Type A Behavior and Hyperactivity/ADHD

Are They Related?

BY

LILIANNE NYBERG

ACTA UNIVERSITATIS UPSALIENSIS
UPPSALA 2002
Dissertation for the Degree of Doctor of Philosophy in Psychology presented at Uppsala University in 2002

ABSTRACT


The present thesis focuses on Type A behavior in children and its possible relation to hyperactivity/ADHD. Type A behavior in children has commonly been studied as the child equivalent behaviors of the adult pattern, in other words, competitive achievement-striving, impatience/time-urgency, and aggressiveness.

Study I investigated the convergent and discriminant validity of observationally assessed Type A behavior with regard to parent- and teacher-rated Type A behavior (Matthews Youth Test for Health [MYTH] questionnaire) and hyperactivity (questionnaire) among 8-year-olds. Study II was similar although these relations were studied longitudinally between 4 and 8 years of age, and hyperactivity was observationally assessed at age 4. The results of Studies I and II showed that Type A behavior is discernible already at age 4 and that it should be regarded as a phenomenon rather distinct from hyperactivity. Assessing aspects of Impatience, however, was found to be problematic, both in terms of discriminating between Type A behavior and hyperactivity, and in terms of showing stability over time. The MYTH was concluded to measure Type A behavior too indiscriminately, showing a substantial overlap with hyperactivity.

Study III attempted to differentiate Type A behavior (MYTH-defined) and hyperactivity/ADHD using observed motivation during a reaction time task. The results pointed to the MYTH as indiscriminant from hyperactivity measures with regard to observed motivation and task performance. The perception of Type A individuals as highly motivated to achieve was not evident in this study.

In Study IV, an observationally assessed Type A group was compared to a Type B group and an ADHD group on measures of inhibitory control and executive functioning. The results pointed to similarities between Type A and ADHD boys regarding overt displays of time-urgency and impatience. However, differences on other tasks of executive functioning lead to speculations concerning differing origins of overtly similar characteristics of Type A behavior and ADHD.

Key words: Type A behavior, hyperactivity, ADHD, observations, children, MYTH, development.

Lilianne Nyberg, Department of Psychology, Uppsala University, Box 1225, SE-751 42, Uppsala, Sweden

© Lilianne Nyberg, 2002

ISSN 0282-7492
ISBN 91-554-5223-x

Printed in Sweden by Universitetstryckeriet, Ekonomikum, Uppsala 2002
ACKNOWLEDGEMENTS

There are numerous people to whom I am grateful, for providing both the opportunities and inspirational boosts necessary to complete this work. It has truly been a rich experience, both personally and academically.

First and foremost, I wish to express my warmest thanks to my supervisor, Gunilla Bohlin, whose enthusiasm for scientific research has inspired me throughout this work and whose most knowledgeable guidance, insight, patience, and sense of humor have made this work not only possible, but enjoyable as well! I am sincerely grateful for the time we have spent together and the work we have accomplished. I also wish to thank Berit Hagekull, one of my co-authors on two of the papers in this thesis, who was particularly influential regarding my area of study. Her keen scientific mind and careful attention to detail have led to tedious work with numerous rewrites, but have also made me work to express my thoughts more clearly.

I am grateful to both past and present members of our research group in Developmental Psychology, for encouragement and support throughout this work, for interesting scientific discussions, for valuable comments on previous drafts of the papers included in this thesis, and for many good times and the social events we have shared, which have made my work particularly pleasurable. Thanks also to Lisa Berlin for her collaboration as a co-author in Studies III and IV.

Furthermore, I wish to express my thanks to Lars-Olof Janols for inviting me into the field of ADHD research and for collaboration concerning the clinical groups included in Studies III and IV, and to Eva Lundgren for her assistance at the clinic. Many thanks are due to the parents and children who have participated in the studies, as well as to the various people who have been involved in data collection and assessments. The studies would not have been possible without them!

I am grateful to Håkan Stattin for valuable comments on a draft of this thesis.

Thanks also to the entire staff at the Department of Psychology for providing a friendly work environment. Special thanks are due to Lars-Erik Larsson for putting up with my constant nagging about unruly technical equipment during phases of data collection.

I also wish to thank Kerstin Andersson, my “twin” colleague, for being a reliable friend, a talkative roommate, as well as a good listener. We’ve had a lot of fun together!

My dear family and friends (especially “maffiosi” and Jessica), although not necessarily involved in my work, have contributed enormously through their love and support, encouragement, and good laughs, making sure I know there is more to life than research. Many thanks and hugs to you all!

My deepest and most personal thanks go to my loving and supportive husband Micke and dear son Kristoffer – the lights of my life, who constantly remind me about life’s richness.

The studies in this thesis have been funded by the Bank of Sweden Tercentenary Foundation, the Axel and Margret Ax:son Johnson Foundation, and the non-graduated researchers’ fund at Uppsala University.

Uppsala in January, 2002

Lilianne
In memory of my mother, Ruth Eninger

Time is the wisest counselor
The present thesis is based on the following studies, which will be referred to in the text by their Roman numerals:


Reprints were made with kind permission from Lawrence Erlbaum and Associates, Inc. (Study I) and John Wiley & Sons, Ltd. (Study III).
INTRODUCTION ........................................................................................................... 11
The Type A Behavioral Pattern in adults ................................................................. 11
Conceptualizations of Type A behavior .................................................................... 14
The Type A Behavioral Pattern in children ............................................................. 18
Empirical studies regarding Type A behavior in children ....................................... 19
Possible etiologies and familial association/socialization of Type A behavior ....... 20
Hyperactivity and Attention Deficit Hyperactivity Disorder (ADHD) ...................... 20
Empirical overlap between measures of Type A behavior and hyperactivity ......... 22
Developmental aspects with regard to Type A behavior and hyperactivity ........... 22
Inhibitory control, executive functioning, and sustained attention ....................... 24
Relations to IQ and achievement and problem behaviors ...................................... 28
Type A behavior and hyperactivity - - Are they related? ........................................ 28
EMPIRICAL STUDIES ................................................................................................. 30
AIMS .......................................................................................................................... 30
METHODS .................................................................................................................. 31
Participants ............................................................................................................... 31
Table 1 ....................................................................................................................... 33
Procedures and Methods ....................................................................................... 33
Studies I & II ............................................................................................................ 33
  4 years ................................................................................................................... 33
  8 years ................................................................................................................... 34
  8 ½ years ............................................................................................................... 34
  8 ¾ years ............................................................................................................... 34
Study III .................................................................................................................... 34
  Data wave 1 ......................................................................................................... 34
  Data wave 2 ......................................................................................................... 35
Study IV .................................................................................................................... 36
Measures .................................................................................................................. 37
Studies I & II ............................................................................................................ 37
  Observed Type A behavior, 4 and 8 years ............................................................ 37
  Observed hyperactivity, 4 years .......................................................................... 38
  Ratings of Type A behavior, 4 years .................................................................... 38
  Ratings of Type A behavior, 8 ½ years ............................................................... 39
  Maternal ratings of hyperactivity, 8 years ......................................................... 39
  Achievement measures, 8 years and 8 ¾ years ................................................... 39
  Ratings of problem behaviors, 8 ½ years ............................................................ 39
Study III .................................................................................................................... 40
  Ratings of hyperactivity ..................................................................................... 40
  Ratings of Type A behavior ............................................................................... 40
  Behavioral ratings of task motivation ................................................................ 40
  Complex Reaction Time performance ................................................................ 41
Study IV…………………………………………………………………………41

Measures of Type A behavior and hyperactivity…………………………………41
  Observed Type A behavior……………………………………………………41
  Ratings of hyperactivity……………………………………………………42

Measures of inhibitory control and executive functioning……………………..42
  Go/no-go task………………………………………………………………43
  Tower of Hanoi task………………………………………………………43
  Time reproduction task……………………………………………………43
  Hand movements task. Repetition of behavioral sequence……………………44
  Cheating during puzzle task……………………………………………….44
  Story recall………………………………………………………………44
  WISC Performance measure of IQ………………………………………….45

RESULTS AND CONCLUSIONS………………………………………………45

Study I………………………………………………………………………………45
  Dimensionality of observed Type A behaviors…………………………………45
    Table 2……………………………………………………………………46
  Convergent validation: Relations between the two Type A measures………….46
  Discriminant validation: Relations between hyperactivity and
    Type A measures…………………………………………………………47
    Conclusions……………………………………………………………47

Study II……………………………………………………………………………48
  Individual stability of Type A measures………………………………………49
    Table 3……………………………………………………………………50
  Convergent validity among Type A measures and hyperactivity measures…..50
  Discriminant validity of Type A measures with regard to hyperactivity……51
  Longitudinal relations to achievement and externalizing problem
    behaviors at age 8……………………………………………………51
  Systematic change in Type A behavior over time……………………………52
  Conclusions………………………………………………………………52

Study III……………………………………………………………………………53
  Group differences in task motivation and CRT performance…………………53
    Table 4……………………………………………………………………54
  Relations between Type A behavior, hyperactivity, task motivation,
    and CRT performance…………………………………………………55
    Table 5……………………………………………………………………55
  Conclusions………………………………………………………………55

Study IV……………………………………………………………………………56
  Group differences in inhibitory control and various aspects of
    executive functioning…………………………………………………..56
    Table 6……………………………………………………………………57
  Conclusions………………………………………………………………58

DISCUSSION……………………………………………………………………58
  Contributions made by the present research……………………………………58
    Study I…………………………………………………………………58
    Study II………………………………………………………………58
INTRODUCTION

This thesis has its focus on two constructs in child development research, namely Type A behavior and hyperactivity, and their possible interrelations, both from a methodological point of view and from a phenomenological standpoint. First follows a description of each phenomenon and thereupon an account of their possible interrelations.

The Type A Behavioral Pattern in adults

Surely everyone, at least those living in Western societies, has at some point come across a person who is intensely achievement-striving, perhaps even aggressively so, and who displays a "win at all costs" attitude. Most likely, this person also tends to become very frustrated when he or she has to wait for someone or something, angered over every minute being "wasted". He or she appears to be constantly struggling against time, in a state of hurry, attempting to accomplish more and more in less and less time. Likewise, this person is the one who weaves between lanes in traffic, trying to save minutes or seconds, frustrated by other drivers blocking his or her path. This individual probably seeks to gain full control over his or her environment, being easily frustrated in less controllable situations. In addition, there may be a considerable amount of free-floating, albeit well-rationalized, hostility present in this person.

These behaviors have been proposed to comprise a specific behavioral pattern, the so-called Type A Behavior Pattern (Friedman & Rosenman, 1974). This pattern was first described by Friedman and Rosenman (1959), with regard to its proposed association with coronary artery disease, and was thereafter further defined and validated (1974). Persons chronically struggling against time, events, and other people were believed to be at greater risk for coronary heart disease (CHD) because of chronic overstimulation of sympathetic nervous system pathways resulting in elevated catecholamines and corticosteroids, increased blood pressure and heart rate, arterial constriction, release of free fatty acids, and increased platelet aggregation (Friedman &
Rosenman, 1974). Type A behavior in adults is characterized by a chronic sense of
time-urgency ("hurry sickness"), an excessive competitive drive, and free-floating (but
usually well-rationalized) hostility, whereas Type B behavior is characterized by the
relative absence of these behaviors. This behavior pattern has been a topic of great
interest (although research efforts were more pronounced during the 1970’s and
1980’s) in adults as well as children.

During the 1980’s, there was still a preponderance of findings showing a
significant but modest positive relation between Type A behavior and CHD outcomes
(see e.g., meta-analysis by Booth-Kewley & Friedman, 1987). However, studies were
increasingly pointing to certain components of the Type A behavior pattern, rather than
the entire complex, as important risk factors in CHD, more specifically anger and
hostility (e.g., Dembroski, MacDougall, Costa, & Grandits, 1989). There have,
however, been many inconsistent findings within Type A research with regard to
associations with physiological measures related to coronary disease and coronary
disease outcomes. These inconsistencies could be the result of many factors (see e.g.,
Miller, Turner, Tindale, Posavac, & Dugoni, 1991), for instance, the use of different
disease outcome measures, different Type A assessment methods, and different study
populations.

Further, different meta-analyses over the years have revealed different results,
and varying conclusion have thus been drawn. Booth-Kewley and Freidman (1987), for
example, found that among various personality variables, the strongest associations to
CHD outcomes was for Type A behavior and depression although
anger/hostility/aggression and anxiety also related reliably to CHD. Type A behavior
constituted a small effect, although this was deemed “highly reliable and certainly
nontrivial”. The authors point to a considerable caveat within Type A research,
however, namely that every researcher working in the Type A domain seems to have
his or her own conceptualization and accompanying operational definition of the Type
A construct. Another meta-analysis by Matthews (1988), which was based on
prospective studies, found Type A behavior as measured by the Structured Interview to
be related to CHD, whereas when all Type A measures were included, predictions to
CHD were only significant in population studies, and not high-risk studies. A more recent meta-analysis (Myrtek, 1995), however, found the small associations of Type A behavior to CHD to be of "no practical significance". Miller and colleagues (Miller et al., 1991) suggest that the trend toward null findings is due in part to a type of range restriction bias, disease-based spectrum bias. Further, they found that self-report measures of Type A were often associated with null findings, as were studies using fatal myocardial infarction as a disease criterion. Dichotomized measures of Type A behavior also seem to reduce associations. Studies using Structured Interviews of Type A, however, frequently reported associations of Type A with CHD: more Type As (70%) were found in diseased populations of middle-aged men than in healthy populations of middle-aged men (46%). Furthermore, Friedman and coworkers (1986) found significantly lower rates of recurrence in post-myocardial infarction patients whom had received intervention focusing on alteration of Type A behavior, compared to those in a comparison group (receiving cardiac counseling only) and a control group (receiving no treatment).

Type A behavior as assessed by the Structured Interview (Rosenman et al., 1964) has been shown to be more consistently related to CHD than other methods of assessment, such as self-reports or questionnaires. In scoring the Structured Interview, the focus is mainly on the behaviors and speech characteristics displayed during the interview (e.g., interruptions, rapid and forceful speech), rather than the content of answers. Many studies have reported low correlations between different measures of Type A behavior (see e.g., Matthews, 1982). This is probably a result of the considerable conceptual confusion evident within Type A research. In fact, Thoresen and Powell (1992) have stated that the "conceptual development in Type A behavior is in urgent need of help". They suggest that the significance of Type A as a predictor of CHD has resulted in the dominating influence of epidemiological research methods that often required Type A to be assessed only as an independent, trait-like variable using one mode; this has thus left the psychology of Type A behavior badly neglected.

The common discussion about whether phenomena should best be described in terms of dimensions or categories is relevant to Type A behavior also. Both traditions
have been followed in previous research. The cut-off point for categorization is arbitrary in that it is most often based on the median. Suffice it to say that it would be reasonable to assume that the degree of Type A behavior varies between persons even within the more crude categorical distinction.

**Conceptualizations of Type A behavior**

Over the years there have been several different conceptualizations of Type A behavior. For instance, Glass (1977) has proposed that the hallmark of Type A lies in the inappropriate coping skills exhibited by Type A persons; Type A behaviors represent the Type A person’s excessive desire to assert and maintain control over stressful aspects of his or her environment. Matthews and Siegel (1982), on the other hand, have suggested that Type A behavior may involve a strong value in productivity combined with ambiguous standards for evaluating that productivity, which should lead to a sense of time passing rapidly. Dembroski and colleagues (Dembroski, Weiss, Shields, Haynes, & Feinleib, 1978) have proposed that the most important aspect of the Type A behavior is physiological reactivity, which contributes to arterial damage, while being expressed in Type A characteristics such as rapid speech. Wright (1988) has speculated that there are certain so-called critical experiences in the development of Type A behavior, namely a high need to achieve (which is based on linking achievement to self-esteem), early success and therefore reinforcement for striving efforts, and exposure to timed activities that provide a personal blueprint for achieving more by more efficient use of time and by chronic activation. These critical experiences are relevant only where self-esteem is lacking, however, and the development of Type A behavior is further dependent on the decision to remedy low self-esteem via achievement.

Thoresen and Powell (1992) point to the importance of personal and social cognitions, with their associated emotional states in relation to specific situations. They refer to a model of self-evaluative processes by Strube (1987), in which the uncertainty about one’s ability to succeed in situations perceived as important, yet often confusing
and uncontrollable, stimulates Type A behavior as a coping style. Type As seem to have stable schemata in their memories about past Type A-related behaviors, emotional states, and situations. These cognitive and perceptual processes are assumed to influence behavior as well as physiology.

Wright (1988) has described the time-urgent Type A person as being left in a suspended suspense, with a resulting emotional and hormonal surplus, due to the presence in their everyday activities of both the pre-exertion response (adrenaline/activation response) and post-exertion response (a deep breath), but without the intervening response for which the Type A person is mobilized. He argues that, rather than overt manifestations of underlying anger (Friedman & Ulmer, 1984), this may be manifestations of task-related activation, or a tendency to overly mobilize the body’s physical resources in response to minimal physical tasks. This inner/physiological activation in the absence of corresponding physical activity may result in a different metabolism, thus leading to adverse health effects (the differential health effects of the concepts of anger-in and anger-out may also be regarded in this light).

An alternative psychiatric view is presented by Larson (1993), in which he argues that there is a failure within Type A research to distinguish between Axis I symptoms and Axis II personality traits. The Type A behavior pattern was originally described as a constellation of time-urgency, hostility, and competitiveness, triggered by certain situations; however, Type A behavior has rather been viewed in practice as an enduring personality trait. He concludes that Type A should be defined as an Axis II Personality Disorder, and Stress Disorder or Hostility Disorder should be used to describe the Axis I symptoms.

There has been a recent attempt to conceptualize Type A behavior as a motivational orientation (Sturnam, 1999). Findings showed that an extrinsic orientation was associated with Type A behavior, whereas an intrinsic orientation was associated with achievement motivation. The study further revealed a linkage between Type A behavior and instrumental concerns about interpersonal superiority and prestige. In accordance with Glass’ conceptualization, it was found that Type As are particularly
attuned to their surroundings, and much of their achievement-related behavior is instrumental.

Another recent study has investigated risk factors for CHD from a temperamental perspective (Keltikangas-Järvinen, Ravaja, & Viikari, 1999). More specifically, Cloninger’s (Cloninger, 1987; Cloninger, Przybeck, & Svrakic, 1993) temperament dimensions were cluster-analyzed and the resulting profiles were related to traditional physiological risk factors for CHD. The study revealed that the “risk profile” described a person who was high on perseverance (P), high on reward dependence (RD), average on novelty seeking (NS) and low on harm avoidance (HA). According to Cloninger and coworkers (1993), individuals with high P show perseverance despite frustration and fatigue. Reward dependent persons are described as being sympathetic, eager to help and please others, highly dependent on emotional support and intimacy with others, highly sensitive to social cues of approval/praise and rejection from others, leading to excessive reward-seeking behaviors. As workers, they are hard-working, confident, persistent, ambitious, and forceful overachievers who frequently push themselves to exhaustion (Cloninger, 1987). Low harm avoidance is characterized by a lack of inhibition and of appropriate caution, by activities with a risk of physical injury, and by high energy levels with quick recovery from exertion, stress, and minor illness. If low HA persons also are low in novelty seeking, they will usually be cheerful, boastful, and overconfident. The description of the coronary prone person portrayed in this study is lacking in some traditional coronary-prone characteristics such as cynicism, pessimism, and anticipatory worrying. Interestingly, however, the risk profile described by Keltikangas-Järvinen and associates is markedly similar to Pattern A as originally described by Friedman and Rosenman (1974).

In a comprehensive effort to conceptualize this pattern, Glass and his associates conducted a series of experiments (see Glass, 1977). These investigators reported evidence showing that Type As assessed by the Jenkins Activity Survey (JAS; Jenkins, Zyzanski, & Rosenman, 1971) work hard to succeed, suppress subjective states (such as fatigue) that might interfere with task performance, and conduct their activities at a rapid pace. Glass has suggested that Type A persons exert greater efforts than their
Type B counterparts to control stressful events that are perceived as threats to their sense of control. Furthermore, if that is the case, when faced with a stressful event, they should struggle to control that event and, in consequence, appear hard-driving and aggressive, easily annoyed, and competitive. If their efforts to control are met with repeated failure, however, they should give up responding and act helpless. In other words, the Type A behavior pattern may be seen as a style of coping with uncontrollable stressful events.

The conceptualization of Type A behavior by Glass (1977) described above is of special interest because of its focus on uncontrollable stress. As pointed out by Pickering (2001), mental stress may be precipitated/elicited by a number of factors, including job strain, and negative affect, such as depression, hostility, and anger, all which have in common a perceived loss of control over one’s environment. Furthermore, these factors have all shown to be related to an increased risk of hypertension and CHD. Interestingly, a number of these factors are also defining characteristics of the Type A behavioral pattern.

Other studies have found persons exhibiting the Type A behavior pattern to be especially focused in their attention to tasks (Matthews and Brunson, 1979), and Type As have even been described as hypervigilant (that is, to direct sustained attention to all stimuli involved in a task) during ambiguous tasks (De la Casa, Gordillo, Mejías, Rengel, & Romero, 1998).

In terms of the appearance of Type A individuals, there seems to be a preponderance of certain physical characteristics, for example: frequent straining type of facial grimace; dramatic or overly forceful movements while conducting minimal tasks; overly forceful speech style; rapid eating; hyperalertness; short response latencies; frequent, breathy sighs; repetitive (or fidgety) movements of the feet, fingers, or jaw; and an intense look with frequently inhibited smile or laugh (most taken from Friedman, Hall, & Harris, 1984).
The Type A Behavioral Pattern in children

Although it is not entirely clear to what extent the Type A behavioral pattern, or some dimension thereof, constitutes a risk factor for heart disease, child equivalent behaviors of the Type A behavior pattern have been studied in childhood and adolescence in the hope that a further understanding of the behavior pattern and its development could allow preventive action with regard to later heart disease. Atherosclerosis as well as other coronary risk factors, begin or are present already in childhood (Berenson et al., 1980; Moller, Taubert, Allen, Clark, & Lauer, 1994), and researchers have found coronary-prone concentrations of serum apolipoproteins in children demonstrating the Type A behavioral pattern (Räikkönen, Keltikangas-Järvinen, & Solakivi, 1990). Behaviors comprising the Type A behavioral pattern could be seen as indicative of mental stress, which has been widely found to have many and varying adverse health effects. Studying the development of Type A behavior could perhaps help prevent later stress-related illness more generally.

The Matthews Youth Test for Health (MYTH) questionnaire, developed by Matthews and Angulo (1980), is the most frequently used method of assessment for Type A behavior in children. The MYTH was constructed with adult Type A behavior in mind, that is, behaviors commonly seen in the Structured Interview (Rosenman et al., 1964). The MYTH questionnaire consists of two factor-analytically derived dimensions of Type A behavior, Impatience/Aggression and Competitiveness, measured as continuous variables, and has been found to be a reliable measure in children, using test-retest with a 3-month interval (Matthews & Angulo, 1980). Although there is a problem with validity criteria when studying Type A behavior in children, the construct validity of the MYTH has been tested using various behavioral indices of competitiveness, impatience, aggression and frustration, as well as gross motor activity, and restlessness (Matthews & Angulo, 1980; Vega-Lahr & Field, 1986). Lundberg and his associates (Lundberg, Westermark, & Rasch, 1990) have used a Swedish translation of the MYTH and included three items regarding speech characteristics ("this child talks fast," "this child speaks with a loud voice," and "when
this child answers questions, he/she does it slowly” [reversed scoring]) when employing the Swedish version of the MYTH.

**Empirical studies regarding Type A behavior in children**

In an overview of the correlates of child Type A behavior, Nay and Wagner (1990) report that the four major behavioral components of the adult Type A behavior pattern, competitive-achievement striving, time urgency, aggressiveness-hostility, and impatience have been found in child/adolescent Type A subjects, using both observational methods and self-report questionnaires.

Type A children, in accordance with their adult counterparts, have been found, for example, to make greater efforts to excel on tasks with ambiguous performance criteria, compared to Type Bs, and to underreport subjective fatigue relative to effort expended (Matthews & Volkin, 1981), respond to highly salient uncontrollable events with more vigorous efforts to assert control (Matthews, 1979), select higher standards for self-evaluation (Matthews & Siegel, 1983), underreport a wide variety of physical symptoms (Leikin, Firestone, & McGrath, 1988), and increase their systolic blood pressure more during challenge (Lundberg, 1983). Furthermore, Type A children have lower self-esteem, more external locus of control, and higher anxiety level than their non-Type A counterparts (Nay & Wagner, 1990).

With regard to the development of Type A behavior, Matthews (Matthews & Jennings, 1984; Matthews & Volkin, 1981) believes that Type A tendencies develop in a linear fashion and points to both behavioral and physiological similarities between adults and children. In addition, studies of development have reported stability of Type A behavior during childhood (e.g., Matthews & Avis, 1983), and between adolescence and adulthood (e.g., Bergman & Magnusson, 1986; Steinberg, 1987), although instability was evidenced between childhood and adulthood (e.g., Steinberg, 1987). Data from the New York Longitudinal Study (Steinberg, 1986) found Type A tendencies to correlate positively with psychological adjustment in childhood, to be unrelated in adolescence, and to be negatively correlated in adulthood.
Possible etiologies and familial association/socialization of Type A behavior

Matthews (1978) and Price (1982) have suggested the possible role of parents’ continually escalating performance standards, constant disapproval, and punitive or hostile methods of control in the childhood etiology of Type A behavior. One study in accordance with this view (McCranie & Simpson, 1986), found Type A males to be significantly more likely to describe both parents as placing high emphasis on achievement, expecting competence in a wide variety of areas, and continually demanding better performance. They were also more likely to describe parents as being strict, using frequent physical punishment or other hostile methods of control, and communicating frequent dissatisfaction and disapproval. In a similar vein, Treiber and colleagues (Treiber et al., 1990) found that, in high CHD risk families, maternal verbal hostility was significantly positively related to preschoolers level of MYTH-defined Type A behavior (specifically Impatience/aggression).

There have been studies pointing to a significant degree of similarity between the Type A of children and that of their mothers, but not their fathers (e.g., Matthews & Krantz, 1976; Sweda, Sines, Lauer, & Clarke, 1986). Twin studies among adults regarding the heritability of Type A behavior have presented some evidence of a genetic contribution. For instance, Rahe and colleagues (1978) found that the Speed-Impatience component of the JAS exhibited some degree of heritability, whereas the overall Type A score was not significant. Matthews and Krantz (1976), however, found the Hard-Driving component of the JAS, rather than Speed-Impatience, to be heritable.

Hyperactivity and Attention Deficit Hyperactivity Disorder (ADHD)

There have been substantial research efforts with regard to Attention Deficit Hyperactivity Disorder (ADHD), especially in recent years. This disorder afflicts approximately 3-5% of children, the majority being boys (DSM-IV; APA, 1994).
Hyperactivity is, together with Impulsivity, one of the major components of ADHD in DSM-IV (APA, 1994). Hyperactivity is characterized by behaviors such as fidgeting, squirming, running about when inappropriate, and talking excessively. Impulsivity is defined by difficulties awaiting turn, interrupting or intruding on others, or blurting out answers before questions have been completed. Inattention is the other major component of ADHD and is defined by, for example, difficulties with sustained attention, being easily distracted, or making careless mistakes (DSM-IV; APA, 1994).

ADHD is likely to be associated with a number of impairments in many different domains (see Barkley, 1998). For instance, these children often exhibit decreased nonverbal and verbal working memory, impaired planning ability, and a poor sense of time. Many ADHD children display speech impairments, poor organization of speech, delayed internalization of speech, poor rule-governed behavior, and deficient academic achievement skills. Furthermore, there are delays in motor coordination and deficiencies in terms of regulating emotions. With regard to task performance, ADHD children often show poor persistence of effort, greater variability in responding, and decreased performance under delayed reward conditions.

In terms of etiology, neurological and genetic factors are believed to play a substantial role in the occurrence of ADHD (Barkley, 1998). There appears to be a disturbance in a pathway of the nervous system, more precisely the prefrontal cortical-striatal network. Perhaps what is transmitted genetically is a tendency toward a smaller and less active prefrontal-striatal network. The disorder may also be caused or exacerbated by pregnancy complications, exposure to toxins, or neurological disease. Social factors involving family and social adversities, although not causal per se, may also exacerbate the condition, contribute to its persistence over development, and contribute to comorbid disorders (Barkley, 1998).

The construct of hyperactivity is often used to denote not only pure hyperactive behaviors as described earlier, but also encompasses inattentive and impulsive behaviors, in other words, it does not necessarily refer to clinically diagnosed ADHD. Examples are the Conners parent and teacher rating scales, developed and revised by
Conners (1990) and a shorter, ten-item version (Abbreviated Teacher Rating Scale; Conners, 1990), which are commonly used hyperactivity measures.

**Empirical overlap between measures of Type A behavior and hyperactivity**

Several studies have shown an overlap between the MYTH scale and various hyperactivity measures such as Conners rating scales (Hunter et al., 1985; Rickard & Woods de Rael, 1987; Treiber et al., 1989; Whalen & Henker, 1986). However, this overlap in different operationalizations of hyperactivity and Type A behavior has generally not been studied in depth and is thereby not well understood. Hyperactivity may be regarded as maladjusted behavior, in that it is often related to performance deficits and externalizing behavior problems. At the descriptive level, some of the behaviors pertaining to hyperactivity and ADHD may show similarities with Type A behaviors, perhaps indicating some common aspect of impatience. The descriptions of inattention, however, do not fit in with the conception of Type A behavior (see e.g., Matthews & Brunson, 1979). It may be difficult, using questionnaires, to capture the distinctive aspects of Type A behavior and hyperactivity, respectively. In other words, there is the possibility that the overlap between Type A, as measured with the MYTH, and hyperactivity to a large extent is due to an operationalization problem.

**Developmental aspects with regard to Type A behavior and hyperactivity**

According to Posner and Rothbart (2000), children’s reactive tendencies may be observed early, whereas self-regulatory executive attention develops relatively late (between 3 and 4 years of age) and continues to develop throughout the early school years. Effortful control, the temperamental aspect related to this development (thought to be highly influenced by socialization), may play a role in modulating the expression of approach-related tendencies (Ahadi & Rothbart, 1994). Children high in effortful control may be better able to inhibit task-irrelevant thought and persist at tasks in response to frustration (Rothbart & Ahadi, 1994). Type A behavior would thus be expected with age to become
more discernible as overt behavior as well as more differentiated in terms of different dimensions, due to the increasing capacity for self-regulation, setting the stage for achievement motivation and persistence, even in the presence of hardships. Accordingly, Lundberg and colleagues (1990) found a systematic increase in Competitiveness scores of the MYTH between the ages of 4 and 7 years.

Furthermore, studies of development show that high activity levels are normative at younger ages, whereas high activity levels beyond the age of five are usually associated with negative outcomes (Eaton, 1994). In addition, there are age-dependent increases in sustained attention, self-regulatory capabilities, and persistence (e.g., Rothbart & Bates, 1998). These characteristics of normal development have been found to be delayed/deficient in children with ADHD (e.g., Barkley, 1997). Problems with hyperactivity and deficient self-regulation should also tend to become more pronounced upon school entry, which places a high demand on self-regulatory capabilities.

The importance of viewing Type A behavior as a multidimensional construct has been stressed by several researchers (e.g., Matthews, 1982; Steinberg, 1987), in that it has important implications for developmental research. For instance, the respective dimensions have been found to show different relations to a number of correlates (e.g., Bachman, Sines, Watson, Lauer, & Clark, 1986), to be differentially predictable from early measures, and may also have different precursors (e.g., Bergman & Magnusson, 1986; MacEvoy et al., 1988; Steinberg, 1987). MacEvoy and colleagues found that the child’s liveliness, sociability, and poor appetite predicted Type A irritability and hurried behavior in adulthood, whereas shyness, poor appetite, and anger (interaction) predicted the work-involvement clusters. Steinberg (1985, 1987) also found certain aspects of early temperament to be related to Type A behavior. For instance, high adaptability, negative mood, high approach, and low rhythmicity predicted achievement-striving (accounting for 25% of the variance), whereas low sensory threshold, low persistence, and low adaptability predicted the impatience-anger dimension (accounting for 13% of the variance).

In addition, Steinberg (1987) found different correlational patterns between the Competitiveness and Impatience dimensions at different ages, with positive
correlations during childhood, non-significant correlations during adolescence, and negative correlations during adulthood. Although the relations between the achievement-striving and impatience-anger dimensions changed with age, these dimensions showed impressive stability between childhood and adolescence and between adolescence and adulthood. Steinberg concluded that findings point to Type A behavior as a product of an interaction between underlying dispositions and a particular set of socialization experiences.

Although temperamental differences were not predictive of later Type A behavior in a study by Heft and associates (Heft et al., 1988), they found that high Type A children reported more stress-related behaviors, higher levels of depression, anger, anxiety, and cognitive disorganization, and greater reactivity than low Type As. They speculate that Type A behavior evolves in adulthood from a more global and less differentiated pattern of behavioral and emotional arousal in younger people. They further suggest that different behavioral pathways may emerge during childhood, influenced primarily by parental, peer group, and environmental contexts, resulting in highly cynical and hostile persons, highly competitive persons, and yet other persons manifesting an exaggerated pattern of time urgency and impatience.

**Inhibitory control, executive functioning, and sustained attention**

**Inhibitory control and executive functioning**

It may be possible to specify differences and similarities between Type A behavior and hyperactivity using tests of inhibitory control and executive functioning (although these mostly have been used within ADHD research), and thereby increase our understanding of the empirical overlap shown using questionnaires.

One example of such a task is the Go/no-go paradigm, which has provided evidence of poor motor inhibition, that is, an inability to withhold a response to infrequent target stimuli (commission error), in ADHD in a number of studies (e.g., Shue & Douglas, 1992). Another example is the Tower of Hanoi (see Glosser & Goodglass, 1990), which taps executive functions such as working memory and
planning. Studies of ADHD using the Tower of Hanoi, as well as a related task, Tower of London, have consistently found ADHD children to perform more poorly than normal children (e.g., Pennington, Grossier, & Welsh, 1993; Weyandt & Willis, 1994).

In addition, time estimation tasks, thought to tap working memory, have been used both in studies of ADHD and Type A behavior. Using a time reproduction task, Barkley and coworkers (Barkley, Koplowitz, Anderson, & McMurray, 1997) found ADHD subjects, in comparison with controls, to make greater errors of time estimation as measured by absolute discrepancy scores, and further, that the ADHD subjects overestimated the passage of time, whereas controls slightly underestimated the passage of time. Regarding time estimation in Type A individuals, Glass (1977) found a relation between the time-urgent features of Type A and a tendency to perceive time as passing slowly. In other words, Type Bs overestimated whereas Type As underestimated the passage of one minute. Howton and associates (1998) also found a positive association between visual imagery and a more accurate time perception, especially for individuals scoring high on Type A behavior.

Furthermore, rule-governed behavior is predicted in Barkley’s model to be deficient in ADHD, in that it requires a capacity for working memory that gives rise to a sense of past and future. Rule-governed behavior has been described as the control that language has over motor behavior (implicating the internalization of speech). Self-directed rules assist with bridging temporal gaps in behavioral contingencies and thus contribute to the cross-temporal organization of behavior. Interestingly, Barkley (1997) states that tasks where verbal instruction is involved are confounded by the subject’s capacity for rule-governed behavior, that is, the capacity to self-regulate (sustain) motivation to the task, and that poor performance may instead reflect the individuals’ lack of adherence to rules!

Other tasks which may be of interest in terms of differentiating Type A behavior and ADHD are meant to tap capacities for behavioral synthesis and reorganization (i.e., reconstitution). For instance, in order to repeat or produce novel behavioral sequences, such as hand gestures in the Kaufman Hand Movements Test (Kaufman & Kaufman, 1983), the person must be able to mentally represent the observed sequence of hand
gestures during the delay between demonstration and the required reproduction of that sequence. ADHD children have shown such difficulties with imitation (Grodzinsky & Diamond, 1992; Mariani & Barkley, 1997). Story narratives may also be considered a measure of reconstitution, in that they demand the accurate and efficient communication of information. ADHD children have been found to produce less information and to be less organized in their story narratives (Tannock, Purvis, & Schachar, 1993).

Continuous performance and choice reaction time tasks

Continuous Performance Tasks (CPTs) or choice reaction time tasks have commonly been used as outcome measures in studies involving children diagnosed with ADHD. Children with ADHD have been shown to make more errors and have longer reaction times compared to controls (for a review, see Corkum & Siegel, 1993).

Using CPTs with a slow presentation rate (inter-stimulus intervals, ISIs > 2s), van der Meere and colleagues (van der Meere, Shalev, Börger, & Gross-Tsur, 1995) have found ADHD children to show a greater performance decrement compared to controls, especially with experimenter absent, indicating a deficit in sustained attention. Van der Meere (1996) has explained this as a “state regulation deficit”, reflecting difficulties of ADHD children in regulating their motivation/effort level with regard to state factors, such as time-on-task, incentives, or feedback. The notion of ADHD children’s poor performance being caused by motivational factors is also in accordance with theorizing by Barkley (1997a, 1997b, 1998), who suggests that problems with self-regulation of motivation, being closely linked to inhibitory control, should be seen as the core aspect of ADHD.

A Continuous Performance Task demands that the child respond both accurately and quickly throughout the task, thus requiring the child to regulate his or her behavior in order to perform in an optimal way. The child has to regulate his or her speed of responding so as to respond accurately, as well as regulate his or her motivation in order to stay on-task. A specially designed choice reaction time meter called the Complex Reaction Time (CRT) measure has been developed and employed by Frisk (e.g., 1995). This rather monotonous task employs a slow presentation rate with three
different intervals presented randomly, and should thus be well suited for studying sustained attention/performance from a motivational aspect. A recent study by the authors (Berlin, Bohlin, Nyberg, & Janols, 2001) using the CRT task found significant differences in both overall and sustained performance between a clinical ADHD group and a normal control group, and showed that differences in sustained performance could be explained largely by motivational aspects.

In terms of discriminant validity, this task, insofar as it is achievement-oriented, is likely to trigger Type A behaviors related to achievement; however, it is not explicitly a competitively oriented task. Differences in motivation to perform well on this task should be readily observable, due to the monotonous nature of the task and its lack of intrinsic appeal. It is well documented that children with ADHD have difficulties in the self-regulation of motivation (persistence of effort in particular) in tasks requiring repetitive responding that involve little or no reinforcement (Barkley, 1997b). Because high motivation (more specifically, achievement drive which produces a high level of effort) (Glass, 1977) is one of the hallmarks of Type A behavior, it should be possible to disentangle the phenomena of Type A behavior and hyperactivity using this task.

Few studies have been conducted on Type A individuals using results of continuous performance tasks as outcome measures, and studies involving children are particularly scarce. When working on choice reaction time tasks with long preparatory intervals, Type A adults have been found to do more poorly, in terms of exhibiting longer reaction times, than Type Bs, although they make fewer errors (Glass, 1977) (see also Price & Clarke, 1978; Abrahams & Birren, 1973). This has been suggested to be a consequence of their characteristic impatience; their tension level rises when patience is required to absorb information, and may therefore make discrimination more demanding, perhaps resulting in a speed-for-accuracy trade-off. The CRT task used in this study employs long inter-trial intervals, and thus may result in longer response latencies for the Type A group. However, the task is not particularly demanding in terms of discrimination, and a speed-for-accuracy trade-off may therefore not be essential to good performance in this case. It may therefore be
expected that Type A individuals would perform better, at least in terms of making fewer errors, as a result of their characteristically higher motivation level.

**Relations to IQ and achievement and problem behaviors**

Studies have found Type A behavior (at least the competitiveness component) to be positively related to achievement and IQ (Matthews, Stoney, Rakaczky, & Jamison, 1986; Bachman et al., 1986; Stamps & Clark, 1987). In contrast, studies on ADHD children frequently report deficient performance on IQ measures in comparison to control children, and other studies have found hyperactivity to be negatively related to achievement and IQ (Sonuga-Barke, Lamparelli, Stevenson, Thompson, & Henry, 1994). Although many studies comparing ADHD children to normal controls have conducted analyses controlling for IQ, doing so may be questionable in that deficient performance on IQ measures may be directly related to ADHD and the associated impairments in executive functioning (see Barkley, 1997). Furthermore, hyperactivity (Barkley, 1998) as well as the MYTH Impatience component (Bachman et al., 1986) have shown positive relations to problem behaviors.

**Type A behavior and hyperactivity - - Are they related?**

Several authors have suggested that Type A behavior and hyperactivity may be related phenomena (e.g., Rickard & Woods de Rael, 1987; Steinberg, 1985; Bergman & Magnusson, 1986). For example, Bergman & Magnusson (1986) reported that boys who were high in motor hyperactivity, aggression, or overambition and girls who were high in motor hyperactivity at age 13 had significantly higher Type A scores in adulthood.

With regard to hyperactivity as a possible predisposition of Type A, one study found hyperactivity at early ages to predict the so-called antisocial Impatience/aggression dimension but not the so-called prosocial Competitiveness dimension of Type A in adolescence (using a MYTH-based questionnaire) (Räikkönen
& Keltikangas-Järvinen, 1992). However, this predictive relationship may just reflect stability over time for a singular behavioral dimension and thus be considered an indication of the impurity of MYTH impatience, in light of its large concurrent overlap with hyperactivity. It would therefore be of interest to investigate whether or not this prediction could be replicated, not only for Type A behavior as measured by the MYTH, but also as measured by behavior observations.

A possible common link between Type A behavior and hyperactivity/ADHD may be deficient inhibitory control, which may be expressed in the impatience component of Type A behavior, while the other Type A components capture aspects of functioning distinct from hyperactivity. Thus, although Type A behavior and hyperactivity may have behavioral aspects in common, the presence of other, for example, achievement-striving components of Type A behavior, may result in functional differences between the two phenomena (with hyperactivity involving disordered functioning), evidenced by differential relations to aspects such as cognitive performance and problem behaviors.
EMPIRICAL STUDIES

AIMS

The general purpose of the empirical studies included in this thesis has been to further our understanding of Type A behavior in childhood and its relation to hyperactivity and ADHD. This has been sought using observational assessments, as well as questionnaires, a reaction-time task, and various tests of inhibitory control and executive functioning. In addition, the empirical studies have included children from normal as well as clinical populations, and studies have been conducted using concurrent as well as longitudinal measures. More specifically, the main aims and research questions have been:

♦ To investigate, in a normal sample of 8-year-olds, the relation between Type A behavior, as measured by a questionnaire as well as behavioral observations, and hyperactivity as measured by questionnaires (Study I).

The research question posed was whether child Type A behavior was phenomenologically related to hyperactivity at age 8, or if the previously found overlap in constructs could be attributed to impure/indiscriminant measures. The dimensionality of Type A behavior as measured by the behavioral observations was also investigated, and relations between various components of Type A behavior and hyperactivity were studied.

♦ To longitudinally investigate, in a normal sample, the relation between Type A behavior, as measured by a questionnaire as well as behavioral observations, and hyperactivity as measured by questionnaires (Study II).

The research questions asked were 1) whether Type A behavior as measured by both questionnaires and behavioral observations would show stability between the ages of 4 and 8, and 2) whether longitudinal predictions could be made between measures of Type A behavior and hyperactivity or if the phenomena could be shown to be
distinct, and further, if relations to external criteria such as achievement and problem behaviors would clarify relations between the two constructs.

♦ To clarify the standing of Type A behavior, as measured by the MYTH, relative to hyperactivity and ADHD, using measures of observed task motivation and performance on a choice reaction time task (Study III). The research question posed was whether a differentiation of phenomena would be possible using observed task motivation, that is, whether Type A behavior and hyperactivity would show different relations to task motivation, and whether the Type A group would differ from the non-clinically hyperactive, non-hyperactive, and clinical ADHD groups in terms of task motivation and CRT-performance.

♦ To clarify the standing of Type A behavior, as measured by behavioral observations, relative to ADHD, using measures of inhibitory control and executive functioning (Study IV).

The research questions posed were whether a differentiation of phenomena would be possible using behavioral observations of Type A behavior, and whether the Type A group would differ from the Type B and clinical ADHD groups in terms of inhibitory control and executive functioning.

METHODS

Participants

Studies I and II were parts of one longitudinal project (project A, sample A), while Study III was part of another longitudinal project (project B, samples B and C) as was Study IV (project B, samples B and D). A summary of data concerning both projects is presented in Table 1.

Sample A was recruited from the official birth register at the University Hospital in Uppsala, Sweden. The inclusion criteria were that the infant was healthy, single-born, and not born more than 6 weeks before term. Furthermore, the mother should speak Swedish, be listed in the official telephone directory, not be planning to move
out of the area, and be available for a home visit during the scheduled period. Main reasons for declining participation were time shortage, no interest in research, or research seen as an invasion of privacy. Reasons for attrition over the years was mainly the same as for declining participation, in addition to severe illness or death in the family or moving out of the area.

Sample B was selected from a random sample of 1000 boys between the ages of 6 and 13, living in Uppsala, Sweden, whose mothers were sent a questionnaire. The response rate after two reminders was 61.5%, yielding 615 questionnaires, with 480 respondents (78%) agreeing to further contact. Out of those who had agreed to further contact, three groups (Sample B) were selected, which comprised the reference group consisting of 63 boys overall. Selection into groups was based on mothers’ responses to statements regarding hyperactive behavior and Type A behavior. Reasons for attrition from the next phase of the study included time shortage, illness, language difficulties, disinterest in research, and no longer living in the area. Children with parent-reported dyslexia or other behavioral problems were excluded from the reference group. Among the reference groups, there were no differences between the group which agreed to further contact and the group which did not in terms of number of siblings, child age, and mean scores of hyperactivity and Type A behavior. However, the group which did not agree to further contact had a significantly lower SES, as measured by the educational level of the fathers ($F = 5.55; p = .0189$) and a tendency toward fewer reported medical or psychiatric problems ($F = 3.05; p = .0811$).

Samples C and D were clinical ADHD samples, which were not followed longitudinally, because some of the boys in the two samples received pharmacological treatment (amphetamine) shortly after assessments were completed. Sample C consisted of 24 boys between the ages of 6 and 13 years ($M = 10.3, SD = 1.9$). All boys received a primary diagnosis of ADHD according to DSM-IV criteria (APA, 1994; Primarily Hyperactive-Impulsive Type: 8 boys; Combined Hyperactive/Inattentive Type: 16 boys), although 96% had comorbid diagnoses.

Sample D consisted of 14 boys between the ages of 7 and 13 years ($M = 8.7, SD = 1.4$). All boys received a primary diagnosis of ADHD according to DSM-IV criteria
(APA, 1994; Primarily Hyperactive-Impulsive Type: 3 boys; Combined Hyperactive/Inattentive Type: 11 boys), although all had comorbid diagnoses.

Table 1
*

Data regarding the four samples on which the empirical studies are based.

<table>
<thead>
<tr>
<th></th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample A</td>
<td>Sample B</td>
</tr>
<tr>
<td>Enrolled families/eligible</td>
<td>123/200 (61.5%)</td>
<td>63/128 (49%)</td>
</tr>
<tr>
<td>Boys/girls</td>
<td>63/60</td>
<td>63/0</td>
</tr>
<tr>
<td>Age at inclusion (M yrs)</td>
<td>6 weeks</td>
<td>6-13 yrs (9.8)</td>
</tr>
<tr>
<td>Duration of project</td>
<td>9 years</td>
<td>2 ½ years</td>
</tr>
<tr>
<td>Attrition over the years</td>
<td>27 families, 22%</td>
<td>10 families, 16%</td>
</tr>
<tr>
<td>Included in studies I-IV</td>
<td>91 children, 73%</td>
<td>61(III) 41(IV)</td>
</tr>
<tr>
<td>Boys/girls</td>
<td>45/46</td>
<td>61/0, 41/0</td>
</tr>
</tbody>
</table>

Procedures and Methods

Studies I and II

Data from questionnaires as well as a laboratory visit at age 8 have been used in Study I, whereas Study II is based on data from questionnaires and laboratory visits at ages 4 and 8. The children for whom there were questionnaire as well as observational data at age 8 were included in both studies \( n = 91 \).

4 years. The mothers \( n = 91 \) and fathers \( n = 77 \) responded to a mailed questionnaire battery, including a Swedish version of the Matthews Youth Test for Health (MYTH), which consists of the original 17 statements (Matthews & Angulo, 1980) as well as 3 statements concerning voice characteristics (Lundberg et al., 1990). For the Swedish version, ratings were made on an 11-point scale (0-10), corresponding to the extent to which each statement was typical of the child. In addition, the questionnaire was filled out by daycare personnel or another person in charge of a group activity in which the child regularly participated (subsequently referred to as daycare personnel; \( n = 81 \)).
Most of the children \((n = 81)\) participated in a visit at the departmental laboratory, accompanied by either the child's mother \((n = 44)\) or father \((n = 37)\), whereas two of the children were visited in their homes. The visit was video-recorded in its entirety, with written consent from the accompanying parent, for later assessment.

8 years. Most of the children \((n = 83)\) participated in a visit at the departmental laboratory, accompanied by the child's mother (in all but two cases, in which the father attended), whereas eight of the children, who had moved out of the county, were visited in their homes. The visit was video-recorded in its entirety, with written consent from the accompanying parent, for later assessment. Among other tasks, the child was asked to complete a reading comprehension test (Björkquist & Järpsten, 1975) and the WISC Block Design. During the visit, the accompanying parent filled out two questionnaires concerning their child's temperament and personality, with items from The Colorado Childhood Temperament Inventory (Rowe & Plomin, 1977) and The EASI Questionnaire (Buss & Plomin, 1975), and the Big Five Personality Questionnaire Child Version (Lanthier, 1993), all in Swedish translation.

8 ½ years. The children's teachers \((n = 87)\), mothers \((n = 91)\), and fathers \((n = 75)\) responded to a mailed questionnaire battery, including a Swedish version of the Matthews Youth Test for Health (MYTH), which consists of the original 17 statements (Matthews & Angulo, 1980) as well as 3 statements concerning voice characteristics (Lundberg et al., 1990), a Swedish version of A Children's Behaviour Questionnaire for Completion by Parents (Rutter, Tizard, & Whitmore, 1970), and questions regarding work style (A-M. Rydell; personal communication, 1992).

8 ¾ years. The children were paid a home visit \((n = 91)\) during which they completed an arithmetic test, as well as several other tasks which are not reported here.

Study III

Data wave 1. Mothers of boys between the ages of 6 and 13 responded to a mailed questionnaire battery, consisting of 72 questions, including Conners Abbreviated Teacher Rating Scale (ATRS) in Swedish translation and a Swedish version of the Matthews Youth Test for Health (MYTH). Responses to the questionnaire battery served as a basis for selection into three different groups,
comprising the reference group studied at the second part of Study III. We wished to select 1) children rated by their mothers as exhibiting Type A behaviors, 2) children rated by their mothers as hyperactive, but not diagnosed with ADHD, and 3) children who were not rated as hyperactive. Inclusion of the non-clinical hyperactive group was based on Barkley’s (1997, 1998) idea that children with ADHD represent the extreme of a normal distribution of self-regulation and inhibitory control. A non-clinical hyperactive group was randomly selected from the 20% highest scores on the ATRS, a non-hyperactive group from the remaining 80%, and a Type A group was selected from the 20% highest scores on the MYTH. The boys in the three groups were matched with regard to age. The mean ages at the time of the laboratory visit (data wave 2) were 9.5 years ($SD = 2.1$) for the hyperactive group, 10.2 years ($SD = 1.7$) for the non-hyperactive group, and 9.8 years ($SD = 1.6$) for the Type A group.

Data wave 2. Approximately 9 months after completion of the questionnaire, the selected reference group, consisting of 63 boys, and 24 ADHD boys (mean age of ADHD group 10.3 years, $SD = 1.9$ years) participated in a laboratory visit. Among other tasks, the boys were asked to perform the Complex Reaction Time (CRT) Task (see, e.g., Frisk, 1995), with an experimenter present in the room during the whole procedure. The CRT measure involves evoking a choice-response to a visual stimulus. The apparatus consists of four differently colored fields, measuring five by five cm, arranged in a square, which are illuminated one at a time in random order and a random intervals. Below this square are four differently colored response buttons, measuring two by two cm and also arranged in a square, corresponding in color and position to the fields. The colored fields are illuminated (visual signal) for a period of 0.24 s, and responses are registered during a limited period of 2.4 s following the visual signal. Each response period is followed by a latency interval, varying in length between 4.75 s, 7.50 s, and 10.75 s. The entire task takes 20 minutes, during which 145 signals are presented (between six and nine per minute). The mean reaction time, mean number of incorrect responses and mean number of omissions are registered across all 20 minutes as well as separately for each minute.
The boys were instructed to respond by pressing the button corresponding in color and position to the visual signal, as quickly as possible without pressing the wrong button. They were also told that the test would last for 20 minutes and that they would be informed when half the time had passed. After the test, the boys were informed about their performance, both verbally and as a print-out. The visit was video-recorded in its entirety for later assessment, with written consent from the accompanying parent.

Study IV

Study IV comprises a follow-up of the reference group from Study III; however, the clinical ADHD group from Study III was not followed longitudinally and, therefore, a new ADHD group was recruited specifically for Study IV.

All boys participated in a laboratory visit (approximately 14 months after the first laboratory visit for the boys in the reference group) in which they were asked to perform several different tasks. The tasks attempted to measure behavioral inhibition and different aspects of executive functioning.

The boys were first asked to perform the Tower of Hanoi task using wooden models with 3 to 4 differently colored and sized balls to be placed in a specific pattern on one to three pegs. The goal of the task is to make as few moves as possible in matching the design, and there is no time-limit, although usually a 20-move limit is employed along with allowing several attempts. The boys were instructed to perform the task according to certain rules: they were not to place a larger ball on top of a smaller ball, they were only allowed to move one ball at a time, and they were to move the balls to the specified end state using as few moves as possible.

Thereafter, they performed a computerized Go/no-go paradigm. The Go/no-go task requires subjects to emit a motor response, such as pressing a response button, as fast as possible on certain frequent stimuli, and then to inhibit responding to a less frequent stimulus, which is interspersed throughout the task in a random fashion. In addition, the boys were asked to complete the WISC Block Design, which is part of the Performance subscale (Wechsler, 1994/1992). The boys were then told a short story using three male dolls, a ball, a small doll house, and a small box. They were instructed
to listen carefully to the story because they would be asked to answer some questions about it afterwards. The boys were then asked to reproduce eight time-intervals (two intervals each of 12, 24, 36, and 48 seconds) presented by the experimenter, using a flashlight. The lengths of the intervals were unknown to the child.

Next, the boys were asked to perform the Hand Movements task, and thereafter to complete as much as possible of a puzzle with wooden shapes during 5 minutes, without looking. The puzzle frame was hidden under a box with a cloth covering the open end of the box, and the 11 puzzle pieces were placed in full view in front of the box. For the puzzle task, the experimenter made an excuse to leave the room, in order to enhance the possibility of cheating. Lastly, the boys were asked to recall as much as possible of the story told earlier, by retelling the story in front of the camera. The boys were thereafter given a bag of candy and thanked for their participation. The visit was video-recorded in its entirety for later assessment.

Measures

Studies I-IV have some aspects in common in terms of the treatment of data. All observations in the laboratory were video-recorded and most of the observational assessments were made from these recordings using different coders. Each of the respective situations was rated by one coder, and interobserver reliability was thereafter established using independent assessments from a different coder on 15-20 of the observations. Interobserver reliability was expressed as Pearson correlation coefficients ($r$), and homogeneity of scales/internal consistency was determined using Cronbach’s alpha ($\alpha$).

Studies I & II

Observed Type A behavior, 4 and 8 years. Sequences from the visits at child ages 4 and 8 were chosen which were relevant to Type A behavior, and were chosen to be as similar as possible at ages 4 and 8. At age 4, the child's behavior was assessed during a laboratory sequence containing Griffiths' Performance Scale (E-scale; Alin-Äkerman & Nordberg, 1991), totaling 20-25 minutes, involving the child and
experimenter. At age 8, two sequences were used: one containing the WISC (Wechsler, 1974/1977) Block Design (10-15 minutes), involving the child and experimenter, and a cooperative task involving an Etch-A-Scetch (The Ohio Art Company, Baron, Ohio, USA; 5 minutes), with the child and mother participating.

The Type A observation items were derived from adult scales and interview behaviors, as well as from some items in the MYTH scale. Approximately 20 video recordings were studied in order to pinpoint specific behaviors in each situation which may be relevant for the assessment of Type A behavior. Five experts, both in the field of adult Type A behavior (users of the Type A Structured Interview) and in the field of child Type A behavior, were consulted to rate each behavior according to relevance to Type A behavior in children. Those specific behaviors determined by all experts to be most relevant were then included in the instrument, that is, those behaviors receiving a 2 or 3 on a scale from 0-3. The Type A-items used at the respective ages are shown in Table 1.

Each behavior was assessed on a 5-point scale ranging from 1 (no occurrence) to 5 (frequent or pronounced occurrence[s]). At both ages, an overall global rating of how pronounced the Type A behavior was over the entire sequence was also made and ranged from 1 to 10. Four different scores were used for analysis at each age, the overall global rating, and three factor-analytically derived scale scores based on the observations at age 8. For scale construction, observation items with factor loadings greater than .35 were selected and summed up, each with a weight of 1. The three scale scores were denoted Impatience, Competitiveness/Rapidity, and Control (see Results of Study I). At age 4, items corresponding to those used for scale construction at age 8 were summed up into three respective scale scores.

**Observed hyperactivity, 4 years.** Observations of the child's distractibility, squirminess, inattention, and lack of perseverance during the Griffiths' Performance test were made using 5-step rating scales and aggregated into a mean score ($M = 2.56$, $SD = 0.63$; $\alpha = .66$; IR = .70).

**Ratings of Type A behavior, 4 years.** MYTH scores, on 11-step response scales, were aggregated over ratings from parents and daycare personnel, in order to give as
broad a measure as possible of the children's behavior. MYTH scale scores, Competitiveness, Impatience/aggression, and Voice, were calculated as well as a total MYTH score.

**Ratings of Type A behavior, 8 ½ years.** MYTH scores, on 11-step response scales, were aggregated over ratings from parents and teachers. MYTH scale scores, Competitiveness, Impatience/aggression, and Voice, were calculated as well as a total MYTH score. Teacher ratings were considered separately as well, because the MYTH is developed as a teacher rating scale. Interrater agreement between teacher ratings and ratings aggregated over mothers and fathers was significant at $r = .62$ ($p < .0001$; total MYTH score). In addition, for some purposes, analyses were conducted using individual items with scores aggregated over parent and teacher ratings.

**Maternal ratings of hyperactivity, 8 years.** Mother ratings were used for the hyperactivity measure since the mothers had completed the full set of questionnaires. Items from the CCTI, the EASI Questionnaire, the Big Five Personality Questionnaire Child Version, the CBQ, and a questionnaire concerning work style, all with 5-step response scales, were used to form a measure of hyperactivity. Factor analysis of these items resulted in two factors, denoted Lack of Perseverance and High Activity Level. Corresponding scale scores were calculated using the items with factor loadings greater than .40 in their respective factor. There was no significant correlation between the two scale scores ($r = .09$). To answer research questions regarding hyperactivity, analyses were conducted using individual items here as well.

**Achievement measures, 8 years and 8 ¾ years.** Age-adjusted stanine scores for the WISC Block Design (part of the Performance subtest) and a reading comprehension test were used as achievement measures. Furthermore, an arithmetic test was used (addition - nine items, subtraction - nine items) where the mean number of correct items for each part were the resulting scores.

**Ratings of problem behaviors, 8 ½ years.** The measure of externalizing behavior was summarized as a mean score of 15 items from the Swedish version of A Children's Behaviour Questionnaire for Completion by Parents, aggregated over parent and teacher ratings.
Study III

Three subjects, one from the ADHD group and two from the non-clinically hyperactive group, were excluded from analyses because their scores on at least one variable were outliers, deviating over three standard deviations from the group mean (Tabachnick & Fidell, 1989). Furthermore, one subject from the ADHD group was excluded due to incomplete data. The number of boys with complete data sets in each group was thus as follows: 21 boys exhibiting Type A behavior, 22 ADHD boys, 20 non-clinically hyperactive boys, and 20 non-hyperactive boys.

Ratings of hyperactivity. Mother ratings on the abbreviated ten-item teacher version of the Conners rating scale (Abbreviated Teacher Rating Scale [ATRS]; Conners, 1990) were used. Ratings were made on 4-step response scales (0-3) corresponding to the extent to which each item is characteristic of the child. Internal consistency (α) was .92 for all ten items. The mean score on the scale was 2.08 points (SD = 0.68) for the ADHD group, 1.46 (SD = 0.43) for the hyperactive group, 0.17 (SD = 0.22) for the non-hyperactive group, and 0.98 (SD = 0.56) for the Type A group.

Ratings of Type A behavior. Mother ratings on the MYTH questionnaire, consisting of 11-step response scales, were used. MYTH scale scores, Competitiveness, Impatience/aggression, and Voice, were calculated as well as a total MYTH score. The mean total score was 5.37 points (SD = 1.52) for the hyperactive group, 3.48 points (SD = 1.27) for the non-hyperactive group, and 6.53 points (SD = 0.68) for the Type A group. The MYTH questionnaire was not included in the test battery for the ADHD group.

Behavioral ratings of task motivation. The videotaped sequences were used to study the children’s task oriented behavior during the 20-minute long Complex Reaction Time (CRT) measure. Global motivation level with regard to the task was assessed every two minutes using a nine-point scale, ranging from “1 - not motivated at all” to “9 - highly motivated”. Ratings of task motivation were based on the child’s overall state of arousal and energy mobilization in relation to the task, as indicated by, for instance, body and hand positioning (that is, to what extent it was optimal for
performing the task as proficiently as possible), facial expressions, focus of attention to the task, and task persistence. In other words, task motivation refers to a state which the child has to regulate in order to perform the task optimally. Interobserver reliability amounted to .98 using scores from 15 children and two raters, blind as to the group-belonging of the child. Two of the children from the ADHD group had missing behavioral data, one due to apparatus failure and the other due to the child’s refusal to be video-recorded.

Global task motivation scores were summarized as overall performance (mean score of ten ratings). Furthermore, the score for the first two minutes of the task was used as a measure of initial performance. In order to study sustained performance, a trend coefficient was calculated by multiplying the score for every two minutes of the task with linear trend coefficients.

**Complex Reaction Time performance.** For all of the CRT-variables, number of correct and incorrect responses, number of omissions, and mean reaction time, the total value (mean value for reaction time) over 20 minutes was used as a measure of overall performance. Furthermore, for each of the four variables, measures of initial performance (mean score for the first two minutes), and sustained performance (a trend coefficient) were calculated.

**Study IV**
Twelve older boys who were determined to be outliers on age were excluded from analyses. The number of boys with complete data sets in each group were thus as follows: 20 boys exhibiting Type A behavior (mean age =10.6 years, $SD = 1.1$ ), 21 boys in the Type B group (mean age =9.9 years, $SD = 1.2$ ), and 14 ADHD boys (mean age =8.7 years, $SD = 1.4$ ).

**Measures of Type A behavior and hyperactivity**

**Observed Type A behavior.** The observations of Type A behavior were made during performance of the Tower of Hanoi as well as during the WISC Block Design. Assessments of Type A behavior were made on a 10-point scale, reflecting the presence of Type A behaviors. The mean over four different scores was used for analysis, including an overall global rating, an Impatience rating, and a
Competitiveness rating during Tower of Hanoi, and, in accordance with Studies I and II, an overall global rating during the WISC Block Design. Assessments of Competitiveness were based on aspects of task performance such as persistence, speed/hurrying, eyeing the protocol/stopwatch, goal orientation, not giving up despite difficulties, and not giving up upon receiving help. Assessments of Impatience were based on aspects of task performance such as interrupting experimenter out of eagerness/agitation, rushing, fumbling, being irritable, and sighing as a sign of frustration when encountering difficulties. Assessments of overall Type A behavior were based on both the competitive and impatient aspects of task performance. Furthermore, assessments of Type A behavior were made with regard to the functional significance of the child’s behavior, that is, in terms of goal orientation, or achieving as much as possible in as short a time as possible. Internal consistency (α) of the four measures equaled .95. Interobserver reliability for 16 individuals amounted to $r = .92$.

The mean Type A score across all groups was 3.42 points ($SD = 1.71$), and groupwise, 2.42 points ($SD = 1.00$) for the ADHD group, 5.21 ($SD = 1.35$) for the Type A group, and 2.37 ($SD = 0.66$) for the Type B group. With regard to convergent validity of the Type A observational measure, the MYTH Type A measure was significant correlated with the mean observed score ($r[50] = .32$, $p < .05$).

**Ratings of hyperactivity.** Mother ratings on the abbreviated ten-item teacher version of the Conners rating scale (Abbreviated Teacher Rating Scale [ATRS]; Conners, 1990), aggregated over data waves 1 and 3, were used. Ratings were made on 4-step response scales (0-3) corresponding to the extent to which each item is characteristic of the child. Internal consistency (α), was .89 for all ten items aggregated over two points of measurement. The mean score on the scale was 0.97 ($SD = 0.80$) overall, and groupwise, 1.88 points ($SD = 0.70$) for the ADHD group, 0.60 ($SD = 0.54$) for the Type A group, and 0.72 ($SD = 0.58$) for the Type B group.

**Measures of inhibitory control and executive functioning**

Each of the measures used in this study may generally be said to measure several aspects of inhibition and executive functioning; indeed, many of these aspects are
themselves interrelated. Therefore, the measures are presented by task, not by the specific function they purport to measure.

Go/no-go task. The mean number of commission errors on the Go/no-go task, that is, responses to the infrequent target stimuli, was used as a measure of inhibition. In addition, the mean number of omission errors, that is, lack of response to the frequent stimuli, as well as the mean reaction time were used as measures of performance more generally.

Tower of Hanoi task. An accuracy coefficient score was calculated for each item of the Tower of Hanoi task, by dividing the number of actual moves with the least number of moves possible to complete each item. A mean accuracy score was then calculated across all ten items, and was purported to measure working memory and mental representation (although other executive functions, such as response inhibition and sustained motivation, are also likely to be involved).

Latency in seconds to first move was also assessed for each of the ten items, using the video recordings. Again, a mean latency score was calculated across all ten items, and was used as a measure of planning ability.

The amount of time required to solve each item was assessed from the video recordings, measuring the time from the first move to the correct end state. Here as well, a mean score was calculated across all ten items.

Rule-breaking (that is, either placing a large ball on top of a small one, or moving more than one ball at a time) was assessed as the number of broken rules for each item. A mean rule-breaking score was calculated across the ten items and was assumed to measure working memory, mental representation, and internalization of speech.

Time reproduction task. The boys were asked to repeat each of eight time intervals (two intervals each of 12, 24, 36, or 48 seconds) shown with a flashlight by the experimenter. An accuracy score was then calculated for each interval, by dividing the boy’s estimated time with the actual duration of the time interval presented by the experimenter. A mean score across the eight intervals was calculated and was used as a measure of working memory.
Hand movements task. Repetition of behavioral sequence. The hand movements task from Kaufman’s Assessment Battery for Children (Kaufman & Kaufman, 1983) was expanded to include somewhat older children (older than 12 years), and consisted of 20 items (ranging from 2- to 6-movement sequences, using “fist,” “palm,” and “side”). Incorrect repetitions were scored as ”0” and correct as ”1,” resulting in a maximum total score of 20. This was used as a measure of working memory, mental representation, and reconstitution.

Cheating during puzzle task. The puzzle task used in this study was similar to the ”regulation puzzle box task” described by Eisenberg and colleagues (Eisenberg et al., 1997). The wooden puzzle contained 11 pieces of ordinary shapes (e.g., star, oval, square, circle), and the children were instructed to try to assemble the puzzle without looking at the puzzle. The puzzle frame was placed underneath a box with an opening for the hands and a cloth covering the front. The cloth could be lifted up so that a child could cheat by looking at the puzzle. The children were told that they should try to get as many pieces in place as possible during 5 minutes. The experimenter then made an excuse to leave the room, asking the child to keep track of the time using a stop-watch. The camera was left running during the entire visit so as to make it as inconspicuous as possible. Cheating was assessed on a five-point scale (1 = no instances of cheating; 5 = many instances of cheating and/or flagrant cheating, by, e.g., removing the box covering the puzzle, rather than just peeking under the cloth covering the open end of the box) using video recordings of the children’s behavior during the puzzle task, for which the experimenter temporarily had left the room. Interobserver reliability ($r$) based on 16 individuals amounted to .97. This was assumed to measure rule-governed behavior and internalization of speech.

Story recall. The children’s story recall was transcribed verbatim from the video recordings and thereafter assessed with regard to content, in accordance with the study by Tannock and colleagues (1993) on narrative abilities in children with ADHD. However, the story used in this study was shorter with fewer details. It was therefore difficult to study separate levels of recall and types of errors. The measures used in this study reflected overall recall, with complete recall resulting in a maximum of 50
points, as well as recall of main themes of the story (maximum of 9 points). Interobserver reliability (r) amounted to .94, both for overall recall and main themes. Story recall was purported to reflect capacities for behavioral synthesis and reorganization (reconstitution).

**WISC Performance measure of IQ.** Performance on the WISC Block Design measure was used to assess IQ. Raw scores were translated into age-adjusted scores, ranging from 1 to 19 points.

**RESULTS AND CONCLUSIONS**

The number of included children, means, standard deviations, and Cronbach’s alpha coefficient whenever applicable, for each of the variables used in the calculations for Studies I and II, Study III, and Study IV are presented in Appendices A, B, and C, respectively. All results reported as significant reached the significance level of at least $p < .05$ with two-tailed tests of significance, unless otherwise specified.

**Study I**

**Dimensionality of observed Type A behaviors**

Factor analysis was conducted using the observational items, with an iteration procedure to estimate communalities. A three-factor solution with orthogonal rotation was determined to be the most suitable, and the three factors were interpreted as Impatience, Competitiveness/Rapidity, and Control. The items included in each of the factors are presented in Table 2. The items marked with an asterisk were included in the observational measure at age 4 as well (see Study II). For scale construction, items with factor loadings greater than .35 were selected and summed up, each with the weight of 1. One item was excluded in the scale construction, because it loaded on both the Impatience and Competitiveness/Rapidity factors.
Table 2
Item content and factor loadings of the Type A observational measure at ages 4 and 8

<table>
<thead>
<tr>
<th>Item</th>
<th>Impatience</th>
<th>Competitiveness/Speed</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>One step ahead*</td>
<td>.73</td>
<td>.14</td>
<td>.24</td>
</tr>
<tr>
<td>Takes charge of tasks</td>
<td>.68</td>
<td>.18</td>
<td>.08</td>
</tr>
<tr>
<td>Interrupts*</td>
<td>.61</td>
<td>.18</td>
<td>.23</td>
</tr>
<tr>
<td>Questions instructor*</td>
<td>.60</td>
<td>.05</td>
<td>.21</td>
</tr>
<tr>
<td>Irritated when fumbles</td>
<td>.52</td>
<td>.42</td>
<td>.02</td>
</tr>
<tr>
<td>Irritated when fails*</td>
<td>.41</td>
<td>.33</td>
<td>.12</td>
</tr>
<tr>
<td>Achievement-oriented</td>
<td>.35</td>
<td>.16</td>
<td>.23</td>
</tr>
<tr>
<td>Fumbles because works fast*</td>
<td>.19</td>
<td>.81</td>
<td>.08</td>
</tr>
<tr>
<td>Works quickly/energetically*</td>
<td>.25</td>
<td>.79</td>
<td>.01</td>
</tr>
<tr>
<td>Attention aimed at time factor*</td>
<td>.12</td>
<td>.56</td>
<td>.27</td>
</tr>
<tr>
<td>Comments on stopwatch</td>
<td>-0.23</td>
<td>.41</td>
<td>.00</td>
</tr>
<tr>
<td>Irritated at mother</td>
<td>.12</td>
<td>.09</td>
<td>.72</td>
</tr>
<tr>
<td>Desires to be in charge*</td>
<td>.21</td>
<td>.19</td>
<td>.71</td>
</tr>
<tr>
<td>Voice level*</td>
<td>.28</td>
<td>.18</td>
<td>.54</td>
</tr>
</tbody>
</table>

Note: Items marked with an asterisk were included in the observational measure at both ages 4 and 8. Boldface entries denote significant factor loadings (greater than or equal to .35) from the factor analysis of items at age 8.

Convergent validation: Relations between the two Type A measures

Pearson correlation analyses were conducted between the behavior observation scale scores and the MYTH scale scores. Correlations were similar for the MYTH teacher ratings and the MYTH ratings aggregated over parents and teachers, with significant correlations of the MYTH total score and MYTH Impatience on one hand, to the observed Impatience on the other hand (significant correlations ranged from .24 to .29; \( p < .05 \) to \( p < .01 \)). In addition, teacher ratings of MYTH Voice was related to observed Impatience \( (r = .29; p < .01) \). Furthermore, all of the MYTH subscales, including the total score, were significantly related to the observed global Type A rating. To further investigate convergent validity, partial correlations were calculated, controlling for Lack of Perseverance and High Activity Level, respectively. Generally, changes in coefficients were small, ranging from -.04 to +.03 for the relations of the various MYTH scales to the observed global Type A measures.
Discriminant validation: Relations between hyperactivity and Type A measures

No significant correlations were found between the behavior observations (global Type A rating and scale scores) and the hyperactivity scale scores, respectively ($r$s ranged from -.03 to .15), nor were there any significant correlations between individual items of the hyperactivity measure and the behavior observations (global rating and scale scores).

Regarding the MYTH measure, however, there were significant correlations between all of the respective scales and the scale score for High Activity Level ($r$s ranging from .20 to .63; $p$s < .05 to .001), and all of the MYTH scales except Competitiveness showed significant correlations to Lack of Perseverance. Furthermore, the individual items of the MYTH scale, aggregated over parent and teacher ratings, were found to be significantly correlated with those of the hyperactivity measure across all items. Out of 380 inter-item correlations, 215 (57%) were significant at $p$ < .05.

Conclusions

Three dimensions emerged upon factor analysis of the observed Type A behaviors, Impatience, Competitiveness/Rapidity, and Control, the first two which correspond well with the dimensions of the MYTH. The Control dimension does not have a counterpart in the MYTH; however, as shown by, for example, Glass (1977) in an observational study and also in the scoring of the Type A Structured Interview, need for control is an integral part of adult Type A behavior. Thus the three obtained components of observed Type A behavior would seem to represent significant aspects of Type A behavior in children.

Convergent validity for the behavioral observations in relation to the MYTH questionnaire was obtained to a certain extent. More specifically, the overall global Type A rating correlated with the Total MYTH score as well as with its subscale scores, and the observed Impatience showed significant relations to the Total MYTH score in addition to the MYTH subscale scores for Impatience and Voice. Furthermore, partialling out the effect of hyperactivity only slightly affected the relations to MYTH scores, thereby strengthening the convergent validity of the observations. Observed
competitiveness did not correlate significantly with the MYTH counterpart. Closer inspection of item content suggested that the two instruments might measure different aspects of competitiveness; thus competitiveness is perhaps measured too narrowly in both cases. The Control scale score of the behavior observations was not significantly correlated with any of the MYTH scale scores. However, this dimension of the behavioral observation emerged only in the session during which the child was to cooperate with the mother on a specific task, suggesting that situations may have to be tailored rather specifically in order for cooperative or controlling behavior to emerge.

When considering discriminant validity, the MYTH was found to be substantially and globally correlated with measures of hyperactivity, the only exception being the non-significant association between MYTH Competitiveness and Lack of Perseverance. It is plausible that qualitative differences in behavior, for instance, the impatient yet persevering behavior characteristic of Type A individuals versus the impatient and non-persevering behavior of hyperactive children, are difficult to capture using questionnaires. The MYTH competitiveness scale demonstrated both convergent and discriminant validity to some extent, and may therefore be a more adequate measure of Type A behavior than MYTH impatience. In contrast to the MYTH, the observation measure of Type A behavior showed no correlations to either of the hyperactivity scores, with correlations being close to zero. Thus, the variance that the observations shared with the MYTH showed no overlap with hyperactivity.

**Study II**

In all cases, Pearson correlation analyses were conducted in order to determine the longitudinal relations between variables. Furthermore, in order to determine the extent of the overlap between Type A behavior and hyperactivity, partial correlation analyses were conducted for the above longitudinal relations, controlling for the two hyperactivity subscales at age 8. Age-dependent change in Type A behavior was investigated using dependent sample *t*-tests, comparing the Type A measures which
were the same at ages 4 and 8 (included all the MYTH scores and all observation scores except Control).

The longitudinal relations presented in Table 3 may be illustrated in terms of individual stability, convergent validity, and discriminant validity. Accordingly, the whole rectangles represent individual stability of the two Type A measures; the dotted rectangles illustrate convergent validity among the two Type A measures, as well as among the different hyperactivity measures at age 4 and 8, respectively; and lastly, the ellipses illustrate discriminant validity of the Type A measures with regard to hyperactivity.

**Individual stability of Type A measures**

In terms of individual stability (illustrated by the whole rectangles in Table 3), observed Type A behavior showed significant relations between ages 4 and 8. More specifically, the Global rating and the Competitiveness score (age 4) correlated significantly with all observed dimensions at age 8 (significant correlations ranged from .24 to .51; \(p < .05\) to .001). Partial correlation analyses controlling for hyperactivity at age 8 resulted in small changes, ranging from -.04 to +.03, in the stability coefficients for observed Type A behavior, with all significant correlations remaining (except for the predictive relation between observed Competitiveness and Impatience, which was reduced to near-significant).

With regard to the stability of the MYTH, all of the scores at age 4 were significantly related to all of the MYTH scores at age 8 (significant \(r_s\) ranged from .26 to .60; \(p < .05\) to .001). The significant relations were still evident when data from different raters were used, with the exception of that regarding the stability of Voice as well as the reciprocal relations between Voice and Impatience. Partialling out hyperactivity at age 8 resulted in rather large changes in stability coefficients, ranging from -.24 to -.09. Most of the relations remained significant, except for various relations of the Voice component, although the magnitudes of coefficients were reduced.
### Table 3

**Significant longitudinal relations between measures of Type A behavior and hyperactivity**

#### Age 8

<table>
<thead>
<tr>
<th>Age 4</th>
<th>Global</th>
<th>Comp</th>
<th>Impat</th>
<th>Control</th>
<th>Total</th>
<th>MYTH</th>
<th>Hyperactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Global</strong></td>
<td>******</td>
<td>**</td>
<td>**</td>
<td>******</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Comp</strong></td>
<td>**</td>
<td>**</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Impat</strong></td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td>**</td>
<td>**</td>
<td></td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td></td>
<td>***</td>
</tr>
<tr>
<td><strong>MYTH</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td>***</td>
</tr>
<tr>
<td><strong>Hyperactivity</strong></td>
<td>******</td>
<td>*</td>
<td></td>
<td>******</td>
<td>**</td>
<td>**</td>
<td>***</td>
</tr>
</tbody>
</table>

+ $p < .10$  
$* p < .05$  
$** p < .01$  
$*** p < .001$  

*a negative correlation*

Convergent validity among Type A measures and hyperactivity measures

With regard to convergent validity of the two Type A measures (displayed in the dotted rectangles in Table 3), all of the MYTH scores at age 4 but Impatience showed significant (near-significant for Voice) longitudinal relations to the Global rating and the Impatience score at age 8 (rs ranged from .20 to .29; ps < .10 to .01). Partialing out hyperactivity resulted in changes ranging from -.07 to +.11 in correlation coefficients. The predictive relation between MYTH Competitiveness and Global Type A remained significant. The remaining three significant coefficients were reduced to either non-significant or near-significant. Similarly, the observed Type A behavior at age 4 was significantly related to MYTH scores at age 8 (significant correlation coefficients ranged from .25 to .35; ps < .05 to .01). More specifically, the Global rating of the observations at age 4 showed significant relations to MYTH Total and Impatience scores at age 8, observed Competitiveness at age 4 correlated with MYTH Competitiveness (age 8), observed Impatience (age 4) correlated with all of the MYTH scores but Competitiveness at age 8, and observed Control (age 4) correlated with the MYTH Total and Impatience scores (age 8). Partialing out hyperactivity at age 8 resulted in changes ranging from -.17 to +.06 in correlation coefficients, with longitudinal relations of observed Impatience becoming non-significant.
Furthermore, the observed hyperactivity at age 4 showed significant longitudinal relations to both the Lack of Perseverance and the High Activity Level scores at age 8 ($r = .34$ and $r = .32$, respectively; both $ps < .01$).

**Discriminant validity of Type A measures with regard to hyperactivity**

In terms of discriminant validity (illustrated by the ellipses in Table 3), the observed hyperactivity measure at age 4 showed no significant relations to the observed Type A behavior at age 8, whereas it correlated significantly with all of the MYTH scores at age 8 except Voice (significant $rs$ ranged from .33 to .43; $ps < .01$ to .001). Regarding the longitudinal relations of the two Type A measures to later hyperactivity, observed Impatience (age 4) was positively related to Lack of Perseverance at age 8 ($r = .24; p < .05$). There were no other significant correlations between the observed Type A scores at age 4 and the hyperactivity scores at age 8. Furthermore, the MYTH scores at age 4 were significantly correlated with both the Lack of Perseverance and the High Activity Level scores at age 8. Specifically, the MYTH Total and Impatience scores predicted Lack of Perseverance at age 8, and all of the MYTH scores predicted High Activity Level at age 8 (significant correlation coefficients ranged from .32 to .47; $ps < .01$ to .001). Even here the significant relations remained when different raters were used, with the exception of the correlation between Voice and High Activity Level.

**Longitudinal relations to achievement and externalizing problem behaviors at age 8**

The MYTH Total and Impatience scores at age 4 showed negative correlations with performance on the WISC Block Design at age 8 ($r = -.23$ and $r = -.24$, respectively; $ps < .05$). In contrast, the observed Global Type A score (age 4) was positively correlated with reading comprehension, addition, and subtraction at age 8 ($r = .30$, $r = .24$, and $r = .26$, respectively; all $ps < .05$). The observed hyperactivity measure did not show any significant longitudinal relations in terms of achievement at age 8.

Externalizing behavior at age 8 was correlated with all of the MYTH scores at age 4 except Voice ($rs$ ranged from .24 to .46; $ps < .05$ to .001). When different raters were used, the MYTH Total and Impatience scores were still significantly correlated with externalizing behavior. In contrast, the observed Type A scores showed no significant relations to externalizing behavior at age 8. Observed hyperactivity at age 4
showed significant longitudinal relations to externalizing behavior at age 8 \((r = .36; p < .01)\).

**Systematic change in Type A behavior over time**

Dependent sample \(t\)-tests revealed significant increases over time in MYTH Competitiveness \((t = -2.37; p < .05)\), as well as observed Competitiveness \((t = -6.03; p < .0001)\) and Global scores \((t = -4.68, p < .0001)\).

**Conclusions**

The results of this study showed considerable individual stability with regard to both measures of Type A behavior. Significant predictive relations to observed Type A behavior at age 8 was obtained for all of the observed dimensions at age 4 but Impatience. There was also substantial stability in MYTH scores, although the correlations were not only dimension-specific, but appeared across different dimensions as well.

Convergent validity was demonstrated both for the Type A observational method, via longitudinal relations between the two Type A measures, and for the observed hyperactivity measure at age 4, via longitudinal relations to the parent-reported hyperactivity at age 8. The relative standing of the aspect of impatience was, however, somewhat difficult to interpret. With regard to discriminant validity, early MYTH scores showed significant correlations with both aspects of hyperactivity at age 8. The early observed Type A behavior was not significantly related to hyperactivity at age 8, with the exception of the significant relation between early observed Impatience and Lack of perseverance, and thus demonstrated discriminant validity for all dimensions but Impatience. Moreover, the observed hyperactivity measure at age 4 showed significant relations to later MYTH scores but not to observed Type A scores at age 8.

With respect to developmental considerations for the conceptualization of Type A behavior and hyperactivity, Type A Impatience seems to be difficult to operationalize for the preschool years. Perhaps this impatient yet persevering behavior is not an integral part of Type A behavior during the preschool years, but rather an aspect which develops in relation to school-work and increasing self-regulatory abilities. Impatient behavior measured at early ages may therefore not be a relevant descriptor of child
Type A behavior and may instead reflect deficient impulse control and thus be more characteristic of the hyperactivity construct. This notion was supported by the fact that observed Impatience at age 4 did not show dimensional stability and was significantly related to Lack of perseverance at age 8.

The various relations between Type A behavior and hyperactivity revealed in the present study seem to suggest that there is some degree of impurity, especially when studying younger children, in measures used to assess child Type A behavior. The MYTH was not longitudinally discriminant in terms of hyperactivity, and, in addition, showed longitudinal relations to negative aspects of external criteria. The observational Type A measure, however, with the exception of the Impatience component, showed convergent validity with regard to the MYTH and discriminant validity in terms of hyperactivity (all observational dimensions were concurrently discriminant in terms of hyperactivity at age 8, see Study I), and furthermore, the observed Type A measure generally showed longitudinal relations to positive aspects of external criteria.

**Study III**

One-way analyses of variance, with group as the independent variable and observed task motivation and CRT performance as dependent variables, were conducted with specified *a priori* comparisons between the ADHD group, the hyperactive group, and the non-hyperactive group on the one hand, and the MYTH-defined Type A group on the other hand. The clinical group was thereafter excluded from further analyses. Correlation analyses were carried out in order to further investigate the proposed relations between hyperactivity and Type A behavior, with hyperactivity and Type A scores on the one hand, and observed task motivation and CRT performance on the other hand.

**Group differences in task motivation and CRT performance**

As shown in Table 4, the MYTH-defined Type A group showed a higher level of task motivation than the ADHD group, but had a lower task motivation level than the non-hyperactive group, both initially and overall. There were, however, no differences
regarding sustained task motivation, with all groups exhibiting a decrease in task motivation.

With regard to overall CRT performance, group differences emerged in the mean number of correct and incorrect responses only, not in terms of omissions or mean reaction time. The Type A group showed a tendency toward a greater number of correct responses overall than the ADHD group; planned comparisons regarding incorrect responses were, however, not significant.

There were no significant group differences regarding initial CRT performance. In terms of sustained CRT performance, there were significant differences in the mean number of correct responses as well as omissions over time, with planned comparisons revealing a performance decrement for the ADHD group in relation to the Type A group. Furthermore, the Type A group showed a greater increase in reaction time than the non-hyperactive group.

Table 4

<table>
<thead>
<tr>
<th>CRT measure</th>
<th>$F$</th>
<th>Planned comparison with Type A group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed motivation$^1$</td>
<td>7.65**</td>
<td>A&gt;D*, A&lt;C*</td>
</tr>
<tr>
<td>- initial performance</td>
<td>3.60*</td>
<td>A&gt;D*, A&lt;C+</td>
</tr>
<tr>
<td>- trend</td>
<td>1.14</td>
<td>ns</td>
</tr>
<tr>
<td>Correct responses$^1$</td>
<td>3.32*</td>
<td>A&gt;D+</td>
</tr>
<tr>
<td>- initial performance</td>
<td>0.31</td>
<td>ns</td>
</tr>
<tr>
<td>- trend</td>
<td>4.15*</td>
<td>A&gt;D*</td>
</tr>
<tr>
<td>Incorrect responses$^1$</td>
<td>2.76*</td>
<td>ns</td>
</tr>
<tr>
<td>- initial performance</td>
<td>0.02</td>
<td>ns</td>
</tr>
<tr>
<td>- trend</td>
<td>2.09</td>
<td>ns</td>
</tr>
<tr>
<td>Omissions$^1$</td>
<td>1.42</td>
<td>ns</td>
</tr>
<tr>
<td>- initial performance</td>
<td>1.14</td>
<td>ns</td>
</tr>
<tr>
<td>- trend</td>
<td>2.94*</td>
<td>A&lt;D*</td>
</tr>
<tr>
<td>Mean reaction time$^1$</td>
<td>2.00</td>
<td>ns</td>
</tr>
<tr>
<td>- initial performance</td>
<td>2.49+</td>
<td>ns</td>
</tr>
<tr>
<td>- trend</td>
<td>2.03</td>
<td>A&gt;C*</td>
</tr>
</tbody>
</table>

$^1$refers to overall performance; $+p < .10$  $^*p < .05$  $^{**}p < .01$
Relations between Type A behavior, hyperactivity, task motivation, and CRT performance

As shown in Table 5, both hyperactivity and Type A behavior showed significant positive relations to omissions and reaction time, and negative relations to task motivation. For those outcome variables showing significant correlations to both hyperactivity and Type A behavior, the same correlation analyses were conducted for MYTH scores with hyperactivity partialled out, whereupon the relations were no longer significant.

Table 5
Significant relations between Conners hyperactivity and MYTH Type A behavior and the Complex Reaction Time measure (reference groups).

<table>
<thead>
<tr>
<th>CRT measure</th>
<th>Conners Hyperactivity</th>
<th>MYTH Total Type A</th>
<th>MYTH Competitiveness</th>
<th>MYTH Impatience</th>
<th>MYTH Voice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed motivation</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- initial performance</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- trend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correct responses</td>
<td>*</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- initial performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- trend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incorrect responses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- initial performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- trend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Omissions</td>
<td>*</td>
<td>+</td>
<td></td>
<td>**</td>
<td>+</td>
</tr>
<tr>
<td>- initial performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- trend</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean reaction time</td>
<td>***</td>
<td>+</td>
<td>**</td>
<td>**</td>
<td>+</td>
</tr>
<tr>
<td>- initial performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- trend</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

N=61; +p < .10 *p < .05 **p < .01 ***p < .001

1 refers to overall performance

Conclusions

The results of Study III show that, although the MYTH-defined Type A group is different from the clinically diagnosed ADHD group, it is markedly similar to the
Conners-defined hyperactive group, displaying comparable CRT performance and low level of task motivation. In addition, the relations of Type A behavior to task motivation and CRT performance were unexpected, in that they were conceptually more indicative of hyperactivity than of Type A behavior. The Impatience subscale of the MYTH was concluded to be particularly problematic in terms of discriminant validity.

**Study IV**

Group differences in the various aspects of executive functioning were examined using the general linear models procedure of the SAS Systems Software, which also accounts for differences in group size. Planned comparisons were carried out in relation to the Type A group. In that the groups were not matched with respect to age (the ADHD group was relatively young), these analyses were conducted with age as a covariate, as well as with both age and our WISC Performance measure of IQ as covariates.

**Group differences in inhibitory control and various aspects of executive functioning**

Group differences regarding aspects of executive functioning, with age as a covariate, are presented in Table 6. Planned comparisons between the Type A group and the Type B group revealed significant differences in terms of latency of response on the Tower of Hanoi and reaction time on the Go/no-go task, with the Type A group showing shorter latencies and shorter reaction times. There were no differences between the Type A group and the ADHD group with regard to these variables. However, planned comparisons found several measures of executive functioning to differ between the Type A group and the ADHD group, with the Type A group showing superior performance. More specifically, Type As showed fewer errors of omission, greater accuracy in time reproduction, marginally better story recall (both overall and main theme), and tendencies toward less cheating and greater accuracy of hand movements. Neither the Type B group nor the ADHD group differed from the Type A group with regard to commission errors on the Go/no-go task, the Tower of Hanoi accuracy score, nor the time required to solve the Tower of Hanoi. Some of the differences between
the Type A and ADHD groups became non-significant upon controlling for both age and WISC IQ, although the difference with regard to time reproduction remained, as did the differences in omission errors. The differences between Type As and Type Bs with regard to latency of response and reaction time also remained significant.

Table 6
Group Differences in Various Aspects of Executive Functioning (Using Least Square Means, Controlling for Age)

<table>
<thead>
<tr>
<th></th>
<th>A Type A (n=20) M</th>
<th>B Type B (n=21) M</th>
<th>C ADHD (n=14) M</th>
<th>F with age as covariate</th>
<th>Planned comparisons with Type A (with age as covariate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go/no-go (omission errors)</td>
<td>2.23</td>
<td>5.13</td>
<td>15.04</td>
<td>3.65*</td>
<td>A&lt;C*</td>
</tr>
<tr>
<td>Go/no-go (commission errors)</td>
<td>12.80</td>
<td>10.25</td>
<td>12.78</td>
<td>1.19</td>
<td>ns</td>
</tr>
<tr>
<td>Go/no-go (reaction time)</td>
<td>524.19</td>
<td>590.52</td>
<td>525.31</td>
<td>2.89+</td>
<td>A&lt;B*</td>
</tr>
<tr>
<td>Tower of Hanoi - accuracy score</td>
<td>1.54</td>
<td>1.43</td>
<td>1.51</td>
<td>0.64</td>
<td>ns</td>
</tr>
<tr>
<td>Rule-breaking (Tower of Hanoi)</td>
<td>1.51</td>
<td>1.11</td>
<td>2.60</td>
<td>2.22</td>
<td>ns</td>
</tr>
<tr>
<td>Latency of response (Tower of Hanoi)</td>
<td>4.80</td>
<td>10.62</td>
<td>5.09</td>
<td>4.02*</td>
<td>A&lt;B*</td>
</tr>
<tr>
<td>Time required to solve task (Tower of Hanoi)</td>
<td>41.63</td>
<td>44.66</td>
<td>45.80</td>
<td>0.28</td>
<td>ns</td>
</tr>
<tr>
<td>Repetition of time interval - accuracy score</td>
<td>0.98</td>
<td>0.97</td>
<td>1.21</td>
<td>4.25*</td>
<td>A&lt;C*</td>
</tr>
<tr>
<td>Story recall - total score</td>
<td>20.97</td>
<td>19.01</td>
<td>15.78</td>
<td>1.54</td>
<td>A&gt;C+</td>
</tr>
<tr>
<td>Story recall - main theme</td>
<td>8.11</td>
<td>7.31</td>
<td>6.53</td>
<td>1.47</td>
<td>A&gt;C+</td>
</tr>
<tr>
<td>Cheating during puzzle task</td>
<td>1.88</td>
<td>1.81</td>
<td>2.67</td>
<td>2.26</td>
<td>A&lt;C+</td>
</tr>
<tr>
<td>Hand movements</td>
<td>11.13</td>
<td>9.84</td>
<td>8.66</td>
<td>1.90</td>
<td>A&gt;C+</td>
</tr>
<tr>
<td>Conners hyperactivity</td>
<td>1.68</td>
<td>1.73</td>
<td>2.74</td>
<td>12.40***</td>
<td>A&lt;C***</td>
</tr>
<tr>
<td>Observed Type A behavior</td>
<td>5.12</td>
<td>2.36</td>
<td>2.57</td>
<td>37.13***</td>
<td>A&gt;C***</td>
</tr>
<tr>
<td>WISC Block Design (age-adjusted score)</td>
<td>12.55</td>
<td>11.67</td>
<td>9.67</td>
<td>3.12+</td>
<td>A&gt;C*</td>
</tr>
</tbody>
</table>

+ p < .10  * p < .05  ** p < .01  *** p < .001

* Least square means and F-value are not calculated using age as a covariate, in that the score is already age-adjusted.
Conclusions
The Type A group and the ADHD group exhibited similarities in terms of reaction time and latency of response. However, it was possible to differentiate the Type A and ADHD groups on tasks of executive functioning which placed greater emphasis on working memory and mental representation, for example, rather than abilities related to time only. Thus, although Type A behavior and ADHD may have aspects of impatience and time-urgency in common, the functional significance of these similarities may differ as may the determinants of overt behavior.

DISCUSSION

The present thesis has focused on a phenomenon within child development research, namely Type A behavior, and its conceptual overlap with some aspects of hyperactivity and ADHD.

Contributions made by the present research

Study I: ”Assessing Type A Behavior in 8-Year-Olds: Exploring the Overlap Between the Constructs of Type A Behavior and Hyperactivity”

Study I showed that it is possible to measure Type A behavior as distinct from hyperactivity at age 8, using behavioral observations of Type A behavior. Although the observational measure used may not cover all aspects of Type A behavior equally well, the results imply that the MYTH questionnaire measures Type A behavior too indiscriminately, showing a substantial overlap with hyperactivity.

Study II: ”Assessing Type A Behaviour in Children: A Longitudinal Exploration of the Overlap Between Type A Behaviour and Hyperactivity”

Study II showed, together with the results of Study I, that Type A behavior is discernible already at age 4 and that it should be regarded as a phenomenon rather distinct from hyperactivity. In addition, this behavioral pattern shows considerable stability between the ages of 4 and 8, although the status of the impatience component
needs further investigation. A particular strength of this study was the longitudinal perspective as well as the use of behavioral observations in the assessment of Type A behavior at both ages as well as of hyperactivity at age 4.

**Study III: “Differentiating Type A Behaviour and Hyperactivity Using Observed Motivation During a Reaction Time Task”**

The results of Study III indicate that MYTH-defined Type A behavior is indiscriminant from Conners-defined hyperactivity in terms of observed task motivation and CRT-performance, although the MYTH was discriminant regarding clinical ADHD. The validity of the MYTH as a measure of the Type A construct is questioned, in that the perception of Type A individuals as highly motivated to achieve is not evident in this study.

**Study IV: “Inhibition and Executive Functioning in Type A and ADHD Boys”**

The results of Study IV point to certain similarities between Type A and ADHD boys in terms of overt displays of time-urgency and impatience. However, differences on other tasks of executive functioning lead to speculations concerning differing origins of overtly similar characteristics of Type A behavior and ADHD.

**Further reflections on the results presented**

**Aspects concerning convergent and discriminant validity**

In three of the four studies included in this thesis, Type A behavior was assessed using behavior observations. Two of these studies (Studies I and II) also included the MYTH as a measure of Type A behavior, along with hyperactivity assessments, for comparisons with regard to convergent and discriminant validity. In Study IV, Type A behavior was assessed by observations, with a subsample rated on the MYTH as well, for purposes of convergent validity only. In Study III, which did not include observed Type A behavior, the MYTH was instead used in defining a Type A group, although observations were made of task motivation, a concept with relevance to the Type A construct.

In all three studies which used observations of Type A behavior, the
observational measure showed significant convergent validity in relation to the MYTH instrument, as well as discriminant validity in relation to hyperactivity (Studies I and II) and ADHD (Study IV). In all studies, assessing aspects of Impatience, in particular, was found to be problematic, both in terms of discriminating between Type A behavior and hyperactivity (Studies I and II), and in terms of showing stability over time (Study II). Impatience further became an issue in Study IV, in which aspects of impatience and time urgency in relation to executive functioning tasks were found to be present among both Type A boys and ADHD boys.

The various relations between Type A behavior and hyperactivity revealed in Studies I and II seem to suggest that there is some degree of impurity, especially when studying younger children, in measures used to assess child Type A behavior. The MYTH was neither concurrently (Study I) nor longitudinally (Study II) discriminant in terms of hyperactivity. The observational Type A measure, with the exception of the Impatience component, showed convergent validity with regard to the MYTH and discriminant validity in terms of hyperactivity (all observational dimensions were concurrently discriminant in terms of hyperactivity at age 8). One further indication of this impurity is the fact that MYTH scores and observed Type A scores showed different relations to external criteria, the achievement measures as well as externalizing behavior problems; the MYTH showed significant longitudinal relations to negative aspects, whereas the observed Type A measure generally showed relations to positive aspects.

Studies I and II showed that it is possible to measure Type A behavior as distinct from hyperactivity. Although the Type A observational measure used may be too narrow, being obtained in a particular situation, and thereby perhaps not covering all aspects of Type A behavior equally well, the results imply that the MYTH questionnaire is too indiscriminate. In the development of instruments for children’s Type A behavior, discriminant validity has to be considered to a greater extent in specifying the content of the Type A construct and in designing validation studies than what has been the case with the MYTH. Many of the behaviors, which in validation studies have distinguished Type A children from Type B children, would be equally
well descriptive of hyperactive children. Examples of such behaviors are aggression against a Bobo doll (Matthews & Angulo, 1980, Vega-Lahr & Field, 1986); Impatience throughout a study session (Matthews & Angulo, 1980); and annoyed facial expressions, interruptions during classroom free-play, and gross motor activity (Vega-Lahr & Field, 1986).

The results of Study I and II generally support the notion of impatience as an important characteristic of Type A behavior in children, but question whether it should be as inclusive as that measured by the MYTH. MYTH Impatience includes restlessness (“Can sit still long” [reversed]) and general aggressiveness (“Tends to get into fights”), which might be overinclusive when used as indicators of Type A behavior. This is in agreement with the suggestion by Bachman and associates (1986) that the MYTH Impatience/aggression factor, in light of its correlations with behavior problem ratings, measures a general pathology factor that is maladaptive in all settings. The impatience implied by the Type A construct may be more specific, primarily concerning task situations and achievement orientation.

The results of Study III pointed to further problems of the MYTH instrument in terms of capturing fundamental aspects of the Type A concept. Generally, relations of the MYTH to CRT performance measures and task motivation were more indicative of the hyperactivity construct than of Type A behavior. When correlations between task motivation and MYTH scores were studied, it was the Impatience factor of the MYTH which correlated negatively with task motivation, as did the hyperactivity score. Of interest is also the finding that the negative relation between task motivation and MYTH Impatience became non-significant when hyperactivity was partialled out. In light of the common conceptualization of Type A individuals as achievement striving, it is further surprising that neither the Total MYTH nor the Competitiveness subscale showed any positive correlations to observed task motivation. Correlations were in fact negative, although not significant for these dimensions. Furthermore, when partialling out hyperactivity from the correlations between Type A and CRT, a high degree of overlap with hyperactivity was demonstrated in the MYTH Impatience subscale; all associations between Impatience and CRT variables became
non-significant. This supports the conclusions from Studies I and II that it is the Impatience subscale in particular that is indiscriminant in terms of hyperactivity. Although the discriminant validity of the MYTH was not an issue which was addressed in Study IV, the results are nevertheless of interest here in that they pointed to some similarities between the observationally assessed Type A group and the ADHD group with regard to aspects of impatience and time urgency.

Attempts to distinguish between Type A behavior and hyperactivity/ADHD

As pointed out by Barkley (1997b), normal children may develop the capacity to bridge temporal delays between the elements of behavioral contingencies by using executive functions (such as using self-regulation of motivation to stay on-task). In other words, they are not as dependent as ADHD children upon external reinforcement in order to persist in goal-directed acts. ADHD children, on the other hand, have a diminished capacity to bridge such temporal delays. Self-regulation of motivation enables normal children not only to keep in mind the goal of their performance and encourage themselves to persist, but also to create the drive necessary for such persistence. In that this type of goal-oriented drive and persistence is particularly relevant to Type A behavior, we believed that it would be possible to discriminate Type A behavior from hyperactivity using the observed measure of task motivation (Study III).

The results of Study III revealed differences in the level of task motivation between the Type A group and both the ADHD group (lower than Type A) and the non-hyperactive group (higher than Type A), but not the hyperactive group. These two latter findings were not in accordance with the conceptualization of Type A behavior, especially in that the results for initial level of task motivation were comparable to the results overall. The group means indicated a similar overall level of task motivation for the Type A and hyperactive group ($M = 6.50$ and $M = 6.62$, respectively), whereas the non-hyperactive group exhibited a significantly higher level of task motivation overall ($M = 7.12$). The perception of Type A individuals as highly motivated to achieve was not evident in these findings, which again, questions the validity of the MYTH as a measure of the Type A construct. Although there is a possibility that even Type A individuals would show a diminished interest in the task eventually, they would not be
expected to have lower task motivation than the other reference groups from the beginning.

In summary, the results of Study III show that the MYTH-defined Type A group is different from the clinically diagnosed ADHD group; however, it is markedly similar to the non-clinical hyperactive group, displaying comparable CRT performance and low level of task motivation. Furthermore, the correlation analyses between Type A behavior on the one hand and CRT performance and task motivation on the other hand, revealed unexpected associations, which were conceptually more indicative of hyperactivity than of Type A behavior. In addition, the correlation between MYTH-defined Type A behavior and Conners-defined hyperactivity was positive and significant \( r = .61^{***} \), replicating what previous studies have found using various hyperactivity measures in relation to the MYTH (Hunter et al., 1985; Rickard & Woods de Rael, 1987; Whalen & Henker, 1986). Correlation analyses which partialled out hyperactivity also indicated that the MYTH Impatience subscale, in particular, has much in common with hyperactivity.

In Study IV, further attempts were made to distinguish Type A behavior and ADHD, on measures of inhibitory control and executive functioning. We suggested that a possible common link between Type A behavior and hyperactivity/ADHD might be problems with inhibition, which may be expressed in the impatience component of Type A behavior, while the other components capture aspects of functioning distinct from hyperactivity. Thus, although Type A behavior and hyperactivity may have behavioral aspects in common, the presence of other, for example, achievement-striving components of Type A behavior, may result in differential performance on tasks tapping executive functioning. The results of Study IV pointed to similarities between the observationally assessed Type A group and the ADHD group concerning aspects of impatience and time urgency. It was, however, possible to distinguish these two groups using tasks of executive functioning which placed greater emphasis on working memory and mental representation, for example, rather than abilities related to time only. Thus, although Type A behavior and ADHD may have aspects of
impatience and time-urgency in common, the functional significance of these similarities may differ as may the determinants of overt behavior.

Developmental considerations for the conceptualization of Type A behavior and hyperactivity

The question remains regarding impatience and the conceptualization of Type A behavior. Type A impatience seems to be difficult to operationalize for the preschool years. Perhaps this impatient yet persevering behavior is not an integral part of Type A behavior during the preschool years; rather, it may be an aspect which requires maturation of self-regulatory capacities (see e.g., Posner & Rothbart, 2000) in order to be observable. Further, development of this behavioral aspect may be enhanced by experiences of conflicting internal and external demands of the kind often entailed in school work. Impatient behavior measured at early ages may therefore not be a relevant descriptor of child Type A behavior and may instead reflect deficient impulse control and thus be more characteristic of the hyperactivity construct. This notion is supported by the findings in Study II that observed Impatience at age 4 did not show dimensional stability and was significantly related to Lack of perseverance at age 8. Furthermore, MYTH Impatience, and to some extent also observed Impatience, were related to external criteria in a way which would be expected for the hyperactivity construct. An interesting speculation is one by Heft and colleagues (1988), suggesting that Type A behavior may evolve from a more global and less differentiated pattern of emotional and behavioral arousal in youngsters.

Type A behavior and hyperactivity - - Nature of relation

From the results presented in this thesis, it seems plausible that the constructs of hyperactivity and Type A behavior may have "impatience” in common, although conceptually this would be expected to be qualitatively different between the two. For instance, Type A children may display impatience in relation to a task, yet persist at it and possibly show irritation, whereas hyperactive children may display impatience, an increasing disinterest in the task, and may eventually give up. The characteristic achievement drive of Type A individuals would thus allow them to persist at the task despite growing impatience. Thus, although impatience may be a common aspect to
some extent, task motivation and performance on executive functioning tasks, for instance, may be expected to be different for the two constructs.

The comparisons between the Type A and Type B groups presented in Study IV illustrate the view of Type A as characterized by time urgency and impatience. Interestingly, these characteristics of Type A behavior were also shown by the ADHD group, which could be taken as support for the idea that deficits in inhibitory function are shared between the two. Although this interpretation is complicated by the fact that the central variable for an evaluation of inhibition, that is, commission errors in the Go/no-go task, did not show a significant group effect, it can be noted that the values for the ADHD and Type A groups were very similar and higher than those for the Type B group. In fact, when the differences between the Type A and B groups was studied in terms of effect size ($d$), as recommended by Cohen (1992), we found a small- to medium-sized effect ($d = .42$), indicating that with increased statistical power, an actual, yet modest, group difference may have been identified. Moreover, in Study IV, the Type A children did not differ from the Type B children on any of the performance measures, whereas they showed superior performance as compared to the ADHD children on several of them. It may therefore be concluded that Type As do not display deficits with regard to executive functioning, of the kind often found when ADHD children are compared with normal controls. With reference to the findings presented in this thesis, Type A behavior and hyperactivity/ADHD appear to be well-differentiated except with regard to what may be interpreted as impatience.

In light of their characteristic achievement drive, it was somewhat surprising to find in Study IV that Type As were deficient in planning with regard to the Tower of Hanoi task, insofar as latency of response may be regarded as a measure of planning. However, as stated by Bronson (2000), self-regulation and motivation are intricately related concepts; thus, although an individual may be capable of self-regulation (in this case, inhibiting response sufficiently in order for planning to take place), he or she may not be motivated at the time to inhibit responding, or he or she may have motives in conflict with some aspects of performance. In other words, the Type A individual may
not necessarily have a problem with inhibition although he or she shows deficient planning on the Tower of Hanoi.

It does not appear that the performance of the Type As can be explained as the result of some sort of trade-off between speed and accuracy. Neither the results of Study III nor those of Study IV support such an interpretation. For instance, in Study III, the performance decrement with regard to reaction time was larger for the Type A group than that of the non-hyperactive group, which may be indicative of a trade-off. However, the Type A group did not show superior sustained performance in relation to the other reference groups in terms of correct responses. In Study IV, findings that the Type A group had short latencies on the Tower of Hanoi task (i.e., exhibited deficient planning), could be interpreted as a sacrifice of accuracy for speed. However, Type As neither exhibited shorter times for solving the task, nor were they less accurate.

Barkley’s (1997) reflection that rule-governed behavior is involved in any task where verbal instruction is given, may be relevant to some of the findings of Study IV; that is, Type A individuals may fail to adhere to the specified rule of completing the Tower of Hanoi in as few moves as possible, and instead follow their own ”rule” of performing as quickly as possible. This line of reasoning may also apply to our negative findings with regard to commission errors in Study IV; Type A boys may show many commission errors because they are, in a sense, ”compelled” to perform quickly regardless of errors, whereas ADHD boys show many errors because they are unable to inhibit responding. As argued by Schachar, Tannock, and Logan (1993), failure to withhold a response on a no-go trial could be due to strong prepotent go processes, as well as to disinhibition. It may further be relevant to consider the possibility of different types of inhibitory deficits, for example, deficits in motivational inhibition or executive inhibition, in Type A behavior and ADHD, respectively (for reviews on types of inhibition, see Nigg, 2000, 2001).

With reference to the results on time reproduction in Study IV, the Type A boys seem to have a accurate perception of the passage of time, in contrast to the ADHD boys, who tended to overestimate the passage of time. The tendency for ADHD children to overestimate time has also been found in previous studies of ADHD and
time reproduction (e.g., Barkley, Koplowitz, Anderson, & McMurray, 1997). It may be possible that at least some of the ADHD boys’ impatience/inability to tolerate slowness may be attributed to their inaccurate perception of time, or “time blindness,” as stated by Barkley (1997). ADHD boys may become frustrated and impatient because they have difficulties grasping the concept of time. The Type A boys, on the other hand, may be frustrated as a result of their accurate perception of time, and thus an accurate sense of not being able to control the passage of time. In other words, although both groups may show impatience and frustration, the underlying components of this frustration/impatience differs between the groups. In terms of latencies and reaction times, the Type A group differed from the Type B group, but not from the ADHD group. It should be noted that the Type A group did not differ from the Type B group with regard to time reproduction; they were equally accurate. However, in combination with Type A characteristics, an accurate sense of time may lead to frustration with the inability to control time, which was not evident in Type Bs.

Possible limitations of the empirical studies

Constitution of the samples
Regarding the longitudinal sample from which data were used in Studies I and II, there was a certain amount of attrition over the years, as is often the case with longitudinal studies. There is a possibility that the attrition group would have differed from the study samples with regard to Type A behavior or hyperactivity. Perhaps parents with a certain disposition would be less inclined to respond to questionnaires or to find the time for a laboratory visit. However, this would most likely have led to an underrepresentation of the behaviors of interest.

The attrition between Study III and Study IV with regard to the reference groups consisted for the most part of boys belonging to the hyperactive group as well as older boys in general. This may have affected the results of Study IV to the extent that hyperactive behaviors may have been diminished in the resulting Type A and Type B groups. This in turn may have increased the likelihood of finding differences between
the reference groups and the ADHD group, and also, if indeed there is an overlap between Type A behavior and hyperactivity, may have decreased the likelihood of finding differences between the Type A and Type B groups.

With regard to the representativeness of the samples included in Studies I to IV, the children in the non-clinical samples all had relatively well-educated parents, although (as revealed in Study III) parents of the ADHD children were not particularly well-educated. The generalizability of the results are further limited due to the study of boys only in Studies III and IV; The patterning of Type A behavior may be different for girls, as has been suggested with regard to hyperactivity in girls (e.g., Barkley, 1998).

**Strength of the results**

In both Studies III and IV, there was diminished power for detecting group differences due to the relatively many groups studied and the small sample size (in particular the ADHD groups). In addition, the relatively young age of the ADHD group (Study IV) in comparison to the reference groups may have presented a problem. Although we conducted precautionary analyses in order to determine whether using age as a covariate would produce obscurities, matching groups on age is recommended when possible.

**Multiple comparisons**

A large number of tests were conducted in the studies, with the risk of retaining some false results (i.e., committing a *Type I error*). However, this was not determined to be a significant risk, in that the conclusions were based primarily on the patterning of results. In other words, each result was seen as part of a whole.

**Behavioral observations**

Some shortcomings with respect to the observational assessments of Type A behavior used in Studies I, II, and IV should be noted here. In that the observational situation was not tailored specifically for studying Type A behavior, certain aspects of Type A behavior may have been more prominent than others; more weight may have been given to competitive aspects than impatient aspects. In addition, it may have been difficult to fully capture some aspects of Type A behavior, for instance, competition in
relation to peers, or impatience not specifically related to task performance. It follows that if more weight could have been given to the impatience aspects of Type A behavior (had it been assessed in a more provocative situation, for instance), perhaps the similarities in this regard between Type A boys and ADHD boys would have been more prominent in Study IV.

With regard to Study IV, possible limitations include using the crude median split on the A-B scale, which may lead to misclassification of subjects. Our results may thus be interpreted as conservative in that differences between the groups probably would have been larger using a less inclusive categorization. Our use of an overall measure of Type A behavior rather than separate dimensions may also have affected the results.

Further, in Study III, task motivation was assessed during a task which may not have been optimal for studying Type A behavior. A task which is more inherently competitive may have been more appropriate.

Other considerations
With regard to possible shortcomings of Study III, the fact that the experimenter was present during the task could have had a positive influence on performance (see e.g., van der Meere et al., 1995), especially for the ADHD group. However, the ADHD group did show a greater decrement in reaction time compared to the non-hyperactives (see Berlin et al, 2001) in spite of the experimenter being present. One further limitation concerns informing the children when half the time of the test had passed, which could be proposed to either enhance or depress motivation, thereby possibly obscuring the expected decline in sustained attention. However, additional analyses indicated that changes in task motivation and CRT performance in conjunction with half-time did not differ between groups.

In Study IV, our WISC Performance measure of IQ was, not surprisingly, found to be correlated with several measures of executive functioning, and as a result, controlling for IQ found many group differences to become non-significant. Controlling for IQ, however, is questionable, in that, as Barkley and colleagues (Barkley, 1997; Mariani & Barkley, 1997) have argued, deficits in IQ in children with ADHD may be directly related to ADHD and the toll that disorder takes on executive
functioning. Thus, controlling for IQ removes part of the influence of the very independent variable (ADHD) one is attempting to study. One may be tempted to argue that the measure of Type A behavior used in Study IV merely reflects differences in ability or IQ. However, although the ADHD group differed significantly from the Type A group in this respect, the Type B group did not.

An issue concerning the IQ measure used is that scores are partially based on the time spent to complete the task, which may have confounded results in relation to time urgent characteristics, for example. However, there were no significant differences between the Type A and B groups regarding IQ scores (Study IV). Empirically, Type As have been found to expend greater effort than Type Bs on tasks with ambiguous performance criteria, whereas both groups exert greater efforts on tasks with explicit deadlines (compared to no deadlines; Matthews & Volkin, 1981). Anecdotal evidence from Study IV also suggests this to be the case; most children seemed to be affected by the presentation of the stopwatch in the WISC Block Design, whereas only the Type As seemed to be working as quickly as possible on the Tower of Hanoi task, which had no explicit time limit. Thus, regardless of the children’s time-urgent characteristics, they were expected to be similarly affected by the aspect of time involved in the WISC task.

Future directions

Although the results of the studies presented in this thesis point to some similarities between Type A behavior and hyperactivity, they do not lend specific support to speculations concerning common origins of the two constructs. However, there is still the possibility that, within the realm of a construct encompassing behavioral and emotional arousal or activation and aspects of impatience, a common ”theme” underlying the two constructs will be found. Future studies should investigate the possibility of a common component, which may, perhaps through differential reactions to environmental demands, give rise to different developmental patterns, for example, positive outcomes such as high achievement, on the one hand, and negative outcomes,
such as externalizing behavior, on the other hand. One possibility may be to search for cardiovascular measures or other physiological markers which could be common to or different between Type A behavior and hyperactivity. This may aid in clarifying the developmental relations between the two phenomena. Future studies of Type A behavior should address various aspects of impatience, time-urgency, and inhibitory control, particularly in relation to task performance and task motivation. In addition, Type A behavior should be assessed using behavioral observations, in order to clarify how it relates to hyperactivity, and executive functioning.

Theoretical formulations with possible relevance to both Type A behavior and ADHD
There are a number of theoretical formulations that may be relevant to both Type A behavior and hyperactivity/ADHD. Although these viewpoints have not been directly tested empirically in the studies presented in this thesis, an account of them is possibly of interest for speculations and future studies regarding common and/or distinct developmental pathways giving rise to specific aspects of behavior.

Imbalances of activation and inhibition. As stated by Ruff and Rothbart (1996), a balance between the two influences of activation and inhibition is required in order for attention to be appropriately modulated to meet the needs of external constraints and self-determined goals. The integration of these opponent processes leads to proper deployment of attention and organized activity, whereas imbalances may lead to maladaptive distribution of attention and poorly organized responses.

Future studies may be able to further clarify the inhibitory deficits common to both ADHD and Type A behavior. Regarding what may lie behind such a deficit, explanations in terms of imbalances of activation and inhibition may be sought. For instance, Quay (1997) has argued that the underlying problem in ADHD is an underaroused Behavioral Inhibition System (BIS; Gray, 1987). According to Gray, the BIS involves the septo-hippocampal area and its connections to the frontal cortex. The BIS of ADHD individuals is most likely underaroused, perhaps due to diminished norepinephrine inputs from the locus coeruleus. In a study of reward and extinction by Iaboni, Douglas, and Ditto (1997), ADHD children were found to have a weak BIS, as hypothesized by Quay (1997), and possibly a weak Behavioral Activation System.
In terms of imbalances in BIS and BAS, it could be speculated that Type A individuals have a normally functioning BIS, but an overactive BAS, which may result in problems of regulating inhibitory responses. Thus, the proposed “imbalance” in Type A individuals may result in some aspects of overt behavior similar to hyperactives, although the deficit of ADHD children seems to lie in an underactive BIS, and perhaps also an underactive BAS.

Along the same lines, Porges (1976, 1992) hypothesized that hyperactive individuals are deficient in inhibitory control of behavior with a parallel deficit in parasympathetic control, observed in their failure to slow heart rate and suppress heart rate variability in response to demands for sustained attention. A recent study found inattentive behaviors in ADHD children to be related to low sympathetic arousal (Anderson et al., 2000). In contrast, Type A individuals, both children and adults, have been found in many studies to display exaggerated sympathetic arousal (e.g., Howard, Rechnitzer, Cunningham, Wong, & Brown, 1990; Lundberg, 1982; Matthews & Jennings, 1984; Rääkkönen, Keskivaara, Keltikangas-Järvinen, Butzow, & Lyytinen, 1995; Sundin & Öhman, 1992; Sundin, Öhman, Palm, & Ström, 1995; Williams, Suarez, Kuhn, Zimmerman, & Schanberg, 1991).

An analogy which may be useful is that of a car going through a red light; hyperactives fail to stop at the red light because they have poor brakes, whereas Type As fail to stop because their accelerator is pressed to the floor. Thus, the causes of running the red light may be different, but the effect, or overt behavior, is the same. Hypotheses regarding the influences of the BIS and BAS on behavior as a means of differentiating Type A behavior and hyperactivity need to be tested specifically. Future studies should thus focus on the possibility of differing imbalances of behavioral activation and inhibition which may produce similar overt behavior, and previous research in this area should be extended to include the Behavioral Activation System (BAS) and those exhibiting the Type A behavior pattern. It would be of special interest to study adults as well as children in these respects. Although a certain imbalance in physiological/neurological substrates involved in excitatory and inhibitory pathways may, with results of future studies, be regarded as a necessary condition, it is most
likely not sufficient in itself with regard to the development of Type A behavior and hyperactivity/ADHD, respectively.

Regulatory control problem. Douglas (1999) views attentional and inhibitory deficits in ADHD as different manifestations of an underlying regulatory control problem. That is, the major problem characteristic of children with attention deficits and hyperactivity is difficulty mobilizing and sustaining the effort necessary to persist at intrinsically dull tasks, such as continuous performance tests. She emphasizes that there is convincing evidence to support both facilitating (activating) and inhibitory problems in ADHD (in contrast to Barkley who focuses on the inhibitory aspects). This is also in accordance with Sergeant and coworkers (Sergeant, Oosterlaan, & van der Meere, 1999), who argue for a deficit involving the allocation of energetic resources. More specifically, they suggest that ADHD children’s lack of response inhibition is modulated by their inability to adjust their state, with regard to pools of effort, arousal, and activation. Type A individuals may have similar problems adjusting their state, but perhaps the specific pool that appears to be dys functioning differs from that of ADHD children. For instance, the activation pool is speculated by Sergeant and associates to be deficient in ADHD, whereas perhaps the arousal or effort pools may instead be dysfunctional in Type A behavior.

Along a similar vein, Rothbart (e.g., Ruff & Rothbart, 1996) has pointed to effortful control as a third factor of temperament (in addition to behavioral inhibition and activation), which includes children’s capacity to focus and shift attention, ability to inhibit action when it is called for, and response to low-intensity stimulation and reward. Restraint of impulsive behavior is thought to be actively controlled by self-regulatory mechanisms, including attention (in contrast to the passive control of the BIS). It is possible that one crucial aspect by which to differentiate the two phenomena, Type A behavior and hyperactivity, is that of self-regulation. With maturation and increasing environmental demands in terms of behavioral self-control, some children become able to regulate their own behavior, with regard to what is expected in different situations (Derryberry & Rothbart, 1997; Kopp, Krakow,
Vaughn, 1983). However, in other children, behavior is left “unharnessed,” resulting in various problem behaviors such as hyperactivity.

Another interesting point of view is that presented by Muraven and Baumeister (2000), where they posit that self-control relies on a limited, consumable resource, much like muscle strength. Consequently, failures to inhibit or override competing urges, behaviors, or desires may be attributed to depletion of this limited resource. People may also be able to conserve their self-control strength when less motivated, for use in situations where their motivation to use this resource is greater.

Social interactions in development

Inhibitory control is strongly implicated in socialization, which often requires that children actively inhibit their impulses and comply with caregivers’ standards of conduct. Consequently, Kochanska (1993) has postulated that inhibitory control may be one of the individual characteristics that make children better or worse prepared to internalize family and societal standards. In that sense, it may be regarded as a temperamental contribution to the complex process whose final outcome depends on multiple factors, including parents’ and peers’ influences, cognitive maturation, and social cognition. Furthermore, as noted by Ruff and Rothbart (1998), it is important to consider individual differences concerning the degree of frustration felt and the tolerance for frustrating circumstances. The use of person-centered holistic approaches in future studies may be especially appropriate here.

Needless to say, individual differences in behavior are not merely a result of varying degrees of activation and inhibition. The child’s social experiences are especially important in the development of attention and self-regulation (Ruff & Rothbart, 1996). Barkley (1997) also stresses that the capacity for self-regulation is not taught, but rather emerges out of an interaction between the child’s maturing neurological capacity and his or her interactions with a social environment that stimulates and encourages self-regulative behavior. Social interactions are further the bases during which certain neural pathways are made dominant over others and thereby affect future behaviors (see, e.g., Siegel, 1999). As pointed out by Ruff and Rothbart (1996), adults have an important role in terms of helping the child regulate arousal.
levels through calming and stimulation, learn strategies through demonstration and instruction, and move toward increasing self-control of attention.

**Concluding remarks**

The studies included in the present thesis have furthered our understanding of Type A behavior in children. This was accomplished, more specifically, by studying the empirical overlap between Type A behavior and hyperactivity/ADHD in depth. Although the empirical overlap between the phenomena has been noted previously by other researchers, the relation between the two has not been fully studied. Type A behavior and hyperactivity/ADHD were found to be clearly distinguishable except with regard to overt displays of impatient behavior. However, the similarities between Type A behavior and hyperactivity, evidenced in the studies herein, are intriguing. Although problems in operationalizations of Type A behavior were evidenced, the findings overall still point to some overlap between Type A behavior and hyperactivity with regard to impatience. Whether the similarities between the two may be extended to physiological or neurological aspects is, however, a topic for future studies. Of further interest are the processes through which these proposed similarities might result in different developmental trajectories. Future studies may aid in clarifying whether the shared impatience is just topographically similar behavior or whether a common origin may be identified in the Type A and ADHD behavioral patterns.
REFERENCES


Steinberg, L. (1986). Stability (and instability) of Type A behavior from childhood to early adulthood. Developmental Psychology, 22, 393-402.


behavioral characteristics and children and teacher demographic characteristics. 
*Journal of Personality Assessment, 53, 770-782.*


Appendix A
Means and standard deviations for the variables included in Studies I & II.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Type A Behavior (age 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global rating</td>
<td>83</td>
<td>4.33</td>
<td>1.69</td>
<td>--</td>
</tr>
<tr>
<td>Impatience</td>
<td>83</td>
<td>1.65</td>
<td>0.47</td>
<td>.67</td>
</tr>
<tr>
<td>Competitiveness/Rapidity</td>
<td>83</td>
<td>1.97</td>
<td>0.73</td>
<td>.75</td>
</tr>
<tr>
<td>Control</td>
<td>83</td>
<td>1.79</td>
<td>0.82</td>
<td>.46</td>
</tr>
<tr>
<td>MYTH Type A Behavior (age 4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregated ratings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>4.36</td>
<td>1.20</td>
<td>.85</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>89</td>
<td>4.45</td>
<td>1.27</td>
<td>.80</td>
</tr>
<tr>
<td>Impatience/aggression</td>
<td>89</td>
<td>3.94</td>
<td>1.41</td>
<td>.74</td>
</tr>
<tr>
<td>Voice</td>
<td>89</td>
<td>5.13</td>
<td>1.46</td>
<td>.56</td>
</tr>
<tr>
<td>Observed Hyperactivity (age 4)</td>
<td>83</td>
<td>2.56</td>
<td>0.63</td>
<td>.66</td>
</tr>
<tr>
<td>Observed Type A Behavior (age 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global rating</td>
<td>91</td>
<td>5.47</td>
<td>2.51</td>
<td>--</td>
</tr>
<tr>
<td>Impatience</td>
<td>91</td>
<td>1.69</td>
<td>0.69</td>
<td>.77</td>
</tr>
<tr>
<td>Competitiveness/Rapidity</td>
<td>91</td>
<td>2.57</td>
<td>0.82</td>
<td>.73</td>
</tr>
<tr>
<td>Control</td>
<td>91</td>
<td>3.00</td>
<td>0.96</td>
<td>.75</td>
</tr>
<tr>
<td>MYTH Type A Behavior (age 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher ratings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>4.06</td>
<td>1.79</td>
<td>.89</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>87</td>
<td>4.62</td>
<td>2.26</td>
<td>.81</td>
</tr>
<tr>
<td>Impatience/aggression</td>
<td>87</td>
<td>3.38</td>
<td>1.96</td>
<td>.83</td>
</tr>
<tr>
<td>Voice</td>
<td>87</td>
<td>4.71</td>
<td>2.22</td>
<td>.70</td>
</tr>
<tr>
<td>Aggregated ratings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>4.45</td>
<td>1.32</td>
<td>.91</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>91</td>
<td>4.95</td>
<td>1.68</td>
<td>.89</td>
</tr>
<tr>
<td>Impatience/aggression</td>
<td>91</td>
<td>3.83</td>
<td>1.39</td>
<td>.86</td>
</tr>
<tr>
<td>Voice</td>
<td>91</td>
<td>5.02</td>
<td>1.74</td>
<td>.75</td>
</tr>
<tr>
<td>Hyperactivity Measure (age 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of Perseverance</td>
<td>91</td>
<td>2.19</td>
<td>0.79</td>
<td>.92</td>
</tr>
<tr>
<td>High Activity Level</td>
<td>91</td>
<td>3.66</td>
<td>0.80</td>
<td>.81</td>
</tr>
<tr>
<td>Externalizing Behavior</td>
<td>82</td>
<td>1.58</td>
<td>0.88</td>
<td>.85</td>
</tr>
<tr>
<td>WISC Block Design</td>
<td>91</td>
<td>6.25</td>
<td>1.90</td>
<td>--</td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>91</td>
<td>5.45</td>
<td>2.00</td>
<td>--</td>
</tr>
<tr>
<td>Arithmetic - Addition</td>
<td>91</td>
<td>7.16</td>
<td>2.20</td>
<td>--</td>
</tr>
<tr>
<td>Arithmetic - Subtraction</td>
<td>91</td>
<td>6.09</td>
<td>2.20</td>
<td>--</td>
</tr>
</tbody>
</table>
Appendix B

*Means and standard deviations for the variables included in Study III, over all groups.*

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child age (years)</td>
<td>83</td>
<td>10.12</td>
<td>1.76</td>
<td>--</td>
</tr>
<tr>
<td>Observed motivation (overall)</td>
<td>81</td>
<td>6.48</td>
<td>1.09</td>
<td>--</td>
</tr>
<tr>
<td>- initial performance</td>
<td>81</td>
<td>7.30</td>
<td>1.12</td>
<td>--</td>
</tr>
<tr>
<td>- trend</td>
<td>81</td>
<td>-23.90</td>
<td>21.48</td>
<td>--</td>
</tr>
<tr>
<td>Correct responses (overall)</td>
<td>83</td>
<td>135.66</td>
<td>8.99</td>
<td>--</td>
</tr>
<tr>
<td>- initial performance</td>
<td>83</td>
<td>12.54</td>
<td>1.59</td>
<td>--</td>
</tr>
<tr>
<td>- trend</td>
<td>83</td>
<td>13.44</td>
<td>24.25</td>
<td>--</td>
</tr>
<tr>
<td>Incorrect responses (overall)</td>
<td>83</td>
<td>7.28</td>
<td>7.74</td>
<td>--</td>
</tr>
<tr>
<td>- initial performance</td>
<td>83</td>
<td>1.26</td>
<td>1.32</td>
<td>--</td>
</tr>
<tr>
<td>- trend</td>
<td>83</td>
<td>-9.28</td>
<td>19.31</td>
<td>--</td>
</tr>
<tr>
<td>Omissions (overall)</td>
<td>83</td>
<td>2.06</td>
<td>3.06</td>
<td>--</td>
</tr>
<tr>
<td>- initial performance</td>
<td>83</td>
<td>0.19</td>
<td>0.72</td>
<td>--</td>
</tr>
<tr>
<td>- trend</td>
<td>83</td>
<td>2.83</td>
<td>12.54</td>
<td>--</td>
</tr>
<tr>
<td>Mean reaction time (overall)</td>
<td>83</td>
<td>0.78</td>
<td>0.18</td>
<td>--</td>
</tr>
<tr>
<td>- initial performance</td>
<td>83</td>
<td>0.74</td>
<td>0.15</td>
<td>--</td>
</tr>
<tr>
<td>- trend</td>
<td>83</td>
<td>1.16</td>
<td>2.09</td>
<td>--</td>
</tr>
<tr>
<td>MYTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Total</td>
<td>61</td>
<td>5.15</td>
<td>1.74</td>
<td>.91</td>
</tr>
<tr>
<td>- Competitiveness</td>
<td>61</td>
<td>5.64</td>
<td>2.16</td>
<td>.89</td>
</tr>
<tr>
<td>- Impatience</td>
<td>61</td>
<td>5.30</td>
<td>0.95</td>
<td>.86</td>
</tr>
<tr>
<td>- Voice</td>
<td>61</td>
<td>4.48</td>
<td>1.89</td>
<td>.52</td>
</tr>
<tr>
<td>Conners hyperactivity</td>
<td>82</td>
<td>2.18</td>
<td>0.86</td>
<td>.93</td>
</tr>
</tbody>
</table>
Appendix C
Means and standard deviations for the variables included in Study IV, over all groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child age (years)</td>
<td>55</td>
<td>9.85</td>
<td>1.42</td>
<td>--</td>
</tr>
<tr>
<td>Go/no-go (omission errors)</td>
<td>56</td>
<td>6.48</td>
<td>12.51</td>
<td>--</td>
</tr>
<tr>
<td>Go/no-go (commission errors)</td>
<td>56</td>
<td>11.70</td>
<td>6.32</td>
<td>--</td>
</tr>
<tr>
<td>Go/no-go (reaction time)</td>
<td>56</td>
<td>550.52</td>
<td>101.11</td>
<td>--</td>
</tr>
<tr>
<td>Tower of Hanoi (accuracy score)</td>
<td>55</td>
<td>1.49</td>
<td>0.31</td>
<td>--</td>
</tr>
<tr>
<td>Rule-breaking (TOH)</td>
<td>56</td>
<td>1.61</td>
<td>2.24</td>
<td>--</td>
</tr>
<tr>
<td>Latency of response (TOH)</td>
<td>56</td>
<td>7.16</td>
<td>7.60</td>
<td>--</td>
</tr>
<tr>
<td>Time required to solve task (TOH)</td>
<td>56</td>
<td>43.82</td>
<td>16.32</td>
<td>--</td>
</tr>
<tr>
<td>Time reproduction (accuracy score)</td>
<td>56</td>
<td>1.04</td>
<td>0.25</td>
<td>--</td>
</tr>
<tr>
<td>Story recall (total score)</td>
<td>53</td>
<td>19.21</td>
<td>8.48</td>
<td>--</td>
</tr>
<tr>
<td>Story recall (main theme)</td>
<td>53</td>
<td>7.49</td>
<td>2.51</td>
<td>--</td>
</tr>
<tr>
<td>Cheating during puzzle task</td>
<td>56</td>
<td>2.04</td>
<td>1.40</td>
<td>--</td>
</tr>
<tr>
<td>Hand movements</td>
<td>54</td>
<td>10.04</td>
<td>3.29</td>
<td>--</td>
</tr>
<tr>
<td>Conners hyperactivity</td>
<td>56</td>
<td>1.98</td>
<td>0.79</td>
<td>.89</td>
</tr>
<tr>
<td>WISC Block Design (age-adjusted score)</td>
<td>54</td>
<td>11.54</td>
<td>3.27</td>
<td>--</td>
</tr>
<tr>
<td>Observed Type A behavior</td>
<td>56</td>
<td>3.47</td>
<td>1.74</td>
<td>.95</td>
</tr>
</tbody>
</table>