A Tripartite Classroom-Based Intervention Model for
Children with Attention-Deficit/Hyperactivity Disorder

A project by
Sana H. Tabit Abou Faraj
Lebanese American University

Submitted to the Lebanese American University in Beirut
in partial fulfillment of the requirements for the degree of
Masters of Arts in Education

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To the memory of my extraordinary mom

and to my son Karim, the joy and pride of my life
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Abstract
This project proposes a tripartite model that relies on the concurrent implementation of three forms of interventions for teaching ADHD children in the regular classroom. The model postulates that the combinatory effect of behavioral techniques, environmental interventions, and specific instructional strategies can circumvent the differential nature of deficits associated with ADHD. This model is the culmination of several years of working experience with ADHD children and a comparative analysis of research findings that stem from three discrete domains: biology, psychology, and education. The model targets the underlying neuropsychological deficits of ADHD children rather than their symptomatic manifestations, and suggests that the three forms of interventions are needed for controlling the variety of executive function difficulties affected by the inhibitory control deficit of ADHD as well as the classroom variables that exacerbate or ameliorate those difficulties. This model attempts to respond to a need for a comprehensive educational approach for ADHD children, which aims mainly for enhancing their academic performance. The hypothesized effectiveness of the model still needs to be empirically verified. The prospective limitations and the role of the teacher as the implementing agent of the model are also discussed.
CHAPTER ONE

Introduction

Contextual Background

Attention-Deficit/Hyperactivity Disorder (ADHD) is prevalent in about 3 to 5% of school-age population (Barkley, 1998; Tannock & Martinussen, 2001) affecting at least one child per classroom (McGoey, Eckert, & DuPaul, 2002), which makes effective classroom interventions a significant matter for all educators. Children with ADHD display a cluster of inattentive, overactive, and impulsive behaviors that affect their development to a great extent and hinders significantly their social and educational success. Children with ADHD face a risk of school failure two to three times greater than other children with equivalent intelligence (McInnes, Humphries, Hogg-Johnson, & Tannock, 2003; Zentall, 1993), and often feel demoralized when they believe that their successes will be blocked by circumstances out of their control. Alienation and animosity may even result when a form of intervention such as token reinforcement is used to motivate them while giving them performance ultimatums that don’t take into consideration their specific learning needs (Brim & Whitaker, 2000). Accordingly, children with ADHD often need to receive behavioral, educational, pharmacological, and social interventions in the general education classroom (Salend, 2001). However, researchers have tested few interventions for children with ADHD in school settings and even fewer in regular classrooms (Fiore, Becker, & Nero, 1993). So far, investigators have tested relatively few interventions that speak to the day-to-day difficulties of these students in the classroom or to the larger issues related to developing comprehensive educational programs for them (Fiore et al.). Besides, the effects of school-based
interventions on the ADHD child’s academic progress as found by DuPaul and Eckert (1997) in a meta-analysis of the available research studies were almost uniformly in the low range (i.e., effect sizes = 0.3 and less, using Cohen’s [1988] criteria), and 1.5 to 2 times less than the effect of classroom interventions on behavior outcomes. These interventions were also evaluated as ineffective in treating some other deficits related to ADHD, such as low frustration tolerance, emotional vulnerability, and high distractibility (Snider, Busch, & Arrowood, 2003). Consequently, a well-conceived integrated intervention that addresses effectively the ADHD child’s learning and social needs, and targets academic achievement and treatment of classroom problems is sorely needed.

Moreover, the specific diagnostic procedure of ADHD entails care in estimating the severity of symptoms and their level of developmental inappropriateness, and the degree of scholastic and social impairment they cause (Hazel et al., 2000). Thus, classroom teachers play an integral role with parents and medical personnel in making an accurate initial screening and diagnosis of ADHD students, and in assessing treatment effectiveness once it has begun (Buchoff, 1990; Snider, et al., 2003). In addition, the implementation of different forms of intervention for ADHD students in the classroom emphasizes the teacher’s pivotal role in several other respects. However, Snider, Busch & Arrowood found that although two thirds of the teachers whom they surveyed were the first to recommend referral and diagnosis suspecting almost up to 20% of all children as actually having ADHD, the teachers had insufficient knowledge about ADHD or its treatment. Similarly, Pfiffner (1997) found that almost all teachers whom she surveyed were out of date in their knowledge of the nature, outcome, causes and treatment of
ADHD. Hence, a compact intervention package that educates teachers in the latest information on the etiology of ADHD and the educational implications is required.

**Purpose of the Project**

The purpose of this project is to develop a classroom-based intervention model that would respond to the classroom difficulties of ADHD children and the concerns of their classroom teachers by integrating behavioral, instructional, and environmental intervention strategies into one intervention model to be implemented as a whole. This tripartite classroom-based intervention model that is proposed herein is based mainly on recent biological findings and their educational implications. In fact, unlike the paucity and inconclusiveness of research in the classroom arena, most research that stems from the fields of medicine and clinical psychology has provided substantial biological findings related to the problem of ADHD. The proposed model is a culmination of field observations, personal experience, and a review of the existing research base for meeting the classroom needs of children with ADHD. Personal expertise in educating ADHD children has consistently fueled the idea that the behavior problems, learning difficulties, and emotional distress often experienced by the ADHD child in the regular classroom can be managed with a properly orchestrated multi-dimensional program.

The model proposed in this project emphasizes the crucial function of teachers and practitioners who come in contact with the child, and involves employing behavioral strategies and educational intervention techniques as preventive measures for developmental delays, academic failure, and the potential development of more severe behavioral and conduct problems. The project also informs classroom teachers of the current views on the etiology of ADHD that propelled the development of the model.
Another purpose of the project is to produce an example or a prototype of the tripartite model. Hence, an application of the model in the elementary science classroom is presented although the model is equally applicable across different subject matters and grade levels.

**Significance of the model**

The structure of this multi-component intervention model permits its application in the regular classroom where more than one contextual variable need to be controlled, and where the dual nature of neuro-psychological core difficulties of ADHD (i.e., disinhibition of non-required behaviors and thoughts and under-stimulation of required responses) must be overcome simultaneously. Thus, as each intervention will manipulate a different variable, they will collectively and interdependently control for all possible variables that might hinder the ADHD child’s learning or behavioral response. Besides, introducing an otherwise one form of intervention might sometimes inadvertently exacerbate the child’s other difficulties or problems. In other words, this model is unlike most documented interventions that focus on one problem and ignore the complexity of the environmental context or neglect other simultaneous or induced problems. In addition, this model is suggested in response to a panel commissioned by the National Institute of Health which concluded that investigations targeting academic achievement in the population with ADHD are sorely needed (NIH, 1998), especially that the most common treatments for children with ADHD (i.e., stimulant medication and behavior therapy) have been found to exert minimal effects on academic outcomes (DuPaul & Eckert, 1997). This model is also an attempt to invest the conclusive research that comes almost exclusively from the fields of medicine and clinical psychology for finding
solutions for the frustrations of teachers with school programs that acknowledge academic problems but often fail to offer solutions that help children with ADHD achieve their potential. The model might also propose a common ground for school, psychology, and medical professions, who have not yet come to some kind of consensus on definition, treatment, methodology, and remediation intervention for assisting teachers of children with ADHD (Calhoun & Greenwell, 1997).

Literature Review

Chapter two of this report presents a literature review of recent biological findings and the implied psychological interpretations in conceptualizing the ADHD child’s behavior problems and learning difficulties. Currently, ADHD is viewed as a neurologically determined developmental disorder, with neuro-physiological, and neuropsychological abnormalities. (DSM-IV, 1994; Dowdy, Patton, Smith, & Polloway, 1998; Tannock & Martinussen, 2001). Many researchers have documented subtle neuro-anatomical differences in the brains of ADHD children (Voeller, 1991) that are responsible for behavioral inhibition, sustaining attention, and controlling emotions and motivation, as well as using language (i.e., rules and instructions) to control behavior and plan for the future (Barkley, 1998). In fact, a neuro-chemical imbalance of two neurotransmitters seems to disrupt a variety of behaviors: attention, inhibition, response of the motor system and motivation (Clark, Geffen, & Geffen, 1987), one is involved in inhibiting the activity of other cells in the brain (Zametkin, Nordahl, Gross, King, Semple, Rumsey, Hamburger, & Cohen, 1990), and the other is associated with stimulation (Zentall, 1993), executive control and language (Zametkin and Rapoport, 1987). Consequently, ADHD children suffer from two simultaneous difficulties:
inhibition of excessive inappropriate responding and initiating and sustaining required responses. Especially emphasized in the literature review is Barkley’s (1997) pioneering theory on unifying behavior inhibition, sustained attention, and executive functions in ADHD. The chapter also explores documented research results of different forms of interventions directed at improving the academic performance and behavior management of ADHD children in the regular classroom, and some guidelines presented by experts in the field of ADHD. Finally, the chapter ends with a conclusion that advocates the simultaneous use of behavioral, instructional, and environmental strategies as one whole package in the regular classroom.

Method

Chapter three of this report identifies the resources used and procedure followed in the production of the model. The resources include multiple-field research findings pertaining to the biological, neuro-psychological, psychological, educational, and classroom arenas. The procedure involves four major steps. The first step aims at recognizing the psychological deficits, learning needs, and difficulties of the ADHD child in the classroom based mainly on neuro-psychological findings. The second step examines the results of research studies that investigated the application of one mode of interventions with ADHD children in the classroom. The third step focuses on examining the efficacy and sufficiency of the available classroom-based interventions to meet the behavioral and learning needs of the children with ADHD in the classroom. The resultant analytical evaluation constitutes the cornerstone in the development of a new proposed model that adheres to research findings from more than one field, thus giving it a triangulated momentum. Consequently, the fourth step involves designing a new
intervention model for children with ADHD that would be potentially effective for ameliorating their classroom-instigated difficulties and hence improving their academic performance in the regular classroom setting.

*Description of the Model*

The fourth chapter delineates the proposed “Tripartite Classroom-Based Intervention Model for Children with ADHD” that is derived from the literature review. Consequently, this model is based on both, a sound understanding of the biological basis for ADHD and on empirical one-mode interventions found in research studies to individually ameliorate one of the classroom difficulties associated with ADHD (e.g., blurt ing out answers, incompletion of academic tasks, or excessive fidgeting) through manipulating one kind of external variables, such as contingency management, educational stimulation or environmental structuring. In contrast, the model proposed herein involves interconnected and concurrently applied environmental, behavioral, and instructional intervention strategies. The first section of this chapter illustrates the rationale of the model. The second section defines the teacher’s role and the classroom-based intervention strategies that are adopted by the model. For clarity and organization, the recommended intervention strategies are categorized according to the three modes of intervention even though the application of the model demands the concurrent implementation of the three modes of interventions.

*Limitations*

One should keep in mind that the implementation of this model in the classroom requires the consent of a collaborative team consisting of the school principal, teachers, and sometimes parents in order to be applied successfully. Thus, issues such as
principal's involvement, teachers' training, and parents' cooperation may be raised. Moreover, time constraints imposed by academic considerations for all students in the classroom such as curricular content coverage may compromise the adoption of the model. However, this limitation can be overcome by a flexible curriculum and the help of classroom assistants, two factors that may not be available in all schools.

Another limitation stems from the time consuming pre-planning phase consistently needed in the preparation of every classroom session along the three main dimensions, which are the environmental structuring of the classroom, classroom management using behavior modification techniques, and the adequacy of instructional approach and materials. However, it is hypothesized that with practice, the preparatory phase will become less time-consuming and more spontaneous. Besides, the time spent in the proactive planning phase will pay off, since the application of the model will potentially engender a supportive learning environment that will be conducive to the students' well-being and optimal functioning. Consequently, less classroom teaching time will be invested to manage the everyday behavioral problems and learning obstacles often experienced by the ADHD students. Nevertheless, future research that would assess the effects and the actual process of implementation of the model in several schools and with different teachers and students is necessary to judge the validity and acceptability of the model to be used with ADHD children in the regular classroom. Future research results might also determine which variables can be manipulated in order to enhance the acceptability and effectiveness of the model.
CHAPTER TWO

Review of the Literature

Introduction

The conceptual underpinning mechanism of ADHD had raised many controversial issues in the past century that evolved sequentially from the terminologies of deficiencies in volitional inhibition, minimal brain dysfunction or damage, hyperactivity, attention deficit disorder (Douglas, 1972) and finally to the establishment of ADHD as a category in the Diagnostic and Statistical Manual of Mental Disorders (DSM-III, 1980). However, systematic experimental analysis of the performance of ADHD did not support a direct link with a psychological mechanism of attention. Instead, there have been repeated attempts at reformulation. Reformulation aimed at giving equal weights to all three main symptoms of ADHD (i.e., inattention, impulsivity, and hyperactivity) and attributing their concurrence to the same core deficit(s).

Fortunately, advances in bio-medical technologies helped researchers to allocate a biological description of this disorder on the gross brain-anatomical level and the neuro-chemical level that supported all attempts for a more accurate psychological conceptualization of ADHD. Simultaneously, research studies that targeted possible interventions for ADHD on the behavioral, educational, and medical levels added also new evidence to more accurate portrayals and treatments of ADHD.

The first part of this chapter delineates a literature review of the biological and neuropsychological findings related to ADHD and their psychological implications constituting recent theoretical frameworks of ADHD, followed by a list of the main behavioral and learning difficulties of the ADHD child in the regular classroom. The
second part presents an overview of classroom treatments of ADHD concentrating on research findings related to the behavioral, environmental, and instructional modes of classroom-based intervention strategies.

*Current Conceptualizations of ADHD and Classroom-Associated Difficulties*

1. Biological Conceptualization of ADHD

Concurrent with shifts in conceptualization, research related to the biological basis of ADHD has taken many avenues that examined the neuro-anatomic structure and the physiological and chemical functioning of the brain. In sum, the end result of combining findings arising from those research avenues has provided a primary conception of ADHD as a developmental failure of the brain circuitry that underlies inhibition and self control.

*Neuroanatomical findings.* Research studies have consistently found that the frontal lobe (Mostofsky, Cooper, Kates, Denckla, & Kaufmann, 2002), the two basal ganglia called the caudate nucleus and globus pallidus, and the brain cerebellum are smaller in size in patients with ADHD (Berquin et al., 1998; Castellanos et al., 2001), which are the exact regions of the brain involved in regulating attention, ignoring distractions and editing behavior. Findings of magnetic resonance imaging (MRI) studies also revealed a decreased size in right frontal lobes of children with ADHD relative to frontal lobes of controls, which provided additional morphological evidence of frontal lobe involvement in ADHD (Hynd, Sermund-Clikeman, Lorys, Novey, & Eliopoulos, 1990).

*Neurophysiological findings.* Electrophysiological measures in children with ADHD revealed increased slow wave activity predominantly in the frontal regions
compared to normal controls (Mann, Lubar, Zimmerman, Miller, & Muenchen, 1992). Similarly, studies that examined cerebral blood flow showed decreased metabolic activity in the frontal lobes and basal ganglia of children with ADHD (Lou, Henriksen, Bruhn, Borner, & Nielsen, 1989), and studies using positron emission tomography (PET) showed reduced glucose utilization and less energy consumption in the frontal lobe of patients with ADHD (Zametkin et al., 1990). Such physiological results indicated decreased arousal in the cortical areas of the brain that are frequently associated with executive control, and substantiated an underlying neurological basis for ADHD (Riccio, Hynd, Cohen, & Gonzalez, 1993).

A more novel technique called diffusion tensor imaging looked deeper -at a more microscopic level- into the brains of children with ADHD and showed abnormalities in the fiber pathways in the frontal cortex, basal ganglia, brain stem, and cerebellum areas that regulate attention, impulsive behavior, motor activity, and inhibition (Schmithorst, Wilke, Dardzinski, & Holland, 2002). Similarly, Mega and Cummings (1994) found that the brain circuits that connect the frontal lobe to the striatum, which are thought to mediate motor, oculomotor, cognitive executive functions and socially responsive behavior were also inefficient. Thus, the primary dysfunction in ADHD seemed to involve neuronal circuits that connect the frontal lobe to sub-cortical structures in the brain; regions that are important in control of attention and responsiveness.

**Neurochemical findings.** An underlying neuro-chemical basis for the above indicated anatomic brain abnormalities and physiological under-activity in children with ADHD was attributed to a neuro-chemical imbalance or deficiency in certain neurotransmitters, mainly the catecholamines: dopamine and norepinephrine (Clark,
Geffen, & Geffen, 1987). The dopaminergic neurotransmitter system, known to be involved in inhibiting or modulating the activity of other neurons in the brain, was the one most extensively studied in children with ADHD, and the impairment found in this system was argued to be the cause of the frontal lobe dysfunction involved in ADHD (Zametkin et al., 1990).

Researchers such as Voeller (1991) applied some of the neuroanatomical, physiological, and chemical findings mentioned above, across the frontal lobe, basal ganglia, and cerebellum to the brain-activation system proposed by Eichler and Antelman, (1979) and suggested the following biological interpretation of ADHD. According to Eichler and Antelman (1979), the functional system that activates/inactivates other brain regions is made up of two loops that connect the frontal lobes, basal ganglia, and cerebellum: the first loop is made up of the ascending/arousal pathways and the second loop is made up of the descending/inhibitory pathways. Thus, if the first loop is disrupted, an adequate level of arousal to the specifically targeted brain regions at the level of the cortex cannot be maintained, and if any disruption occurs along the second loop an adequate level of inhibition/attention cannot be maintained. Voeller (1991) thus argued that any interference or imbalance at any level of this loop may lead to disinhibition or non-arousal that brings about the cluster of inattentive, impulsive, and hyperactive behaviors associated with ADHD.

Genetic etiology. Although the exact etiology is still unknown, it is widely recognized to have a significant genetic component as demonstrated by family studies (Beiderman et al., 1992; Slaats-Willemse, Swaab-Barneveld, De Sonneville, Van der Meulen, & Buitelaar, 2003) and by adoption studies (e.g., Cadoret & Stewart, 1991). In
addition, twin studies such as those conducted by Sharp et al. (2003) and Faraone & Biederman (1998) have converged on estimates of heritability of approximately 0.80. The heritability of ADHD was also supported by molecular genetic studies that have implicated susceptibility genes of which the most extensively examined were the dopamine D4 receptor (DRD4) and dopamine transporter (DAT1) (Hawi, Kirley, Lowe, Fitzgerald, & Gill, 2003). Parenthetically, DRD4 is a gene traditionally associated with personality trait of “high novelty seeking”. Although the exact genetic etiology of ADHD is not confirmed yet, a genetic mutation appears to cause differences in the synthesis of dopamine transporters and receptors, which are essential for the uptake of the chemical transmitter dopamine that maintains the continuity of neuronal circuitry in the synapses between neurons. Thus, although the mechanism behind the developmental mutations suggested in ADHD is not fully understood yet, ADHD is increasingly conceptualized as neuro-developmental in origin (DSM-IV, 1994; Tannock & Martinussen, 2001).

II. Psychological Conceptualization of ADHD

Neuro-cognitive correlates. Several neuro-psychological studies that examined neuro-cognitive correlates in children with ADHD, (i.e., mapping cognitive functions on brain regions or circuits), have provided research base findings of deficits in Executive Functions (EF). EF refers to a broad and loosely defined set of self-regulatory capabilities, such as working memory, planning, temporal processing, and inhibitory control (i.e., the ability to inhibit a prepotent response). Neuro-cognitive research studies that used functional MRI and PET have demonstrated an overlap between the EF and the anatomical regions of the frontal cortex and its subcortical connections. So, the frontal cortex and its subcortical connections that were repeatedly implicated in ADHD have
been also found to serve as the major underpinnings for EF deficits in ADHD (Eslinger, 1996; Lezak, 1995; Pennington & Ozonoff, 1996). In fact, the impairments of the specific EF in ADHD were also specifically linked to a dysfunction within the dopamine-rich areas in the prefrontal lobe, basal ganglia, and neocerebellum (e.g. Castellanos et al., 2001).

Henceforth, ADHD was increasingly associated with deficits in EF including working memory, response inhibition, temporal processing, sustained attention, and planning processes (e.g., Barkley, 1997; Castellanos & Tannock, 2002). As a result, ADHD was postulated to arise from a deficit in executive functioning which limits the child’s early development of self-regulation skills that guide behavioral and cognitive functioning, thus leading to the symptoms and typical performance of ADHD (e.g. Pennington & Ozonoff, 1996; Barkley, 1996; Castellanos & Tannock, 2002).

The following section explores neuro-cognitive research findings related to the individual EF deficits in ADHD followed by current psychological conceptualization of ADHD based on those neurocognitive findings. This conceptualization would naturally provide a theoretical framework for a deeper psychological understanding of the classroom-associated difficulties of children suffering from ADHD.

1. **Deficits in working memory.** Working memory (WM) is one aspect of EF implied in recent theories of ADHD, and has been associated with dorsolateral and parietal cortices that overlap with the prefrontal regions implicated in ADHD (Castellanos et al., 2002). The deficits in WM have been demonstrated repeatedly in ADHD (e.g. Mariani and Barkley, 1997) particularly in the executive aspects of WM, which are the proactive, planning, and organizational processes that underlie other EF
including reasoning, control of attention, and the ability to resist distraction by irrelevant stimuli, (Engle, Kane, & Tuholski, 1999).

WM by definition is the “mental workplace” or the ability to retain information during a delay and then to make a response based on internal mental representations. In other words, working memory is the capacity to simultaneously store, process, and monitor information (Baddeley, 1996). WM has two functional components, one for short term maintenance of information and the other for manipulation of information during complex cognitive tasks (e.g., in making inferences) (Miyake & Shah, 1999). So, WM refers to the ability to hold task-relevant information actively in mind during both situations, the processing of information and the manipulation of information during complex problem-solving tasks. The first component of WM that is responsible for maintenance of information is further separated into two units, a phonological loop that maintains verbal information, and a visuospatial sketchpad that holds visual-spatial information (Baddeley, 1986). For instance, visuospatial (non-verbal) WM is required in tasks that involve remembering the position of objects and verbal WM is utilized in tasks that involve remembering phonemes, letters, or digits. The second component of WM, the central executive component, accesses and manipulates the constructed and maintained information in order to serve complex cognitive functions. WM is thus utilized to construct, maintain, and update detailed and coherent mental representations of both, explicit information and implied inferential information (McInnes, Humphries, Hogg-Johnson, & Tannock, 2003).

It has been suggested that the inability of ADHD children to hold events in mind and to defective planning is due to deficits in the visuospatial and executive aspects of
WM (Barkley, 1997). As such, complex tasks which require management of information, such as ordering and categorization, are difficult for children with ADHD as due to their poor WM strategies. Nevertheless, some studies indicated that training in WM tasks can enhance executive functioning including WM, response inhibition, and reasoning (Klinberg, Forssberg, & Westerberg, 2002a, 2002b) indicating plasticity of the neural systems underlying WM. Besides, the overlap existent in neural systems, as evidenced by the increased brain activity in the overlapping prefrontal and parietal cortices could explain how training of visuospatial WM could generalize to reasoning and response inhibition (Olesen, Westerberg, & Klinberg, 2004). So, if WM and EF can improve by practice, one would then also expect some degree of practice effect for children with ADHD from everyday activities of very high WM loads, such as mathematics and other demanding academic activities.

2. Deficits in response inhibition. Inhibitory dysfunction is germane to current conceptualization and research of ADHD, and is reflected in the moment-to-moment fluctuations in performance and lapses of intention and attention that characterize children with this disorder (Castellanos & Tannock, 2002; Kooijmans, Scheres, & Oosterlaan, 2000; Oosterlaan & Sergeant, 1998). According to Barkley (1996), behavioral inhibition is related to three processes: (1) inhibition of a prepotent response (i.e., a response that has been previously reinforced); (2) inhibition of an ongoing response; and (3) interference control (i.e., protection of a response from disruption by competing responses). Evidence from functional imaging studies suggests the involvement of frontostriatal circuits in the deficient response inhibition in children with ADHD (Casey 2000).
In a recent study, Shalev and Tsal (as cited in Tsal, Shalev & Mevorach, 2005) found that children with ADHD show visual selective attention problems only when they’re required to respond to, or look for a target that is embedded within adjacent incongruent distracters. These findings suggested that children with ADHD were unable to restrict visual attention to a limited spatial area, especially within a high density display due to their deficiency in inhibitory control so as to selectively respond to relevant information while effectively ignoring distracting information. In another study examining response inhibition, Slaats-Willemse, Swaab-Barnveld, De Sonnevile, Van der Meulen, & Buitelaar (2003) also found that a deficient response inhibition is not only a cognitive endophenotype of ADHD, but constitutes a genetic susceptibility to ADHD. In other words, ADHD is considered a dimensional natural trait with genetic liability expressed as the extreme of a behavior, which is in line with Barkley’s (1997) natural genetic notion of ADHD versus a pathological notion.

3. Deficits in planning. Planning is the capacity to generate and execute a sequence of steps for the attainment of a future goal. It therefore incorporates also the ability to anticipate the consequences of one course of action on another and monitor goal attainment. Planning was found to rely heavily on frontal cortex functioning, which was also implicated in ADHD (Baker et al., 1996). Children with ADHD have shown impairments in planning, particularly in terms of hasty decision making and not adjusting their planning time with increasing difficulty level. For example, a recent study by Oosterlaan, Scheres, & Sergeant (2005) demonstrated that an impulsive planning strategy was evident in ADHD, because the children with ADHD in this study made the first move before successfully generating an appropriate solution to the problem, and also
because their planning time remained constant with different or increasing difficulty levels of the practiced tasks.

4. Deficits in time perception/temporal processing. Time perception is a complex cognitive process linked to basal ganglia, cerebellar and prefrontal cortex functioning (Casini & Ivry 1999). Some recent reviews approved of abnormalities in time perception and in motor-time organization in children with ADHD (Mullins, Bellgrove, Gill, & Robertson, 2005). Specifically, children with ADHD showed deficits in time reproduction, time production, and motor timing with a tendency to overestimate short time periods and underestimate long ones compared with children without ADHD (Barkley, Koplowitz, Anderson, & McMurray, 1997). Such impairments in time keeping would have a negative effect on academic task performances in which a speeded response is required or time restrictions are in place. For instance, the children’s tendency to underestimate time may lead to a hurried and/or inconsistent response that would not accurately reflect the ability of children with ADHD (Mullins, et al., 2005).

Sonuga-Barke (2002) examined time use by children with ADHD according to four competing models of time utilization in order to identify the cause of ADHD’s underutilization of processing time. The four suspected and tested models included the “premature task disengagement model”, the “cognitive-deficit model”, the “state regulation deficit model”, and the “ecological niche model”. The results of the study supported the “state regulation model” because controls outperformed children with ADHD on the 5 seconds and the 15 seconds trials, but not on the 10 seconds trials, which showed that a specific executive deficit differentially affect the performance of ADHD during short and long intervals. The state regulation model suggested that performance on
short intervals required highly structured and organized search strategies with short stimulus inspection times and rapid switching between stimuli, whereas performance on longer intervals required less disciplined search but greater persistence and more effective memory. Therefore, according to Sonuga-Barke (2002), children with ADHD perform poorly under both short and long trials but for different EF reasons in each state, and they perform relatively well on trials of intermediate length because this context is less demanding of both these sets of EF. These findings and rationale have important educational implications for the rate of presentation of new information to be learned and responses to be performed, as will be discussed later.

5. Deficits in sustained attention. A deficit in sustained attention, or a problem of attentional disengagement, is defined as a gradual decline over time in the amount of attention allocated to a given task, or a problem in redirecting momentarily focused attention to a different location in space. Although early views of ADHD emphasized problems of sustained attention per se (Douglas, 1972), contemporary leading theories have identified the core deficit as a deficit in EF including working memory, planning, and inhibitory control that lead to a deficit in sustained attention (e.g., Barkley, 1997). Moreover, research findings have shown that children with ADHD are capable of diverting attention both, automatically to the abrupt onset of an exogenous cue and salient stimuli and voluntarily on the basis of an informative cue (Pearson, Yaffee, Loveland, & Norton, 1995). Thus, their problem is not primarily a deficiency in their ability of selective attention, but a difficulty in sustaining attention to relevant information over a relatively long period of time while withholding responses to irrelevant items (Barkley, 1997). Similarly, Zentall (1993) described this deficit in sustained attention as an
"attentional bias" as she argued that a deficit connotes a lack of attention whereas bias connotes adequate attention but with specific tasks, periods, and conditions. Thus, children with ADHD do not have an attention problem in generating an attentional response but in maintaining the consistency of an attentional response to specific tasks and during specific conditions.

Leading Psychological Theories of ADHD

Earlier emphasis was primarily on attention deficits until Douglas (1984) suggested that a central impairment in self-regulation is implicated in ADHD, and Zentall (1985) proposed an optimal stimulation theory of ADHD, and Barkley (1990) finally described response inhibition deficits as being the central impairment of this order. Currently, ADHD is widely perceived as a developmental disorder of behavioral inhibition that impairs the development of effective EF necessary for self-regulation (Barkley, 2000).

Barkley's scientific theory of ADHD. Barkley (1997) provided an elaborate unifying model which presumed that deficient inhibition in ADHD leads to secondary impairments in four neuropsychological abilities that are partially dependent on inhibition for their effective execution. That is, deficiencies in behavioral inhibition give rise to a secondary impairment of the four EF cognitive abilities: (1) WM, (2) self-regulation of affect, motivation, and arousal, (3) internalization of speech and the temporal organization of complex behavior sequences, and (4) reconstitution of behavior by analytical and synthetic processes, which all lead to a deficiency in the individual's capacity for self-regulation. Self-regulation is defined as the control of one's behavior by internally represented information, self-motivation, and arousal, and the guidance of that
behavior towards the future and away from the moment. As such, Barkley (1997) argued that ADHD is a developmental disorder of behavioral inhibition that impairs the development of effective EF that gives rise to defective self-regulation, and is not as its name implies chiefly a disorder of attention. In fact, the latter conception, whose basis is discussed below, gained wide acceptance since most researchers now agree that a problem in behavior inhibition seems to be unique to ADHD and its hallmark symptom (Barkley, 2000).

The basis of Barkley's model refers to earlier theories of cognitive functioning mediated by the frontal lobes. Barkley (1997) had extended the "hybrid model of EF and self-regulation" that originated in earlier theories (Bronowski, 1977), and the "functions of the prefrontal lobes" (Damasio, 1995; Fuster, 1980, 1995; Goldman & Rakic, 1995a, 1995b), and pioneered his scientific theory and model for ADHD accordingly. Barkley first noted that the function of the prefrontal cortex of the brain was found to be involved in the inhibition of behavior and mediating responses to environmental stimuli. Next, he argued -based on Bronowski's (1977) model- that the four neuropsychological EF of the overlapping cortical frontal lobe necessary for self-regulation depend on inhibition for their own effective performance. Then, extending his argument to ADHD, Barkley suggested that inhibitory deficiencies in children with ADHD create a rippling of secondary impairments into their EF that would then give rise to a deficiency in their capacity for self-regulation. In support of this argument, Anastopoulos and Barkley (1988) had noted that cerebral blood flow, neuro-physiological and neuro-psychological findings have provided evidence of under-activity in these specific cortical and subcortical regions of the brain in children with ADHD. Consequently, Barkley (1997)
concluded that the effect of poor behavioral inhibition in children with ADHD on the EF of the brain that permit self-regulation and control of behavior by internally represented information, self-motivation, and arousal lead to a unitary condition of disturbances in rule-governed behavior, motor control, and sustained attention. These disturbances collectively demonstrate an inability of children with ADHD to modulate their behavior in response to different situational demands, but render them under the control of immediate gratification, stimulation, and environmental circumstances in a given situation that lead to the cluster of symptoms associated with ADHD (Abikoff, 1985; Barkley, 1998).

It is noteworthy that this is the only theory that made a distinction between two forms of sustained attention: (a) context dependent, contingency shaped, and externally controlled attention, and (b) rule-governed, goal-directed, and internally motivated attention. According to Barkley, children with ADHD have problems with the second form of attention, and therefore will be found inattentive when minimal reinforcement is available and behavioral responses have to be created and self-sustained. Educational implications of the latter conception should then hypothesize an amelioration of the inhibitory deficit by immediate and potent reinforcement that would improve motor control upon normalization of EF which adhere to and direct behavior.

Furthermore, Barkley (1997) suggested that ADHD is neurodevelopmental in nature based on earlier findings which showed that EF develop gradually in the form of a "hierarchical model of development" during childhood, adolescence, and early adulthood in which the maturation of one EF domain is necessary for the development of a second EF domain (e.g., Welsh & Pennington, 1988). Accordingly, the development of the
ability for response inhibition is a prerequisite for the development of other EF domains such as working memory and planning. In view of that, Barkley (1997) proposed that minor EF deficits during the child's early developmental stage would be considered as the cause of future gross EF deficits that translate into impairment in the ability to plan, execute and regulate one's own goal-directed behavior.

Zentall's conceptualization of ADHD. Zentall (1985) proposed a theory of under-stimulation in ADHD suggesting that children with ADHD suffer from reduced physiological reactivity to internal and external sources of stimulation, which produces a greater need for stimulation. In other words, ADHD children are under-active or under-reactive to stimulation or to differences among stimuli because they don't have the chemical avenues for optimizing effective stimulation or arousal (Zentall, 1993). Consequently, children with ADHD are more reliant on behavioral means for maintaining a state of arousal or alertness rather than cognitive avenues.

In fact, although Barkley’s and Zentall’s conceptualizations adopt different rationales, one would not find a contradiction in the implications of both, because Barkley also stressed the secondary impairment of the EF of self-regulation of arousal and motivation in ADHD and the ameliorating effect of behavioral means on this impairment. However, Barkley’s theory is the most comprehensive theory to date, since it provides a unified explanation for all three patterns of uncontrolled impulsiveness, inattentiveness, and hyperactivity involved in ADHD, and not solely for the problems of attention. Nevertheless, Barkley and Zentall both agree that the behavioral patterns of ADHD are not under the control of the self but depend more on conditions of immediate situation. Considering ADHD from these perspectives helps identify intervention
strategies that are likely to be successful by promoting greater stimulation, motivation, and regulation of behavior through modifying the conditions of immediate situation.

*Classroom-Associated Difficulties of Students with ADHD*

Obviously, executive deficits and inattention problems would constitute a bottleneck for everyday classroom functioning or academic performance for children with ADHD. In fact, studies exploring the academic achievement of children with ADHD imply that they are more likely than children with equivalent intelligence to obtain lower grades in academic subjects and on standard measures of reading and math (e.g., Barkley, Fischer, Edelbrock, & Smallish, 1990; Wener, 1990), mainly due to several common academic difficulties induced in regular classrooms (Reid, Maag, Vasa, & Wright, 1994). In fact, half of the students with ADHD will experience school failure or fail at least one grade (Barkley, et al., 1990), and over one third will fail to finish school (Weiss & Hechtam, 1986). It was found that the development of essential self-regulation skills that guided the behavioral and cognitive functioning of ADHD children in the classroom was limited by their neuro-developmental deficit in EF (McInnes, et al., 2003). The instigated classroom-associated difficulties or behaviors are outlined herein and are directly linked to a deeper neurocognitive and psychological understanding of ADHD that was illustrated above.

1. *Attention difficulties in the classroom.* Students with ADHD demonstrate a short attention span in class and can be easily distracted (Barabasz & Barabasz, 1996), as they fail to sustain attention to task at hand or inhibit the urge to shift to more rewarding or interesting activities. Consequently, they often dislike, avoid, and fail to complete
academic tasks that require sustained mental effort (Reis, 2002). This task-related difficulty of children with ADHD may be linked to four of their EF cognitive deficits.

First, their inhibitory control deficit does not allow them to resist or avoid things that remove their attention from where it needs to be for as long as the required task demands, or to inhibit thoughts that are not related to task at hand. In fact, responding to task unrelated thoughts (TUTS) is a disruption in attention that was found to differentiate students with ADHD from students suffering from other attention disorders (French, Zentall, & Bennett, 2003). Second, due to their planning difficulties, students with ADHD do not regulate their behavior according to rules and plans, but respond too quickly to all stimuli without reference to their past experience or anticipation of consequences and planning for the future. Third, due to their “attentional bias”, students with ADHD tend to attend to novel or immediately salient stimuli in order to increase their arousal by seeking stimulation and excitement, and this renders repetitive tasks that decrease in novelty, especially when not reinforced at high rates, lead to incompletion or to more problems and errors in performance during later trials of the same task (Zentall, 1993). Fourth, the difficulty of students with ADHD to visualize or invoke spatial mental imagery for processing procedural explanations while holding online an entire sequence of steps or task instructions jeopardizes the completion of complex tasks successfully and efficiently.

Thus, the inattention of students with ADHD is more likely perceived as a difficulty in blocking out distractions and regulating their behavior according to plans and rules instead of increased spontaneous stimulation. Students with ADHD would be readily drawn to rewarding activities and will do little work now for a small reward than
for a much bigger reward not available until later, and will avoid effortful tasks especially if tedious and repetitive (Barkley, 1997). Instead, they would engage enthusiastically in activities that don’t require much attention and impulse control such as T.V. and videogames or outdoor and high interest activities (Pliszka, 1991). Also, once these children actually focus on personally relevant interesting tasks, they may become so involved that it becomes hard to direct their attention to something else (Parker, 1988).

2. Hyperactivity in the classroom. Students with ADHD show excessive hyperactivity in the classroom that is more accurately defined as spontaneous, uncontrollable, overt, purposeless motor activity that is internally driven by the students’ greater rate of responding and exacerbated by their difficulty in self-regulation and sustaining attention (Calhoun & Greenwell, 1997). Specifically, they show excessive fidgeting with hand, feet and objects, and they squirm a lot and have trouble remaining in their seats specifically when they can’t regulate their motor activity to meet the demands of the situation (Barkley, 1997). Their hyperactivity, or what is more likely perceived as hyper-motor responsiveness, was particularly observed in situations that demanded attention and self-control such as doing math or reading, but not in free-play situations such as PE sessions or recess (Pliszka, 1991). For example, symptoms’ display were maximized when students with ADHD were required to restrict their behavior in accordance with situational demands and commands of others, and with rules of appropriate social conduct (Pliszka, 1991). Whereas, symptoms’ display were minimized by “novelty” since the students with ADHD showed more hyperactive behaviors over time or during later trials of academic tasks due to the decreasing novelty of tasks (Zentall, 1985).
3. Impulsivity in the classroom. Secondary to their low impulse control or the inability to delay responding to the environment (Shapiro, DuPaul, & Bradley-Klug, 1998), students with ADHD exhibit the following three impulsive symptoms in the classroom. First, they demonstrate poor pragmatic language functioning such as calling out, blurting out answers in class, speaking out of turn, interrupting others, talking excessively and badgering excessively for a promised reward. Second, they might be physically and verbally abusive to peers (Campbell, 1990), and often engage in aggressive, immature, and uncooperative behaviors such as not sharing with others or failing to wait their turn during social activities (Salend & Rohena, 2003). Third, they produce careless academic errors especially in unclear, ambiguous, detailed, or complex tasks that require a delay in response on which they appear to respond impulsively to what is immediately available or salient (Zentall, 1993), committing even more errors during later trials of the same task (Zentall, 1985). These three impulsive symptoms can be linked to their self-control deficit that affects the separation of thoughts and emotions and guidance of behavior by the internalization of rules, and analysis and synthesis of covert ideas.

4. Poor organizational skills in the classroom. Students with ADHD exhibit poor organizational skills due to their inability to self-manage (Shapiro et al., 1998), and to their failure to delay responding (Aaron, Joshi, Palmer, Smith, & Kirby, 2002). They often have difficulty finding their books, keeping their desks neat, or finding their homework and are accordingly described as careless, disorganized and carefree (McGocy, Eckert, & DuPaul, 2002). Also, they typically demonstrate poor cognitive
organization skills in problem-solving situations, and are actually aware that they fail to plan ahead or anticipate final steps (Zentall & Smith, 1993).

5. **Difficulties in following directions in the classroom.** Following teacher’s directions is extremely difficult for students with ADHD. They often seem to be non-compliant and defiant in response to commands (CHADD, 1996), not as the result of defiance but due to an inability to cooperate and be productive (Barkley, 1998). For example, oppositional behavior and temper tantrums were observed as common occurrences in preschool-aged children with ADHD (McInnes et al., 2003; Hazell et al., 2000). Similarly, students with ADHD appeared not to listen, frequently forgot, and failed to follow through on instructions although their oral language listening skills appeared normal (McInnes et al., 2003). In fact, due to their inhibitory control deficit, it was shown that students with ADHD could not ignore competing, overlapping or contiguous information while trying to attend to a specific message, especially given the ephemeral nature of auditory instructions that can’t be reexamined or previewed (Brock & Knapp, 1996). Moreover, added details, description, and overlapping conversations had more disruptive listening effects on the students with ADHD (Zentall, 1993) due to their deficits in their underlying cognitive processes of inhibitory control.

6. **Language difficulties in the classroom.** Students with ADHD experience two types of language-related difficulties: language production difficulties and task-specific language comprehension difficulties. In complex language production tasks, students with ADHD may show difficulties in oral language expressions that are associated with the planning and organizational aspects of verbal expressions (i.e., maintaining the coherence, organization and self-monitoring of verbal production), (Douglas, 1999;
Pennington & Ozonoff, 1996; Tannock & Schachar, 1996). For example, the weakness demonstrated by students with ADHD in lengthy or complex verbal production tasks are associated with their EF deficit of sustaining attention to covert task-unrelated thoughts (TUTS) instead of sustaining attention to related thoughts especially when the students don’t initiate their conversations (French et al., 2003). As a result, students with ADHD tend to ask less due to their difficulty in the formulation of requests, and to the delays incumbent with such requests in the classroom (Zentall, 1993). In fact, it was suggested that these subtle oral language difficulties in the classroom might be behind the maladaptive behavior, learning, and social skills of students with ADHD that limit their ability to participate fully in classroom situations that require efficient language processing (McInnes et al., 2003).

Similarly, students with ADHD show language comprehension difficulties in specific academic tasks although their language comprehension abilities are appropriately developed. Such specific tasks put more demands on working memory leading to unsuccessful comprehension. For example, Brock and Knapp (1996) found that the performance of students with ADHD on comprehension of main ideas and facts was as normal as that of students without ADHD, but comprehension deficits appeared on comprehension tasks that required higher degrees of vigilance, effort and controlled processing. Similarly, McInnes et al. (2003) reported that students with ADHD may experience unexpected difficulty comprehending more complex expository genre texts (as in school science), which present less predictable, less relevant, and greater information density doesn’t rely on context and prior knowledge. Apparently, students with ADHD can comprehend factual details from both narrative and expository tasks as
well as students without ADHD do, but have significantly more difficulty with subtle aspects of comprehension that require sequential manipulation of expository information, such as making inferences or monitoring comprehension of complex facts. This situation-specific comprehension difficulty is linked to the students' working memory deficit, whereas their normal comprehension of facts is linked to their intact verbal memory span (Cohen et al., 2000; Barkley, 1997).

Furthermore, results of the study by McInnes et al. (2003) have shown that students with ADHD experienced more difficulty in maintaining as well as manipulating visual spatial information than verbal information during performance of complex tasks, mainly because their spatial memory span was more impaired than their verbal memory span. Consequently, children with ADHD are less likely to fall behind in vocabulary tasks or simple comprehension tasks related to main idea or surface details, but may be poorer than other students in comprehension of long complex passages or tasks that require higher degrees of inferences and monitoring of instructions (McInnes et al., 2003).

7. Visual-motor difficulties in the classroom. Students with ADHD have visual motor deficits (Zentall & Kruczek, 1998) manifested in the classroom as a weakness in fine-motor skills (e.g., cutting), illegible handwriting, and a visual-motor low speed coordination problem. These weaknesses may be linked to the failure of students with ADHD to sustain attention to repeated practice, as was demonstrated, for example, by their illegible handwriting which was exacerbated instead of being improved after adaptation on a repetitive copying task (Zentall & Kruczek, 1988; Barkley, 1990). These motor deficits may be also linked to the students' differential deficiency in temporal
control of tasks, because they tend either to underestimate time requirements of fine-motor tasks leading to hasty illegible handwriting or to overestimate time requirements leading to avoidance of writing tasks altogether (Sonuga-Barke, 2002).

8. Self-regulation difficulties in the classroom. Students with ADHD show a difficulty in modulating their state to meet changing task demands (Sonuga-Barke, 2002) and demonstrate an inability to modulate their behavioral response to different situational demands (Abikoff, 1985; Barkley, 1998; McGoey et al., 2002). That is, they have a highly context-dependent pattern of task performance and behavioral response, and so they have particular difficulties during transitional time or shifting between tasks. This behavioral pattern is attributed to their state regulation deficit of time use (Sonuga-Barke, 2002), which renders them unable to regulate their activation state both in shorter intervals due to overactivation with unorganized interfering stimuli, and in longer intervals due to a state of underactivation caused by a slow rate of presentation that requires greater persistence and more effective memory (French et al., 2003). Thus, students with ADHD exhibit better performance during medium intervals or when supported by cognitive energetic variables such as rewards or salient stimuli. The mediating effect of rewards and saliency again indicates that situational variation in behavioral symptoms and academic performance of students with ADHD is the rule rather than the exception.

9. Learning difficulties in the classroom. Students with ADHD experience learning difficulties when learning novel complex material, in drill and practice learning tasks, and in regular classroom settings. First of all, students with ADHD don’t show problems in new verbal learning per se, such as recalling of auditory-learned information,
but in learning new complex information that involves ordering or semantic clustering of information, especially in the absence of a visual cross-modality representation and when accompanied by some time-delay and auditory interfering stimuli (French et al., 2003; Cutting, Koth, Mahone, & Denckla, 2003). In fact, their weakness in the ability to learn and retain new verbal material does not appear in the initial learning phase that is associated with encoding, short-term retention, and retrieval memory requirements, but when the deficient executive aspects or manipulation functions of working memory are involved. For example, Cutting et al. (2003) reported that efficient WM manipulative strategies were needed in tasks with a delay-period, or when relevant information was neutral, embedded, detailed, or less salient while contiguous irrelevant stimuli were more novel and salient. During these unfavorable learning conditions, students with ADHD can't utilize their disrupted WM in constructing, maintaining, and updating detailed and coherent mental representations of both explicit and inferential information. Likewise, their underlying poor inhibitory mechanism does not help them to filter out irrelevant information, and consequently their WM becomes congested with simultaneously activated irrelevant information whereas relevant information become less salient and less activated (French et al., 2003).

Secondly, the learning difficulties of students with ADHD appear in drill and practice tasks because such tasks involve exposure to stimuli of decreasing novelty. In fact, long term retention of learned material requires sustained verbal rehearsal for the development of rote skills, which is difficult for students with ADHD unless reinforced at high rates. Nevertheless, it was demonstrated that the attentional bias of students with
ADHD to novelty appeared to contribute to greater creativity in their writings compared to their classmates (Zentall, 1988).

Thirdly, students with ADHD experience learning difficulties in regular classroom settings that involve either independent learning or group work, whereas “signs of the [ADHD] disorder may be absent in a one-to-one situation while the person experiences frequent rewards for appropriate behavior” (DSM-IV, p.17). In fact, the high rate of off-task behavior of students with ADHD compromises both their performance on independent assignments and their ability to cooperate and be productive in group discussions (Barkley, 1998), which affect their learning and lead to academic underachievement (Weiss & Hechtman, 1993).

10. Social and emotional difficulties in the classroom. One quarter of the students with ADHD show classroom-induced anxiety due to their low self-esteem which is secondary to constant conflict with teachers and peers over misbehavior compounded by a lack of school success (Pliszka, 1991). These students are frequently reprimanded by their teachers because they cannot stay on task until completed, move a great deal and cannot function well in traditional school settings (CHADD, 1992). Besides, students with ADHD typically demonstrate social skill deficits in the classroom (Barkley, 1998a), and their impulsive and uncooperative behaviors lead their peers to avoid or reject them (Salend & Rohena, 2003). Moreover, as they enter elementary school, academic and behavioral demands increase their high level of inattentiveness and its negative impact on their school performance, so they may start to feel frustrated and socially rejected, and to develop low self-esteem and a dislike of school (Parker, 1996). Thus, their inattentiveness and disorganization interfere not only with their learning, academic
performance, and their social interaction with others, but with their emotional
development as well (Salend, 2001).

Conclusion

Any combination of these characteristics is likely to exhaust teachers, disrupt
classroom, and impede the learning process for students with ADHD who have to
continuously divert energy from learning to behavioral inhibition leading to serious
academic problems. On the other hand, the above review of all classroom-associated
difficulties of students with ADHD reveals that “situational variation in behavioral
symptoms is the rule rather than the exception” (Pliska, 1991, p.1269). That is, students
with ADHD seem capable to learn but regular classroom conditions constitute
unfavorable learning situations that exacerbate their difficulties in sustaining attention
and impulse control that negatively affect their performance. In other words, “the
problems of the ADHD child don’t stem from a lack of skill but a lack of self control and
ADHD is not therefore a problem with a child’s knowing what to do but a problem with
doing what the child knows” (Barkley, 2000, p. 47). Consequently, several
environmental, behavioral, and instructional strategies are often recommended to be
implemented in the classroom in order ameliorate those difficulties.

In fact, since research related to ADHD comes almost exclusively from the fields
of medicine and clinical psychology (Fiore, Becker, & Nero, 1993), the reviewed
findings in part one of this chapter are instrumental in developing effective classroom-
based interventions for students with ADHD. And despite that research studies that
examined school-based intervening strategies are scarce, their findings are also vital for
the purpose of building adequate classroom interventions and hence are reviewed below.
Classroom-Based Interventions for Students with ADHD

Although students with ADHD present a unique set of characteristics that challenge educators to find strategies to ensure their academic success (Bussing et al., 2002), too much attention was attributed to labeling and classification issues and not enough energy devoted to intervention and remediation strategies that help educators (Calhoun & Greenwell, 1997; Zentall, 1993). For example, Calhoun and Greenwell (1997) found that out of 3,259 academic articles on ADHD, only 615 articles were related to education, and also found that most articles aimed at ascertaining the etiology of ADHD and life long effects of the disorder and not on how teachers should work with these students. A similar fact stemmed from a revision by DuPaul and Eckert (1997) who found that during a 24-year period only 63 investigations have evaluated the efficacy of school-based interventions on ADHD compared to hundreds of studies that have examined stimulant medication effects, of which even relatively fewer have examined the efficacy of instructional and structural interventions.

In addition, results gathered from a needs assessment indicated a strong need for educating teachers about ADHD, particularly providing interventions directed at improving the academic performance and behavior management of students with ADHD (Eckert, Mcgocy, & DuPaul, 1996; Brim & Whitaker, 2000). Moreover, Fiore et al. (1993) identified 137 empirically-based articles that examined interventions specific to children with ADHD of which only 21 were reported in actual classroom settings. Following is a review of research findings related to the four modes of interventions applied for students with ADHD in the general classroom.
Medical Interventions

Results of two meta-analyses of school-based intervention studies for students with ADHD indicated that, even with stimulant medication, the academic improvement of students with ADHD was almost "uniformly low" despite the positive effects of interventions on behavioral outcomes (Brim & Whitaker, 2000; DuPaul & Eckert, 1997). Those results were suggested to be due to lack of adjunctive successful interventions based on the students’ specific educational needs (Brim & Whitaker, 2000). Moreover, despite medication efficacy in treatment of behavioral problems associated with ADHD, medical intervention is limited by many factors. (a) It is ineffective with 20 to 30% of children with ADHD (Pliszka, 1991). (b) It has the potential of inducing several side effects such as headaches, stomachaches, lethargy, agitation, insomnia, moodiness, and loss of appetite (McGoey et al., 2002; Salend & Rohena, 2003; Snider, Busch, & Arrowood, 2003; Swanson, McBurnett, Christian, & Wigal, 1995). (c) It has the potential as all schedule II drugs for abuse (NIH, 1998; Brown, 2000). (d) It lacks measurable long-term effects in terms of academic achievement (Frankenberger & Cannon, 1999; NIH). (e) It is insufficient without adjunctive behavioral interventions (DuPaul & Eckert, 1997). (f) It doesn’t have an incompressive control on all behavior problems of ADHD (Snider et al., 2003). (g) It may cause deterioration in learning at doses higher than 1mg/Kg (Pliszka, 1991). Moreover, Food and Drug Administration has not approved the use of stimulants for children under the age of six, who are more vulnerable to significant side effects (Hazell et al., 2000). Yet, 1.2% of 2 to 4-years-olds were still prescribed stimulant medication in USA (Zito et al., 2000). Such considerations relevant to the medical mode of intervention for students with ADHD indicate a need for the
development and investigation of alternative or adjunctive classroom interventions, especially because students with ADHD spend most of their school time in integrated classrooms (Reid et al., 1994).

Behavioral Interventions

Teachers are often expected to develop a range of behavioral interventions focused on symptoms of ADHD (Salend & Rohena, 2003) that would exert an external control on the students' behavior to compensate for their lack of inner self-control and motivation. Earlier research showed that classroom behavior improvement of students with ADHD as a result of classroom behavior treatments was equivalent to that obtained with stimulant medication (Rapport, Murphy, & Bailey, 1982), and recent research showed that classroom behavior treatments improved the “adaptive, aggressive, self-control behaviors, and social skills but not academic skills” of students with ADHD (Barkley et al., 2000, p. 319). Besides, behavior treatments could not improve the low frustration tolerance, high distractibility, information processing, or emotional lability of students with ADHD in the classroom (Tansey & Bruner, 1983). Yet, Piffner and Barkley (1990) found that students with ADHD were found to perform akin to their classmates under conditions of relatively immediate and frequent reinforcement.

However, it had been always suggested that interventions other than or beside contingency management and stimulant medication are needed to address comprehensively the academic performance deficits exhibited by students with ADHD (DuPaul et al., 1998). In fact, behavioral interventions or contingency-management techniques based on a functional analysis of the student’s behavior (cf. FBA: Salend & Taylor, 2002) are usually recommended as treatments for the behavioral problems of
students with ADHD (e.g., DuPaul & Eckert, 1997; Fabiano & Pelham, 2003; McGcoey et al., 2002; among others). The classroom-based behavioral management techniques that were often recommended for students with ADHD included token economies, contingency contracts, response-cost, peer-mediated interventions, school-home report cards, and time-out (Garrick Duhaney, 2003).

1. Token economy. Several research reviews provided evidence that “positive reinforcement” procedures, most often using “tokens” as secondary reinforcers coupled with “response cost”, were effective in reducing the disruptive and hyperactive symptoms of ADHD and in improving the academic performance of students with ADHD as well as increasing their on-task time (e.g. DuPaul & Eckert, 1997; McGcoey et al., 2002). Using tokens, redeemable for later rewards but awarded in shorter and more frequent intervals, usually help students with ADHD bridge the gap extant in delayed reinforcement especially that they couldn’t work toward long-term rewards no matter how appealing was the incentive. In particular, the effectiveness of implementing a whole “token economy” system as a classroom-based intervention for students with ADHD was often indicated (Fiore et al, 1993). These token economy systems often included consistent explicit rules and consistent application of removal of privileges, together with immediate specific feedback and “strategic positive attention” (Garrick Duhaney, 2003). Strategic positive attention meant that teachers would deliberately look for and “catch the student being good” (CBG) by applying differential reinforcement of alternative behaviors (DRA). Buchoff (1990) also found that tokens became even more effective when the students participated in selecting the rewards and listing the cost of each. Similarly, the effectiveness of tokens increased when used in conjunction with “home-school
behavioral programs”, because teachers were allowed to gain indirect control over the most powerful reinforcers in the students’ lives (Flick, 1998; Xin & Forrest, 2002). Moreover, token economies were found to be more effective when targeting small gradual successes rather than major rapid changes, and when used with “priming” or “cuing” that reminded students of pre-arranged reinforcers prior to required responses (Flick, 1998).

2. Home-school notes. It was often reported that “home-school partnership” could further enhance the efficacy of behavioral programs implemented in the classroom (Salend & Rohena, 2003) demanding just “little use” of teacher’s time (Buehoff, 1990), and was sometimes found as an important indicator of long-term academic outcomes (Jimerson, Egeland, Sroufe, & Carlson, 2000). For example, McCaine and Kelly (1993) found that the use of “school-to-home notes” procedure dramatically decreased the disruptive behavior and activity level of students with ADHD and increased the frequency of their on-task behavior. Similarly, parent training in behavior management techniques produced significant improvement in the children’s classroom behaviors and in maintenance of treatment effects (e.g. Anastopoulos, Shelton, DuPaul, & Guevremont, 1993; see also Fiore et al., 1993 for a comprehensive review).

3. Contingency contracts. Contingency contracts based on Premack’s principle, which connotes using high frequency or valued activities to reinforce low-frequency behaviors or less valued activities, were found particularly effective with students with ADHD (Garrick Duhaney, 2003).

4. Time-out. Time-out was reported as an effective punishment technique for decreasing the disruptive behavior of students with ADHD when other less intrusive
interventions were proved ineffective (Coleman & Webber, 2002). However, “time-out” could be totally ineffective unless implemented in a generally rewarding setting (Flick, 1998). Besides, time-out was considered by some as being psychologically damaging, especially when not kept brief or overly used with students with ADHD (Garrick Duhaney, 2003).

5. **Cognitive behavioral modification.** Cognitive behavioral modification (CBM) techniques that were designed to directly address the core problems of students with ADHD, mainly self-regulation and impulse control, have persistently yielded inconsistent findings throughout the research (Fiore et al., 1993). Cognitive behavioral interventions mostly used with students with ADHD involved self-management techniques that emphasized changing within child variables using self-instruction, self-monitoring and self-reinforcement (Shapiro & Cole, 1994). Empirical evidence was not uniform in the effectiveness of self-instruction, but self-monitoring and self-reinforcement strategies, which required combining behavioral techniques with cognitive strategies, have been found more effective (Rhode, Morgan, & Young, 1983). Those results suggested that CBM may produce positive changes in sustained-attention, impulse control, and hyperactivity of students with ADHD (Fiore et al., 1993), but the premise that it would lead to greater generalization across settings relative to that obtained with contingency procedures has not been borne out in the literature yet (Barkley, 1989).

*Environmental Interventions*

Environmental interventions meaning specific classroom arrangements and procedures were often recommended in response to the pitfalls of ADHD (Turk & Campbell, 2003). These interventions focused on antecedent-oriented manipulations and
are based on assessments of functional relations between target behaviors and environmental variables (DuPaul & Eckert, 1997). In fact, in their meta-analysis of several school-based intervention research studies for ADHD, DuPaul and Eckert (1997) had examined the discrepant results across studies and concluded that an interaction between type of intervention and type of environmental setting might have accounted for those discrepancies. Similarly, Reis (2002) explained that in order to enhance the academic achievement of students with ADHD, environmental engineering (i.e., modifying the physical and emotional settings of the classroom) was implemented so that potential problematic behaviors of students with ADHD were not prompted to occur as would otherwise might happen in regular classroom settings.

Thus, the purpose of the environmental manipulations is that the specific classroom-induced problems become less likely to occur (Xin & Forrest, 2002), and the student’s opportunity for earning promised rewards upon appropriate behavior be increased (Fabiano & Pelham, 2003). In brief, environmental interventions emphasized that for students with ADHD “it is not the disability that is critical, but how an educational environment is arranged.” (DuPaul et al., 1998, p.589). Following are some examples of the empirically studied classroom environmental modifications for students with ADHD.

1. **Seating Arrangement.** It was found that physical proximity with the teacher helped the teacher maintain proximity control that allowed him/her to frequently monitor, assist, cue, redirect, and disseminate rewards and fines to the student with ADHD without being intrusive and without making his/her presence known (Garrick Duhaney, 2003; Hogan, 1997). In fact, since students with ADHD are easily distracted, unorganized, and
require constant feedback, seating close to the teacher is obviously vigorous, especially
that research has shown that loudly reprimanding students with ADHD actually increased
their misbehavior and class disruption relative to "quiet correction" (Garrick Duhaney,
2003).

Research has also shown that seating arrangements in semi-circle desks or
standard rows, among well focused role-model classmates, and away from visual and
auditory stimulating areas were less distracting for the ADHD student relative to seating
within groups at round tables (Reis, 2002).

2. Control of physical and affective variables in the classroom. Several physical
elements in the classroom setting were found competing with the teacher for the attention
of students with ADHD. For example, Reis (2002) reported that the "hum" of
"florescent" light induced the distraction of students with ADHD, whereas periodically
using "strobe" light created additional stimulation and enhanced their alertness. Similarly,
students with ADHD showed high rate of deviant behavior in noisy rooms because they
were easily distracted to ambient sounds (Pfiffner, 1996; Pliszka, 1991). Consequently
"white noise" was found beneficial for focusing during newly introduced complex tasks,
whereas rhythmic moderate background noise provided an incentive or a stimulant for
on-task behavior during repetitive simple tasks (Garrick Duhaney, 2003).

Moreover, visual cues and pointers often helped students with ADHD focus their
attention as well as locate and follow important points (Flick, 1998). For example, non-
verbal signals such as blinking lights, ringing bells, clapping patterns, tapping shoulders,
or using pointers was found as effective attention grabbing strategies while giving
directions, signaling transitions, and asking students to focus on a new task (Salend &
Rohera, 2003). For example, in a study by Zentall (1993), the use of visual cues was found to normalize the skill of students with ADHD in following directions, and the use of diagrams or color-coded maps of the classroom was found to help those students ameliorate their difficulty in finding their school material and keeping things organized.

In addition, the affective component of learning was found to affect the way students with ADHD behave in the classroom (Garrick Duhaney, 2003). For instance, they seemed to flourish in a positive, firm, fair, and risk free climate that fostered cooperation and acceptance of individual differences (Hogan, 1997).

3. Schedule and structure. Research results showed that students with ADHD thrived in a predictable and structured environment but had difficulty modulating their state to meet new routines or demands (Sonuga-Barke, 2002; McGcocy et al., 2002). Accordingly, it was rationalized that students with ADHD function better when they know the order of classroom activities because it compensates for their inner disorder (Salend, 2001), whereas novel unfamiliar classroom events trigger their inattention as they can’t self-regulate spontaneously (Garrick Duhaney, 2003). And, it was suggested that they should be prepared for significant changes ahead of time to avoid this disorientation (Hogan, 1997; Buchoff, 1990). In fact, Pfiffner (1997) denoted that a fair consistent schedule charting daily activities according to the attention parameters of the student with ADHD that alternates between low-interest and high-interest activities may enhance the alertness of students with ADHD; and that integrating regular breaks and physical exercises within the schedule, such as doing classroom chores, play-in-class games, and rigorous individual out-of-class games provide the students with an opportunity to be active with permission. Also, Flick (1998) added that the efficacy of
scheduling can be further enhanced if supported with efficient time-transitioning strategies between different activities such as providing a brief notice ahead of transitional time using auditory cues (e.g., bells, recitals) and a brief review of classroom rules specific to transition-time. Similarly, Buchhoff (1990) indicated that attaching the pre-planned schedule of classroom activities to the side of the student’s desk would allow the students to visually review the order and duration of each separate classroom activity. Noticeably, predictability rather than rigidity was sought from recommending such classroom schedules that provide students with continuous momentary expectations.

4. Consistent rules and routine. Since students with ADHD react “in the moment”, their struggles in the regular classroom were often attributed to lack of order, discipline, and consistency of rules within the classroom (Turk & Campbell, 2003). Thus, established routines were recommended in order to help students with ADHD develop daily expectations, and posting clear classroom rules with large block lettering in prominent places was suggested to make classroom expectations consistently accessible to the students (Buchhoff, 1990).

Instructional Strategies

Educators often need to use a variety of instructional strategies in order to help students with ADHD overcome their inner underlying neuro-psychological failure to use effective learning strategies which often hinders their academic performance (Zentall, Moon, Hall, & Grskovic, 2001). However, little research has been conducted regarding instructional and curricular manipulations aimed at enhancing the learning and academic performance of students with ADHD (DuPaul & Stoner, 1994). And although most researchers often recommended that strategies should focus on curricular materials,
instructional methods, or assignment considerations (Dowdy et Dowdy, Patton, Smith, & Polloway, 1998), few have tested such interventions in school settings and even fewer in regular classrooms in order to address key questions concerning effective curricular and instructional materials (Fiore et al.). Yet, research has provided some sense of what might work in the classroom but not enough information to make definitive categorical programming for students with ADHD (Fiore et al., 1993). The few research findings related to instructional interventions for students with ADHD or simply some of the experts’ recommendations on the topic of ADHD in the classroom are presented in what follows. Briefly, this review demonstrated that students with ADHD typically thrive in a high-interest meaningful curriculum with relevant topics, a stimulating instructional approach, and specific academic task modifications.

1. Curricular manipulations. A high-interest curriculum with sufficient relevancy and saliency was often recommended for students with ADHD. However, designing curricular material that take into consideration the specific learning and attention needs were mostly suggested but rarely tested in empirical research studies. Zentall (1993) for example suggested that modification strategies that focus either on content or structure of curricular material are needed to decrease the attention load on the students with ADHD by making the learned material sufficiently salient in both novel and practice learning situations. Zentall (1993) argued that the attention load increases for the student with ADHD during those two regular classroom learning situations; that is when new, complex, and unstructured information is presented to be learned and during repetitive practice of learned material. The first situation requires advanced strategies for searching and locating important stimuli in a multiple-stimulus field, whereas the second situation
requires sustained attention and alertness under conditions of decreasing novelty during practice-learning tasks (Zentall, 1993). Accordingly, relevancy of content and saliency of structure are proposed to reduce the attention load in both situations.

First, relevancy of content can be achieved by content-based strategies that involve adding sufficient and sometimes excessive relevant information to the content to make it salient. For example, attaching personal relevancy to the content such as relating material to the student’s interests, experiences, popular characters, and items was found to be extremely motivating for student with ADHD (Salend, 2001). Similarly, real life examples were added to content when learning new academic skills such as practicing real life money skills in math lessons (Reis, 2002; Zentall & Meyer, 1987). In fact, some researchers suggested that associating personal meaning to difficult information or learning difficult topics in personal contexts renders a task salient enough to provide continuous stimulation for the ADHD child (French et al., 2003), and it also provides more opportunities for connections and anchors, which enable ADHD children to understand and recall information (Reis, 2002). Moreover, tailoring the curricular content to the individual student’s cognitive style by assessing and accommodating the extent to which the student is a global versus analytical learner, teacher versus self-directed learner, or peer versus adult-oriented learner may provide greater relevancy and saliency to that particular student (Grossman, 1995; Hogan, 1997).

Second, the recommended structure-based strategies for students with ADHD that concentrated on increasing the saliency of content (i.e. information and instructions) included ordering the content, making it livelier, and/or using scaffoldings. One ordering strategy called the “grouping or chunky strategy” was suggested to augment the saliency
of the content and reduce the attention load for the ADHD student, since it orders the content according to semantic categorization and without adding new information (French et al., 2003; Salend & Rohena, 2003; Flick, 1998). Another ordering strategy that was widely recommended for the student with ADHD is “utilizing content-enhancement organizers” during the initial processing of complex information because it would reduce the load on the student’s verbal and spatial working memory (Melnnes et al., 2003; Reis, 2002; Salend, Elhoweris, & Gaederen, 2003), and at a later point of practice learning tasks because it would provide a clearer reference (Reis, 2002). Examples of content-enhancement organizers would include visual-spatial illustrations such as diagrams, graphic organizers, and semantic webs that organize information in central, comparative or hierarchical relations among the concepts to be learned.

Structural strategies that render the content salient enough by making it livelier or more vigorous were also recommended and examined for students with ADHD. For example, the “sticky strategy”, which involved covering words in a reading text and then uncovering those words gradually along reading was found to pique and whet the curiosity of students with ADHD and help them focus (Langer, 1997). Another enlivening strategy involved adding “color novelty” to the learned material, which was found to differentially improve the performance of students with ADHD (Zentall, 1993). That is, when color was added to complex or unstructured tasks such as to clue words or symbols in math problems, it helped guide the students’ attention to what was important, but when added later to practice tasks such as math computations, copying, and rehearsal of rote skills it helped them maintain the alertness needed for completion of tasks. Nevertheless, Zentall (1989, 1993) noted that when color was placed on unimportant task
features of novel tasks, it interfered with the performance of students with ADHD, and when color novelty was used for repetitive practice tasks such as spelling it led to performance gains only if colorful trials were preceded by simple initial black-letter trials.

Finally, scaffolding strategies such as using external verbal and non-verbal cueing were suggested as potentially advantageous for the ADHD student. For example, the teacher's or text's guidance of the students with ADHD during response tasks, by using beginning and ending verbal or visual cues, prompted the students first to initiate a response and then maintain their focus and attention to relevant covert ideas (Zentall, 1993; Brim & Whitaker, 2000).

2. Instructional approaches. Innovative instructional approaches or "non-traditional" instructional strategies have been widely believed to be optimally stimulating for students with ADHD and to improve the chance of their academic success (Armstrong, 1996; Bower, 1998; Fiore et al., 1993). Essentially, these stimulating strategies act as a kind of "educational psycho-stimulants" which are internally empowering rather than externally controlling (Zentall, 1993). Specifically, Zentall (1993) found that using stimulating approaches helped arouse and sustain the interest of students with ADHD especially when tasks were familiar or repetitive, and too difficult or too easy. The stimulating instructional approaches often recommended included hands-on learning, interactive learning, computer-assisted learning, multi-sensory learning, teaching to multiple intelligences, and other innovative approaches (Salend et al., 2003).
First, physically active learning that involved stimulating the concentration of students with ADHD through allowing body movements or manipulation of objects—contrary to common belief—often helped these students focus and increase attention to task (Brim & Whitaker, 2000). Moreover, it was noted that students with ADHD could not tolerate waiting unless verbal and motor responses were possible during the interim (Armstrong, 1996; Zentall, 1993). Similarly, the immediate effects of physical exercise as a potential for helping students with ADHD release their excess energy and stress and clear their heads and focus were recently particularly stressed and examined (e.g., Tanilillo, Kesick, Hynd, & Dishman, 2002). Furthermore, asking students with ADHD to give gross motor responses to regular rote tasks, such as clapping, pointing, jumping, etc., instead of written or verbal responses helped them channel their excessive energy constructively and reduced their sensation-seeking activity and impulsive errors (Calhoun & Greenwell, 1997; Zentall & Meyer, 1987).

Second, interactive learning situations such as play-acting sessions, play-games learning situations—excluding competitive games—and cooperative hands-on learning activities, students with ADHD were found to perform better than in regular learning situations (Reis, 2002; Salend, 2001). Similarly, it was found that through “peer tutoring” in which a tutor provides a tutee with instruction, assistance, and feedback (Shapiro et al., 1998), or through “peer-mediated instruction” in which peers periodically checked each other’s comprehension during teacher presentations, students with ADHD were provided sufficient stimulation and immediate feedback in lieu of teacher’s delayed feedback (Zentall et al., 2001). More important, the effect of “class-wide peer tutoring”
on task-related attention and academic performance was found superior to that of other treatments of ADHD (i.e., medication) (Shapiro et al., 1998).

Third, the multi-sensory approach to learning was often recommended as being most stimulating to students with ADHD because it could accommodate their different perceptual strengths and incorporate more of their senses. For example, in one study it was found that adding music to math activities improved the productivity of students with ADHD (Szeibel, Abikoff, & Courtney, 1989). Similarly, another study showed that loud reading helped students with ADHD sustain attention, reduce their errors and improve their reading comprehension relevant to silent reading (Dubey & O’Leary, 1975 as cited in Zentall, 1993). Likewise, emphasizing tactile-kinesthetic modalities in teaching was recommended for students with ADHD because it allowed more movement and sensation seeking opportunities (Brand, Dunn, & Greb, 2002; Hogan, 1997). More important, livening up teacher’s presentation style by using attention-grabber teaching strategies such as hands-on demonstrations, on-stage performances, or interactive head projector presentations and frequently changing the voice volume and speed during lesson presentations seemed to eliminate the drone effect of lecturing and to be more stimulating for students with ADHD (Salend & Rohen, 2003).

Fourth, Ota & DuPaul (2002) found that computer-assisted instruction led to positive effects on task engagement and academic performance of students with ADHD. In fact, computer-assisted instruction can provide a highly stimulating learning environment and an opportunity for cross-visual learning modality and immediate frequent feedbacks, which constitute an optimal learning medium for students with ADHD.
3. Task modifications. Although educational tasks, carefully modified according to the capabilities and needs of students with ADHD would provide uniquely effective learning opportunities, they were rarely applied. The typical task modifications often recommended for students with ADHD for changing the nature of in-class and homework assignments included adapting the response requirements, adjusting the workload, and varying the time needed to complete the assignments (Salend & Rohena, 2003; Zentall, 1993).

First, suggestions for adapting the response requirements for students with ADHD included requesting visual projects, computer print-outs, and story boards instead of hand-written material, which would reduce the frustration of students with ADHD that often accompanies writing tasks (Hogan, 1997). Similarly, Heward et al. (1996) suggested using “response cards” with preprinted answers for the same purpose.

Moreover, it was found that modifying the response mode of assignments by requesting active-responding instead of written responses had normalized the attentional performance and decreased the commission errors of students with ADHD (Pation, 1994; Salend, Elhoweris, & Garderen, 2003; Zentall, 1993). Likewise, requesting “motor responses” to rote tasks reduced the impulsive errors of students with ADHD on simple word recognition tasks (Fiore, Becker, & Nero, 1993). In addition, “True-False” questions were used to measure inferential comprehension for students with ADHD since they placed reduced demands on the students’ relatively difficult retrieval processes (McInnes et al., 2003). Likewise, Zentall (1993) suggested that multiple-choice question formats with only two answers rather than five-response options might accommodate the students’ difficulty in withholding immediate responses (Zentall, 1993). Moreover,
individualizing assignments based on the individual student's preferred learning style might provide extra effective accommodations and adaptations (Salend & Rohena, 2003).

Second, adjusting the workload according to the attentional parameters of the student with ADHD may take several different avenues. For example, Salend and Rohena (2003) and Hogan (1997) suggested allowing additional time and breaks. A more meticulous strategy that helped decrease the attentional load for students with ADHD involved decreasing information overload by eliminating unnecessary details in assignments especially when unimportant information was relatively salient, contiguous or overlapped with task formation, which might consequently disrupt the performance of the students (Flick, 1998; McInnes et al., 2003; Zentall, 1993). What’s more, many researchers have emphasized decreasing "assignment loads" by shortening assignments, dividing long assignments into shorter manageable parts or into a series of logically progressed smaller assignments, and reducing the number and types of component items (Brim & Whitaker, 2000; Zentall, 1993; Salend & Rohena, 2003; Xu, Reid, & Steckelberg, 2002). The rationale behind this emphasis was to decrease the requirements of longer time and work span that normally exacerbated errors in the writing, reading comprehension, and spelling performance of students with ADHD. The objective of such recommendations was therefore to foster accuracy and motivation rather than volume or speed of work. Furthermore, McInnes et al. and Salend and Rohena (2003) proposed that students with ADHD seemed to have a threshold of difficulty where they began to function like learning-disabled students, and often had trouble with fast-paced tasks, rigid expectations and settings. Accordingly, many researchers advocated using
developmentally appropriate assignments that were within the capabilities of the individual student with ADHD and tailored according to his/her pace in order to bring task within his/her capabilities and levels of mastery (Brim & Whitaker, 2000; DuPaul et al., 1998; Salend, Elhoweris, & Garderen, 2003; Salend & Rohena, 2003).

Third, some researchers recommended more specific temporal adjustment of tasks for students with ADHD. For example, Sonuga-Barke (2002) and Fiore et al. (1993) argued that as students with ADHD have difficulty responding during short or long intervals, more specific tailoring of the temporal structure of tasks to the learning tempo of students with ADHD is needed. In other words, requiring medium intervals for academic responses might be more effective than the mere division of learning time into manageable chunks.

Finally, Strayhorn and Bickel (2002) suggested that tailoring tasks in order to be given within a one-to-one situation would provide the ideal learning condition to students with ADHD. One-to-one settings would ensure almost continuous interaction, feedback, and social reinforcement, which constitute the ideal setting for accurate and sustained performance for the student with ADHD.

Conclusion

Looking at ADHD from different perspectives helps design and advocate more potentially successful classroom interventions for students with ADHD than those relying solely on the results of research studies that pertain to one domain. Moreover, such alternative routes in designing educational interventions is particularly vital since researchers have always stressed the need for adequate intervening educational strategies targeting especially the academic outcomes of students with ADHD in view of the
insufficiency or sometimes ineffectiveness of other interventions such as medical or behavioral ones (e.g., Power and DuPaul, 1996). Besides, knowing the cognitive functioning of underlying confirmed biological mechanisms of students with ADHD might be more informing on potentially effective interventions than knowing their overall behavioral outcomes or symptoms. For example, focusing on inattentiveness per se and not on a primarily executive functioning cognitive problem may be of no help or may even exacerbate the problems of students with ADHD. In other words, although the processing difficulties of students with ADHD such as their shifting in focus make them appear inattentive and disorganized, focusing on attentiveness per se in recommending strategies may be less effective than focusing on the vulnerability of students with ADHD to increases in processing demands such as having to flexibly shift between activities or to link a sequence of cognitive operations in an on-line fashion. Possible interventions might alternatively concentrate on strategies that relax overall task constraints by modulating the pace of presentation, simplifying multi-step tasks, moderating the amount and speed of the output response required, and teaching metacognitive skills.

Thus, the findings presented in the first part of this chapter not only provide information in support of theory construction, but also facilitate the targeting of effective interventions. Of specific significance was the conditional nature of deficits associated with students with ADHD (i.e. in novel vs. repetitive contexts, factual vs. inferential comprehension, with vs. without delay tasks, global cues vs. detailed representations, relevant vs. expository information, etc.) that provided a useful insight into the effectiveness of specific classroom interventions, and magnified the importance of
tailoring the qualitative and temporal structure of learning activities to the learning tempo and needs of students with ADHD.

In addition, the second part of this chapter concentrated on the behavioral, environmental, and academic strategies that have been found to be successful with students with ADHD, but which have been uniquely manipulated for research study purposes. However, the real dynamic setting of the classroom usually incorporates interdependent and complementary effects of many contextual variables in the learning situation. And, the shortcoming of these interventions lies in neglecting whether a combination of intervening measures could provide a higher degree of efficacy. The combinatory effect of multi-interventions could be extremely beneficial especially given the conditional nature of deficits involved in ADHD, and the fact that what typifies the activity or performance of students with ADHD is that they are environmentally variable. For instance, students with ADHD show excessive verbal and motoric activity depending on the properties within the learning setting (i.e. novelty, duration, complexity, motivation, structure, etc.) that set the occasion for differential changes in behavior. However, each of these properties can be targeted by a different intervention strategy using either behavioral, environmental or instructional means. Thus, all three forms of interventions are needed to be implemented simultaneously in order to cater for the effects of all classroom variables present at any one time on the responses of students with ADHD.

The purpose of the proposed tripartite model presented in the fourth chapter of this report is to provide a tentative solution to the conditional nature of executive functioning deficits associated with ADHD. This solution dwells on the combinatory
effect of all three types of individual intervention strategies in order to control the major classroom variables that differentially govern the behavior and responses of students with ADHD.
CHAPTER THREE

Method

The method adopted for the production of the model is a multi-step procedure that involves an extensive review and analysis of available research followed by a synthesis of the model propelled by several years of personal expertise in teaching students with ADHD.

Step One: Multi-dimensional Literature Review

The major purpose of exploring the neurological, neuro-psychological, and psychological research findings was to study the etiology of ADHD in order to understand its core underlying deficits. The neuro-biological research used new technological advances in medical diagnostic procedures (MRI, EEG, DTI, etc.) that provided new evidence of the subtly defected brain regions and neuro-chemical imbalance associated with ADHD. The neuro-psychological research used neuro-cognitive correlates to identify the exact psychological functions of the defected areas and neuronal circuits. The psychological research examined the behaviors and symptoms of children with ADHD to pinpoint the specific nature of ADHD. Besides, recent psychological theories used those neuro-psychological and psychological findings to provide a new portrayal and conceptualization of ADHD. The literature review thus helped to identify the underlying biological underpinnings of ADHD and its psychological and cognitive implications rather than to identify a constellation of symptoms that may overlap with symptoms of other attention or psychological disorders.

The information gained from this literature review of the specific psychological deficits and cognitive difficulties of children with ADHD were particularly informative in
designing the present tentative classroom-based intervention model instead of simply targeting the observant symptoms or manifestations of the deficits in the classroom. In fact, as would be illustrated in a later chapter of this report, the variability of the symptomatic manifestations of the underlying deficits implied in ADHD is what typifies this disorder. In other words, students with ADHD have an underlying differential type of deficit that can be controlled by the environmental properties, motivational aspects, and cognitive demands of each contextual situation. Besides, this multi-dimensional literature review helped to build the model on some solid multi-source foundation that included neuro-anatomical, neuro-chemical, neuro-cognitive, and psychological research findings. It is noteworthy to mention that the different multi-resource research results were in accordance with each other. In other words, the regions in the brain that were mostly suspected by psychological research to be impaired in ADHD were the exact regions most implicated in biological research related to ADHD. Another purpose of the literature review was to address the psycho-pathological and/or genetic notion of ADHD in response to the several out-loud calls in some educational quarters that considered ADHD a “myth” or simply a natural personality trait (e.g., Armstrong, 1999) rather than a problem that students with ADHD have to struggle with during each school day.

Consequently, this report represents an attempt to bring about some consensus between the medical and educational spheres around the issue of ADHD, and to acknowledge the fact that although ADHD is a medical condition it can still be managed by educational means adjunctive or alternative to medical means in view of the conditional deficits associated with this disorder.
Step Two: Analysis of Classroom-Associated Symptoms of ADHD

The second procedure followed in this project was to rethink of the symptoms and learning difficulties of students with ADHD that are often expressed in the classroom as reflections of the specific and exact underlying difficulties of those students. The classroom associated behavioral and learning difficulties of those students were thus individually linked to each of the confirmed underlying difficulties, which provided an opportunity to propose a more potentially effective intervention by targeting the causes rather than the results of the classroom difficulties. In fact, knowing the cognitive functioning of underlying mechanisms rather than overall behavioral outcomes or responses is more informing not only in support of theory construction, but in facilitating the targeting of effective interventions.

Step Three: Review of Classroom-Based Interventions

Next, a review was conducted on the effects and pitfalls of the four forms of interventions used for ADHD when applied in the classroom, namely the medical, behavioral, environmental, and instructional strategies. However, one can consider the reviewed studies to be limited by being focused on one or two variables that were individually manipulated for research purposes whereas the natural classroom setting usually incorporates several interrelated variables that affect one another. Consequently, it was rationalized that all or most variables must be controlled when targeting a conditional deficit that can be externally controlled, such as ADHD.

Step Four: Synthesis of the model.

The present novel model was suggested for enhancing the academic performance as well as controlling the maladaptive behaviors of students with ADHD based on (1) an
analysis of the exact underlying problems of students with ADHD and on (2) an analysis of the contextual variables extant in the classroom and their effects on those problems. To achieve this result, the model tries to control the major variables that affect the students' behaviors and performances by implementing a multifaceted form of intervention strategies. The rationale behind this suggestion based on the multidimensional literature review was doubly folded.

First, the inhibitory control deficit of ADHD affects different executive faculties of which each may be targeted by a different form of intervention strategies. For example, the executive motivation deficit that guides behavior is often controlled by behavioral interventions whereas the arousal and working memory deficits are ameliorated by instructional stimulating interventions, while the self-organization deficit may be controlled externally by appropriate environmental interventions.

Second, the natural setting in a regular classroom usually includes several variables that affect inadvertently the students' motivation, learning, and behavioral outcomes let alone the effect of a particular intervention strategy when deliberately chosen and used to increase the reinforcement, structure, or cognitive demand of a specific learning task. So, for a student with a special problem such as ADHD, all of the natural or introduced classroom variables should be controlled otherwise his/her problem may be exacerbated. For example, using only behavioral interventions to reinforce a student with ADHD to perform a certain academic task might challenge and worsen the student's performance if the task is not brought within the student's executive cognitive abilities. Thus, the use of instructional and environmental strategies is essential to bring the task within the capabilities of the student with ADHD otherwise the behavioral
intervention would be deterring rather than enhancing the student’s academic responses. Consequently, the tripartite model suggests the concurrent use of all three forms of interventions as essential to control classroom variables that differentially affect the underlying executive deficits in ADHD.
CHAPTER FOUR

The Tripartite Classroom-Based Intervention Model for the ADHD Child

Theoretical Basis and Postulated Effects of the Model

Based on current conceptualizations of ADHD, the problems of ADHD are the result of insufficient disinhibition that stem from a neuro-chemical deficit and its effect on the four cognitive faculties that guide behavior internally (e.g., Barkley, 1997). Thus, the students with ADHD can neither inhibit unwarranted responses to extant stimuli in the classroom nor can they self-arouse, guide and sustain warranted responses to demanding academic tasks (Zentall, 1993). Consequently, when the student with ADHD has to continuously divert energy from learning to behavioral inhibition, he/she may have serious academic problems.

Nevertheless, the symptomatic manifestations of ADHD can be externally controlled, since differential changes in the behavior and performance of the ADHD child depend on the properties within the particular learning setting such as structure, novelty, duration, stimulation, and complexity (Zentall, 1993). Accordingly, what typifies the behavioral manifestations or learning problems of ADHD is the fact that they vary according to the extraneous environmental stimuli and the endogenous cognitive demands embedded within the learning task. In fact, due to the ameliorating effect of external factors, students with ADHD demonstrate a conditional nature of deficits. For example, deficits appear in repetitive but not in novel contexts, or in inferential but not in factual comprehension, or in delay tasks but not in without delay tasks, or in detailed representations but not in global cues, so on and so forth.
Understanding the conditional nature of the core deficit of ADHD provides a useful insight into designing learning situations that place less demands on self-inhibition and reinforce academic responses. Such designs involve the use of potentially effective classroom interventions that tailor the qualitative and temporal structure of learning activities and situations to the learning needs and tempo of students with ADHD. In sum, these interventions include (1) contingency management techniques, (2) the provision of a highly-structured environment with specific, concise directions and demands, and (3) various stimulating instructional accommodations. The instructional accommodations should be grounded in what students with ADHD enjoy and can succeed in. In reference to findings reviewed in chapter two of this report, these strategies should basically focus on appropriate task modifications and adding novelty, saliency, relevancy, and order to the learning activities in the classroom.

Although the above different forms of interventions are usually individually studied for research purposes, the real dynamic setting of the classroom usually incorporates the combined and interdependent effects of several contextual variables, of which each can be manipulated by a different form of intervention. And since students with ADHD are sensitive to all contextual variables in the learning situation, linking behavioral, instructional, and environmental interventions into one multi-component intervention is fundamental to control the behavior and promote the academic performance of the ADHD child in the regular classroom.

The proposed model stipulates that the three forms of interventions must go hand in hand in one combinatory tripartite intervention and not in separate unrelated chunks. Adopting one out of the three forms of interventions to be implemented in the classroom
might not only be ineffective, but might also inadvertently generate deleterious effects. This is due to the effects of the multi-variables already found in the classroom and/or introduced by any form of intervention on the conditional deficits of students with ADHD. Thus, a critical balance has to be maintained by monitoring the interdependent relationships and effects of various interventions on all those variables and consequently on the performances of students with ADHD. The hypothesized adverse effects of implementing a one form of intervention in the classroom without concurrently implementing the other two forms of interventions are presented hereafter followed by the alternative recommendations of the tripartite model.

First, relying solely on a tight behavioral modification plan for managing and reinforcing the behavior of the ADHD student without providing the necessary structure or appropriate environmental set up might impose an extra pressure on the child to conform, and therefore induce unwarranted frustration. Instead, the tripartite model suggests that the classroom environment should be first structured for potential success, and then supported with behavioral interventions that would maintain motivation and guide behavior. Along the same lines, Piffhner (1997) recommended to “put [both] the structure and incentives in place, then let the child be responsible for his behavior” (p. 169).

Second, although using stimulating instructional strategies is often recommended because they can potentially provide greater learning opportunities for the ADHD child, these strategies might also lead to hazardous chaos if not appropriately structured. This chaos might exacerbate the difficulties of the ADHD child who often strives on external structure to compensate for internal chaos and ineffective self-regulation. Therefore, the
tripartite model suggests that the stimulating learning tasks should be built on and supported by a sound, salient, and consistent structure in order to reap targeted results.

Third, an appropriately structured and stimulating activity may still be insufficient to enhance self-regulated appropriate behavior over a long period of time without an external locus of control. In other words, although a stimulating activity will definitely grab the attention and arouse the interest of the ADHD child, it may not lead to sustained attention unless the motivational input is sustained. The tripartite model thus recommends enhancing both the stimulating and motivational value of the task at hand in order to capture and sustain the attention of the ADHD child.

Fourth, increasing the stimulating and motivational value of the task at hand might still be insufficient by itself to induce ongoing compliance without modifying initially its conditions (i.e., duration, number of steps, response modality, etc.) in a way that accommodates the child’s difficulties. Consequently, the tripartite model suggests that the learning tasks should be modified according to the learning and temporal needs of the ADHD child and be presented in a well-structured and predictable environment, rather than just increase their stimulating and motivational value.

The list of hypothesized examples is endless, but all show that the effects of all three categories of interventions seem to be interconnected and interdependent forming an overlapping tripartite intervention model as illustrated in Figure 1. This intervention model needs to be implemented as a whole in order to hypothetically combat the inhibitory and self-control deficits of the ADHD child.

Moreover, the intervention strategies presented in this model, that target the deficits of the child with ADHD, can be also beneficial for other children who do not
suffer from ADHD. In fact, the model demonstrates—as will be clearly illustrated later—how the needs of the ADHD child can be met in the regular classroom through environmental adaptations, positive reinforcement, organizational procedures, and learning activities with variety and interest all of which can help all students reap better results. However, for the student with ADHD, the consistent implementation of the tripartite intervention model is recommended as the fundamental foundation or bedrock for effective learning to take place in the classroom.

For organizational purposes, the behavioral, environmental, and instructional interventions that constitute the three pillars of the model are discussed and categorized in what follows under three distinct headings. However, the three pillars are by no means to be thought of as distinct entities or to be implemented separately. The challenge is to incorporate environmental structuring and highly salient antecedent stimuli together with meaningful reinforcers that are observed to enhance the appropriate behaviors of children with ADHD. The behavioral interventions or the manipulation of consequences are firstly discussed, followed by the environmental and instructional interventions that involve all antecedent conditions which are recommended to promote better behavior control and academic performance. The recommended interventions are also directly linked to the neuro-psychological conceptualization of the classroom associated difficulties of students with ADHD that were discussed in chapter two. The role of the teacher is also emphasized and consequently a specific section in this chapter is devoted to identify the qualities or responsibilities of the classroom teacher who would be able to orchestrate such multi-component mode of classroom interventions.
Behavioral Techniques

"The developmental deficiencies in behavioral inhibition, the regulation and maintenance of behavior by internalized rules and self-motivation give rise to problems with sustained attention and following rules or instructions, particularly in situations where consequences for such behaviors are delayed, weak, or non-existent" (Barkley, 1990, p. 71). Unfortunately, most classrooms are structured to provide delayed infrequent reinforcement, under the assumption that students become internally motivated to conform to rules and complete academic tasks. Even grades or teacher’s praise are on the low end of the saliency continuum. These are precisely the conditions that most likely lead to inattentive disruptive behaviors in children with ADHD.

Implications of this conceptualization are clear; interventions must include changes in the kind and rate of consequences for particular target behaviors of the individual child. In general, the most targeted behaviors include remaining seated, compliance and non-defiance in response to changing situational demands, delaying responsiveness to environmental stimuli, and sustaining attention to learning tasks. The target behaviors must be however accurately specified for the individual child. In brief, the use of positive reinforcement especially under conditions of relatively immediate and frequent reinforcement, and with the use of highly salient and meaningful reinforcers, constitute the cornerstone in the design of consequence management strategies for the student with ADHD. The classroom behavior change programs that provide such appropriate conditions for students with ADHD include token economy, contingency contracting, and school-home notes.
Token economy. Token economies incorporate secondary generalized reinforcers that can be exchanged for a variety of privileges. Tokens can bridge the gap between behavior response and reinforcer delivery by providing the reward immediacy, specificity, and potency that are often required for children with ADHD. DuPaul and Stoner (1994) have noted that preferable rewards include teacher praise, hugs, and social attention for children less than five years of age, tangible rewards for children up to nine years, and activity rewards for older children.

Contingency contracting. On the other hand, contingency contracts don't involve the use of secondary tangible tokens and therefore don't work for ADHD children under the age of six as effectively as with older children (DuPaul & Stoner, 1994). This is due to the inability of younger children to delay reinforcement for longer periods of time. However, for children over six years of age, behavioral contracts are often successfully used with the appropriate choice of target behaviors, reinforcers, and timing of delivery.

Home-school note cards. "Home-school notes" are home-based contingency management procedures based on the child's behavior or academic performance at school, which circumvent some of the practical limitations in the regular classroom such as the restricted range of possible reinforcing activities (Kelley, 1990). Although classroom-based contingencies are more immediately linked to the responses of students than home-school contingencies, the use of school-to-home notes in conjunction with "behavior charts" provides the immediacy needed to yield significant results.

Automated reinforcement. The automated reinforcement system is a potentially successful behavior management program for children with ADHD that was invented by Dr. Mark Rapport and then mass-produced by Dr. Michel Gordon under the name of the
Attention Trainer (as cited in Barkley, 2000). This system involves administering or taking away points electronically via a remote control immediately and privately onto the child's desk to be exchanged later for promised rewards. This way, the teacher delivers to the ADHD child unobtrusive but effective feedback about his/her behavior during regular classroom activities and without having to generalize treatment.

Response Cost. On the other hand, contingency arrangement strategies consisting solely of positive reinforcement are sometimes not sufficient (Piffiner & O'Leary, 1993). Therefore, mild penalties following inappropriate behavior are then needed in the form of reprimands and response costs. These consequences should be delivered privately and immediately following a transgression and with a minimum of discussion and affect.

Time-out. Time-out is another consequence-based strategy that incorporates the removal of the child with ADHD from a reinforcing situation swiftly, and for a specified ratio of time. According to DuPaul and Stoner (1994), this ratio equals to 1 min per every 2 years of age. In fact, the removal from the reinforcing environment is the most salient and effective variable in the success of the time-out strategy and not the amount of time spent.

Moreover, positive and negative contingencies can be implemented concomitantly in the classroom. In fact, the concurrent use of token reinforcement and response cost has often demonstrated an increase in the levels of on-task behavior, seatwork productivity and academic accuracy of children with ADHD (e.g., DuPaul, Guereumont, & Barkley, 1992; Rapport, Murphy, & Bailey, 1982).
**Environmental Interventions**

Children with ADHD demonstrate an inability to modulate their behavior in response to different situational demands (Abikoff, 1985; Barkley, 1998; McGeeey, Eckert, & DuPaul, 2002). Instead, they function best in a highly structured and organized environment with specific routines, predictable schedules, concise directions and demands. Such environmental interventions constitute the second group of interventions suggested by the tripartite model to be implemented in the regular classroom. They are divided into (1) planning adequate schedules and routines, (2) building structure and rules, and (3) environmental engineering.

**Schedule and routine.** Established routines provide a consistency that enhances a sense of predictability and security. Thus, daily routines would help the ADHD child acquire a sense of order that compensates for internal and external chaos. They would also help the ADHD child channel his/her energy productively in the classroom and consequently act as an effective deterrent to disruptive and inattentive behaviors. The tripartite model recommends preplanning of detailed classroom schedules for every class period that would carefully delineate the type and sequence of all the learning activities that would take place. The effectiveness of the use of schedules as preventive behavioral means depends on the manner followed in the selection and sequential order of the learning activities. In other words, the classroom activities should be alternated according to their (1) level of interest to the child, (2) mental effort or attentional demand, (3) degree of novelty, (4) medium of instruction, (5) level of physical movement allowed, (6) degree of difficulty or complexity, (7) extent of active involvement, (8) mode of student
output (i.e., writing, reading, drawing, acting, etc.), (9) duration, and (10) noise level involved.

A schedule consisting of appropriately alternated activities according to the needs of the children with ADHD helps keep them on track, reduces their frustration, and induces compliance, especially if the last activity is an extra-curricular fun activity. This activity would best be the one most interesting to the child or left vacant to give the child a free choice of a favorite activity. In fact, this is an effective simple form of combining a behavioral strategy which is the promise of a preferable or a free choice activity with an environmental scheduling intervention. Moreover, for the young child, schedules should be pictorially illustrated and anchored to his/her desk, or posted in his/her immediate field of vision. The child should be trained to refer recurrently to schedule and put a sign next to every accomplished activity. It is also preferable to occasionally remind the child of the last interesting activity especially when he/she shows some signs of losing his/her attention (see Figures 2 and 3). Using creative ways in following up the schedule can also assist the child in monitoring his/her progress throughout the classroom period. For example, the child might be asked to pretend to be a pirate who moves, upon completion of each activity, a step closer to the treasure box, which would be his/her most favorite activity.

In addition, transitional time or lag time are the most difficult for the ADHD child, and surprises usually disturb the security of following a predictable plan. Therefore, it is essential to (1) tell the child beforehand of any changes in routines or schedules, (2) reward easy transitions, and (3) plan for every potential lag time. Planning involves the provision of interesting distracting activities that can keep the child engaged
during transitional time and channel his/her potentially disruptive behaviors into constructive responses. For the purpose of providing an immediate engaging activity to be used in lag times, a fun idea drawer can be prepared that includes books with hidden pictures, mazes, board games, play-dough, junior boggle, lotto, and puzzles. Again, as a combinatorial behavioral strategy, allowing the child a free selection of a fun activity for transitional times can be also used as an incentive, which he/she would look for upon completion of the preceding academic task.

Structure and clarity of rules. Classroom rules need to be made explicit and salient and not indirectly implied or judged by the ADHD child’s own response. Besides, those specific rules need to be posted in prominent places and taught and rehearsed like any other academic skill. In other words, each rule should be explained, modeled, checked for understanding, reviewed, and reinforced. Moreover, the rules can be made sufficiently clear and salient by being pictorially illustrated such as traffic light signs (see Figure 4) or in pictures of children or the ADHD child himself/herself while displaying those rules. Then, they should be posted in a prominent place or pasted on the child’s desk. A copy of those rules can be used as a daily behavioral chart (see Figure 5), or they could constitute the terms of a behavioral contract with the ADHD child. It is also recommended to review the rules every morning before going in class and frequently during the day, and not only upon violation of the rules. In effect, the teacher’s preplanned actions and not his/her late reactions to inappropriate behaviors work best for the ADHD child.

Finally, a word of caution must be mentioned. The goal of scheduling and structuring is to channel potential energy productively and not to impose undue pressure.
Therefore, the schedule and structure should not mean rigidity but should allow for some flexibility of movement or brief time away.

*Environmental engineering.* Classrooms are not organized for a one-to-one teaching situation, where children with ADHD function best or tend to respond and ask more questions. Instead, classrooms are organized for group learning and therefore delays are always incumbent with the student’s chance to respond or request anything from the teacher or even receive teacher’s feedback. Besides, multi-distracters are naturally available in all regular classrooms. Therefore, the ADHD child needs to be seated away from highly distracting centers, among well-focused attentive students, close to and at an eye level with the teacher. Teacher’s proximity is particularly important because it allows immediate control, monitoring of specific target behaviors, and dispersion of rewards and fines quickly and frequently.

Moreover, the ADHD child demands extra leg space and desk top space. The student’s desk should be cleared of all distractions and the student should be given extra physical space, which should be defined with clear physical boundaries (e.g., by using masking tapes). The class should be also structured in a way that permits some leeway movement, and ensures physical outlet for the ADHD child. For example, a free corner or an extra desk can be arranged at the back of the classroom to be used by the child as a resort after being seated for a while and need sometime off; or to be used for a one-to-one teaching setting when needed. Armstrong (1999) suggests adding to this corner a rocking chair or a lectern with a sewing machine treadle at the bottom. Study carrels can also be used to block out distractions, but sparingly or as a privilege. Armstrong also denotes the importance of enlivening the classroom setting with comfortable furniture (e.g.
beanbags), plants, or pets (e.g. gerbil cage, aquarium), which ensures a nurturing environment for the ADHD child.

In addition, all needed materials should be organized in well-marked areas and be made readily available. An abundance of stimulation tools should be also prepared by the teacher who is often competing with the child’s internal and classroom’s external stimuli. For this purpose, bells, flashlights, puppets, binoculars, magical wands, timers, toys, or musical instruments can be used creatively.

Finally, care should be taken to maintain a low noise level in class because the ADHD child is usually audiologically sensitive. The teacher is thus advised to drop the pitch of her voice to get the child’s attention rather than raise her voice; otherwise, the ADHD child will only hear the static (Pfiffner, 1997).

*Instructional Strategies*

Little research has been conducted regarding instructional and curricular manipulations aimed at enhancing the learning and academic performance of children with ADHD (DuPaul & Stoner, 1994). However, the findings of neuro-psychological and psychological research can be extremely instrumental in designing potentially successful instructional interventions. Accordingly, such findings have propelled the instructional recommendations of the tripartite model as illustrated in the following.

Research findings show that focusing on attentiveness per se and not on a primarily self-regulation deficit may exacerbate the ADHD problem, because the attention problem of children with ADHD is an impairment in sustained attention (Barkley, 1997), or an attentional “bias” (Zentall, 1993), rather than a problem in selective attention. Accordingly, the attention deficit of ADHD affects the adequate
attention, memory, and comprehension required only in particular learning tasks depending on the conditions incorporated in the given learning activity or situation. For example, students with ADHD have an attentional preference for novelty and a greater need for active responding, and would spontaneously respond to what is more immediately salient (Zentall). Meanwhile, they have a difficulty in maintaining the consistency of their attentional response to relevant stimuli that are neutral, subtle, or embedded within learning tasks and activities.

The educational implications of these findings are clear. Educational interventions should concentrate on designing stimulating instructional approaches that focus on increasing the saliency of stimuli embedded within learning activities or require more active involvement from the students. The saliency of stimuli can be achieved either by making them more visibly ordered, more novel, or more relevant to the particular child. The suggested stimulating recommendations are categorized in what follows under novelty, relevancy, ordering, and active responding subheadings. But first, task modification strategies are recommended because specific curricular task modifications are also essentially needed in response to the ADHD students' conditional learning difficulties.

*Task Modifications.* Several properties of the academic learning tasks should be modified in accordance with the learning and temporal needs of the ADHD child. These properties include the duration, response modality, directions of the given academic task, and specific considerations associated with complex tasks. In addition, specific paper organization rules should be followed in writing tasks or material.
First, the "duration" of an academic task, including the amount and speed of output required, should be moderated and matched to the ability and attention span of the individual child (DuPaul & Stoner, 1994). However, the nature of the academic task should be first examined to decide whether its potential difficulty for the individual student stems from a prerequisite academic skill that this student might be missing or the sustained attention it requires of him/her. Then, some rules should be followed. In general, the accuracy of the performance of the ADHD child usually declines with length of activity, and therefore long tasks should be broken into doable obtainable tasks. Barkley (2000) identifies a rule of thumb: the assigned amount of work for the ADHD child should be appropriate for a child not suffering from ADHD who is 30% younger. For example, teaching new spelling words should be reduced to five at a time because spelling improves by repetitive practice, which unfortunately constitutes the most difficult task for the ADHD child. Moreover, in view of the temporal deficits of the ADHD child, relaxing overall time constraints of the task at hand is recommended, such as moderating the speed of output required. Specifically, the written workload should be reduced because the ADHD child takes much longer time than his/her classmates to complete written assignments.

Second, several response modalities should be considered when designing specific academic tasks for the ADHD child. The written modality constitutes the area of greatest challenge for the ADHD child, since it demands sustained mental effort and eye-hand coordination, whilst the ADHD child experiences frequent lapses of inattention. Besides, the ADHD students’ illegible handwriting is usually exacerbated during later repeated practice, which might lead them to anticipate the frustration induced in this kind
of activities and try to avoid it. Thus, learning tasks should require minimal writing or
different modes of output response. In other words, the objectives of requesting a written
response from the student with ADHD should be reevaluated and the task modified
whenever the learning objective of the task itself is not jeopardized.

Consequently, several alternative written responses to long full sentences should
be considered. For example, tasks may include multiple choice questions, filling in the
blanks, matching, finishing incomplete sentences, underlining, and true and false
questions, which all require minimal writing. However, multiple choice questions are
preferably confined to two options because children with ADHD might spontaneously
respond to what is immediately available, and because they have to hold in their working
memory (WM) more than one optional response online.

Moreover, alternative modalities to responding through writing should be
encouraged. In fact, oral academic tasks such as requesting oral reports on a tape recorder
or oral presentations often make the ADHD child shine. For example, in one study, some
ADHD students were able to get A's on oral spelling tests whereas they failed on written
tests (Reif, 1993). Besides, a ten-seconds wait for an oral response is preferable to quick
five-second or late ten-second responses, due to the ADHD students' specific self-
regulation temporal deficit (Sonuga-Barke, 2002). Other alternative modalities also
include requesting print handouts, authentic projects, or essays produced on a monitor by
using a mouse pen and a digital panel. Many available computer writing programs such
as "ROBO-Writer" are also recommended to be used in writing assignments.

Third, carefully planned and clearly represented directions should accompany
academic tasks for the ADHD child. Directions for a given task should be systematically
elaborated in small clear steps and given one at a time. Directions should be also conveyed in a combined oral and written or pictorial format because of the ephemeral nature of auditory directions that can’t be reexamined or previewed by the ADHD child. Directions should be kept brief and should avoid overlapping details.

Moreover, task completion and the ability of ADHD students to follow through on instructions is affected by their inability to invoke mental imagery for processing procedural explanations and task instructions, or to hold online an entire sequence of steps (McInnes et al., 2003). Thus, regular monitoring of the child’s following of directions is essential and can be significantly effective. For example, “Nag tapes” can be used to remind the child of directions. The teacher can also prompt the child to follow directions and complete tasks by asking him/her to “beat the clock” using visual timers or intermittent beeps from alarm clocks. Moreover, the teacher and child may agree on private measurable cues such as scribbling five marks on the board and taking off a mark each time the child is off task and finally rewarding remaining ticks. Again, the child can be trained to self-check his/her following of directions and task completion by crossing out completed ministeps or small tasks sequentially.

Fourth, papers used in writing tasks should be clearly and simply organized, written in large bold print, and highlighted with colors to emphasize important words. It is fundamental to avoid cluttered pages, deliver one page at a time and even cover unused parts of a page. Pages can be also scanned and read from a stimulating colorful monitor instead of a dull paper. Writing activities should be organized in a way that avoids unclear, ambiguous, or detailed complex tasks.
Fifth, specific arrangements should be followed in designing complex academic tasks for students with ADHD. This is recommended because making inferences or performing similar complex tasks requires manipulation of information and linking a sequence of cognitive operations in an on-line fashion, which is specifically difficult for the ADHD child due to a higher demand on WM. Therefore, complex tasks that involve inferential comprehension or problem solving should have significant information saliently highlighted, and less relevant information more neutral or embedded within tasks. These complex tasks should also include adjoined graphic organizers or other visual illustrations for two reasons. Firstly, the ADHD students’ visuospatial component of WM, which is needed for maintaining task-relevant information actively in mind, seem to be more impaired than their verbal WM component (Melnnes et al., 2003). Secondly, concise visual representations allow the student to perform recurrent referrals to task-relevant information easily, especially during the unfavorable delay periods incumbent in such tasks. In addition, long tasks should be divided into more manageable smaller tasks whenever possible, or the students could be trained to sketch a brief plan of the steps they need to follow and cross out each completed step sequentially as they proceed.

Finally, special considerations should be followed when giving exams to students with ADHD. For example, they should be given extra time on exams, shorter exams, and variable modes of testing. Oral or typed answers should be allowed whenever the objective of the exam in not compromised. In addition, a choice of content, medium, and sequence of testing activities may be offered whenever the objective of the exam is again not jeopardized.
Stimulating instructional approaches. Instructional approaches that increase the saliency or stimulating value of the learned material or activities are recommended in order to arouse the interest and sustain the attention of the ADHD child. For this purpose, several approaches that manipulate the levels of novelty, relevancy, active-responding, and order of material in learning activities are suggested.

First, the novelty of learning activities should be maintained as much as possible. This is because the learning weaknesses of students with ADHD to retain verbal material do not appear in their initial learning phase but only after a delay-period, due to the frontal sub-cortical circuitry abnormalities which affect WM and its effect on encoding and retrieval (Cutting et al., 2003). Thus, these students show more academic errors in performance during later trials and more activity over time, whereas novelty minimizes ADHD symptoms’ display. They even avoid verbal rehearsal and repetitive practice tasks unless reinforced at higher rates, because such tasks involve exposure to stimuli of decreasing novelty.

Thus, computer-assisted instruction (CAI) is recommended as an effective instructional strategy for the ADHD child (Barkley, 1998b) because it provides non-static and consistently novel stimuli. Besides, CAI has several inherent features that characterize effective teaching for children with ADHD, such as immediate frequent feedbacks and reinforcement, individualized instruction according to the student’s level of functioning and pace of learning, continuous opportunities for active involvement, and alleviation of difficulties in eye-hand coordination and sustained mental effort. Interestingly, Armstrong (1999) hypothesized that computers help the ADHD child acquire information in a way that is in synch with his/her associative divergent hyper-
mind, and he pinpoints the similarity in terms between "hyper-text" and "hyper-active child" and their non-linear way of accessing information through clicks that link to further clicks along a network of vast possibilities.

Another teaching method that circumvents the ADHD child's preference to novelty is incidental learning. This approach involves allowing and then redirecting the distractions and recurrent wonderings of the ADHD mind to relevant tasks instantaneously before the child loses track completely. Implementing a "3A redirecting procedure" (i.e., Allow, Adapt, and Add) can be used for this purpose. To illustrate, the teacher can allow the child's incidental engagement in novel stimuli, and then adapt and add the less salient stimuli of the learning task at hand. As a result, the less novel stimuli of the previous learning task become sufficiently novel and salient again.

Second, relevancy of academic tasks or learned material to the individual child should be enhanced. Students with ADHD are more likely to initiate responses to relevant tasks because these insure less demand on sustaining attention. In effect, the level of relevancy of a learning task to the individual child will affect the relative saliency of this particular task to the child and therefore ensures more sustained attention. This is also because the attention difficulties of children with ADHD appear during academic learning tasks as a disruption in attention to task unrelated thoughts (TUTS) and not in their ability to pay attention (French, Zentall, & Bennett, 2003). The challenge is therefore to make task-related thoughts sufficiently relevant to the child in order to swap the attention given to TUTS. For example, the use of mnemonic devices is one method for making the learning task more relevant to the child and consequently reduces retrieval and WM demands.
Several other instructional approaches that make academic tasks more relevant to the individual child and consequently place less processing demands include: brain-based learning (Caine & Caine, 1997a; 1997b), (2) learning to multiple intelligences (Gardner, 1993) and (3) learning styles (Dunn & Dunn, 1992; Brand, Dunn, & Greb, 2002). In brain-based learning, instruction is presented in the context that gives meaning to the child and in the form of contextual learning experiences (Caine & Caine). In such learning conditions, the ADHD child can perceive relevance and grasp complex concepts better (Reif, 1993). For example, Marilyn Burn’s Math Solutions - About Teaching Math (1992) is a K-8 program based on meaningful brain-based strategies such as solving real life problems which rivet and engage the attention of the ADHD child.

Similarly, teaching to multiple intelligences (Gardner, 1993) and learning styles (Dunn & Dunn, 1992) accommodates the student’s individual learning preferences and consequently ensures more individual relevance. The ADHD child will benefit the most from both, the attention grabbing techniques involved in multi-learning styles methods and the relevance of the individually preferred processing style. For example, tactile learners might learn vocabulary by creating paper sculptures such as “bulbous”, “fragmentary”, or “elongated”, or might learn spelling by writing words with glue and then sprinkling them with sand (Armstrong 1999). Kinesthetic learners, on the other hand, might learn spelling while bouncing a ball or jumping rope. As for auditory learners, studies have shown that the use of rock music may be therapeutic for children with ADHD; because the rhythmicity and intensive repetitive beat stimulates an increased arousal of cerebrum and overrides all other environmental distractions, it acts as “musical Ritalin” (Cripe, 1986). Finally, a very simple strategy to promote more relevance in
learning activities is to incorporate current fads or hobbies that interest the individual student or students of the same age.

Third, text material should be clearly ordered especially in expository genre texts, such as school science books that normally present less predictable, greater information density and less relevant information. Such texts require higher degrees of vigilance, effort, and controlled processing, which may lead to comprehension difficulties for the ADHD child due to WM overload (Brock & Knapp, 1996; McInnes et al., 2003). The solution is therefore to reduce information load by avoiding added details and overlapping descriptions, or by making important information sufficiently salient. For the latter purpose, ordering strategies may be applied to text material. For example, categorizing information or ordering material in clear semantic maps make text information more salient leading to successful comprehension. Similarly, the use of concept maps, graphic organizers, and venn diagrams organize information in a brief, meaningful, and visual display, which increases saliency and reduces information workload. However, diagram displays should be limited to one per page or board display.

Moreover, setting anticipatory or study guides before a lesson can help the child in the comprehension of text material by directing his/her attention to important information. Similarly, using ordinal words such as “first, second, third,...” or guiding questions within a text can help the ADHD child maintain focused attention to significant information.

Similar to written texts, teachers should add more order to their multi-step presentations and should follow strategies that modulate the pace of presentation by providing additional time to make transitions between topics. Besides, presentations
should involve creative, dynamic, and novel formats that captivate the attention of the ADHD child, especially if the teacher can incorporate current fads and activities.

Fourth, learning tasks that involve “active-responding” outputs are recommended as effective accommodations for children with ADHD in accordance with their greater need for active responding. It is also vital to recognize the potential energy, creativity, and spontaneity of children with ADHD when deciding on accommodations for them (Zentall, 1993). Typically, in traditional classroom settings, academic tasks such as writing and reading are usually performed as seatwork activities that have to be completed without allowing any movement, which makes it difficult for students with ADHD to function productively (Brand, Dunn, & Greb, 2002). In fact, this is one of the reasons why those students show excessive motor activity in situations that place high demands on attention with minimal physical movement such as reading and math, while they engage enthusiastically in other play situations such as PE sessions, recess, or outdoor activities (Pliszka, 1991). Examples of learning situations that can accommodate the ADHD students’ preference for active physical engagement are presented in the following.

Play-based learning may be very effective for ADHD children (Hansen, Meissler, & Ovens, 2000), because it involves game lessons that can enliven the somewhat dull learning material and help maintain the ADHD child’s attention through consistent active responding. For example, the teacher can use “memory games” or “go fish” for teaching vocabulary, spelling, science, or math facts. Similarly, there are other social board games that are specifically effective for teaching academic and social skills at the same time (e.g., Scrabble, Monopoly, Boggle, etc.).
Hands-on learning also promotes active engagement of the student through either the use of manipulative materials for teaching abstract concepts, or through the adoption of performance-based teaching strategies. For example, math teachers may use different manipulatives for teaching addition or numerical place value such as Lego blocks, abacus, etc. Similarly, language teachers can use magnetic letters or edible alphabet cookies for teaching spelling and reading. Also, in performance-based learning, the students may become actively involved in building their own projects. For example, building models and authentic projects, or performing real science experiments provide the tactile stimulation and active involvement that help the ADHD child sustain his/her attention to task at hand.

A third active-responding instructional approach that is more specific to the ADHD child involves channeling the potential movement of students with ADHD into productive academic objectives. In other words, academic activities can be directly linked to gross motor responses. For example, students can learn spelling words by jumping out of seats on vowels and sitting down on consonants. Similarly, they can learn multiplication table by, for example, moving around the class in a conga line and shaking hips on multiples of three for example (Armstrong, 1999).

Finally, cooperative group learning is another approach that engages the ADHD student in both active responding and interaction with peers, which helps him/her in two major areas of weaknesses; academics and social skills. In fact, a research study showed that as a function of class-wide peer tutoring, an ADHD student was able to significantly improve his on task behavior, activity level, and academic performance (DuPaul & Stoner, 1994). Reciprocal peer teaching or reading with a partner instead of silent reading
are examples of cooperative group learning approaches in which the ADHD child can be actively participating, receive immediate feedback, get shorter waits and practice social skills simultaneously.

**Teacher’s Role**

Being the implementing agent of the tripartite model, the teacher is the primary decisive factor in the success of the model in the regular classroom. Teachers’ attitude and knowledge on the subject of ADHD can be turning points for the ADHD child (Piffner, 1993). The saying: “Teachers affect eternity; one can never tell where their influence ends”, is typically true for the ADHD child who draws his/her strengths from the efforts of a caring and knowledgeable teacher.

**Teacher’s attitude and commitment.** Although the teacher is urged throughout this report not to belittle the plight of children with ADHD, she is equivocally urged not to belittle her expectations. This is significantly vital for the ADHD child because his/her academic performance doesn’t usually reflect his/her aptitude which is often controlled by the effects of the immediate situation or task at hand. Thus, the teacher must clearly differentiate that, although ADHD is a neurological disorder, the manifestations or severity of its symptoms are environmentally based and controlled. This knowledge must be instrumental in adopting the effective intervention strategies that can extract the hidden potential of the ADHD child who is often highly intuitive and remarkably gifted. Accordingly, Armstrong (1999) referred to the ADHD child as the child with the “Edison trait” in reference to many inventors and artists who have won world acclaim despite their behavioral difficulties in school, such as Einstein, Churchill, Beethoven, Sarah Bernard and many others. Therefore, the crucial function of the teacher is doubly folded,
promoting the strengths and learning preferences of the ADHD child while at the same time attending to his/her needs and difficulties. In fact, the tripartite model is proposed as a potential solution that allows the teacher to perform this dual function.

*Teacher’s education on ADHD.* The initial step in the implementation of the model must be educating the teachers on the specific nature and treatment of ADHD. However, the teacher should not shift away from her role as educator and must not focus on the problem as being intrinsic to the child, but she should rather ask herself what kind of learning environment one can create for the child in order to attract his/her attention and bring out his/her natural learning abilities. Meanwhile, she should not be duped by the inconsistent patterns of behavior and academic performance, but should realize that the child’s behavior is often driven by the differential relation between the child’s neurophysiology and the controlling factors of the particular contextual situation.

*Teacher’s philosophy and flexibility.* A teacher’s philosophy that is in synch with behavioral management principles is the second important ingredient in the implementation of the tripartite intervention model. In other words, the teacher should have enough experience with behavioral techniques, and be willing to make behavioral interventions an ongoing process in her classroom instruction. Pfiffner (1997) cautions that some teachers share misplaced and untrue concerns that behavior modification principles are too mechanical and do not adequately foster the child’s natural development and motivation to learn. This belief is certainly problematic for the ADHD child because the kind and rate of consequences that work for other children in the classroom are not usually sufficient to keep him/her on track. A flexible teacher, on the
other hand, is tolerant of individual differences and is not afraid to make exceptions or modify assignments for children with special needs (Pfiiffer, 1997).

Teacher’s consistent communication with parents. Another critical ingredient in the success of the tripartite classroom intervention model is a strong relationship between the teacher and the parents of the child. Teacher-parent meetings should be more frequent for the ADHD child than for other children. This might entail regular communication on a daily basis through the use of “teacher-parent note cards” that were discussed earlier. This communication is crucial for a consistent use of behavioral programs and sharing of effective instructional strategies.

Teacher’s stressing social skills training. Finally, a word should be mentioned on the significance of social skills training for ADHD children. These students are usually at risk of being rejected by their peers, can’t pick up easily on social cues, and are desperate to make friends. Thus, the teacher should be aware that social failures in school can be devastating and consequently affect the success of any form of classroom interventions including the proposed tripartite intervention model. Thus, the teacher has to teach and model social skills, and act as facilitator in helping the ADHD child build successful social relations with his/her peers.

Conclusion

In conclusion, the above behavioral, environmental, and instructional forms of intervention proposed by the tripartite intervention model share a common rationale and goal although they differ in procedure. The common rationale is the fact that although ADHD is an intrinsic neurological disorder, the situational variation in behavioral and academic responses of students with ADHD cannot be ignored (Pliszka, 1991). The
common goal is to arouse and sustain the attention of students with ADHD to warranted academic responses and to inhibit their unwarranted responses to other stimuli in the regular classroom. The three different procedures can be briefly summarized in three respective terms: salient reinforcement, structured environment, and stimulating instruction (see Figure 6 for a pictorial representation).

The recommended behavioral management techniques focus on the use of salient reinforcers for an external control on the behavior of ADHD children in the classroom in view of their self-regulation deficits. The suggested environmental interventions emphasize the role of added structure to the learning setting that would compensate for planning difficulties and internal chaos. The proposed instructional strategies concentrate on stimulating the ADHD child in the form of an interesting classroom environment that would increase the saliency of learning tasks and consequently place less demands on his/her WM and sustained attention, which according to Zentall (1993) would be equivalent to an educational psychostimulant.

Obviously, the three procedures target different learning needs or behavioral difficulties and consequently are collectively needed for improving the behavioral outcomes and academic performance of the ADHD child. Moreover, the success of each form of intervention relies on the adjunctive effects of the other two forms. In other words, salient reinforcers would be naturally unachievable in a chaotic, inconsistent setting and consequently, induce frustration instead of compliance. Similarly, predictable and reinforced settings are not sufficient for enhancing the academic performance of the ADHD child unless they accommodate his/her educational needs and learning preferences. Alternatively, instructionally stimulating environments may lead to total
chaos if not grounded in structured and saliently reinforced environments. In sum, the hypothetical success of the model is based on the concurrent implementation of the three modes of interventions.

Nevertheless, future studies that examine the effectiveness of the model for the ADHD child by implementing it in the real classroom are needed. The first step would be educating the teachers on the nature of ADHD and training them in applying the recommended interventions. In addition, the collaborative efforts of the parents and school principal are needed in order to facilitate the implementation process. It is worth mentioning that the recommended strategies can be also appropriate for children without ADHD, which allows its application in the regular classroom, especially that many recommended strategies are generalized and not individually applied; however this has yet to be verified by research. The findings of future studies of the sort would be instrumental in defining the limitations of the model and/or the variables that control its effectiveness, acceptability, feasibility of application, and appropriateness for children with and without ADHD. The two major research questions should be whether the combination of all three forms of interventions would resolve the ineffectiveness observed with other forms of school intervention on the academic progress of students with ADHD (e.g., DuPaul and Eckert, 1997), and whether the model would be effective in treating the students’ low frustration tolerance, emotional vulnerability, and high distractibility (e.g., Snider et al, 2003).

In addition, issues such as teachers’ training, principal’s involvement, and parents’ cooperation should be studied. In sum, the validity of the model should be empirically examined in terms of effectiveness on the students’ academic, social and
affective outcomes as well as practicality of application in regular classroom settings and acceptability by teachers, parents, and principals.
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Figure 1. Tripartite intervention model for the ADHD child in the regular classroom.
Figure 2. Example of a schedule chart for a KG1 math class period to be used with students with ADHD. A student's copy to be anchored to his/her desk and checked by the student successively.

<table>
<thead>
<tr>
<th>KG I</th>
<th>Math Period: Counting and Writing Numerals</th>
<th>55 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rug-time</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Counting</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Matching</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Tracing Numerals</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Number Storybook</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>Cutting Numbers</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>Your Choice</td>
<td>?</td>
</tr>
</tbody>
</table>

![Diagram of schedule chart with visual icons for each activity.]
Figure 3. Teacher’s copy of the schedule for the KG1 math class period of Figure 2.

<table>
<thead>
<tr>
<th>Duration 8 minutes each</th>
<th>Lesson Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teacher’s objectives of each activity in the schedule</td>
</tr>
<tr>
<td>1</td>
<td>Teacher explains classroom rules, theme and schedule of lesson. Proactive behavioral strategy and reinforcement of listening skills</td>
</tr>
<tr>
<td>2</td>
<td>Children count manipulatives: blocks, beads, sticks, etc. Hands-on learning with some physical movement allowed.</td>
</tr>
<tr>
<td>3</td>
<td>Teacher checks for understanding by matching activities. Giving immediate feedback and social praise.</td>
</tr>
<tr>
<td>4</td>
<td>Children practice pre-writing numerals for a short period of time Children sustain attention to a seatwork writing activity.</td>
</tr>
<tr>
<td>5</td>
<td>Children assign meaning to counting numbers: Story of Snow White and Seven Dwarfs; a brain-based learning strategy.</td>
</tr>
<tr>
<td>6</td>
<td>Children practice fine motor skills and learn to read and write numbers by a different tactile modality.</td>
</tr>
<tr>
<td>7</td>
<td>A reinforcement activity upon completion of scheduled activities. A behavioral strategy used with a structuring strategy.</td>
</tr>
</tbody>
</table>
Figure 4. An example of a pictorial representation of classroom rules.
Figure 5. An example of a pictorially illustrated behavioral chart for a KG2 child with ADHD who is showing impulsive and disruptive behaviors in class.

### My Classroom Rules

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://via.placeholder.com/150" alt="Smiley" /></td>
<td><img src="https://via.placeholder.com/150" alt="Sad" /></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I write on my own papers.

I share toys with my friends.

I raise my hand before I speak.
Figure 6. The three Ss for the Success of the tripartite classroom-based intervention model for the ADHD child in the regular classroom.
Your search identified only this item.

Title Feasibility study of a cooperative in Guzai area Thesis
Name(s) Musawi, Abdo M.
Physical iii, 58 leaves; ill., tables.
Details
Publication [S.l.] : s.n., 1988
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Subjects Feasibility studies
Cooperative studies -- Lebanon
Notes Research topic (M.S.)--Business Studies Division, BUC, 1988.
Includes bibliographical references (l. 55-56).

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