CONVERGENT VALIDITY OF THREE MEASURES OF ATTENTION-HYPERACTIVITY DISORDER AMONG CHILDREN WITH FOOD ALLERGIES

by

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ABSTRACT

The aim of the present study was to determine the convergent validity of three instruments thought to assess attention deficits and hyperactivity in children. The Freedom from Distractibility factor from the Wechsler Intelligence Scale for Children-Revised, The Conners Parent Symptom Questionnaire and the Gordon Diagnostic System were the instruments chosen for the investigation as they are thought to measure attention deficits across a variety of settings and by different means.

To examine the relationship, responses were collected for 36 children (26 males, 10 females) in Grades 1 to 7 attending schools in the Lower Mainland of British Columbia and who according to parent reports exhibited behavior patterns similar to the descriptions needed for the diagnosis of Attention Deficit-Hyperactivity Disorder.

Results of the analyses are inclusive and need to be followed up in subsequent research. The WISC-R provides a valid and reliable measure of general cognitive ability. Two subtests from the WISC-R, Coding and Digit Span appeared to measure attention, however the Freedom from Distractibility Quotient should not be utilized as a measure of attention. Learning Problems and the Hyperactivity Index on the Conners Parent Symptom Questionnaire also serve as measures of attention. In a more general sense the Conners Parent Symptom Questionnaire might be a useful contribution to an assessment battery as a description of a child's behavior from a parent's point of view and as such provides an ecological assessment of behavior. It also allows one to measure behavior over time. The Vigilance and Distractibility total correct and errors of commission would appear to be measures of attention while the Delay task failed to classify the children according to the behavior objectives set out by the study.

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CHAPTER I. INTRODUCTION

A. BACKGROUND TO THE PROBLEM

Attention deficit, with or without hyperactivity has been the subject of much research and controversy for the last twenty years. Some researchers report that it is one of the leading sources of referrals to child health specialists (Barkley, 1987; Cantwell, 1987a; Ross & Ross, 1982). In educational settings either the behaviors associated with attention deficits, such as impulsivity, poor attention span, and the inability to complete assignments or chronic under achievement are reported as major concerns for assessment and intervention (Barkley, 1987; Garfinkel, 1987b).

A brief description of a child in question might be as follows. This child, usually a boy, behaves impulsively, or acts without thinking; a pattern which leads to social isolation and to academic failure. He can not seem to maintain expected behaviors for more than a few minutes to complete activities he initiates, regardless of the nature of the task. Nor can he supress spontaneous utterances, or control motor activity. Often he is forgetful, frets, has instantaneous mood changes, and is generally very unhappy (Sleator & Ullmann,1981; Zukow, Zukow, & Bentler, 1978). It is hard for him to initiate or maintain friendships.

The school may further comment that the child is lazy, careless, sloppy, can not follow rules and never completes assignments (Sattler, 1982). He is continually involved in altercations with the teachers and other pupils; he is unable to accept responsibility for his actions or achievement. In most cases his social *faux pas* do not have a malicious intent; he is genuinely startled at the anger or rejection his actions elicit. He seems normal in every respect, yet he has inordinate and pervasive difficulties surviving in the everyday world. This is the enigma of the attention deficit, or hyperactive child, a dilemma which continues to puzzle and intrigue health and education specialists.

B. PREVALENCE

Between three and fifteen percent of school age children may be considered hyperactive in Canada or the United States (Cantwell, 1987a; Firestone & Martin, 1979; Schachar, Rutter & Smith, 1981). In Great Britain and Europe this diagnosis is reserved for about one percent of the population of children with normal intelligence who show signs of overactivity and inattention in all situations. Often many of the children who would be diagnosed as hyperactive in North America are termed conduct disordered in Europe (Schachar, Rutter, Smith, 1981). The estimate is dependent on several variables in accordance with the definition criteria used to identify the children, the degree of concensus among those making the diagnosis, the sex of the child, and the socioeconomic status of the family. The prevalence of attention deficit with hyperactivity (AD-HD) is lower when the diagnosis is made by a physician; teacher ratings tend to fall within the higher percentages (Sandoval Lambert & Sassone, 1980; Whalen, 1983). Each of these issues will be discussed briefly later in this section of the thesis; further support and clarification will be offered in Chapter II.

Traditionally boys were thought to have a much higher incidence of (AD-HD) than girls (de Haas, 1986). The ratio of six boys to every girl has been suggested (Barkley, 1987; Kerasotes & Walker, 1983). In non-clinical referral groups Garfinkel (1987b) has suggested the ratio might approach 2 boys to every girl at the elementary level, but this ratio is reversed at the secondary level. One explanation is that some of the boys are reclassified as conduct disordered at the secondary level. Girls emerge as AD-HD at the secondary level partially as a function of the task complexity demanded at that level.

In a landmark study by Lambert, Sandoval and Sassone (1981) the prevalence ranged from 1.9 to 13 percent of school age children depending on the social system defining the disorder. Medical, educational, and family systems were in agreement on the diagnosis 1.9 percent of the time. The prevalence increased to 4.92 percent when one or more systems agreed. It is noteworthy, however, that 7.75 percent were rated as having attention deficts when rated by teachers alone. An overall population rate of four to five percent appears to be reasonable, if not conservative.

C. THE LABEL AD-HD

Some research has suggested there is no relationship between Attention Deficit Disorder with Hyperactivity Disorder (AD-HD) and environmental factors such as race, birth order, parental age, education level and marital status. Other reseachers failed to find a meaningful relationship with socioeconomic variables (Goyette, Conners, & Ulrich, 1978). These findings are important as they argue against the position that ethnic minority or lower income children have been stigmatized by the AD-HD label. However, when the frame of reference is expanded to include high risk factors such as broken homes, overcrowding, and familial distress such as paternal alcoholism or maternal depression significant relationships between these factors and AH-HD do emerge (Cantwell, 1987b; Garfinkel, 1987a; Shapiro & Garfinkel, 1986; Sroufe & Jacobvitz, 1987).

Over the past twenty years there has been a continually changing nosology used to describe a group of behaviors commonly referred to as attention deficits with hyperactivity (Ferguson & Rapoport, 1983). To some extent the authors' backgrounds and training have dictated these changes. Medical researchers such as pediatricians or psychiatrists consult the DSM III (American Psychiatric Association, 1980) or the DSM III-R (American Psychiatric Association, 1987) and discuss the behaviors in terms of attention deficits with or without hyperactivity. Educators and lay persons are more likely to discuss the same symptoms in terms of hyperactivity. The changes have also reflected shifts in ideology from a major central nervous system disturbance to minimal brain damage and then to the term *hyperactivity* which then lead to the term *hyperkinesis*. The changes have involved more than semantics; each change has come about as researchers and clinicians attempted to provide diagnostic labels that would more clearly define the essential features involved in the disorder.

The symptoms of hyperactivity are observable manifestations by which a variety of congential, toxic, and environmental influences are expressed (Rapoport, Quinn, Burg & Bartley, 1979). There is an essential symptomology that is common to all. The interpretation of the observed behaviors has changed over time to reflect more sophisticated measurement devices, or as a result of greater insights into the nature of the problem. Two symptoms that have endured the test of time and appear to be essential elements in the problems associated with attention deficits are impulsivity and an inability to sustain attention. The nature of these constructs is developed in Chapter II.

The hyperactive child often appears to change action or thought in midstream. These frequent and dysfluent shifts refer to impulsivity and the inability to sustain attention (Gittelman-Klein, 1975). It appears that the child makes his decisions too quickly, without regard to the consequences his initial action will have on subsequent action or interactions with others (Klein & Gittelman-Klein, 1975). Deficits in the ability to focus and sustain attention are one of the causes for responses which are impulsive or poorly organized. In the same vein, it is difficult to sustain attention when impulsivity interferes with the ability to attend. Together, impulsivity and the lack of ability to sustain attention produce a pattern of behaviors called *impulsive style.*

Impulsive style has implications for normal children as well as AD-HD children. Normal children who score high on measures of impulsivity make more errors of commission on serial learning tasks and have higher error scores on tests of inductive reasoning. They are more physically active, more distractible and less attentive than their normal peers (Douglas, 1972). With reference to cognitive style Ross & Ross (1982) found hyperactives differ from normal children on reflection and impulsivity but not on motor impulsivity.

On vigilance, or continuous performance tasks, AD-HD children identify fewer correct responses and respond more frequently to incorrect stimuli than their normal peers. Later errors on the same tasks appear to be impulsive in nature (Gordon, 1979).

It is widely accepted that these children are able to initiate activities but that their continued performance is contingent on reinforcement. Barkley (1987) suggests that the nature of the reinforcer either positive or negative is unimportant. What appears to be determining factors are the frequency, novelty, and continuity of the reinforcement (Douglas, 1972).

Inspite of a tremendous amount of research the guidelines for the diagnosis of attention deficits have remained unclear (Cantwell, 1987a; Douglas, 1972). Attention deficit children appear to be a heterogeneous group, and therefore the diagnosis needs to be multifaceted (Barkley, 1981; Garfinkel, 1987b). The lack of observable, objectively determined pathology has hindered identification and diagnosis of this group. Often the absence of something, such as the inability to sit quietly, is the criterion used to guide diagnosis. When the absence, rather than the presence of a behavior is the criterion, difficulty arises in determining who does, or does not, meet the criterion (Sandoval, Lambert, & Sassone, 1980). Previous research and clinical practices have employed vague and subjective descriptions which are of little help in establishing parameters for an operational definition of attention deficit with/without hyperactivity or in defining the construct (Poggio & Salkind, 1979).

There is no single diagnostic label that can adequately describe the full variety of behaviors associated with AD-HD. Consequently, attention deficits may best be approached by examining the individual symptoms that comprise it and then the coexistence of these symptoms in various combinations. The preferred approach is one which examines those tools purporting to measure the individual symptoms in a cross-situational, multidimensional and multidisciplinary assessment (Johnston, 1986). The lack of a universally accepted diagnostic battery further complicates the isolation of underlying traits in this heterogeneous population.

D. PURPOSE OF THE STUDY

The present study examines the utility of three instruments for identifying AD-HD children. Those instruments are subtests from the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Wechsler, 1974), a widely used individually administered intelligence test; the Conners Parent Symptom Questionnaire (CPSQ) (Goyette, Conners & Ulrich, 1978), a behavior rating scale commonly used in clinical practice; and the Gordon Diagnostic System (GDS) (Gordon, McClure & Post, 1986), a relatively new, empirical instrument reported to assess impulsivity and attention.

E. JUSTIFICATION

In educational settings school psychologists are often asked to assess children with attention deficits accompanied by academic failure or underachievement. Given the time restrictions and sometimes limited resources in terms of assessment tools, it is important to put together a battery of tests which is both practical and portable, as the psychologist usually visits the child in his/her home school.

F. DEFINITIONS

a. AROUSAL

Arousal refers to the quantity and quality of cortical and automatic activation commonly referred to as physiological arousal since both are mediated by the reticular activating system (Rosenthal & Allen, 1978).

b. ATTENTION DEFICIT-HYPERACTIVITY DISORDER (AD-HD)

AD-HD is age inappropriate attention, impulse control, and rule governed behavior; being significantly pervasive in nature; and is not the direct result of general intellectual retardation, severe language delay or emotional disturbance, or gross sensory or motor impairment (Barkley, 1982)

c. SELECTIVE ATTENTION

Selective attention is the ability to attend and respond to a specific, specified stimulus. (Klein & Gittelman-Klein, 1975; Pelham, 1981; Tarver, 1981).

d. DISTRACTIBILITY

Distractibillity is the extent to which the presence of irrelevant information interferes with the individual's ability to selectively attend, and sustain attention to complete a task.

e. IMPULSIVITY

Impulsivity is the inability to restrain from responding or to reflect upon one's responses to the solution of a problem when several possibilities or alternatives are present and there is uncertainty about which is the most appropriate response.

f. SUSTAINED ATTENTION/VIGILANCE

Sustained attention refers to the type of attention that is needed to focus and maintain attention for the period of time necessary to respond to the target stimuli or to complete a task (Krupski, 1981).

G. STATEMENT OF THE PROBLEM

Few researchers of attention deficit disorder with hyperactivity have concerned themselves with the measurement instruments used in their studies. Because of this focus, extensive information on the reliability and the validity of the instruments used is not usually presented in the research reports. In many cases a standard assessment battery such as a WISC-R or a parent rating scale is given to each child at the referral centre regardless of the reason for referral. The underlying hypothesis seems to be the instruments chosen are appropriate for diagnostic purposes. The critical question that is seldom asked is: are these instruments valid or reliable in this assessment capacity?

The intent of the present study is to examine the convergent validity of three instruments thought to assess hyperactivity: the Freedom from Distractibility Factor on the WISC-R (Kaufman, 1979), the Conners Parent Symptom Questionnaire (Goyette, Conners & Ulrich, 1978), and the Gordon Diagnostic System (Gordon, McClure & Post, 1986). The rationale for choosing these three instruments is as follows. The Freedom from Distractibility factor on the WISC-R (Kaufman, 1979) has been well documented in several analyses of Wechsler profiles of hyperactive children (Hale & Landino, 1981; Milich & Loney, 1979; Sattler, 1982) and shown to be sensitive in discriminating clinical groups from normal children (Thompson, 1981).

The Conners Parent Symptom Questionnaire was chosen because of its widespread use in clinical practice. The items in Factor 1, Conduct Disorders and Factor IV, Impulsivity-hyperactivity appear to be sensitive to impulsivity and vigilance. The effects of poor selective and sustained attention would impact on Factor II, Learning Problems.

The Gordon Diagnostic System (GDS) has created interest due to its objective format and normative data (Gordon, McClure & Post, 1986), and as such it is important to investigate the extent to which its scores correlate with those from the WISC-R and the Conners Parent Questionnaire.

H. INSTRUMENTS

In educational settings the Wechsler Intelligence Scale for Children-Revised (WISC-R) has often been used to identify children with learning problems. This test was developed to measure general intelligence and provide clinicians with a useful instrument to predict a child's aptitude for school related achievement. The test has good validity and reliability for this purpose (Sattler, 1982). Its utility for the identification of hyperactivity is, however, not clearly demonstrated (Mueller, Dennis, & Short, 1986).

Kaufman's (1975) analysis of the WISC-R normative data revealed three factors. Two factors, Verbal Comprehension and Perceptual Organization, are thought to be measures of intellective abilities. The third factor, Freedom from Distractibility, appeared to measure behavioral rather than intellectual aspects of cognitive performance (Kaufman, 1979). For years researchers have questioned exactly what this statistically derived factor measures. To date no one has been able to adequately identify or substantiate the utility of this third factor in the interpretation of the WISC-R. Those who recognize this factor suggest it measures the ability to attend and concentrate, to screen out extraneous influences and to sustain attention on relevant aspects of the task. It is also said to measure numerical reasoning ability and sequencing ability. If it could be demonstrated that the third factor is capable of assessing these abilities it would be invaluable in the assessment of attention deficit with hyperactivity disorder.

Another instrument that has been very popular in the diagnosis of AD-HD is the forty-eight item Conners Parent Symptom Questionnaire (CPSQ). This scale is an abridged version of an earlier 93 item scale developed to aid in the identification of hyperactive children and to evaluate the effectiveness of treatment interventions. The scale was shortened and reworded in an attempt to simplify administration and interpretation. Behavioural observations are grouped into five factors: 1) Conduct Problems, 2) Learning Problems (Inattention), 3) Psychosomatic Problems, 4) Impulsivity-Hyperactivity, and 5) Anxiety.

Conduct problems represent behaviors associated with defiant or aggressive actions. Learning Problems, Factor II, reflects attentional or distractibility difficulties. Factor III consists of health related problems. Factor IV, Impulsive-Hyperactive, reflects restlessness, excitability and troublesome behavior but lacks the aggressive or defiant behavior of Conduct Problems. Factor V has items which identify a shy or withdrawn aspect of behavior.

Factor II and Factor IV contain items which suggest attentional components such as impulsivity and/or a short attention span as underlying causes for the learning and behavior problems hyperactive children encounter in their everyday lives. These two attentional features are essential components in most definitions of hyperactivity. The inclusion of this instrument in the assessment battery could be important because it includes aspects of the child's behavior in many situations and across time as seen by a parent or parents.

The Gordon Diagnostic System (GDS) employs a portable, electronic device designed to assess deficits in impulse control and attention in children. The purpose of this instrument is to evaluate behaviors thought to be critical dimensions of attention and impulse inhibition. In developing the GDS, the authors did not adhere to a theoretical conceptualization or etiology of hyperactivity. Instead they chose to look at the underlying processes of attention and impulse control. The assumption was that deficits in impulse control and sustained attention put children at a significant disadvantage in coping with problem solving (Gordon, McClure & Post, 1986).

The GDS has three subtests: Delay, Vigilance, and Distractibility. The Delay task measures the ability to refrain from responding in a self-paced setting. The child is instructed to press a button, wait a while, and then press it again. A lapse time of at least six seconds is required before a point is awarded for each correct response. The points are given as a means of reinforcing the desired behavior and motivating the child to respond appropriately. This is in keeping with the need for reinforcement to keep hyperactive children motivated to continue working.

The Vigilance and Distractibility subtests measure self-control in situations which require sustained attention. The child is instructed to press a button each time a target number (1) appears when it is followed by another designated number (9). Points are awarded for each correct detection of the appropriate number combination. On these subtests the child is unaware of the number of points he/she has earned until the end of each subtest. The microcomputer records the number of omissions (the number of specified combinations missed) and commissions (random responses).

The Distractibility subtest is identical to the Vigilance task except the digits flash at random intervals on the left and right margins of the screen while the target digits are presented in the centre column of the display. The child must attend and respond to the 1 followed by the 9 in the centre column and ignore the numbers that are flashing in the columns to the left or right of the target position. The task was designed to assess the impact of distractors on the child's ability to sustain attention. The fact the stimulus numbers flash in the centre column is in keeping with the research that suggests the positioning of the relevant stimuli influences the performance of AD-HD children (Swanson, 1981).

I. ORGANIZATION OF THE THESIS

The first chapter presents the general background to the problem, a statement of the problem, the purpose of the study, and concludes with the definitions. Chapter Two consists of a review of the literature related to attention as well as the research related to each of the three tests used in the study. In Chapter Three the research questions are presented; the research design and procedures are described also. The fourth chapter provides an overview of the statistical procedures and the pertinent findings for each hypothesis. The final chapter, Chapter Five, summarizes the findings of this study and states the conclusions and implications for future research and practice.

CHAPTER II. REVIEW OF RELATED LITERATURE

The objective of the present study is to investigate correlations between three measures purported to assess attention deficits observed in hyperactive children (AD-HD). This chapter will examine the literature as it relates to children with attention deficits and hyperactivity as opposed to studies which examine the attention deficits of children with specific learning disabilities.

The learning difficulties the attention deficit or hyperactive child encounters are a direct result of problems with attention and impulse control. It is hypothesized that problems associated with attention and impulse control impair satisfactory functioning in most environments and situations in the AD-HD child's daily functioning. This separates the AD-HD child from the learning disabled child who has one or more specific disabilities (Brown & Wynne, 1982b; Douglas & Peters, 1979; Garfinkel, 1987b). AD-HD children appear to be born with a constitutional predisposition towards impulsivity and an inability to sustain attention (Douglas, 1972; Douglas & Peters, 1979; Lahey, Stempniak, Robinson, & Troler, 1979).

A. AD-HD VERSUS LEARNING DISABILITY

For the most part the literature does not distinguish AD-HD as a unique phenomenon, separate from the diagnosis of specific learning disabilities. The confusion exists, particularly in earlier research, as a function of definitional problems, sample selection and the evolving theories about essential behaviors which constitute the disorder. Research results are beginning to appear which suggest distinct differences in AD-HD, learning disabled, and normal children. Some characteristics reported frequently seem to differentiate the three groups of children. The AD-HD children have demonstrated significant differences on conduct problems, hyperactivity indices, inattentive-passive and sociability factors (Brown & Wynne, 1982a; Delamater, Lahey, & Drake, 1981; Kuehue, Kehle & McMahon, 1987). In addition they demonstrated more difficulties with foresight and planning than do normal children when presented with situations requiring problem solving (Kuehue, Kehle, McMahon, 1987).

Children with specific learning disabilities are the least impulsive of the three groups which lends support for the "passive learner" hypothesis. The passive learner is reluctant to take risks, and appears to wait for direction, rather than interact directly with task demands. It is felt this hesitance might account at least in part for the poor academic standing of the learning disabled (Brown & Wynne, 1982a; McGee & Share, 1988).

B. DESCRIPTION

Attention Deficit-Hyperactivity Disorder may best be described as a configuration of symptoms that include hyperactivity, impulsivity, and attention-concentration problems (Barkley, 1982, 1987; Cantwell, 1987b; Douglas & Peters, 1979; Loney, 1980; Plomin & Foch, 1981). A variety of associated problems such as aggressive behavior, poor peer relations, low frustration tolerance, and nonresponsiveness to discipline may also be present together or in some combination (Barkley, 1987; Garfinkel, 1987a; Klein & Gittelman-Klein, 1975; Sleator & Ullmann, 1981; Weiss, 1975). There is a general consensus that attention deficit, or hyperactive boys have significant problems sustaining attention to relevant information, as well as controlling impulsive responses to nonrelevant information. Due to the lower prevalence of AD-HD in girls there is little published research which addresses the similarities and/or differences between boys and girls. The research that does exists tends to suggest that young girls lack the impulsive behavior seen in their male counterparts (Garfinkel, 1987b; de Haas & Young, 1984). Because of the lack of available research it is not clear if this reflects a sex difference between the two groups, or is an artifact of the sampling procedures used in the two reported studies.

Although hyperactivity as a diagnostic category may seem rather straight forward on the surface, it is difficult to define operationally. The DSM III-R (American Psychiatric Association, 1987) has attempted to capture the essential symptomology in changing the diagnostic label from Attention Deficit Disorder with Hyperactivity (American Psychiatric Association, 1980) to Attention Deficit-Hyperactivity Disorder (American Psychiatric Association, 1987). It has been recognized that hyperactive children may not engage in excessive motor activity per se, but they may present with excessive inappropriate behaviors (Douglas, 1972; Garfinkel, 1987). This change in emphasis reflects the assumption that developmentally inappropriate attention is virtually always present, and is often prominent in children formerly described under a variety of diagnostic headings such as "Hyperactive Child Syndrome" or "Minimal Cerebral Dysfunction" (American Psychiatric Association, 1980). Disenchantment with the emphasis on overactivity as an essential feature of the construct has been pervasive during the last decade or so (Henker & Whalen, 1980; Loney, 1980). It has also been argued that the change in emphasis is appropriate because the excessive motor activity found in younger children diagnosed as having attention deficits often decreases in adolescence, while attention deficits identified in younger children persist into adolescence (Barkley, 1987; Cantwell, 1987a,b; Garfinkel, 1987a). A long standing dissatisfaction with inexact and nonvalidated descriptive terms was the catalyst for the change to more precisely denote children with activity, attention-concentration, and impulsivity problems (Kerasotes & Walker, 1983; Schachar, Rutter, & Smith, 1981). The shift in thinking is an attempt to capture the essential clinical features common to a variety of former diagnostic labels under the rubric "Attention Deficit-Hyperactivity Disorder" (AD-HD). The shift is useful in (a) differentiating AD-HD from other meaningful diagnostic categories; (b) establishing etiologic and prognostic features; (c) determining differential response to available treatments; and (d) formulating and testing new treatments based on this reconceptualization.

It is now widely accepted that the major behavior manifested by AD-HD children involves an inability to sustain attention and to inhibit impulsive responses on tasks, or in social situations, that require focused, reflective, organized, and self-directed effort (Aman & Turbott, 1986; Douglas 1972, 1980, 1983; Garfinkel & August, 1987; Loney, 1980). Impulsivity, hyperactivity, and the inability to sustain, and organize attention are seen as intimately related aspects of the same constitutionally determined problem (Barkley, 1982; Loney, 1983; Rapoport & Ismond, 1984; Whalen, 1983). One of the problems in measuring the hypothesized deficits in attention, is that attention is intimately linked with interest, motivation, and ability factors. Barkley (1987) and Cantwell (1987a) feel that AD-HD children do not suffer from a basic deficit in fundamental cognitive operations involved in concept formation processes. However, the adequacy of performance is dependent on continuous reinforcement, and length of time required to complete the task. Deficits on perceptual memory tasks may be attributed to a failure to invest sufficient effort into such activities as processing visual or auditory information carefully and deeply, committing this information to memory, and then retrieving information that has been successfully processed and stored.

Researchers and clinicians have experienced difficulty in defining and measuring the exact class of behaviors peculiar to this group of children (Eliason & Richman, 1987; Kinsbourne & Swanson, 1979). Three alternative constructs have generated interest: arousal, attention and motivation.

In summary, the clearest and most consistent evidence for arousal deficits in hyperactive children occurs when children are required to remain alert for the appearance of expected stimuli. Reinforcement schedules must cue the children towards the specific demands of the task. The fundamental problem of AD-HD children is difficulty deploying and sustaining attention relative to their peers (Ollendick & Hersen, 1982).

C. ATTENTION

Attention is one of the most poorly understood constructs in cognitive psychology as it can not be measured directly (Pelham, 1981). We can only measure observed behavior or performance on a task and draw conclusions about attention, or lack of attention (Krupski, 1981; Pelham, 1981). Most tasks which require high levels of attention also require other skills, such as those related to memory or motivation (Krupski, 1981). In fact, it may be that a minimum amount of learning is necessary before attention can occur. This leads to serious problems interpreting poor performance on vigilance tasks which are frequently used as measures of attention. Further, caution is needed in making generalizations which go beyond the specific task situation used in a particular experiment to statements and applications in every day life. Attention, like arousal, describes the process by which one receives and processes information. The degree to which one is capable of attending is a function of the quantitative and qualitative features of physiological arousal (Pehlam, 1981). It follows then, that arousal, inhibitory control of activity (impulsivity, fidgeting) and attention are interrelated constructs which describe three separate dimensions of human functioning. Behavioral measures of attention and physiological arousal have correlated to such an extent that in the cases when meaningful correlations have not resulted researchers have been baffled. Cognitive psychologists believe the primary deficit is due to defective inhibitory processes in the brain as the AD-HD operate as if they lack central inhibitory capacity over their internal drives and the external stimuli impinging upon them (Rosenthal & Allen, 1978). Douglas (1972), referred to this as the inability to *stop, look, and listen.* The deficit inhibition presumably leads to inefficient switching, and consequently to poor attention and diffuse patterns of discharge from the brain (Rosenthal & Allen, 1978). This diffuse discharge also activates motor areas resulting in restlessness and impulsivity. AD-HD children have more difficulty regulating motoric tempo, particularly when tasks call for delays before responding (Cotugno, 1987). Distractibility and attention deficits impair problem solving performance as the child makes his decisions hastily without reflection on all available strategies or alternatives, instead basing his solution on partial or faulty information (Douglas, 1983; Schlesser & Thackwray, 1982). Errors result. Consequently when we describe attention, we are actually referring to three distinct components involving attention. Coming to attention (arousal), decision making (selective attention), and maintaining attention (sustained attention). All three are intricately related in that each plays a major role in the observed behavior in an individual (Brown & Wynne, 1984). In normal children the ability to organize, and deploy attention develops with age, as it does in AD-HD, hower, AD-HD do not perform as efficiently as their normal peers on tasks of attention (Brown & Wynne, 1984; Sykes, Douglas & Morgenstern, 1973), a trend which seems to follow them into adolescence and adulthood (Klee, Garfinkel, & Beauchesne, 1986). In order to diagnose AD-HD one needs to demonstrate faulty attention. Douglas and Peters (1979) suggested these deficits are in the investment of attention and effort, inhibition of impulsive responding and the appropriate modality of the arousal level to meet situational or task demands. On Matching Familiar Figures Test AD-HD exhibited shorter response latency and more errors. When methylphenidate was used, impulsivity seemed to lessen, as response latency increased and errors decreased (Flintoff, Barron, Swanson, Ledlow & Kinsbourne, 1982).

a. Selective Attention

The term selective attention is used to describe how attention is distributed among elements of the stimulus field. This implies that selective attention is an active process in which the individual is overwhelmed by the impact of incoming stimuli, making it difficult to focus on the salient features of the information to be processed. An opposing view is that selective attention be used to define the process of choosing to notice a particular event in the environment (Swanson, 1981). This implies a filtering process imposed by limitations in the central nervous system's capacity to process information. The individual must be able to focus on relevant information and to exclude irrelevant or distracting information (Klein, & Gittleman-Klein, 1975; Ollendick & Hersen, 1982; Pelham, 1981; Tarver, 1981). Distractors are most detrimental when there is a chance that they may be evaluated cognitively. Intra-task distractors are more likely to be cognitively evaluated than extraneous information presented outside the task content (Rosenthal & Allen, 1980). The manner the information is perceived will influence the manner in which it is processed. Thus the interpretation of a current event will be in part determined by its similarity to situations from the subject's past experiences and learning (Torgesen, 1981; Vrana & Pihl, 1980). This dependence on past experiences to help structure application to new problems may explain why selective attention improves with age.

Central-incidental learning theory, which is influenced by filter theories of attention, has been applied to investigate selective attention in AD-HD as compared to their normal peers. This method allows for a direct assessment of learning that is relevant to the task, *central learning*; while *incidental learning* provides a measure of the amount of irrelevant or extraneous information retained. Incidental learning scores are usually judged in relation to those of central learning. When central learning is high, incidental learning should be low and vice versa (Douglas & Peters, 1979). The interpretation of both measures is strongly influenced by the belief that there is a necessary trade off between the acquisition of information that is relevant and information the researchers deem irrelevant (Tarver, 1981). When AD-HD and nonAD-HD groups are matched for age, sex, intelligence and socioeconomic status two significant factors emerge. The central learning abilities for both groups improve with age (Aman & Turbott, 1986; Douglas & Peters, 1979), At different age levels AD-HD recall significantly less central learning than their peers (Tarver, 1981; Vrana & Pihl, 1980). There appears to be little or no evidence to suggest AD-HD children are more likely to remember more irrelevant information than their normal peers (Swanson,1983; Tarver, 1981; Vrana & Pihl, 1980). As younger subjects made more errors than older subjects regardless of group designation, it is felt that age related performance reflects a developmental trend in selective attention (Aman & Turbott, 1986; Pelham, 1981; Sostek, Buchsbaum, & Rapoport, 1980; Sykes, Douglas & Morgenstern, 1973).

Another issue that has been raised, but not satisfactorily addressed, is that the observed differences may reflect the capacity of short term memory rather than selective attention (Aman & Turbott, 1986; Douglas & Peters, 1979). Aman & Turbott (1986), found AD-HD perform normally on a wide variety of memory tasks. Their performance seems to break down only on tasks which require elaborate rehearsal strategies. A more widely accepted position is that the inability to sustain attention is that deficit(s) in the processes of stimulus selection are responsible as it was found that the AD-HD employ less effective visual scanning strategies in their search for the correct alternatives. As a consquence they make proportionately fewer systematic visual comparisons among the problem stimuli (Flintoff, Barron, Swanson, Ledlow & Kinsbourne, 1982). It may be that the quality of the AD-HD's interactions with the stimulus field are, to a large extent, limited by the poor quality of selective attention. Also there may be a lack of prequisite cognitive skills of selective attention to abstract the necessary information from a general rule (Schlesser & Thackwray, 1982).

b. Sustained Attention

Sustained attention refers to the type of attention that occurs when a subject must maintain attention for an extended period of time while awaiting the occurrence of a target stimulus (Krupski, 1981; Pelham, 1981). Deficits in attention that interfere with cognitive processes result in observable cognitive and behavior problems (Pelham, 1981). The focal problem with AD-HD is the apparent inability to sustain attention (Barkley, 1982; de Haas & Young, 1984). Confusion is generated by the difficulty defining and measuring attention, heterogenous samples used in research, and the confounding relationship between memory and attention.

Two basic assumptions come into play. The first, AD-HD have the same level of attentiveness or sensitivity to transmitted information as non-AD-HD, but AD-HD show a decline in performance as a function of the length of time spent on task (Gadow, 1981; Goldberg, & Konstantareas, 1981). Decrements in performance are attributed to distractibility and impulsivity. Evidence of this assumption is the frequency with which AD-HD change activities, often before completion (Ollendick & Hersen, 1982). The second assumption, poor attentional performance is attributed to a decrement in the AD-HD's capacity to detect transmitted information adequately. Performance suffers because of a diminished sensory capacity for processing information (Swanson, 1983; McGee & Share, 1988; Sykes, Douglas & Morgenstern, 1973). Two conclusions that follow are: AD-HD have a constitutional inability to sustain attention, and to inhibit responding in situations that require focused, directed, and organized effort (Douglas, 1972); and because of these deficits, AD-HD fail to apply sufficient, organized, and strategic effort to information processing in task settings (Douglas & Peters, 1979). Research demonstrating improved sustained attention with age has supported this position (Swanson, 1983, 1981; Sykes, Douglas, & Morgenstern, 1973).

c. *Vigilance*

The vigilance paradigm has been adopted to study the capacity for sustained attention and distractibility in AD-HD children (Gordon, 1986; Klee & Garfinkel, 1983). This paradigm states attention must be maintained in order to detect a stimulus that occurs randomly and infrequently over time. The objective of vigilance tasks is to detect unpredictable and infrequently presented stimulus signals that are interspersed amongst background stimuli over an extended period of time (Krupski, 1981). In these situations one needs not only to direct and sustain attention to tasks and maintain appropriate vigilance, but also to divide attention, selectively, responding to some cues and ignoring others (Rutter, 1983).

The Continuous Performance Test (CPT) provides an objective method of measuring attention, and is gaining wide spread popularity as it taps attention lapses and impulsivity in AD-HD. Poor performance may result from poor perceptual sensitivity (a failure to distinguish signal numbers from nonsignal numbers), and/or an over or under inclination to respond (to press a response button too many or too few times) (Sostek, Buchsbaum, Rapoport, 1980).

The CPT was first described by Rosvold in 1956 as a measure of brain injury in adults. In its original form subjects were required to view a revolving drum through a small window with the instruction to press a response button each time a designated target letter appeared. Although it was designed for adults, it was found to discriminate between brain damaged and non-brain-damaged children (Eliason & Richman, 1987).

More recently, the CPT has been used to study sustained attention in learning disabled and AD-HD children. Research has suggested a significant three way interaction between group designation x time x modality. This is consistent with the notion that AD-HD differ in how they allocate attentional mechanisms to visual and auditory presentations. Also the AD-HD demonstrate a structured inefficiency in discriminating relevant from nonrelevant information (Swanson, 1983, 1981). Numerous studies have demonstrated a preference for visual modes (Gordon, 1986; Klee & Garfinkel, 1983) over auditory continuous performance tasks as AD-HD achieved significantly higher scores on visual tasks (Barkley, 1987; Klee & Garfinkel, 1983; Swanson, 1983, 1981; Sykes, Douglas, Morgenstern, 1973). Consistently fewer correct responses and more errors of omission and commission were observed for AD-HD as compared to their normal peers (Aman & Turbott, 1986; Douglas, 1980; Gadow, 1981; Swanson, Barlow, & Kinsbourne, 1981). Errors of omission and errors of commission have been interpreted as lapses in sustained attention (Aman & Turbott, 1986; Douglas, 1980; Gadow, 1981; Garfinkel, 1987, Swanson, Barlow & Kinsbourne, 1981).

Slower response rates as well as greater variability in performance are also reported for AD-HD (Douglas, 1972; Goldberg & Konstantareas, 1981; Ross & Ross, 1982; Swanson, Barlow, & Kinsbourne, 1981; Sykes, Douglas, & Morgenstern, 1973). This finding is important because it questions the assumption that AD-HD have the same sensitivity for attention as non-AD-HD and lends support to the second assumption about attention which presents AD-HD as having diminished sensory capacity. Attention has been reviewed only in the capacity of its impact on AD-HD. As may been seen there is still confusion and controversy surrounding the underlying assumptions.

The relevant literature as it relates to the measures used in the study will be the focus for the remainder of Chapter II.

D. STANDARDIZED BEHAVIOR RATING SCALES

Standardized behavior rating scales have provided reliable substitutes for subjective impressions of behavior (Ollendick & Hersen, 1982). The normative data enables an examiner to compare individual ratings against those obtained on larger samples of nonreferred children of the same age and sex. These comparisons are important for judging the degree of deviance in a behavior (Klee & Garfinkel, 1983) and to identify children for selection and evaluation of treatment and research programs (Brown & Wynne, 1982b). A rating scale may also be useful in delineating component, or target behaviors in a presenting problem (Zukow, Zukow & Bentler, 1978). By operationalizing the different component parts, one is able to define not only the target behaviors but also to delinieate between different behavior subtypes (McMahon, 1982; Ollendick & Hersen, 1982).

In view of the shift in diagnostic criterion from a focus on overactivity to a recognition of attentional disturbances and poor impulse control, the relationship of the CPSQ to attentional processing and inhibition control as measured by psychometric tests is important in understanding whether parent ratings on the CPSQ are sensitive to attentional deficits. Although the CPSQ has distinguished between AD-HD and non AD-HD children (Cantwell, 1987a; McMahon, 1982), a review of related literature by Barkley (1982), reported that 70% of the studies fail to use the parents' opinion in the labelling process of AD-HD. This may happen because many of the children are diagnosed in the early school years, with teachers' opinions initiating the referral (Sandoval, Lambert & Sassone, 1980). In one sense teachers have the advantage of using the rest of the class as a comparison group with which to form judgments and ratings. Parents are at a disadvantage as they do not have the same comparison from which make judgments such as "just a little" or "very much" (Routh, 1980).

In using rating scales it must be remembered that they are vulnerable to practice or regression effect: behaviors are more likely to be rated more negatively on the first administration than on the second or subsequent administrations (Barkley, 1987; Gordon, 1986; Ollendick & Hersen, 1982). Another troublesome aspect of behavior rating scales is that information obtained from two sources often fails to correspond. The little research literature that is available on parent ratings is somewhat vague in this respect. Correlations between mother's and father's ratings have ranged from moderate (Goyette, Conners, Ulrich, 1978) to no correlation (Glow, 1981). When sources disagree, it is difficult to ascertain how much of the disparity reflects actual differences in the child's behavior across settings and how much reflects differences due to a failure to define the response alternatives operationally (Ross & Ross, 1982).

Moderate reliability and validity associated with rating scales has been attributed to rater bias, and vague and/or leading questions (McMahon, 1982; Prout & Ingram, 1982).

E. CONNERS PARENT SYMPTOM QUESTIONNAIRE

The Conners Teacher Rating Scale (1978) is one of the most frequently cited behavior rating scales (Barkley, 1987). Although there is an abundance of information related to the validity of this measure there is very little published research on the CPSQ despite its wide spread use in clinical practice (Barkley, 1987).

The 48 item CPSQ (1978) is a revised version of the 93 item scale designed to aid in the diagnosis of hyperactivity and to evaluate treatment effects. The scale was shortened and reworded in some cases to simplify administration and interpretation. Through factor analytic techniques the items were assignated to five factors labelled as Conduct Problems, Learning Problems, Psychosomatic, Impulsivity-hyperactivity, and Anxiety. A composite scale, borrowed items from the other factors plus three unique items formed the Hyperactivity Index.

1. Factor Structure of Parent Ratings

As shown in Figure 1, the items on Factor I, Conduct Problems, indicate clear evidence of defiant or aggressive conduct disorder. Factor II, Learning Problems reflect difficulties related to attention and distractibility. Factor III,

Figure 1: CPSQ by Factor Items in CPSQ

Factor		CPSQ Items in Factor
Conduct Problems	2.	Sassy to grown-ups
	8.	Carries a chip on his shoulder
	14.	Destructive
	19.	Denies mistakes or blames others
	20.	Quarrelsome
	21.	Pouts and sulks
	22.	Steals
	23.	Disobedient or obeys but resentfully
	27.	Bullies others
	33.	Mood changes quickly and drastically
	34.	Doesn't like or doesn't follow rules or restrictions
	39.	Basically an unhappy child
Learning Problems	10.	Difficulty learning
	25.	Fails to finish things
	31.	Distractibility or attention span a problem
	37.	Easily frustrated in efforts
Psychosomatic Problems	32.	Headaches
	41.	Stomach aches
	43.	Other aches and pains
	44.	Vomiting or nausea
	48.	Bowel problems (frequently loose; irregular habits; constipation)
Impulsivity Hyperactivity	4.	Excitable, impulsive
	5.	Wants to run things
	11.	Restless in a squirmy sense
	13.	Restless, always up and on the go
Anxiety	12.	Fearful (of new situations; new people or places; going to school)
	16.	Shy
	24.	Worries more than others (about being alone; illness or death)
	47.	Lets self be pushed around
Hyperactivity Index	4.	Excitable, impulsive
	7.	Cries easily or often
	11.	Restless in the squirmy sense
	13.	Restless, always up and on the go
	14.	Destructive
	25.	Fails to finish things
	31.	Distractibility or attention span a problem
	33.	Mood changes quickly and drastically
	37.	Easily frustrated in effects
	38.	Disturbs other children

Psychosomatic Problems, consists of health related difficulties. Items on Factor IV, Impulsivity-hyperactivity, probe the restlessness, excitability, and troublesome behavior associated with attention deficits, but lack the aggressive behavior components found in Factor I, Conduct Problems. The fifth factor, Anxiety, consists of items suggesting a shy and withdrawn nature.

The CPSQ was standardized on 570 children representing 277 families in the Greater Pittsburgh area. Males accounted for 55% of the sample; while females accounted for 45% of the sample. The mean age of the sample was 9 years, 9 months.

Of the 570 children, 560 children (98%) were Caucasian, eight (.01%) were black, and less than 1% were Asian. Five hundred and thirteen children (90%) had never repeated a grade, while 51 children (9%) had repeated at least one grade. Forty-two children representing 7% of the sample were adopted. Twenty-five children (4%) had received medical treatment, counselling or testing because of behavior problems, while 5% of the sample had been tested because of suspected learning disabilities. Sixty-four (11%) of the sample had experienced separation or divorce of their parents. The occupational levels and family income were normally distributed.

2. Reliability

Varimax rotated factor analysis using principle factors was used in the item analysis of parent ratings. Total score product-moment correlations between mother and father ratings of behavior was .59, with a mean item correlation of .41. All correlations reached the 99% level of significance on two-tailed probability. Statistically significant differences between mother and father ratings ($p<.01$) were found on five items (#2, 16, 24, 37, and 45) with mother's ratings more problematic than father's.

Factor scores for each of the subtests in the CPSQ were used to establish the inter-rater reliability between mother and father ratings. Pearson product moment correlations ranged from .46 on Psychosomatic Problems to .57 on Conduct Problems. All correlations were significant at the $p<.001$ level. Although mother and father ratings differed on five individual items, these differences did not affect the overall level of agreement when the items were rated in the context of the factor scores.

3. Validity

Coefficients of congruence using 40 identical or highly similar items were calculated to determine agreement between the original 1973 (93 item scale) and the 1978 revised scale (48 item scale). The factor structure of the two scales appears to be very similar. The authors believe the shorter, revised scale may be used without a significant loss of information (see Table 1).

4. Age and Sex Norms

The age and sex of a child were significant determinants of a child's score. Two-way analysis of variance revealed significant sex effects for the Conduct Problem and Learning Problem factors. Boys represented more difficulties in each case. Younger children exhibited more Impulsive Hyperactivity Problems and fewer Psychosomatic Problems. Appendix A presents the category norms for the CPSQ.

Goyette, Conners and Ulrich (1978) state that rating scales are unstable across time; the instability is analagous to a practice-effect which occurs primarily between the first and second administration, rather than on the second

Table 1: Factor Structure of Original and Revised CPSQ Scale

Conduct Problem	.94
Learning Problem	.63
Psychosomatic	.91
Impulsivity, Hyperactivity	.70
Anxiety	.90

or subsequent administrations. Therefore it is necessary to state which administration the results are based on and therefore whether they are valid for the first or subsequent administrations of the questionnaire (Milich, Roberts, Loney, 1980).

The norms for the Parent Symptom Questionnaire were based on the first administration (Goyette, Conners, and Ulrich, 1978).

F. GORDON DIAGNOSTIC SYSTEM

The GDS is a recently developed microcomputer which provides an objective measure of impulse control and sustained attention by means of a game like task. Precise measures of impulsivity and sustained attention are needed as these measures reflect the attentional deficits which put AD-HD children at a significant disadvantage coping with problem solving (Gordon, 1986; Douglas, 1972).

The GDS permits two types of tests to be administered. Research in operant conditions provides a theoretical framework for the Delay test. In a procedure referred to as Differentiated Reinforcement at Low Rate Responding (DRL), responses that occur before a set time interval has passed are not reinforced, and subsequently serve to reset the timer governing reinforcement. A subject performing on a 6 second schedule is required to wait at least 6 seconds between responses in order to be successful, or to be rewarded. This procedure allows one to measure a child's ability to inhibit responding in a self-paced setting. The child is instructed "to press a button, wait awhile, and then press it again" (Gordon & McClure, 1983, P.3). A point is awarded for each correct response (i.e. a response made after waiting at least 6 seconds). A light flashes and a counter records the number of points the child has been awarded. If the response is made before the designated time lapse, no point is awarded, and the timer resets.

Two scores are generated for the purpose of this research, the total number of responses and the total number of correct responses.

The Vigilance Test, and the Distractibility Test, are versions of the continuous performance test which measures self control in situations requiring sustained attention (Gordon & McClure, 1983). The Vigilance Test requires the child to press a response button immediately after a predetermined number pair, a 1 followed by a 9, appears on the screen. Performance is measured over three, 3-minute intervals. Two scores are generated for use in the analysis, the total number correct and the total number of errors of commission. Errors of commission are defined as extraneous button pushes. The Distractibility Test follows the same procedure as the Vigilance Test but this time distractors are also present. The target numbers still flash on the screen one at a time in the centre column, however, numbers also appear in the left or right hand column. The child is instructed to respond to the 1-9 combination only when it appears in the centre column, and to ignore the 1-9 combination if one or both numbers appear in the left or right hand columns. Performance is again measured over three, 3-minute time blocks. Two scores are recorded, the total number correct, and errors of commission as described in the Vigilance Test.

While the GDS may be a more objective measure of impulsivity and attention, performance is measured under novel, artificial and even anxiety induced conditions rather than in a natural environment and therefore its relevance to everyday life must be documented (Ross & Ross, 1982).

1. Standardization for the GDS

Subjects were randomly selected from class lists of 13 public schools, 3 private schools, and 2 after school programs and nursery schools in the Syracuse, New York area (91%) and Charlottesville, Virginia (9%). Children with recorded academic failure, emotional problems, neurological impairment, learning disability, prior administration of psychotrophic medicine or involvement in psychotherapy were excluded from the study (Gordon and Mettelman, in press). Table 2 presents the distribution of subjects by age and task.

Table 2: Distribution of Subjects by Age and Task

	AGE (years)			
Task	6-7	8-9	10-11	12-16
Delay Test	308	238	198	219
Vigilance	258	194	160	218
Distractibility	107	99	74	82

Note: Adapted from Gordon & Mettelman (1986). *The Gordon Diagnostic System (GDS): Percentile tables and descriptive statistics*. New York: Gordon Systems Inc.

2. Test-retest Reliability

Ninety children, randomly selected from the standardization sample, were retested on the Delay and Vigilance test between 30 to 45 days following the initial administration of the GDS. Correlations ranged from a low of .68 on Delay-Total Correct to a high of .84 on Vigilance-Total Commissions, with a mean correlation of .75 (Gordon and Mettelman, in press). As a result the test-retest reliability is satisfactory, as the correlations were significant at the $p \leq .001$ level.

The Distractibility test was administered to 40 subjects between 2 and 22 days following the initial administration. The correlation for total correct was .67. The correlation for total commissions was .85. Both correlations were significant at the $p \leq .001$ level, again suggesting satisfactory reliability.

3. Validity

There is very little published research investigating the efficacy of the GDS due to its recent development and release for practitioners' use. Validation of the GDS utility has been hampered by the fundamental disagreement in the diagnostic criteria and consequent confusion surrounding the description of AD-HD (Gordon and Mettelman, in press).

In his doctoral dissertation, Gordon (1979) compared the performance of AD-HD and non-AD-HD. Significant differences were found between groups on the Delay total responses and total correct which suggested the AD-HDs experienced marked difficulty with the delay inherent in the task. In a replication study (McClure and Gordon, 1984), the Delay Task revealed significant differences ($p \leq .0001$) between AD-HD and non-AD-HD.

Various parent and/or teacher ratings and the GDS have found low or negligible correlations (Gordon and Mettelman, 1985). The authors suggest this may be due in light of the lack of agreement amongst parent and teacher ratings of the same child.

GDS ratings of impulsivity were not replicated in a study designed to assess the effects of drug dosage in AD-HD. Practice effects of repeated administrations of this measure may have led to a ceiling effect beyond which the medication effects were not detected (Barkley, Fischer, Newby, Breen, 1988).

G. FREEDOM FROM DISTRACTIBILITY

The Wechsler Intelligence Scale for Children-Revised (WISC-R), a revised version of the WISC (Wechsler, 1949) has become one of the most widely used tests of intelligence since its publication in 1974.

Wechsler (1974) described intelligence as "...the overall capacity of an individual to understand and cope in the world around him". (Wechsler, 1974. Page 5). In this vein, intelligence is a multifaceted construct, which is inferred from the way abilities are manifested in different circumstances and in different conditions.

The WISC-R was standardized on a stratified sample of 2200 American children aged six and a half to sixteen and a half years representive of the 1970 United States Census. The discrepancy between the census and the WISC-R sample was no greater than 1% for whites and 4.5 percent for nonwhites. The discrepancy between the sample and the census was so small it was not felt to compromise interpretation of the tests' scaled scores (Sattler, 1988).

1. Factor Structure of the WISC-R

The revised test has the same twelve subtests as the 1949 version (six on the Verbal Scale, and six on the Performance Scale). Only ten subtests (five from the Verbal Scale and five from the Performance Scale) are used to calculate the IQ scores found in Figure 2.

Kaufman (1975) explored the factor structure of the WISC-R with the standardization data. The intercorrelations of the scaled scores for the 12 subtests which appeared in Wechsler (1974, Table 14) were subject to factor analytic procedures. Principal-components analysis was completed first, followed by varimax rotation of the factors with eiginvalues greater than 1. This provided a solution to the number of factors to rotate, and served as a guide to the appropriate number of meaningful factors.

Kaufman concluded three factors could effectively describe the structure of the WISC-R after the age of 7. Two factors, Verbal Comprehension and Perceptual Organization, closely resembled the Verbal and Performance Scale described by Wechsler (1974). Together these two factors were thought to measure intellectual ability (Kaufman, 1975, 1979). The third factor, which Kaufman (1975) labelled Freedom from Distractibility, was thought to measure behavioral traits such as impulsivity and attention. Figure 3 presents the subtests in each factor. The subtests in this factor and the unique abilities each subtest measures (Kaufman, 1979), may be seen in Figure 4. Freedom from Distractibility measures the ability to attend and concentrate, but it also involves numerical reasoning. Arithmetic is a numerical task, recall of numbers is required for Digit Span and Coding B, requires the association of numbers with abstract symbols.

A review of pertinent research findings relating to the WISC-R scales and

Figure 2: Organization of the WISC-R Scales

Verbal Scale	Performance Scale
Information	Picture Completion
Similarities	Picture Arrangement
Arithmetic	Block Design
Vocabulary	Object Assembly
Comprehension	Coding
Digit Span*	Mazes*

* Optional subtests administered at the examiner's discretion

Note: Adapted from Wechsler (1974). Manual for the Wechsler Intelligence Scale for Children Revised, p. 8.

Figure 3: Kaufman's Factor Composition

Verbal Comprehension	Perceptual Organization	Freedom from Distractibility
Information	Picture Completion	Arithmetic
Similarities	Picture Arrangement	Digital Span
Vocabulary	Block Design	Coding
Comprehension	Object Assembly	

Figure 4: Shared and Unique Abilities of the Subtests in the FDIQ

Subtest	Unique Abilities	Shared Abilities
Arithmetic	Computational skill	Anxiety Attention span Concentration Facility with numbers Long-term memory Verbal comprehension
Digit Span	Short-term auditory memory	Attention span Anxiety Distractibility Memory Sequencing Mental Alertness
Coding (A & B)	Ability to follow directions Clerical speed and accuracy Psycho-motor speed Short-term visual memory	Learning ability Paper and pencil skill Reproduction of models Visuals perception of abstract stimuli (design - symbols) Anxiety Distractibility Working under time pressure

Note: Adapted from Kaufman, A. (1979). Intelligent testing with the WISC-R. Toronto: John Wiley & Sons.

the other two factors may be found in Kaufman (1979) and Sattler (1988).

2. Reliability

The average reliability coefficients for the three subtests comprimising the FDIQ factor and the three standard scales are presented in Table 3. The reliability coefficient for Arithmetic is a split-half correlation. For Digit Span and Coding test-retest coefficients were obtained on about 50 children retested after a one month interval. These correlation coefficients were deemed adequate.

Table 3: Average Reliability Coefficients and Standard Error of Measurement for FDIQ Subtests

Subtest or Scale	Average Reliability	Average Standard Error of Measurement
Arithmetic	.77	1.38
Digit Span	.78	1.44
Coding	.72	1.63
Verbal Scale	.94	3.60
Performance Scale	.90	4.66
Full Scale	.96	3.19

Note: Adapted from: Sattler, J. (1988). Assessment of children (3rd ed.). San Diego: Jerome M. Sattler, Publisher, p. 123.

3. Validity

The Freedom from Distractibility factor has been used extensively in the diagnosis of learning disabilities without empirical evidence to substantiate its use for these purposes (Berk, 1983; Clarizio & Bernard, 1981; Dudley-Marling, Kaufman, N. & Tarver, 1981; Miller & Walker, 1981). When factor analytic techniques are utilized the results reflect the theoretical, and statistical biases of the investigators (Schooler, Beebe, & Koepke, 1978). The focus has been on the existence of the factors, rather than what the factors represent in a theoretical sense or what is measured in clinical contexts (Kaufman, 1981).

Meta-analysis has been used to explore subtest patterns to aid in the differential diagnosis of children. The distinct patterns which emerged were related to the mean Full Scale Intelligence Quotient of the WISC-R of the sample groups rather than psychoeducational diagnosis (Kavale & Forness, 1984; Mueller, Dennis & Short, 1986; Mueller, Mancini & Short, 1984).

H. STANFORD-BINET: FOURTH EDITION-MEMORY FOR DIGITS

The Stanford-Binet:Fourth Edition (SB:FE) is based on a three level hierarchical model. At the highest level of interpretation it is a measure of general intelligence, at the second level, crystallized, fluid and short term memory factors and at the third level it is a measure of more specific factors such as verbal reasoning, quantitative reasoning and abstract visual reasoning.

The SB:FE was standardized on a stratified sample of American children aged two years to adulthood representative of the 1980 United States Census. As this sample included too many children in high SES categories, weighting procedures were used to make the sample conform to the census.

Memory for Digits is comprised of two parts: Digits Forward and Digits Reversed. The rationale for Digit Span (WISC-R) also applies to Memory for Digits (Sattler, 1988).

1. Reliability

The test-retest reliability coefficient for the Memory for Digits subtest is .83. It has a moderate correlation ($r = .64$) with the SB:FE composite score (Sattler, 1988).

a. Summary

Chapter Two presented a review of the literature as it related to attention deficits of AD-HD and three measures purporting to measure these deficits. Two characteristics of the AD-HD hamper the identification and measurement of their problems. The first problem one encounters in identifying this group is that AD-HD children are a heterogeneous group and as such behaviors associated some of the children are not found in others, such as those age related developmental trends such as selective attention. The second is the widely accepted assumption that the major problems manifested by the AD-HD involve the inability to sustain attention and to inhibit impulsive responses. This creates difficulties because attention can not be measured directly. Inferences may only be made with reference to observable behaviors researchers deem to be reliable indices of attention.

To reflect the measurement concerns, it is essential that the assessment battery be multidimensional. As such then, it is imperative measures of attention sample behavior in a variety of settings, using different methods, and involving different ratings or raters. In an attempt to address these concerns it is a valuable exercise to investigate the convergence between assessment tools and their relationship to the existing literature.

CHAPTER III. METHODOLOGY

Chapter Three presents the methodology which is an overview of the research questions, the design and the procedures followed in the study.

A. RESEARCH QUESTIONS

Question I

> What pattern of correlations exist between the Freedom from Distractibility factor on the WISC-R and the three subtests, Delay, Vigilance, and Distractibility, of the Gordon?

It is hypothesized that low to moderate correlations between the two measures will be found. The strongest correlation will be between the Distractibility subtest on the Gordon and the Freedom from Distractibility factor (FDIQ) on the WISC-R If each of the subtests in the Freedom from Distractibility factor is considered separately low scores on the Coding subtest will correspond to lower total correct scores on the Gordon Vigilance and Distractibility tasks resulting in a moderate positive correlation. This correlation is anticipated because both tasks share a visual scanning and a motor component. Low to nonsignificant correlations will result on the Digit Span and Arithmetic subtests. This correlation will be influenced by the difference in input modes: auditory for the WISC-R subtests and visual input for the Gordon subtests.

Question II

> What pattern of correlations exist between the factors of the Conners Parent Symptom Questionnaire and the Delay, Vigilance, and Distractibility tasks on the Gordon Diagnostic System?

Factor I, Conduct Problems will have a low positive correlation with the total responses on the Delay task. The total correct responses of the Delay task will be negatively correlated with Factor I.

Factor II, Learning Poblems on the Conners will be sensitive to the Vigilance and Distractibility tasks on the Gordon. Low negative correlations will be found with the total correct responses. Low positive corrrelations will be found for Learning Problems and the total number of omissions and commissions.

Factor III, Psychosomatic Problems inquires into health related problems such as physical discomfort as a result of pain or bowel problems. Unless the child was suffering from a headache or stomach ache at the time of the testing it is unlikely a significant correlation will be found; therefore it is hypothesized there will not be a significant correlation with this factor.

Factor IV, Impulsivity-hyperactivity asks questions which reflect a level of inordinate restlessness which would interfere with selective or sustained attention. Given this, on the Delay tasks, one would anticipate a moderate to high positive correlation with the total number of responses and a moderate to high negative correlations with the total number of correct responses. As the score increases on the Conners, the number correct should drop on the Vigilance and Distractibility tasks resulting in a moderate to low negative correlations. The total number of responses will form a high positive corrrelation with increased ratings on the Impulsivity-hyperactivity factor. The correlations with both Vigilance and Distractibility commissions will be moderate to moderately high positive correlations with Impulsivity-hyperactivity.

Factor V, Anxiety, rates behavior of a shy withdrawn quality. As such it is felt this dimension will have little bearing on any of the three subtests of the Gordon Diagnostic System. The correlations are predicted to be nonsignificant.

Question III

> What pattern of correlations exist between the WISC-R Freedom from Distractibility factor and each of the five factors on the Conners Parent Symptom Questionnaire?

It is hypothesized that low positive correlations will result with Conduct Problems, Learning Problems, and the Impulsivity-hyperactivity factor. It is further hypothesized that the Psychosomatic Problems and Anxiety will not correlate significantly with the Freedom from Distractibility factor as the tasks measure different target behaviors.

In summary, this thesis will investigate the efficacy of each of the instruments to describe attention deficits in children with or without hyperactivity and will examine the convergent validity of the instruments. In order to establish the overall convergence of the measures and the contribution of each of the subtests multiple correlation and canonical correlation analyses (Dixon, 1983) were performed.

B. SAMPLE

The subjects for this study were solicited through advertisement by a registered psychologist and a medical doctor requesting participants for a study of the relationship between food allergies and hyperactivity. Two advertisements were placed, one in an interview on the Canadian Broadcasting Corporation (CBC) radio, and the other in a newspaper article in the Vancouver Sun Newspaper on November 22, 1986. A copy of the newspaper advertisement appears in Appendix B.

The sample consisted of 36 children (26 males, 10 females) in Grades 1 to 7 attending schools in the Lower Mainland of British Columbia, and who according to parent reports were exhibiting behavior patterns similiar to the descriptions for AD-HD. The sample ranged from 6 years, 5 months to 12 years, 9 months, with a mean sample age of 9 years, 6 months.

C. INSTRUMENTS

Four standardized published tests were used in the present study:

Conners Parent Symptom Questionnaire
(Goyette, Conners & Ulrich, 1978)

Gordon Diagnostic System
(Gordon, McClure & Post, 1986)

The Wechsler Intelligence Scale for Children-Revised
(Wechsler, 1974)

Memory for Digits subtest from the Stanford-Binet IV
(Thorndike, Hagen & Sattler, 1986)

These tests are reviewed in the previous chapter (pages 29-43).

D. DATA COLLECTION

The tests were administered as part of a larger study and as such the senior researcher determined the order of administration for each of the tests. Only the GDS, the WISC-R, and Memory for Digits were included for the purposes of this research. As discussed in Chapter II, fatique or boredom can be a major factor in the performance of the AD-HD (Cantwell, 1987b; Garfinkel, 1987a). As the GDS was judged to be the most sensitive to this phenomenon, it was administered first. The WISC-R was administered second because of the high level of cognitive demands it places on the respondent. In the instances where Digit Span had not been administered on the WISC-R (n=3), the scores for Memory for Digits were used, in which case it was the third test administered.

The subjects were seen individually at the University of British Columbia during January, 1987. Five qualified graduate students and the senior researcher, a Registered Psychologist administered and scored the tests for the children. The parent accompanying the child to the Education Clinic completed the Parent Symptom Questionnaire in the clinic lounge while the child completed the test battery in one of the small rooms in which psychoeducational assessments are completed. Mothers completed the CPSQ for 25 males and 9 females. One father completed the questionnaire for one his son; another father completed the questionnaire for his daughter.

E. TEST ADMINISTRATION

1. CPSQ

The four point Likert scale was explained to the parent, who then filled in the questionnaire while waiting in the clinic lounge for the child to complete the assessment battery. The questionnaire was returned to the examiner at the conclusion of the assessment session.

2. WISC-R and GDS

The WISC-R and the GDS were administered according to the standardized procedures specified in the respective manuals.

F. ITEM SCORING AND PREPARATION

The tests were scored by the examiners who adminstered them.

1. Conners Parent Symptom Questionnaire

The parent responded to descriptive comments regarding his/her son or daughter's behavior on a four point Likert scale to describe the frequency/severity of given behaviors (see Figure 5). "Not at all" received a rating of 1, "just a little", received a 2 point rating, "pretty much" was given a 3 point rating, and "very much" was given a 4 point rating. For example, a parent may have responded to Item 4, "excitable, impulsive" as "very much" which would be recorded as "3".

Using the LERTAP programme (Nelson, 1974) items were sorted into the designated factors (Goyette, Conners, & Ulrich, 1978) as Conduct Problems, Learning Problems, Psychosomatic Problems, Impulsivity-Hyperactivity, Anxiety,

Figure 5: Scoring Criteria for CPSQ

Category	Rating
Not at all	1
Just a little	2
Pretty much	3
Very much	4

and the Hyperactivity Index. Hoyt estimate of reliability was established for each of the above by Lertap (Nelson, 1974). The published category norms for the CPSQ are presented in Appendix A.

2. Gordon Diagnostic System

At the conclusion of each of the three tests in the GDS (Delay, Vigilance, Distractibility) the examiner read and recorded the scores from the printout on the back panel of the GDS onto the test protocol.

Two sets of scores were recorded for each test, total correct (TC) and errors of commission (EC). Errors of omission were not recorded as these errors are reflected in the total number correct (Gordon, 1986) (see Appendix C).

The raw scores were converted to Z scores by SPSS-X (SPSS Inc., 1983) using the means and standard deviations for each of the appropriate age levels (Gordon & Mettelman, 1986).

3. WISC-R

Raw scores for each of the 10 subtests were converted to scale score equivalents (mean 10, standard deviation 3) in accordance with the procedures reported in the WISC-R manual (Wechsler, 1974) for each of the age levels. IQ equivalents (mean 100, standard deviation 15) were derived for the Verbal Scale, Performance Scale, and the Full Scale in accordance with the procedure reported in the manual (Wechsler, 1974). The Verbal and the Performace Scale IQ Scale is attained by entering Table 20 (page 151) using the sum of the five verbal subtests and the sum of the five performance subtests respectively. The Full Scale IQ follows the same procedure using the sum of the ten subtests scores and Table 20, on page 152 of the manual (Wechsler, 1974).

The Freedom from Distractibility quotient is the sum of the scaled scores for Arithmetic (A), Coding (Co), and Digit Span (DS) and is subject to one of two formulas depending on the age of the subject. Gutkin (1978), proposed the formula FDIQ= 2.2[A + Co + DS] + 34 for ages 8 1/2 to 13 1/2 . For younger subjects aged 6 1/2, and 7 1/2 the formula used was FDIQ=2.94[A + Co + DS] + 41.2. SPSS-X (SPSS. Inc., 1983) was used to calculate the sum of the scaled scores and the FDIQ. In the cases where the DS had not been given on the administration of the WISC-R, the Memory for Digits subtest from the Stanford-Binet IV was substituted and scored according to the WISC-R guidelines as both tests have the same number of items, and the same number of digits are in each item.

G. TREATMENT OF DATA

SPSS-X (SPSS. Inc, 1983) was used to address the degree of correlation to answer each of the research questions. A $p \leq .05$ was adopted as the level of statistical significance. In response to the first research question, the FDIQ, the scale scores for Arithmetic, Digit Span/Memory for Digits, and Coding subtests, were entered into the correlation matrix along with six scores from the GDS. Pearson product-moment correlations were generated for the WISC-R scores already outlined, and the total responses and total correct on the Delay Test. Two scores from the Vigilance Test, total correct and errors of commission as well as the same two scores from the Distractibility Test were also entered to determine the direction and degree of correlation.

Pearson product-moment correlations for Question II were generated by using the sums of the raw scores for each factor on the CPSQ (Conduct Problems, Learning Problems, Psychosomatic Problems, Impulsivity-hyperactivity, and Anxiety) and the Hyperactivity Index along with the six GDS scores described in Question I.

The degree and direction of the correlations for the third reseach question were generated using the procedures just described for the CPSQ and the FDIQ and the three individual subtests which constitute the FDIQ. The overall convergence of the tests used in this study and each subtest contribution to the correlation were investigated by means of multiple correlations. SPSS-X (SPSS. Inc., 1983) was used to calculate the correlation coefficient between the FDIQ and the subtests on the CPSQ and the GDS subtests. A second multiple correlation was generated between the Hyperactivity Index and the FDIQ subtests and the GDS subtests. Canonical correlations were computed to investigate the relationship between the FDIQ subtests, the CPSQ subtests, and the GDS subtests.

Chapter four presents the results of these analyses.

CHAPTER IV. RESULTS

This chapter reports the results of the statistical analyses which attempt to establish the the convergent validity of the GDS, CPSQ, and the FDIQ, and subsequently the advisability and utility of including these measures in an assessment battery for hyperactive children with attention deficits which will be discussed in Chapter V.

A. RESEARCH QUESTION I

> What pattern of correlations exists between the Freedom from Distractibility factor on the WISC-R and the two scores generated for the Delay, the Vigilance, and the Distractibility test on the Gordon Diagnostic System?

Table 4 presents the mean and standard deviation for the FDIQ and the GDS. As may be seen in Table 4 two subjects scored below one, but above two standard deviations from the mean of 100. The remaining 34 subjects scored in the average range. The sample mean is in within the average range. The mean scaled scores for the Arithmetic, Digit Span and Coding are in the average range as designated by Wechsler (1974).

The range of the z scores on the GDS, Delay, Vigilance and Distractibility test fall in the abnormal to normal classification as defined by Gordon (1986). The threshold tables which formed the basis for this are presented in Appendix D.

Four scores were obtained from the WISC-R: the FDIQ, and the scaled scores for each of the three subtests which contribute to the FDIQ. A description of the FDIQ scoring procedure may be found in Chapter III.

Table 4: Means and Standard Deviations for the WISC-R and GDS

	Range	Sample Mean	Test Mean	Sample sd	Test sd
WISC-R					
FDIQ[1]	76-122	95.66	100	13.93	15
Arithmetic	2-12	9.58	10	2.59	3
Digit Span	4-14	9.39	10	3.07	3
Coding	4-14	9.06	10	2.97	3
Gordon Diagnostic System					
Delay Test					
Total Responses	-3.66 - 2.72	-.02		1.14	
Total Correct	-3.80 - 1.18	-.30		0.97	
Vigilance					
Total Correct	-7.50 - 0.85	-.53		1.65	
Errors of Commission	-0.74 - 8.10	-.68		1.69	
Distractibility					
Total Correct	-3.31 - 1.27	-.50		1.31	
Errors of Commission	-0.63 - 11.64	1.13		2.67	

n=36

[1] FDIQ = Freedom From Distractibility Quotient

1. Delay Test

To measure impulsivity on the Delay test, two scores were recorded. Total responses records the number of times the response button was depressed during the 8 minute administration of the test. Total correct is a record of the accumulated instances in which the subject waited the requisite 6 seconds before responding.

Table 5 presents the Pearson product moment correlations between the FDIQ, its subtests, and the GDS. The correlation coefficients for the FDIQ and Delay total responses (p=.43) and the total correct responses (p=.48) did not reach significance. Table 5 also demonstrates that the zero-order correlations between Arithmetic, Coding and Digit Span and the Delay test total responses and total correct were not significant.

Table 5: Correlations Between the WISC-R FDIQ Subtests and the GDS

	WISC-R			
GDS	FDIQ	Arithmetic	Digit Span	Coding
Delay Test				
Total Responses	-03	03	-01	-08
Total Correct	-01	-01	-04	02
Vigilance				
Total Correct	25	25	-03	28[1]
Errors of Commission	-11	-06	06	-24
Distractibility				
Total Correct	30[1]	13	20	32[1]
Errors of Commission	-37[2]	-24	-29[1]	-29[1]

n=36 df=34 1 tailed test (.2746 critical) decimals removed

[1] $p \leq .05$
[2] $p \leq .01$

2. Vigilance Test

The correlation coefficients for sustained attention, as measured by the FDIQ, and the three individual subtests (Arithmetic, Digit Span, Coding), the GDS, and the two scores recorded for the Vigilance test. Total correct reflects the ability to focus and maintain attention to the target stimulus. Lapses of attention, or impulsive responses, are reflected in errors of commission which is the sum total of extraneous presses of the response button. Only one subtest, Coding resulted in a significant positive correlation with Vigilance total correct ($r=.28$, $p=.05$). As may be seen in Table 5, the correlation coefficients for the FDIQ and Vigilance total correct and errors of commission is not significant. Inspection of Table 5 shows nonsignificant correlations between Vigilance total responses, and total correct and the Arithmetic and Digit Span. Lapses of attention, as measured by Vigilance errors of commission is not significantly correlated with Coding ($r=.24$).

3. Distractibility Test

The Distractibility test is similar to the Vigilance test, in that it provides a measure of sustained attention; but in this case distractors are present. As with the Vigilance test two scores are recorded. Total correct is the cumulative score for identifying the target stimulus in a stimulus field containing distractions.

The FDIQ and Distractibility total correct resulted in a significant, positive correlation ($r=.30$).

A significant negative correlation was found between the FDIQ and errors of commission ($r=-.37$). When each of the three subtests which make up the composite is considered separately an interesting pattern of correlations develops. Digit Span and Distractibility errors of commission were significantly correlated ($r=.29$, $p<.05$). The correlation coefficient between Coding and total correct was significant ($r=.32$, $p<.05$) as was the correlation coefficient for Coding and errors of commission ($r=-.29$, $p<.05$). Nonsignificant correlation coefficients resulted for Arithmetic and Distractibility total correct and errors of commission. Digit Span and Distractibility resulted in a correlation which did not reach significance.

a. Summary

Only the Distractibility total correct and errors of commission resulted in significant correlations with the FDIQ, the correlations between the FDIQ and the Delay and Vigilance Tests, failed to reach statistical significance on either total correct or errors of commission.

Four correlations reached significance when the WISC-R subtests were correlated with the 6 scales on the GDS. Total correct for both Vigilance and Distractibility were significantly correlated with Coding. The correlation coefficient between Digit Span and Distractibility errors of commission was significant. Lapses of attention, as indexed by Distractibility errors of commission and Coding was significant.

The correlation between Arithmetic and Distractibility errors of commission approached but did not achieve significance.

B. RESEARCH QUESTION II

> What pattern of correlation exists between the Conners Parent Symptom Questionnaire and the Delay, Vigilance, and Distractibility tests on the Gordon Diagnostic System?

Before proceeding to a discussion of the correlations generated to answer the research question, the structure and properties of the CPSQ, as they apply to this sample, will be presented briefly.

The scoring procedure was outlined in Chapter III. LERTAP (Nelson, 1974) was used to assign the individual items to the Conners designated factors and to calculate the sums of the raw scores, range, mean and standard deviation for each factor.

For Conduct Problems, three scores (42, 40, 39) exceeded two standard deviations from the mean; this may suggest that the sample was heterogeneous. The scores of the subjects extended the range and increased the standard deviation substantially. On Learning Problems, one subject obtained a low score of 5 which set it apart from the distribution of the other scores. The means and standard deviations for the present sample for the factor scores on the Conners Parent Symptom Questionnaire may be seen in Table 6.

Table 6: Means and Standard Deviations for the Connors Parent Symptom Questionnaire

CPSQ	Range	Mean	sd
Conduct Problems	14-42	25.06	7.21
Learning Problems	5-16	11.19	2.71
Psychosomatic Problems	5-17	9.69	3.42
Impulsivity-Hyperactivity	4-16	10.56	3.15
Anxiety	3-12	6.92	2.30
Hyperactivity Index	12-36	24.39	6.15
Total Test	51-123	87.81	19.30

n=36

Hoyt estimate of reliability coefficients for each factor are presented in Table 7. Cronbach's Alpha, a function of the intercorrelations among the factors, resulted in an internal consistency estimate of .80 which is judged to be adequate. Correlations for the factors ranged from .59 to .89 for the individual factors which are deemed acceptable for the purposes of this study. The reliability coefficients for items in each factor and the items contribution to the total test are presented in Appendix E.

Table 7: Hoyt Estimate of Reliability Coefficients and Standard Error of Measurement for the Connors Parent Symptom Questionnaire Factors

CPSQ	Hoyt r	sem
Conduct Problems	0.89	2.31
Learning Problems	0.70	1.28
Psychosomatic Problems	0.75	1.52
Impulsivity-Hyperactivity	0.83	1.14
Anxiety	0.59	1.28
Hyperactivity Index	0.85	2.28
Total Test	0.93	4.89

Cronbach's Alpha for the Composite = 0.80

Before proceding to a disccussion of the correlation coefficients generated to address the research questions it is relevant to first consider the extent to which the GDS and the CPSQ Hyperactivity Index identify the same children as AD-HD, or the extent to which the diagnostic criteria for each measure leads to differential diagnoses.

When the chi-square formula was applied to the sample data (see Table 8), it yeilded a χ^2 value of 3.71, which is significant at the $p=.05$ level. This χ^2 value and its corresponding probability lead to the conclusion that the GDS Vigilance total correct and the Hyperactivity Index are distributed differently across the two categories of AD-HD and nonAD-HD, justifying the inference that the classification AD-HD would be dependent on the measure being used.

Table 8: Comparison of GDS and Hyperactivity Index Clinical Severity Classifications

	Gordon Diagnostic System		
Measure of Relationship	Delay	Vigilance	Distractibility
Chi-Square[1]	0.02	3.71	0.00
p	.89	.05	1.00
Kendall's tau B[2]	.09	.38	.02
p	.30	.01	.46

[1] df=1 rounded to 2 significant figures
[2] df=34

In view of this, serious consideration needs to be given to establishing critical cut off points for diagnosis comparable between measures, as arbitrary elements are used in declaring the AD-HD cut off at the present time.

The chi-square statistic for the Delay and the Distractibility tasks and the Hyperactivity Index did not reach significance. This would suggest that the criteria for diagnosis are dissimilar for the two measures.

Table 9 presents the correlations between the the CPSQ factors and the subtests on the GDS.

1. Factor I - Conduct Problems

The correlations between Conduct Problems and the Delay Test total responses and total correct did not achieve statistical significance. The resulting correlations for Vigilance and the Distractibility Test and Conduct Problems are not statistically significant.

Table 9: Correlations Between the CPSQ and the GDS

GDS	CPSQ Conduct	Learning	Psycho-somatic	Impulsivity Hyperactivity	Anxiety	Hyperactivity Index
Delay Test						
Total Responses	-18	-12	-04	-17	10	-20
Total Correct	02	03	-03	05	-29[1]	01
Vigilance						
Total Correct	-12	-39[2]	-14	-25	-14	-33[1]
Errors of Commission	12	38[2]	09	22	20	38[2]
Distractibility						
Total Correct	03	-31[1]	04	-11	04	-19
Errors of Commission	-08	24	01	07	-09	11

n=36 df=34 1 tailed test (.2746 critical) decimals removed

[1] $p \leq .05$
[2] $p \leq .01$

2. Factor II - Learning Problems

The correlation with the Delay Test total responses and total correct, are not statistically significant.

A significant negative correlation ($r=-.39$, $p=.01$) resulted for Learning Problems and Vigilance total correct. Vigilance errors of commission reflect lapses of attention as described by the number of extraneous presses of the response button. A significant positive correlation was achieved between Learning Problems and Vigilance errors of commission ($r=.38$, $p=.01$).

Distractibility total correct provides a measure of sustained attention in the presence of distractors. A significant negative correlation resulted between Distractibility total correct and Learning Problems ($r = -.31$, $p < .05$). The correlation coefficient between Distractibility errors of commission and Learning Problems did not reach statistical significance ($r = .24$).

3. Factor III - Psychosomatic Problems

As was predicted in Chapter I, for Research Question II, the correlation coefficient between Psychosomatic Problems and Delay total responses and total correct did not reach significance.

The correlations for the Vigilance total correct and errors of commission are nonsignificant. Likewise the Distractibility Test, resulted in nonsignificant correlations between total correct and errors of commission and the health related problems on Psychosomatic Problems.

4. Factor IV - Impulsivity-hyperactivity

The correlation coefficients reported in Table 9 for the Delay total responses and total correct and Impulsivity-hyperactivity did not reach statistical significance.

Correlations between Vigilance total correct and errors of commission and the Impulsivity-hyperactivity factor were not significant; also correlations between total correct and errors of commission on the Distractibility Test and the Impulsivity-hyperactivity factor of the CPSQ were not significant.

5. Factor V - Anxiety Problems

A significant negative correlation did result for Delay total correct and Anxiety (r=-.29). The correlation between Anxiety and Delay total responses is not significant. Vigilance total correct and errors of commission and Anxiety resulted in correlation coefficients which were nonsignificant. Here again, the coefficients for Distractibility total correct and errors of commission were not significant.

6. Hyperactivity Index

The correlation between Vigilance total correct and the Hyperactivity Index (r=.33) is significant at the p<.05 level. As shown in Table 9, the correlation coeffient for Vigilance errors of commission and the Hyperactivity Index (r=.38) is significant at the p=.01 level.

Pearson product-moment correlations for Delay total responses (r= -.20) and total correct (r=.01) and the Hyperactivity Index did not achieve statistical significance at the p<.05 level. The resulting correlation coeffient between Distractibility total correct (r=-.19) and errors of commission (r=.11) and Hyperactivity Index did not achieve significance.

a. Summary

Only Learning Problems and the Hyperactivity Index on the CPSQ resulted in significant correlations with the GDS Vigilance total correct and errors of commission. Learning Problems was also significantly correlated with Distractibillity total correct.

C. RESEARCH QUESTION III

What pattern of correlations exists between the FDIQ and each of the factors on the Conners Parent Symptom Questionnaire?

Table 10 presents the correlations between the FDIQ, its subtests, and the CPSQ subtests.

Table 10: Correlations Between the WISC-R FDIQ Subtests and the CPSQ

CPSQ	FDIQ	WISC-R Arithmetic	WISC-R Digit Span	WISC-R Coding
Conduct Problems	16	02	21	12
Learning Problems	-02	-01	22	-25
Psychosomatic Problems	08	03	-03	18
Impulsivity-Hyperactivity	20	01	38 [1]	03
Anxiety	00	06	05	-11
Hyperactivity Index	25	04	45 [1]	03

n=36 df=34 1 tailed test (.2746 critical) decimals removed

[1] $p \leq .01$

When the individual subtests which constitute the FDIQ are considered in isolation an interesting pattern results. Significant correlation coefficient result for Digit Span and Impulsivity-hyperactivity (r=.39) and the Hyperactivity Index (r=.45).

The Arithmetic subtest on the WISC-R and the factor scores on the CPSQ yield nonsignificant correlations. Nonsignificant correlations are found between Digit Span and Conduct Problems (r=.21), Learning Problems (r=.22), Psychosomatic

Problems (r=-.03), and Anxiety Problems (r=.05). There are no significant correlations between Coding and the factors of the Conners Parent Symptom Questionnaire.

There are no significant correlations between the FDIQ and the CPSQ, Conduct Problems, Learning Problems, Psychosomatic Problems, Impulsivity-hyperactivity, Anxiety, and the Hyperactivity Index.

a. Summary

Digit Span was the only test which resulted in significant correlations with the Conners Parent Symptom Questionnaire on the Impulsivity-hyperactivity factor and the Hyperactivity Index.

D. CONVERGENT VALIDITY OF THE MEASURES

Table 11 presents the correlation matrix for the the measures used in the study.

The correlation coefficients in the matrix support the summary tests as they are the highest values justified by the data, and therefore provide the most appropriate relationships. An overall pattern of convergence is added by reference to the last table. Inspection of Table 11 shows a significant multiple correlation between the Hyperactivity Index and the subtests of the FDIQ. Further insight into the relationship is gained by viewing Table F-2 in Appendix F. Digit Span alone is responsible for the significant correlation (r=.49, p=.006). Arithmetic and Coding made very little contribution to the correlation.

The multiple correlation between the Hyperactivity Index and the GDS total correct for Delay, Vigilance and Distractibility was not significant (r=.33, p=.30)

Table 11: Validity Coefficients for Five Measures of AD-HD

AD-HD Measures	1	2	3	4	5
1. WISC-R: FDIQ	---	*	*.24*	.25	*.31*
2. WISC-R: A-B-C	*	---	**.55**	*.46*	**.58**
3. CNRS: 5 factors	*p=.87*	**p=.24**	---	*	**.54**
4. CNRS: HI	p=.14	*p=.05*	*	---	*.33*
5. GDS	*p=.34*	**p=.06**	**p=.30**	*p=.30*	---

Note: Correlations are presented above the diagonal and probabilities below.
bold face = canonical correlation
italics = multiple correlation (multiple regression)
underlined = Pearson product moment correlation
* = not appropriate to compute

Variable Names:
1. FDIQ
2. Arithmetic, Digit Span, Coding
3. Conners - Factor I to V
4. Conners - Hyperactivity Index
5. GDS - Total correct for Delay, Vigilance, Distractibility

The correlation coefficients between the FDIQ and the subtests of the CPSQ and the GDS subtests did not reach significance. Appendix F, Table F-1, summarizes the details of the prediction of the FDIQ from the three subtests in the GDS, and from the five subtests in the CPSQ. As may be seen in Table 11, coefficients for the FDIQ were not significant, suggesting that the FDIQ is less than valid as a measure of AD-HD.

The canonical correlation between the FDIQ subtests and the total correct for the three GDS subtests approached but did not achieve significance. As

Appendix G shows only Digit Span and Coding from the FDIQ made significant contributions; only Distractibility total correct made a significant contribution from the GDS.

The canonical correlation between the FDIQ subtests and the CPSQ subtest scores did not reach a level of statistical significance. As shown in Appendix G the correlation coefficients for the individual subtests in each of the sets of variables did not reach or even approach significance. This pattern of correlation coefficients was seen in the canonical correlation between the CPSQ and the GDS. The contributions each of the subtests towards the the correlation coefficients were not significant.

Chapter V will present a discussion of these findings as they relate to the research questions and the related literature review.

CHAPTER V. DISCUSSION

The intent of the present study was to establish the convergent validity of the FDIQ, the CPSQ, and the GDS to assess attention deficits in children reported distractible by their parents. Pearson product-moment correlations were generated to investigate the relationships between the measures. Overall patterns of convergence were then investigated by means of multiple and canonical correlations. Following this, the advisability and utility of including these measures in an assessment battery will be addressed.

Before proceeding to a discussion of the results it may be instructive to first consider the structure of the present sample. The children were participants in a much larger study investigating the interaction of food allergies and distractibility. A medical doctor determined the severity of the food allergy symptoms, which included a question for the parents to indicate their child's level of distractibility. Only those children with high severity ratings of allergies in combination with high ratings of distractibility were included in the study. In adopting this selection criterion for the sample, a restriction in the range of subjects was introduced which may account for the low correlations among the measures.

The sample consisted of 36 children, with boys outnumbering girls by approximately 3 to 1. This is considerably lower than figures reported in the research which suggest a ratio of 6 boys to every girl. The present sample is more in keeping with the ratio Garfinkel (1987) reported for nonclinical groups which might describe this group as they were identified first for their allergies and second for attention deficits. Before proceding to a discussion of the results, the present sample will be described with reference to the standardization sample for each of the measures.

The mean FDIQ scores of the present sample are well within the average range as compared with the standardization of the WISC-R. In itself, this might be considered significant from a clinical perspective because children with a normal FDIQ typically have been excluded from AD-HD research. The majority of published studies have been with children who have already been identified as AD-HD, as a condition for inclusion in a study. This study may be one of the few to include children with normal FDIQ scores.

In order to establish a descriptive reference between the CPSQ normative sample and the children comprising the present sample, ratings for the Impulsivity-hyperactivity factor and the Hyperactivity Index were calculated for the lowest scoring children according to the test authors' scoring specifications. These calculations suggest that the present sample consists of subjects who fall two standard deviations above the criterion needed for diagnosis, or above the "normal" mean. As a result of these calculations, it is suggested that the present sample consists of youngsters in the deviant to normal ranges.

This sample presents a group of children with FDIQ scores in the normal range but deviant to normal scores on the CPSQ and the GDS. This in itself is striking for it demonstrates the diagnostic criterion of the measures is different. Children diagnosed as AD-HD on the CPSQ would not be considered deviant according to the WISC-R.

Now that a conceptual framework of the sample has been established it is prudent to proceed to the relevant findings for the first research question.

A. RESEARCH QUESTION I

> What pattern of correlation exists between the Freedom from Distractibility factor on the WISC-R and the three subtests, Delay, Vigilance, and Distractibility, of the Gordon?

The FDIQ and Distractibility total correct ($r=.30$, $p<.05$) and errors of commission ($r=-.37$, $p=.01$) resulted in low but significant correlations. This suggests that observed high scores on the FDIQ correspond with high scores on total correct and fewer errors of commission. Conversely, low ratings on the FDIQ pair with fewer correct detections and many errors of commission.

The significant correlation between Digit Span and Distractibility errors of commission ($r=-.29$, $p=.04$) may imply the attention/concentration needed to do well on Digit Span was lacking, as it was on the GDS resulting in many extraneous responses.

Two measures of sustained attention on the GDS, Vigilance total correct ($r=.28$, $p=.05$) and Distractibility total correct ($r=.32$, $p<.05$) reached statistical significance with Coding. Lapses of attention may have accounted for the significant correlation between Coding and Distractibity errors of commission ($r=-.29$, $p<.05$). The fact that Distractibility errors of commission was significant while Vigilance errors of commission was not is consistent with the research to suggest that distractors interfere to a greater extent if there is a possibility they are interpreted in the context of the task (Rosenthal & Allen, 1980). The Vigilance task has no distractors to divert attention, while in the Distractibility task the same target numbers appear in the left or right hand columns as well as in the target column which is the centre column. In Coding one needs to survey the legend to locate the appropriate symbol and then transcribe that symbol into the designated box. The visual scan of the legend, as well as the response boxes, may have served as the same phenomenon as the distractors in the GDS. The significance of the FDIQ correlation is attributed to Digit Span and Coding as these subtests were the only ones with significant loadings on the canonical analysis.

The role of short term visual memory, a unique ability in Coding (Kaufman, 1979) is also necessary for sustained attention. In the GDS as well short term memory is needed. To complete the GDS one needs to remember the directions and the target stimulus. Coding, for its part, places much greater demands on short term memory. Memory of the legend, or at least some of the items enhances the chances for more efficient performance on this timed test. In this perspective a constitutional inability to sustain attention inhibits responses which require directed and organized efforts (Douglas & Peters, 1979). As short term memory was not formally addressed as part of this study, one may only hypothesize that a relationship exists between short term memory and sustained attention. Further research is needed to confirm this interpretation.

The correlation coefficients for the Delay Test total responses ($p=.43$) and total correct ($p=.48$) did not reach significance. Therefore it is concluded, that if the Delay Test measures impulsivity, then the FDIQ is not a reliable measure of impulsivity. The Delay Test reportedly taps one aspect of behavior, impulsivity, while the FDIQ is a composite of three different types of tasks: numerical reasoning, short term auditory memory and psychomotor speed (Kaufman, 1979).

The resulting Pearson product-moment correlations between the Delay Test and the individual WISC-R subtests (Arithmetic, Digit Span, Coding) did not reach significance which is not surprising since the FDIQ was nonsignificant. The subtests are subject to the influence of anxiety, distractibility, concentration and attention, but the other response demands are much more taxing than waiting 6 seconds before responding. Also significant in terms of the demands is that the response on the Delay test is reinforced immediately while reinforcement does not occur with the WISC-R.

The anticipated correlation between Vigilance total correct and the FDIQ approached, but did not reach significance ($r=.25$, $p=.07$). Attention is a prerequisite for both tasks, however, the nature of the response for Arithmetic and Digit Span allows the subject some flexibility in the time he/she takes to respond. The GDS controls the presentation of the stimuli, and therefore the time allowed for a response before the next stimulus is presented.

Swanson (1983) demonstrated AD-HD children perform more effectively in situations which are self paced and continual reinforcement is present. The intention here is not to infer that the WISC-R is self paced, but rather that the subject's rate of response influences the rate of presentation on the untimed tests.

Nonsignificant correlations for Digit Span and Arithmetic may have been influenced by the different imput modes: auditory for the WISC-R subtests and visual for the GDS. It was reported in Chapter II, that some AD-HD children demonstrated better performance on visual tasks, as opposed to auditory modes of continuous performance tests (Klee & Garfinkel, 1983; Swanson, 1983, 1981).

The FDIQ, or any of the subtests therein, do not appear to be measures of impulsivity as indexed by the Delay Test which resulted in nonsignificant correlations. Two subtests, Coding and Digit Span appear to be measures of sustained attention and should be given consideration in lieu of the FDIQ for diagnostic purposes.

B. RESEARCH QUESTION II

> What pattern of correlations exist between the factors of the Conners Parent Symptom Questionnaire and the Delay, Vigilance, and Distractibility tasks on the Gordon Diagnostic System?

The finding that Learning Problems resulted in significant correlations with the GDS Vigilance and Distractibility Test is to be expected if one accepts the premise that these tests provide descriptions of sustained attention in children.

The items in the Learning Problems factor probe attentional problems attributed to the child. An item such as "difficulty learning", given the child has at least average ability and no identifed learning disabilities, suggests that something else is interfering with academic achievement. "Fails to finish things" might be accounted for by poor comprehension of concepts or diversions in attention/concentration to task demands. This possibility might account for the correlation between Learning Problems and Vigilance total correct ($r=-.39$, $p=.05$) and Distractibility total correct ($r=-.31$, $p<.05$) in which high scores on Learning Problems correspond with depressed scores on total correct for Vigilance and Distractibility. The correlation for Vigilance errors of commission and Learning Problems ($r=.38$, $p=.01$) may lead to the suggestion children who are distractible have poor attending skills, as measured by errors of commission.

The fearful, worrisome behavior patterns attributed to Anxiety Problems correlated significantly ($r=-.29$, $p=.04$) with Delay total correct. A fearful child, one with high scores on Anxiety, might be one who through nervousness is not able to formulate the necessary strategies in order to earn points on this test.

The resulting significant correlations for the Hyperactivity Index and the Vigilance Test might be interpreted as demonstrating that lapses of attention and frustration (fails to finish things; distractibility is a problem; cries easily or often) associated with the Hyperactivity Index parallel poor sustained attention on the Vigilance Test.

Conduct Problems was not expected to correlate with the GDS. The items on Conduct Problems are associated with socially/emotionally inappropriate (pouts or sulks; basically an unhappy child) or delinquent (steals, or obeys but resentfully) behavior.

The health related problems identified in Psychosomatic Problems, (headaches; stomach aches) measure physical ailments or discomfort. It is certainly true that physical discomfort may have a negative influence on performance, but this would only apply if the child was suffering from the symptoms at the time of the assessment.

In name alone, Impulsivity-hyperactivity, offers the potential for significant correlations with the GDS. In reality the items on this factor may be attributed to activity level (excitable, impulsive; wants to run things; restless in a squirmy sense; restless always on the go). Also, activity level is not synonomous with quality of attention. Research has shown the AD-HD are at an advantage in more unstructured settings which allow for more variation in behavior patterns (Ross & Ross, 1982; Barkley, 1981).

C. RESEARCH QUESTION III

> What pattern of correlations exists between the Freedom from Distractibility factor and each of the five factors on the Conners Parent Symptom Questionnaire?

Of the twenty-four correlations generated between the WISC-R and the CPSQ only two achieved significance, and only with one subtest of the FDIQ. Digit Span correlated significantly with Impulsivity-hyperactivity (r=.38) which may be attributed to poor selective attention or difficulties forming strategies for remembering the numbers. Memory and poor sequencing ability may play a role as the restlessness documented in Impulsivity-hyperactivity might be a consequence of poor short term memory which would lead to "wants to run things" to gain control in situations rather than fail or be embarrassed by an inability to follow through on the perscribed chain of events. To do well on Digit Span, short term memory as well as sequencing ability is necessary (Kaufman, 1979). The Hyperactivity Index was significantly correlated with Digit Span (r=.45).

Learning Problems and Coding approached significance (r=-.25, p=.07). Given a larger sample size, or a more homogeneous sample of AD-HD, this correlation may have reached significance. Kaufman (1979) considered Coding to be a measure of learning ability. To do well on Coding, a child must be able to follow instructions, have an intact short term memory, clerical speed and accuracy. It may be the hypothesized attention deficits associated with Learning Problems interfere with the requisite skills for Coding.

It is not surprising that nonsignificant correlations resulted between the FDIQ subtests and the other factors on the CPSQ. Nonsignificant correlations with Arithmetic were to be expected by the very nature of the tests. Arithmetic measures a computational skill, while the CPSQ measures five behavioral attributes.

D. SUMMARY

The present sample scores are interesting because they fall in the average range on the FDIQ, but in the deviant ranges on the CPSQ and the GDS. This in itself may suggest that the traits as they are defined and measured on one test are not identical on the other two tests, or that the cut-off criteria for each of the tests vary across measures which leads to different diagnoses. As each of the measures was standardized in different years, the WISC-R in 1974, the CPSQ in 1978, and the GDS in 1986, with different samples, the WISC-R representative of the 1970 United States census, the CPSQ the Greater Pittsburgh area, and the GDS was representative of Syracuse, New York the observed differences may be an artifact of sociological trends over samples and time. Also noteworthy is that the sample in the present study is Canadian. consequently, any generalizations regarding interpretation must be made with caution until such time as we have studies to replicate and substantiate observations.

Only Digit Span and Coding presented as measures of sustained attention with Digit Span correlating with the CPSQ and Coding correlating with the GDS. This suggests when the scores on these two subtests are statistically lower than the other subtests on the WISC-R and there is other collaberative evidence of attention deficits, a psychoeducational diagnosis might be made. It would be important to reference the diagnosis to these two subtests, and not base the diagnosis on the FDIQ which did not demonstrate it was a measure of sustained attention. Digit Span was the only WISC-R variable to correlate significantly with the CPSQ Impulsivity-hyperactivity factor and the Hyperactivity Index. Again here, the role of sustained attention and short term memory have been hypothesized as contributing factors in the correlations.

E. LIMITATIONS OF THE STUDY

As the sample consisted of children residing in the Lower Mainland of British Columbia any generalizations regarding the research findings must be confined to this population.

A sampling bias may have restricted the range random affords as this sample was limited to include only those children with food allergies who displayed AD-HD like symptoms.

The role of short term memory came into question on numerous occasions in this research, and indeed the role of memory in attention deificits needs to be addressed before a definitive causal statement is pronounced.

Correlations among the three instruments were low. Whalen & Henker (1980), offer three reasons which may help to understand why this is so. The first reason may be that the data was collected in one session and in a relatively novel context. It is known that AD-HD children fair better in novel situations (Cantwell, 1987b). Situational or environmental variations among testors or subject reaction to testors may have enhanced or detracted from performance. Appointments for testing ranged from early morning to early evening and therefore fatigue may be a contributing factor especially in the case of the evening appointments. Another consideration relates to the specificity of the assessment measures, and the pervasiveness of measurement errors.

F. CONCLUSIONS AND IMPLICATIONS FOR FUTURE PRACTICE

Research supports the notion of a cross-situational, multidimensional approach to the diagnosis of AD-HD in different situations and by different measures sensitive to various aspects of behaviors deemed to contribute to AD-HD (Johnston, 1986). Sights must be aimed at different aspects of the diagnostic criterion. One must look carefully at each assessment tool and justify its place in the battery according to the test's ability to measure a unique aspect of observable behavior and its convergence with other measures. Test results must therefore be interpreted in an integrative, rather than an either-or manner. The FDIQ does not appear to be a measure of impulsivity or attention and therefore should not be utilized for these purposes. The WISC-R does warrant consideration in an assessment battery for it provies a very reliable and valid measure of cognitive ability. As a predisposing condition AD-HD must have intellectual ability in the normal range. Two subtests of the WISC-R appear to be sensitve to attentional problems although one would want to have confirmatory data from other sources such as the GDS or the CPSQ before a definitive statement is made. Coding and Digit Span have the appearance of being measures of the ability to sustain attention. Learning Problems and the Hyperactivity Index on the CPSQ correlate with the measures of sustained attention on the GDS.

Caution is warranted when interpreting the significant findings of this study by virtue of the low correlation coeffients. These measures share only between 9 and 15 percent of their variance. While the correlations are statistically significant, from a practical point of view the tests are measuring quite different constructs and sustained attention may be better described using alternate tests, rather than the ones used in the present study, such as behavior rating scales used in controlled settings (Barkley, Fischer, Newby, & Breen, 1988).

The WISC-R merits consideration in an assessment battery as it is a very reliable and valid measure of cognitive ability, and by virtue of this reason alone. Subtest or profile analysis is not warranted as was discussed in Chapter II.

Parent ratings are useful in the initial diagnosis of AD-HD as they provide a necessary vehicle for parents to inform school staffs of their observations of behaviors. This is valuable in that it provides an ecologically valid assessment of behaviors in an important setting (the home) as described by important observers (the parents) (Barkley, Fischer, Newby, & Breen, 1988). Parent ratings may provide a valuable tool for discussion purposes and base line data; however their diagnostic ability is suspect.

This research did not demonstrate the efficacy of including the GDS in a diagnostic capacity, however, other researchers (Gordon, 1986) have shown it is sensitive and as such more research is needed to investigate its potential.

G. IMPLICATIONS FOR FUTURE RESEARCH

The results of this research were inconclusive in demonstrating the efficacy of including these instruments in an assessment battery for AD-HD. Although a sample size of 36 is considered acceptable for research purposes, it would be instructive to undertake research studies using larger samples and to include control groups as well as AD-HD groups to serve as a criterion from which to judge the performance of the AD-HD.

Another avenue which needs to be explored is to develop ways of integrating psychometric reports, rating scales and continous performance tasks into a meaningful profile of attention as each of the measures used in this study had different critical cutoff points for diagnosis. It is essential that the diagnostic criterion be uniform across assessment tools and settings. This may suggest the devlopment of Canadian norms for the measures used in this study, or determine the norms as they stand may be used to represent Canadian children without discrimination.

The literature is clear in stating the role of continous performance measures in the diagnosis of AD-HD. Further research is warranted to investigate and/or replicate the role of the continous performance tasks such as the GDS in the assessment.

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APPENDIX A

CONNERS PARENT SYMPTOM QUESTIONNAIRE CATEGORY NORMS

APPENDIX A

Conners Parent Symptom Questionnaire Category (Factor) Norms[1]

	Males by Age (years)				
	3-5 (n=45)	6-8 (n=76)	9-11 (n=73)	12-14 (n=59)	15-17 (n=38)
(I) Conduct Problems					
$\bar{x}$	.53	.50	.53	.49	.47
sd	.39	.40	.38	.41	.44
(II) Learning Problems					
$\bar{x}$	.50	.64	.54	.66	.62
sd	.33	.45	.52	.57	.55
(III) Psychosomatic Problems					
$\bar{x}$	.07	.13	.18	.22	.13
sd	.15	.23	.26	.44	.26
(IV) Impulsivity-Hyperactivity					
$\bar{x}$	1.01	.93	.92	.82	.70
sd	.65	.60	.60	.54	.51
(V) Anxiety					
$\bar{x}$	.67	.51	.42	.58	.59
sd	.61	.51	.47	.59	.58
Hyperactivity Index					
$\bar{x}$	.72	.69	.66	.62	.51
sd	.40	.46	.44	.45	.41

Appendix A continued

	Females by Age (years)				
	3-5 (n=29)	6-8 (n=57)	9-11 (n=55)	12-14 (n=63)	15-17 (n=34)
(I) Conduct Problems					
$\bar{x}$	.49	.41	.40	.39	.37
sd	.35	.28	.36	.40	.33
(II) Learning Problems					
$\bar{x}$	.62	.45	.43	.44	.35
sd	.57	.38	.38	.45	.38
(III) Psychosomatic Problems					
$\bar{x}$	.10	.19	.17	.23	.19
sd	.17	.27	.28	.28	.25
(IV) Impulsivity-Hyperactivity					
$\bar{x}$	1.15	.95	.80	.72	.60
sd	.77	.59	.59	.55	.55
(V) Anxiety					
$\bar{x}$	.51	.57	.49	.54	.51
sd	.59	.66	.57	.53	.53
Hyperactivity Index					
$\bar{x}$	.78	.59	.52	.49	.42
sd	.56	.35	.34	.34	.34

Note: The norms are taken from "Normative Data on Revised Conners Parent and Teacher Rating Scales" by C.H. Goyette, C.K. Conners, and R.F. Ulrich, *Journal of Abnormal Psychology,* 1978, *6,* 221-236. Copyright 1978 by Plenum Publishing Corp. Reprinted by permission. The scores are derived by assigning 0, 1, 2, and 3 points to the answers "not at all," "just a little," "pretty much," and "very much," respectively, for each item. The scores for those items assigned to each factor are then summed and divided by the number of questions assigned to or loading on that factor. The items assigned to each factor from the Conners Parent Questionnaire are as follows:

Conduct problems: questions 2, 8, 14, 19, 20, 21, 22, 23, 27, 33, 34, and 39.
Learning problems: questions 10, 25, 31, and 37.
Psychosomatic problems: questions 32, 41, 43, 44, and 48.
Impulsivity-hyperactivity: questions 4, 5, 11, and 13.
Anxiety: questions 12, 16, 24, and 47.
Hyperactivity index: questions 4, 7, 11, 13, 14, 25, 31, 33, 37, and 38.

[1] Adapted from Barkley, R. (1981). *Hyperactive Children: A handbook of diagnosis and treatment.* New York: The Guildford, pp. 110-111.

Item Contribution to Factors and Total Test[1]

	Subtest (ST)	Total Test (TT)
Factor 1: Conduct Problems		
Item 2	.60	.46
8	.72	.63
14	.58	.64
19	.59	.64
20	.78	.76
21	.40	.56
22	.55	.53
23	.81	.70
27	.55	.53
33	.59	.68
34	.70	.72
39	.35	.30
39	.35	.30
Factor II: Learning Problems		
10	.34	.42
25	.60	.55
31	.49	.41
37	.57	.50
Factor III: Psychosomatic Problems		
32	.49	.17
41	.67	.52
43	.63	.50
44	.53	.45
48	.32	.36
Factor IV: Impulsivity-Hyperactivity		
4	.72	.72
5	.46	.60
11	.72	.75
13	.72	.63
Factor V: Anxiety		
12	.00	.00
16	.53	.42
24	.38	.49
47	.52	.05

	Subtest (ST)	Total Test (TT)
Hyperactivity Index		
Item 4	.74	.72
7	.33	.47
11	.69	.75
13	.66	.67
14	.57	.64
25	.45	.55
31	.41	.41
33	.60	.68
37	.47	.50
38	.58	.55

[1]rounded to 2 digits

APPENDIX B

NEWSPAPER ARTICLE FOR THE STUDY

APPENDIX B

LEARNING PROBLEMS COULD BEGIN WITH DIET

By Anne Mullens
Sun Medical Reporter
Vancouver Sun, November 22, 1986

Two Vancouver doctors are undertaking a study to determine whether food allergies are a cause of children's learning disabilities.

Dr. Stephen Gislason, who specializes in allergies and nutrition, and Dr. Julianne Conry, of the University of B.C.'s education clinic, have proposed a study of children who are performing below expectations at school or have behavioral problems coupled with any number of recurring physical symptoms such as constant colds, headache or skin irritations.

"It is my belief that these children's problems are rooted in a food allergy, and that through diet revision, they will see a dramatic improvement," said Gislason.

Although many have speculated in the past that hyperactive children can be better controlled through diet, Gislason said studies have not conclusively linked learning disabilities to food allergies.

He hopes to do just that.

"In talking with teachers, there is a consensus that too many children are dysfunctional for no apparent reason and that existing remedial methods are not that effective... These illness patterns are prevalent and I suspect that everyone has food allergy in one degree or another."

Gislason and Conry propose to first screen about 50 children who are having trouble in school to see if there is an improvement following diet revision. Gislason hopes to follow the initial study with a controlled study, in which some children receive diet revision and others do not, in an effort to determine whether diet revisions can become a primary treatment for learning disabilities.

Instead of traditional "elimination" diets in which various items are slowly removed from the diet to determine the allergy, Gislason says he revises the diet, eliminating all food additives and usually the two staple food groups, dairy products and cereal grains.

"The diet revisions will be tailored to the child," he said. "Dairy products and grains have the highest incidence of idiosyncratic reaction."

Gislason is looking for children five to 12 years of age to take part in the study with the following symptoms:

APPENDIX C

MEANS AND STANDARD DEVIATIONS BY AGE FOR THE GDS

Table C-1: Means[1] and Standard Deviations by Age for the GDS[2]

	AGE (years)			
	6-7	8-9	10-11	12-16
Delay Test				
Total Responses				
$\bar{x}$	52.00	57.08	61.24	60.23
sd	17.33	15.44	12.89	12.46
Total Correct				
$\bar{x}$	39.87	46.36	50.40	51.55
sd	10.89	10.73	9.44	7.96
Vigilance				
Total Correct				
$\bar{x}$	36.01	40.08	42.75	43.23
sd	6.90	4.60	2.10	2.00
Errors of Commission				
$\bar{x}$	7.79	5.97	3.72	2.39
sd	8.29	6.70	4.74	3.53
Distractibility				
Total Correct				
$\bar{x}$	27.53	30.82	34.74	37.52
sd	8.90	9.26	8.07	6.63
Errors of Commission				
$\bar{x}$	7.27	6.31	5.26	2.61
sd	10.00	8.43	7.02	3.47

[1] rounded to 2 decimal places

[2] adapted from Gordon & Mettelman (1986). *The Gordon Diagnostic System (GDS): Percentile tables and descriptive statistics*. New York: Gordon Systems Inc.

APPENDIX D

THRESHOLD TABLES FOR 6-16 YEAR-OLDS ON THE GDS

APPENDIX D

Threshold Tables for 6-16 Year-olds on the GDS[1]

	6 year-olds		8-9 year-olds		10-11 year-olds		12-16 year-olds	
	TR	TC	TR	TC	TR	TC	TR	TC
Delay								
Abnormal	≥81	≤15	≥76	≤19	≥78	≤32	≥78	≤36
Borderline	64-80	16-32	66-75	20-40	71-77	33-44	69-77	37-46
Normal	≤63	≥33	≤65	≥41	≤70	≥45	≤68	≥47
	TC	EC	TC	EC	TC	EC	TC	EC
Vigilance								
Abnormal	≤21	≥24	≤33	≥19	≤39	≥15	≤39	≥11
Borderline	22-33	10-23	34-38	8-18	40-41	5-14	40-42	4-10
Normal	≥34	≤ 9	≥39	≤ 7	≥42	≤ 4	≥43	≤ 3
	TC	EC	TC	EC	TC	EC	TC	EC
Distractibility								
Abnormal	≤12	≥28	≤13	≥25	≤17	≥20	≤24	≥ 9
Borderline	13-20	8-27	14-24	8-24	18-31	7-19	25-33	4-8
Normal	≥21	≤ 7	≥25	≤ 7	≥32	≤ 6	≥34	≤ 3

TR: Total Responses
TC: Total Correct
EC: Errors of Commission

[1] Adapted from Gordon, McClure & Post (1986). *The interpretive guide to the Gordon Diagnostic System*. New York: Gordon Systems, Inc.

APPENDIX E

CORRELATION MATRICES FOR THE WISC-R, CONNERS PARENT SYMPTOM QUESTIONNAIRE AND THE GORDON DIAGNOSTIC SYSTEM

Table E-1: Correlation Matrix for Wechsler Intelligence Scale for Children-Revised[1]

	FDIQ	Arithmetic	Digit Span	Coding
FDIQ	100			
Arithmetic	75[b]	100		
Digit Span	72[b]	16	100	
Coding	74[b]	39[b]	22	100

[1]rounded to 2 digits, decimals omitted

a) $p \leq .05$
b) $p \leq .01$

Table E-2: Correlation Matrix for Connors Parent Symptom Questionnaire[1]

	Conduct Problem	Learning Problem	Psycho-somatic	Impulsivity-Hyperactivity	Anxiety	Hyperactivity Index
Conduct Problem						
Learning Problem	37[a]					
Psycho-somatic	42[b]	16				
Impulsivity-Hyperactivity	71[b]	42[b]	37[b]			
Anxiety	31[a]	47[b]	25	09		
Hyperactivity Index	74[b]	64[b]	33[b]	89[b]	22	
Total Test	89[b]	64[b]	55[b]	85[b]	43[b]	92[b]

[1]rounded to 2 digits, decimals omitted

a) $p \leq .05$
b) $p \leq .01$

Table E-3: Correlation Matrix for Gordon Diagnostic System[1]

	G1	G2	G3	G4	G5	G6
G1		41[b]	-05	24	12	21
G2			03	05	03	17
G3				-75	60[b]	-79[b]
G4					-50[b]	57[b]
G5						56[b]

[1] rounded to 2 digits, decimals omitted

a) $p \leq .05$
b) $p \leq .01$

G1: Delay Total Responses
G2: Delay Total Correct
G3: Vigilance Total Responses
G4: Vigilance Errors of Commission
G5: Distractibility Total Responses
G6: Distractibility Errors of Commission

APPENDIX F

REGRESSION COEFFICIENTS FOR PREDICTING THE FDIQ

AND THE HYPERACTIVITY INDEX

Table F-1: Regression Coefficients for Predicting the FDIQ from the CPSQ Subtest Scores and the GDS Subtest Scores

Subtest	Beta	p
Regression Coefficients for the CPSQ[1]		
Anxiety	.33	.88
Impulsivity-hyperactivity	.23	.42
Psychosomatic Problems	-.01	.96
Learning Problems	-.14	.52
Conduct Problems	.05	.85
Regression Coefficients for the Delay, Vigilance and Distractibility Total Correct[2]		
Distractibility Total Correct	.24	.26
Delay Total Correct	-.02	.90
Vigilance Total Correct	.10	.62

[1] df=(5,30) Coefficients rounded to 2 significant figures
[2] df=(3,32)

Table F-2: Regression Coefficients for Predicting the Hyperactivity Index from the WISC-R Subtest Scores and the GDS Subtest Scores

Subtest	Beta	p
Regression Coefficients for the WISC-R		
Coding	-.04	.83
Digit Span	.49	.01
Arithmetic	-.10	.58
Regression Coefficients for the Delay, Vigilance and Distractibility Total Correct		
Distractibility Total Correct	.01	.95
Delay Total Correct	.02	.90
Vigilance Total Correct	-.33	.12

df=(3,32) Coefficients rounded to 2 significant figures

APPENDIX G

CANONICAL VARIABLE LOADINGS FOR SUBTESTS IN THE CANONICAL CORRELATIONS

Table G-1: Canonical Variable Loadings for Subtests in the Canonical Correlations

Subtest	r^2	F	p
A. i) Proportion of FDIQ subtest variance predicted by CPSQ subtests[1]			
WISC-R			
Arithmetic	.24	1.83	.16
Digit Span	.27	2.17	.11
Coding	.13	.88	.46
ii) Proportion of CPSQ subtest variance predicted by the FDIQ subtests[2]			
CPSQ			
Conduct Problems	.06	.63	.60
Learning Problems	.06	.64	.59
Psychosomatic Problems	.04	.38	.77
Impulsivity-hyperactivity	.16	1.90	.15
Anxiety	.10	1.12	.36
B. i) Proportion of FDIQ subtest variance predicted by GDS subtests[3]			
WISC-R			
Arithmetic	.06	.63	.60
Digit Span	.23	3.26	.03
Coding	.22	2.93	.05
ii) Proportion of GDS subtest variance predicted by the FDIQ subtests[4]			
GDS			
Delay Total Correct	.01	.08	.97
Vigilance Total Correct	.08	.98	.42
Distractibility Total Correct	.22	3.04	.04

Table G-1 continued

Subtest	r^2	F	p
C. i) Proportion of GDS subtest variance predicted by CPSQ subtests[5]			
GDS			
Delay Total Correct	.21	1.53	.23
Vigilance Total Correct	.12	.82	.49
Distractibility Total Correct	.07	.44	.73
ii) Proportion of CPSQ subtest variance predicted by the GDS subtests[6]			
CPSQ			
Conduct Problems	.14	1.70	.19
Learning Problems	.10	1.17	.34
Psychosomatic Problems	.02	.22	.88
Impulsivity-hyperactivity	.09	1.06	.38
Anxiety Problems	.05	.52	.67

[1] df=5,29; Canonical R=.55, p=.24; Coefficients rounded to 2 significant figures.
[2] df=3,31; Canonical R=.55, p=.24
[3] df=3,32; Canonical R=.58, p=.06
[4] df=3,32; Canonical R=.58, p=.06
[5] df=5,29; Canonical R=.54, p=.30
[6] df=5,31; Canonical R=.54, p=.30

APPENDIX H

CONSENT FORMS

THE UNIVERSITY OF BRITISH COLUMBIA
Faculty of Education
2125 Main Mall
University Campus
Vancouver, B.C., Canada
V6T 1Z5

I hereby authorize the release of test results obtained on my child, ______________________________, on the Wechsler Intelligence Scale for Children-Revised and the Wide Range Achievement Test-Revised, to Stephen Gislason, M.D. and Julianne Conry, Ph.D.

____
Parent/Guardian

____
Date