize the information about the outside world . . . and are the means whereby the behavior of the organism is regulated in conformity with the effect produced by its actions" (p. 263). The cognitive processes associated with this unit provide for the programming, regulation, and verification of behavior, and are responsible for behaviors such as asking questions, solving problems, self-monitoring, regulating voluntary activity, and controlling conscious impulses, and for various linguistic skills such as spontaneous conversation (Luria, 1973). The third functional unit provides for the most complex aspects of human behavior, including personality and consciousness (Das, 1980). Goldberg (2001) succinctly summarizes this frontal lobe dysfunction as "poor planning and foresight, combined with diminished impulse control and exaggerated affective volatility" (p. 179). This conceptualization of processes forms the basis of the Planning, Attention, Simultaneous, Successive (PASS) theory described by Naglieri and Das (2005).

PASS theory (Naglieri & Das, 2005) is rooted in the work of A. R. Luria (1966, 1973, 1980) and was used by Naglieri and Das (1997) as a blueprint for defining the important components of human intelligence included in the Cognitive Assessment System (CAS). There are four basic cognitive processes. Planning is a cognitive process that provides cognitive control, use of knowledge, intentionality, and self-regulation. Planning is critical to all activities during which the person has to determine how to solve a problem, and includes self-monitoring and impulse control as well as generation, evaluation, and execution of strategies for problem solving. Attention is a cognitive process that provides focused, selective cognitive activity over time and resistance to distraction. Attention is involved when a person selectively focuses on particular stimuli and inhibits responses to competing stimuli. The process provides focused and selective attention over time. Focused attention involves directed concentration toward a particular activity, and selective attention is important for the inhibition of responses to distracting stimuli. Simultaneous processing is a cognitive process used to integrate stimuli into groups. An essential aspect of simultaneous processing is the conceptualization of interrelated elements into a whole, which is why this process is often tested using visual spatial tasks. Successive processing is a cognitive process used when stimuli are arranged in a specific serial order to form a chain-like progression. This process is required when information must follow a strictly defined order where each element is related only to those elements that precede it and

where these stimuli are not interrelated. There have been several studies that have examined the performance of children with ADHD-C and ADHD-HI from the PASS perspective.

Combined and Hyperactive-Impulsive Types of ADHD

Naglieri (2000) summarized the research on samples of children with ADHD-C and ADHD-HI. These studies have indicated that children with ADHD-H earn average scores on all measures of PASS except Planning (Dehn, 2000; Naglieri, Goldstein, Iseman, & Schwebach, 2003; Naglieri, Salter & Edwards, 2004; Paolitto, 1999). Importantly, Naglieri et al. (2003) also reported that children with ADHD-HI had a different PASS profile than those with anxiety disorders. Most recently, Van Luit, Kroesbergen, & Naglieri (2005) found that Dutch children with ADHD-HI also earned their lowest score on measures of Planning. These results support the view of Barkley (1997, 1998) that ADHD-C and ADHD-HI involve problems with behavioral inhibition and self-control, which are associated with poor executive control (Planning as described by Naglieri & Das, 2005, and Goldberg, 2001). These findings are particularly noteworthy because they are in contrast to profiles reported for children with reading disabilities (low on Successive processing) and anxiety disorders (no PASS weakness) and they suggest a profile different than those for children who have ADHD-I.

ADHD-I

Barkley (2003) noted that children with the predominantly inattentive type of ADHD have impairment in selective attention and that these children appear daydreamy, hypoactive, passive, apathetic, lethargic, confused, and sluggish as well as socially passive and withdrawn. Luria's (1973) description of the first functional unit has relevance to this type of attention deficit because it provides the brain with the appropriate level of arousal or cortical tone, and directive and selective attention (Luria, 1973). When a multidimensional stimulus array is presented to a person who is then required to pay attention to only one dimension, the inhibition of responding to other (often more salient) stimuli, and the allocation of attention to the central dimension, depends on the resources of the first functional unit. Luria stated that optimal conditions of arousal are needed before the more complex forms of attention involving "selective recognition of a particular stimulus and inhibition of responses to irrelevant stimuli" (Luria, 1973, p. 271) can occur. This is different from inhibition needed to control behavior (a problem for persons with ADHD-HI) in that attentional inhibition means focus on relevant stimuli and resistance to responding to distractors in the environment. This is perhaps best illustrated by the familiar description of children with ADHD-H who can attend to their favorite computer game but have considerable problems staying on task in the classroom. They can attend because children with ADHD-HI are characterized as having a failure of behavioral control, whereas children with ADHD-I are described as having a failure of selective attention. Unlike the research on ADHD-C and ADHD-HI, there have been no studies involving PASS processes for children with ADHD-I, but some descriptions using case studies are reported (see Naglieri & Pickering, 2003).

We agree with Barkley (2003) that children with ADHD-I are probably better conceptualized as having a separate disorder, but it seems even more important to question the very title of ADHD-HI. Why should children characterized as having poor behavioral inhibition (Barkley, 1997) be called attention deficit? Using such a descriptor leads to the logical assumption that these children are poor in attention (as in the ADHD-I). It would be more logical and consistent with the symptomology to describe children with ADHD-I as attention deficit because they do have problems with selective attention, but those with ADHD-HI require a different label – perhaps not having an attention deficit but rather a self-regulation deficit.

The Diagnostic Conundrum

The school psychologist's first concern is misdiagnosing another disorder as ADHD, and the second is missing comorbid diagnoses in a population of individuals with ADHD. Internalizing and externalizing disorders because they occur at such a high rate in persons with ADHD represent a diagnostic conundrum when efforts are made to specifically tie symptoms to diagnoses. Problems with anxiety appear to occur at a significant but certainly lower rate than problems related to depression and other disruptive disorders in the ADHD population. Problems of oppositional defiance, particularly those related to resistance, appear characteristic of impulsive behavior whereas those reflecting spiteful, vindictive patterns are much more likely a consequence of an interaction between biological vulnerability and experience. School psychologists should be aware that the increasing popularity of ADHD has resulted in more children with a variety of problems being referred for ADHD assessment. Desgranges, Desgranges, and Karsky (1995) reviewed 375 patient records requesting ADHD assessment and found that of 119 cases only 45 were confirmed by diagnosis. In the remaining cases, problems related to anxiety, substance abuse, other disruptive disorders, and tic problems were suggested as contributing to ADHD-like behaviors. Finally, in significantly impaired populations the false-positive diagnosis of ADHD is easy to make. Kennemer and Goldstein (2005) demonstrated that, in populations of institutionalized adolescents, one of two youths with a diagnosis of ADHD upon admission, subsequent observation, and treatment over a period of time were deemed to not experience the condition.

Assessment Cautions

Selection of the most appropriate intervention is maximized by an accurate understanding of a child's characteristics, typically accomplished from a comprehensive evaluation. Interpretation of test results can be a difficult task of integrating research and practical knowledge. For example, individual intelligence subtests and specific subtest profiles have been used for diagnosis of attention deficit, learning disabilities, and emotional disturbance. In addition, they are used for instructional planning; identification of sequential processing problems, working memory, and speed of information processing; and to assess freedom from distractibility, social comprehension, executive functioning, and so on. We have witnessed a seemingly unlimited list of factors or abilities measured by subtests from the Wechsler Scale, which was developed largely from the Army Alpha and Army Beta (Yoakum & Yerkes, 1920). For example, the Wechsler Coding subtest comes directly from the Army Beta but has recently been reinterpreted as a measure of selective or focused attention with little more than speculation in place of empirical justification. Assuming that at least some of these many reinterpretations are false, this creates considerable inaccuracies about (a) cognitive profiles of children with ADHD-C, ADHD-HI, and ADHD-I, and (b) how the cognitive disorder may be identified. We strongly discourage the continued reformulation of traditional IQ test scores and subtest profiles in the study of persons with ADHD.

We are suggesting that practitioners should not attempt to find subtest or scale profiles from traditional IQ tests nor that some type of cross-battery approach to interpretation is helpful for identification of the cognitive processing problems in planning and attention discussed here. There is a well-known history of the failure of traditional IQ tests to show sensitivity to the cognitive problems often seen in children with ADHD (see Barkley, 1997). Additionally, well-standardized measures are necessary to ensure that the variables included in any study can be adequately evaluated. Many neuropsychological and experimental tasks have not undergone the rigorous process of test development and standardization, yet they are used in research to determine the characteristics of children and adults with attention deficits. We stress the need for psychometrically strong measurement in all research and practice. Because of the importance that the diagnosis of ADHD has for a child,

it is equally important that the measures used in the assessment meet professional standards (e.g., APA guidelines) and that practitioners avoid the use of experimental tests as well as those that are not standardized using large representative samples.

When researchers and practitioners attempt to determine if children with ADHD have difficulty with the processes associated with, for example, the frontal lobes, called planning by some and executive functioning by others, the tests that they use to assess this concept must have good reliability and validity. For example, Naglieri & Das (1997) found that the Tower of Hanoi task thought to be a measure of executive functioning correlated strongly with both Planning and Successive processing. This finding means that researchers using such a tool would likely find low scores for children with ADHD-H who have low planning but also for children with reading disabilities that are associated with poor successive processing (Das, Naglieri, & Kirby, 1994; Naglieri, 1999). Researchers who reinterpret the validity of various subtests may or may not find anticipated results in the absence of strong empirical support coupled with good theoretical justification.

Implications for Assessment

Assessment of cognitive processing should play an essential role in the assessment and diagnosis of ADHD-HI, ADHD-I, and the Combined Type so that children who are identified have characteristics that are consistent with well-accepted definitions of the disorder. Psychological evaluations should include a multifactored evaluation conducted by a professional with credentials as a psychologist or school psychologist, for example. The content of the evaluation must include four essential elements: inquiry regarding developmental history; the extent to which the person meets DSM-IV criteria using interviews as well as relevant behavior rating scales; assessment of cognitive processes as described above; and assessment of achievement to determine academic or work-related impairment. The tests used must be well-standardized measures with demonstrated reliability and validity. Determination of ADHD, therefore, would require assessment by a highly trained professional who would communicate his or her results to a physician if treatment using medication is to be considered.

Two important issues should be considered when diagnosis of ADHD-C, ADHD-HI, or ADHD-I is made based in part on a disorder in cognitive processing. First, it will be imperative to differentiate between children who have a relative weakness in basic processing (e.g., Planning = 95, Attention = 115, Simultaneous = 115; Successive = 115) from those who have a cognitive weakness in cognitive processing (e.g., Planning = 80, Attention = 115, Simultaneous = 115; Successive = 115) (see Naglieri, 1999, 2000 for more discussion on this topic). This two-dimensional approach ensures that the child with a disorder in cognitive processing is weak relative to his or her own overall level and relative to peers and that the area of weakness is substantially below normal. Children who have a cognitive weakness are very likely to also have academic failure (Naglieri, 2000), and they will warrant academic interventions that take into consideration their particular learning strengths and weaknesses. This is not to say that a cognitive deficit alone would be sufficient to identify a child as having ADHD-C, ADHD-HI, or ADHD-I, but when an appropriate constellation of data that is consistent with ADHD is found along with a processing disorder, then eligibility should be considered.

Second, children with a cognitive weakness in Planning (possibly ADHD-HI) or Attention (possibly ADHD-C or ADHD-I) could qualify for special educational services as having a specific learning disability because current Individuals with Disabilities Education Act (IDEA, 2004) law defines a specific learning disability as "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical

calculations." (ß 602(30)(A)). A child with ADHD and a planning or attention (or both) cognitive weakness who has impaired academic functioning should be considered eligible for special educational services. This would allow these children the opportunity to receive academic instruction that would take into consideration their need to be more able to plan (ADHD-HI) or to better manage their focus of attention and resistance to distraction (ADHD-I) when engaged in academic activities.

In school psychology today there is interest in using a Response-to-Intervention (RTI) approach to specific learning disabilities. This raises the question "Would this method have utility for ADHD assessment?" Briefly, it is important to note that IDEA 2004 states that "the local educational agency *may* [italics added] use a process that determines if the child responds to scientific, research-based intervention as a part of the evaluation procedures." That means that the RTI method is not mandated (see section 614(b)6B of IDEA 2004). The law and the Federal Regulations (2006) both emphasize that a comprehensive evaluation must be used to gather relevant information about the child involving a variety of assessment tools and strategies. Importantly, the use of any single measure or assessment as the sole criterion for determining whether a child has a specific learning disability is not permitted, and practitioners must use technically sound instruments to assess the relative contribution of cognitive and behavioral factors (this is consistent with our position on ADHD assessment). Finally, assessments must be selected and administered so as not to be discriminatory on the basis of race or culture, and the measures used must be valid and reliable for the purposes for which they were intended.

It is important to note that the Federal Regulations (2006) made it clear that RTI may be used as a part of the specific learning disability eligibility process but "determining why a child has not responded to research-based interventions requires a comprehensive evaluation" (p. 46647) and "RTI does not replace the need for a comprehensive evaluation (p. 46648). What RTI does provide is greater assurance that (a) adequate learning experiences have been provided before initiating a comprehensive evaluation, and (b) the child's failure to respond is not the result of inadequate instruction. Thus, the role of RTI in ADHD assessment would be limited to determining that the child's academic failure is not likely attributable to ineffective instruction.

Another final caution regarding assessment is that the differentiation of children who have a cognitive processing weakness and the constellation of symptoms that indicate ADHD-C, ADHD-HI, or ADHD-I from children who have all the symptoms but do not have a cognitive processing weakness has considerable implications for both research and practice. We propose that children with a cognitive weakness require specialized academic instruction that takes into consideration their particular learning needs. In contrast, children who have the symptoms without the cognitive weakness appear to have the ability to perform but require environmental and behavioral management. We now focus more on intervention.

Treatment of ADHD

Psychosocial treatments based on cognitive and neuropsychological theory figure prominently in the guidelines for treatment of ADHD from both the American Academy of Pediatrics (AAP) and the American Academy of Child and Adolescent Psychiatry (AACAP). It continues to be the case that adults and children find such treatments more acceptable than medication (Krain, Kendall, & Power, 2005). Furthermore, more than 100 studies demonstrate that behavior change programs can exert a significant positive effect on children with ADHD broadly reduced disruptive behavior (Evans, Langberg, Raggi, et al., Buvinger, 2005; Pelham, Massetti, Wilson, et al., 2005). Despite the significant reductions in immediate symptoms of ADHD reported with medication (for review, see Barkley, 2006), due to the chronicity, severity, cross-situational nature, and myriad symptoms of ADHD leading to a host of impairments, treatment logically must be long-term

requiring creativity, multimodality, and perseverance (Rapport, 1992). ADHD is a disorder that is managed not cured. Secondary by-products of living with ADHD across the life span (e.g., low self-esteem) must be addressed through cognitive and psychotherapeutic approaches (Brooks, 2002). Additionally, systematically applied cognitive behavioral therapy has been found to lead to symptom and impairment reduction in adults with ADHD (Rostain & Ramsay, 2006; Wilens, McDermott, Biederman, & Abrantes, 1999).

Treatment of ADHD must be multidisciplinary, multimodal, and maintained over a long period (for review, see Goldstein & Goldstein, 1998; Teeter, 1998; Goldstein & Ellison, 2002). By far, the most effective short-term interventions for ADHD reflect the combined use of medical, behavioral, and environmental techniques.

An extensive literature attests to the benefits of medicine, specifically stimulants, in reducing key symptoms of ADHD and thus improving daily functioning across the life span. Side effects appear slightly greater and benefits slightly fewer in young children (Greenhill, Kollins, Abikoff, et al., 2006; for review, see Barkley, 2006; Goldstein & Goldstein, 1998). Stimulants and other drugs principally impacting dopamine and norepinephrine (Volkow, Wang, Fowler, et al., 2001) have consistently been reported to improve academic achievement, productivity, and accuracy of class work (Douglas, Barr, O'Neil, & Britton, 1986); attention span, reading comprehension, and complex problem solving; and to enhance inhibitory processes (Balthazor, Wagner, & Pelham, 1991; Pelham, 1987). Related problems – including peer interactions, peer status, and even relationships with family members – have been reported improved with these drugs as well (Whalen & Henker, 1991).

Behavior management increases the salience of behaving in a way consistent with environmental expectations. The manipulation of the environment (e.g., making tasks more interesting and payoffs more valuable) reduces the risk of problems within the natural setting. Zentall (1995) suggests that students with ADHD possess an active learning style with a demonstrated need to move, talk, respond, question, choose debate, and even provoke. Thus, in classroom settings, children with ADHD do not fare well in sedentary situations. Managing interventions have included positive and negative contingent teacher attention, token economies, peer-mediated and group contingencies, time out, home school contingencies, reductive techniques based on reinforcement, and cognitive behavioral strategies (Abramowitz & O'Leary, 1991). Environmental and task modifications are also critical for classroom success for the students with ADHD. However, additional research is needed, especially in the area of school-based intervention for adolescents with ADHD.

Although popular, the use of cognitive strategies (e.g., teaching a child to stop, look, and listen) as well as other nontraditional treatments (e.g., dietary manipulation, electroencephalogram [EEG] biofeedback) to permanently alter the symptoms of ADHD have not stood the test of scientific research and thus should not be advocated as first-line treatments of choice for children with ADHD. However, these strategies are effective when targeted to specific problems and impairments in the classroom for all students, with or without diagnoses. Shure (1994) suggests that the patient application of cognitive training over a long period of time, applied in the real world setting, can even improve the self-regulatory skills of children with ADHD. Safren, Otto, Sprich, et al. (2005) and Rostain & Ramsay (2006) have demonstrated that cognitive behavioral therapy for ADHD is an effective intervention, reducing symptom severity and impairment, particularly when paired with medication treatment.

Regardless of the treatment modality used, the basic underlying premise in managing problems of poor self-discipline and self-regulation involves increasing the individual's capacity to self-inhibit before acting. This is consistent with the theoretical construct that the core problem in ADHD reflects an inability to permit sufficient time to think or respond consistently to consequences.

Implications for Intervention

The implications that a cognitive weakness in Planning or Attention has for intervention are considerable, but there is need for more research in this area. There is a research base on which to discuss the relationships between Planning and academic instruction, but research is needed regarding Attention and instruction. A series of research studies has been conducted which indicates that children who are poor in Planning can be taught to be better at planning when they complete academic tasks and that facilitating the strategic completion of classroom work positively impacts academic performance. This line of research began with the work of Cormier, Carlson, and Das (1990) and Kar, Dash, Das, and Carlson (1992), and was extended by Naglieri and Gottling (1995, 1997) and Naglieri and Johnson (2000), who demonstrated that learning disabled children improved in math calculation when they were taught to be more strategic. Taken as a whole, these studies suggest that children who are poor in planning and poor in math calculation improved considerably when provided an intervention that helped them to better use their planning processes and to be less impulsive and more thoughtful and reflective when completing academic work. Importantly, this line of research has also been extended to reading comprehension (Haddad, Garcia, Naglieri, Grimditch, McAndrews, & Eubanks, 2003), further suggesting that teaching children with an understanding of their PASS cognitive processing profile can have a positive and significant effect on their academic performance. These studies are further described in the next section.

Planning Strategy Instruction

The connection between Planning and intervention has been well illustrated by research that has examined the relationship between strategy instruction and CAS Planning scores. The studies have involved both math and reading achievement scores. These intervention studies focused on the concept that children can be encouraged to plan better when they complete academic tasks and that the facilitation of plans positively impacts academic performance. The initial concept for Planning Strategy Instruction was based on the work of Cormier, Carlson and Das (1990) and Kar, Dash, Das, and Carlson (1992). These authors taught children to discover the value of strategy use without being specifically instructed to do so. The children were encouraged to examine the demands of the task in a strategic and organized manner. They demonstrated that students differentially benefited from the technique that facilitated planning. Children who performed poorly on measures of Planning demonstrated significantly greater gains than did those with higher Planning scores. These initial results indicated that a relationship between PASS and instruction might be possible.

Planning Strategy Instruction was shown to improve children's performance in math calculation by Naglieri and Gottling (1995, 1997). All children in these studies attended a special school for students with learning disabilities. In the investigations, students completed mathematics worksheets in sessions over about a 2-month period. The method designed to indirectly teach Planning was applied in individual one-on-one tutoring sessions (Naglieri & Gottling, 1995) or in the classroom by the teacher (Naglieri & Gottling, 1997) about 2 to 3 times per week in half-hour blocks of time. Students were encouraged to recognize the need to plan and use strategies when completing mathematical problems during the intervention periods. The teachers provided probes that facilitated discussion and encouraged the children to consider various ways to be more successful. More details about the method are provided by Naglieri and Gottling (1995, 1997) and by Naglieri and Pickering (2003).

The relationship between Planning Strategy Instruction and the PASS profiles for children with learning disabilities and mild mental impairments was studied by Naglieri and Johnson (2000). The purpose of this study was to determine if children with cognitive weaknesses in each of the four PASS processes and children with no cognitive weaknesses showed different rates of improvement

in math when given the same group Planning Strategy Instruction. The findings from this study showed that children with a cognitive weakness in Planning improved considerably over baseline rates, whereas children with no cognitive weakness improved only marginally. Similarly, children with cognitive weaknesses in Simultaneous, Successive, and Attention showed substantially lower rates of improvement. The importance of this study was that the five groups of children responded very differently to the same intervention. Thus, the PASS processing scores were predictive of the children's response to this math intervention (Naglieri & Johnson, 2000).

Another study that examines the effects of Planning Strategy Instruction is reported by Haddad, Garcia, Naglieri, Grimditch, McAndrews, and Eubanks (2003). This study assessed whether an instruction designed to facilitate Planning would have differential benefit on reading comprehension, and if improvement was related to the PASS processing scores of each child. The researchers used a sample of general education children sorted into three groups based on each of the PASS scale profiles from the CAS. Even though the groups did not differ by CAS Full Scale scores or pretest reading comprehension scores, children with a Planning weakness benefited substantially (effect size of 1.52) from the instruction designed to facilitate Planning. In contrast, children with no PASS weakness or a Successive weakness did not benefit as much (effect sizes of .52 and .06, respectively). These results further support previous research suggesting that the PASS profiles are relevant to instruction.

Iseman (2005) examined Planning Strategy Instruction in children with learning disabilities and ADHD. Students in the experimental group engaged in Planning Strategy Instruction designed to encourage effective strategies in mathematics. A comparison group received additional math instruction by the regular teacher. Following the intervention, an analysis examined students with and students without a cognitive weakness in Planning on the CAS. Students with a Planning cognitive weakness in the experimental group improved considerably on math worksheets. In contrast, students with a Planning cognitive weakness in the comparison group did not improve. Students with ADHD in the experimental group with a weakness in Planning improved considerably on the worksheets. In contrast, students with ADHD in the comparison group without a cognitive weakness in Planning did not improve. Thus, individuals with cognitive weaknesses in Planning, with and without ADHD, benefited more from Planning Strategy Instruction than from normal instruction (Iseman, 2005).

The results of these Planning Strategy Instruction studies using academic tasks suggest that changing the way aptitude is conceptualized (e.g., as the PASS rather than traditional IQ) and measured (using the CAS) increases the probability that an aptitude-by-treatment interaction (ATI) is detected. Past ATI research suffered from inadequate conceptualizations of aptitudes based on the general intelligence model. That approach is very different from the basic psychological processing view represented by the PASS theory and measured by the CAS. The summary of studies provided here is particularly different from previous ATI research that found that students with low general ability improve little, whereas those with high general ability improve a lot with instruction. In contrast, children with a weakness in one of the PASS processes (Planning) benefited *more* from instruction compared to children who had no weakness or a weakness in a different PASS process. The results of these studies also suggest that the PASS profiles can help predict which children will respond to the academic instruction and which will not.

Conclusions

In this article we have provided a historical view of ADHD as a psychological disorder that encompasses both behavioral and cognitive processing dimensions. The research literature that we have presented suggests that measures of planning may provide valuable differential diagnostic data that can also facilitate treatment choices and expectations (Goldstein & Naglieri, 2006). We further suggest that well-standardized and well-normed measures of basic psychological processes should

be used and that the diagnostic procedures should include both DSM-IV criteria as well as evaluation of planning processes. The intervention research summarized here illustrates that understanding the cognitive processing demands of a child has implications for intervention as well as for diagnosis.

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