Executive Functioning in Preschool Children: Utility of Two New Instruments.

Karen E.L. Parker

A research thesis presented to the School of Psychology,
Victoria University (St Albans)
as part of a
Doctor of Psychology - Clinical Neuropsychology Degree
August 2005.

DECLARATION

"I declare that this thesis does not incorporate any material previously written by another person except where due reference is made in the text."

"I further declare that the present study adheres to the ethical principles as established by the Ethics Committee of the School of Psychology - Victoria University."

Karen E.L. Parker

March, 2004.

ACKNOWLEDGEMENTS

Thankyou to all those who gave their guidance, support, and valuable time over the course of this project.

In particular to

Dr. Alan Tucker

for

his wealth of knowledge, and endless encouragement and support.

Ψ

Also to the many parents and children who gave up their valuable time to participate

Ψ

and finally to my family and friends, who can now feel free
to ask that dreaded question
"how is your research coming along?"
... without being in fear of their life!

ABSTRACT

Executive Functioning skills develop with age, emerging in infancy and becoming established in early adulthood. Despite the considerable attention given them in child, adolescent and adult research, they have received only minimal attention in research with preschool age children. Many disorders of childhood begin to present themselves as the child begins to emerge from the largely non-verbal world of the toddler. The lack of research in this age group presents a very real problem for clinicians wanting to characterize disorders in time to begin early intervention programs. This study aims to contribute to a greater understanding of executive functioning in the preschool age group, by evaluating two developmentally appropriate instruments with an Australian sample. Thirty-three normally developing preschool children between the ages of 54 and 66 months were tested using two recently developed, preschool specific neuropsychological tests of executive functioning; Espy's (1997) Shape School Task (SST) and Byrne's et al., (1998) Picture Deletion Task for Preschoolers (PDTP). Results showed consistency between US and Australian data on measures of inhibitory control using the SST, but not on measures of mental flexibility. Results from the PDTP showed high levels of variability within the US and Australian samples and quite large discrepancies between US and Australian performances, particularly with regard to omission errors. The absence of IQ data and limited methodological detail in the US studies made comparison of results difficult to interpret. Additional analysis was undertaken on the Australian sample with the division of the group into two separate cohorts of 54-59 and 60-66 months of age. As expected, there were no developmental trends evident between the younger and the older age groups, suggesting that spurts in the development of impulse control and mental flexibility are most noticeable prior to the age of four years. It was concluded that in particular the SST showed promise as a tool for assessing aspects of executive functioning in preschool age children, but that the PDTP with its greater variability requires further refinement. Both tasks would benefit from further investigations with both normally developing children over a wider age range, and with clinical samples. The application of these instruments in two clinical case studies are also presented.

CONTENTS

INTRODUCTION

1:1 Overview

This research study has emerged from concerns about the need for early intervention for the many childhood disorders that manifest in outward signs of executive dysfunction. Although the list of disorders is long, three clinically distinct groups that are characterised by executive dysfunction have received the lion's share of the focus in current literature. They are Traumatic Brain Injury (TBI), Autism Spectrum Disorders (ASD) and to a somewhat larger extent the Disruptive Behaviour Disorders (DBD).

Traumatic Brain Injury is well represented in the literature and statistics indicate that as many as 250 per 100,000 children in the United States are predicted to suffer a head injury in any one year (Kraus; cited in Anderson et al., 1997). ASDs are also well researched with EF deficits often present in many children where intellectual disability is not part of the cognitive profile. Of the three groups however, it is the DBDs and more specifically ADHD that are perhaps the most researched. DBDs are significantly well represented in mental health statistics in Australia. Their presence, which often spans a lifetime, can result in huge emotional costs to the individual and the family, as well as ever increasing financial costs to society. As a context for this study, all three of the above disorder groups will be briefly discussed, before going on to discuss ADHD in more detail, as perhaps the most researched disorder of executive dysfunction in young children.

Within this context minimal research has focussed on the study of EF in the preschool age range, where it seems early intervention strategies need to be targeted for greatest efficacy. Our ability to diagnose and treat these disorders in early childhood is not only confounded by a protracted range of developmentally appropriate executive functioning assessment instruments, but also by our limited knowledge of children's normal development in this age group. This study aims to contribute to further investigations into both these important areas of preschool research.

1:2 Executive Functioning

It is widely accepted that cognitive functioning in normal children develops with maturity. Broadly, such skills as language, visuo-spatial processing, memory, and learning skills have been shown to improve and become more efficient with age (Pennington, 1991). So too do the skills that enable a child to organise their behaviour. The skills inherent in this process, are known as executive functioning skills.

Executive functioning (EF) is an umbrella term that refers to the processes involved in the coordination of human behaviour for the purposes of attaining a certain goal. The cognitive skills that come under this umbrella are many, and are the subject of lively debate in relation to their definition, their function, their importance, and their overlap (Barkley 1997; Stuss, 1992; Dennis, 1991; Roberts & Pennington, 1996). According to Pennington (1991) skills classified as executive functions may include "organisational skills, planning, future oriented behaviour, set-maintenance, self-regulation, selective attention, maintenance of attention or vigilance, inhibition and even creativity" (p13). Denkla's (1996) conception of the executive functions includes interference control, effortful and flexible organisation, and strategic planning. Barkley (1997) identifies five component cognitive skills. The first and most essential of these being behavioural inhibition, with non-verbal working memory, affect/motivational control and reconstitution of language stemming from this (See Barkley 1997, pages 89-91 for explanation). The overlap of skills in each of these accounts highlights our lack of understanding of how these systems interact, and emphasises the complex difficulties which may arise in the accurate measurement of these skills.

The executive functions are widely believed to be mediated by the prefrontal cortex of the brain. Evidence for this has come from studies that are predominantly adult based, and have looked at the functioning of participants who have sustained significant injury to the frontal lobes (Dennis, 1991; Welsh, Pennington & Groisser, 1991; Eslinger & Grattan, 1991). Pennington (1991) notes that the majority of child studies are based on single cases (see Grattan & Eslinger, 1991, for summary description of patients JP, PL, DT, & KM), due to the rarity of purely focal frontal lesions in children. Evidence appears to be consistent with findings from adult studies, suggesting that children, like adults, are susceptible to effects of frontal lobe damage, and that the damage is not silent, temporary or radically different from that suffered by adults. Eslinger (et al., 1991) report in a summary of child frontal lobe lesion studies, that the following issues seem most salient: (1) that damage may not only be immediately apparent but may emerge later as neurobehavioural deficits, (2) that there is only minimal effect on intellectual functioning, (3) that deficits can manifest in a variety of learning impairments, (4) that the social impact of frontal lobe lesion is perhaps the most distinctive characteristic, and (5) that as in adult models, there appears to be a developmental pattern to functional subdivision of the frontal lobes in childhood.

In recent years, the use of *functional* Magnetic Resonance Imaging (*f*MRI) and Positron Emission Tomography (PET) scans have allowed studies of blood flow and metabolic changes in the frontal regions of the brain to add to our understanding of the frontal lobes and executive functioning. However, despite these advances in technology, localisation of the neural systems mediating such specific behaviours do not extend beyond a fairly basic map of the frontal lobes (i.e. orbital, dorsolateral etc.). This lends weight to the argument that executive functioning may well be an integrated system (Gioia, Isquith, Kenworthy & Barton, 2002), and although localisation of function has historically been an intuitively attractive approach, it may not be a neuropsychologically realistic one.

As a gross measure the frontal lobes are divided into three sections; the primary motor region, the premotor region and the prefrontal region. More specifically, the prefrontal region can be dissected into dorsolateral, orbital, lateral and mesial sections each with its particular range of interconnecting functions (Benson, 1994). Stuss and Benson (1984) noted that the overall "importance on the frontal lobes derives from rich connections, both afferent and efferent, with almost all other parts of the central nervous system" (p4); reinforcing the notion that executive functions are extremely difficult to isolate and therefore difficult to measure discretely. This is supported in the literature by studies that have found that instruments purported to measure EF are also affected by other "nonfrontal factors" (i.e. lower order cognitive skills; Anderson, Bigler & Blatter, 1995, p901).

Historically it was thought that until early adolescence, the executive functions were largely inactive, only beginning to operate with the full maturation of underlying structures. Recent research has found this to be untrue, with the initial onset of executive functioning evident even in very young babies (Pennington, 1991; Dennis, 1991). It is now known that the structures subserving the executive functions are actually fully formed at birth, but that the further migration of cells post birth and the continual myelination of nerve tracts into adolescence and early adulthood, give rise to the ongoing development of brain function over a period of many years (Stuss, 1992; Pennington, 1991; Dennis, 1991; Goldman-Rakic, 1987; Grattan & Eslinger, 1991). Thatcher (1991) noted that different functions develop at different stages and rates, and that in most cases development is intermittent rather than continuous. Support for this was reported by Welsh et al., (1991) who found that executive functioning in children developed on different trajectories according to task. Thatcher (1991) proposed that stages of rapid growth occur between birth and two years of age and again between 16 and 19 years, with a less significant growth spurt between the ages of seven and nine years (Thatcher, 1991).

In support of this, Anderson (2002) summarised recent findings of research in the executive functioning domain, reporting that attentional control (i.e. response inhibition and set shifting skills) emerges at about 12 months of age, is relatively well established by three years of age and at nine years a child is able to self monitor their own performance. Information processing speed and verbal fluency skills are said to increase steadily over childhood with noticeable increments in speed between nine and twelve years. Cognitive flexibility seems to emerge between three and four years for simple tasks with competence for more complex tasks arriving around seven to nine years of age. The ability to shift mental set continues to develop into adolescence. It is proposed that simple planning skills and basic conceptual reasoning skills begin to develop in the third year with a noticeable growth spurt of organisational ability and strategic planning skills between seven and ten years (Anderson, 2002).

These spurts of cognitive growth coincide with, and hence are supported by well known cognitive theories such as that of Jean Piaget. Piaget (1950: cited in Groth-Marnat, 1997) proposed that children go through identifiable stages in their cognitive development. Their steady progression of cognitive growth begins in early childhood with trial and error type thinking, then progresses through the pre-operational stage of basic problem solving to more advanced abstract, logical and hypothetical thought. Piaget termed this final stage, the formal operational stage and it coincides quite neatly with neuropsychological theories of the completion of frontal lobe maturation in early adolescence (Pennington, 1991; Case, 1992; Gormly & Brodzinsky, 1993; Anderson, 2002).

In relation to gender differences and general cognitive functioning, Gillberg (1995) and Pascualvaca, Anthony, Arnold, Rebok, Ahearn, Kellam & Mirsky (1997), cite evidence that suggests that boys often perform better visuospatially, (eg. with jigsaw puzzles) whereas girls tend to mature more quickly with language. Gillberg notes that growth spurts have been identified in language skills between 1-2 years in girls, and between 2-3 years in boys, with boys showing greater variation in their performance. More specifically, gender differences in executive functioning appear to be poorly researched, with little information available in the literature. Gillberg (1995) further notes that girls develop earlier and more rapidly than boys, with fewer differences evident in the preschool years. In support of this Espy, Kaufmann, Glisky & McDiarmid (2001) studied a group of 98 preschoolers using seven different executive functioning tasks. They found gender differences on only one of the tasks used in the study. On the "A not B" task, participants were required to use working memory skills and inhibitory control to correctly locate a sweet placed beneath one of two cups on a board. Correct identification was rewarded with the child being able to keep or eat the sweet, after which the location of the sweet in the following trial was moved to the alternate cup. Espy et al., (2001) reported that girls out-performed boys on this task, but cautioned that differences were "not large in magnitude" (p56).

Additionally, some research has taken place in relation to gender differences in attentional skills, which are proposed to be closely linked with EF and in particular with impulse control. Corkum, Byrne and Ellsworth (1995) for example, in a study of preschoolers using two newly developed tests of sustained attention, found that boys were more impulsive than girls in this particular age range. They noted that replication of their results would mean that serious consideration should be given to "gender specific norms" in the development of tests of sustained attention in the future. Corkum et al.,'s (1995) findings are supported by Pascualvaca et al., (1997) who reported that earlier maturation of girls in relation to sustained attention and impulsivity is consistent with literature that suggests that younger children are less efficient than older children (i.e. are faster and make more errors of commission) on Continuous Performance Tests (CPT).

Knowledge about frontal lobe function in normally developing children, not only provides useful data about how children learn, but it also helps us to understand more completely, the difficulties encountered by those children who purportedly suffer from disorders that effect their ability to use executive functioning skills in various forms (Eslinger, et al., 1991; Anderson, 1998). Disorders that have been reported to indicate executive functioning deficits include Epilepsy, Nonverbal Learning Disabilities, Fetal Alcohol Syndrome, the Disruptive Behaviour Disorders, Tourette's Syndrome, Autism Spectrum Disorders and Traumatic Brain Injury. The three most commonly researched of these disorders are Autism, Traumatic Brain Injury and the Disruptive Behaviour Disorders.

1:3 Autism Spectrum Disorder

Autism Spectrum Disorder (ASD) or Pervasive Developmental Disorder (PDD) as it is referred to in the DSM-IV (APA, 1994) is a group of behaviourally defined disorders characterised by qualitative impairment in social communication, social interaction, and imagination, with a restricted range of interests and often stereotyped and repetitive patterns of behaviour. Additionally, children with ASD often display hypo/hypersensitivities to the environment, and exhibit specific neuropsychological deficits, though these are not identified in the DSM-IV criteria for diagnosis. Bailey, Phillips & Rutter (1996) report that in recent years ASD has come to be recognised as a "biologically based neurodevelopmental disorder" (p89) that manifests along a continuum known as the Autism Spectrum.

1:3:1 Diagnostic Criteria

The diagnosis of ASD is based on the identification of a set of behavioural characteristics which begin to appear in the first year of life and become more observable as the child develops. The autistic child fails to develop appropriate social relationships (limited use of eye-to-eye gaze, gesture, facial expressions, social reciprocity), fails to communicate at an age appropriate level (delayed or non existent speech, use of jargon and echolalia, lack of initiation of speech, poor prosody and pragmatics) and has restricted patterns of play and behaviour (limited interactions in play, lack of imagination, repetitive behaviours such as hand flapping, head banging, rocking, spinning and toe walking, and circumscribed interests, for example in Leggo blocks or toy trains)(APA, 1994).

The manifestation of ASD is believed to be along a continuum from milder forms of the disorder often diagnosed as Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS) or Asperger's Disorder (AD), to the more severe manifestation of PDD-Autism, where intellectual disability and limited adaptive functioning are significant. The DSM-IV diagnostic criteria require onset of the disorder prior to the age of three years, and the disturbance must not be better accounted for by another disorder such as Rett's Disorder or Childhood Disintegrative Disorder. AD and PDD-NOS are represented in the DSM-IV as separate disorders on the spectrum, having their own set of criteria. AD at the higher functioning end of the spectrum requires clinically significant impairment in social interaction with restricted and repetitive patterns of behaviour, as does PDD-Autism. However in PDD-NOS, delays in language are not typically observed. PDD-NOS requires difficulties in all three areas of functioning, but not at the level that would satisfy the criteria for PDD- Autism (APA, 1994). Neither of these manifestations of ASD (i.e. PDD-NOS & AD) have significant delays in overall intellectual functioning.

1:3:2 Prevalence, Gender Differences and Developmental Course

Prevalence of ASD is reported to be 10 to 15 children per 10,000 of the population, with a male to female ratio of 3:1 to 4:1 (APA, 1994). Depending on the severity of the disorder, the child with ASD progresses slowly in all areas of functioning. Intense early intervention can lead to the relative development of speech and language skills, play skills, and decreases in repetitive patterns of behaviour. Some children gradually learn to develop affective skills more by habit than by need, but rarely to the level where normal interaction with peers is possible. Longitudinal studies have shown that it is rare for Autistic children to go on to live independently as adults. However, those with communicative skills prior to age 6, higher IQ, and fewer autistic features (i.e. typically those with AD and PDD-NOS diagnoses) tend to enjoy better outcomes (Spreen, Risser & Edgell, 1995; Bailey et al., 1996).

1:3:3 Neuropsychological Deficits

Autism Spectrum Disorder, particularly in its higher functioning forms of AD and PDD-NOS, is also characterised by degrees of executive dysfunction, with studies consistently indicating deficits in planning, organisational skills and mental flexibility (Schultz, 2002; Luna, 2002; Ozonoff, 1998; McEvoy, Rogers & Pennington, 1993; Pennington & Ozonoff, 1996). Indeed Bailey et al., (1996) in their review of clinical, genetic, neuropsychological and neurobiological perspectives on Autism have gone so far as to suggest that "executive dysfunction may be 'universal' to Autism [across the spectrum] and therefore may be the better candidate for a primary deficit" in the disorder (p102). They go on to note however that EF deficits are also present in other childhood disorders, and that further work on developing tests that specifically measure certain aspects of executive functioning is urgently required.

Ozonoff (1998) presented a general review of studies that have found both significant and non-significant differences in functioning between ASD children and controls. (See Table 1:1; See also Pennington & Ozonoff , 1996, p72-73 for more detailed compilation of findings). Ozonoff (1998) concluded from this review that "it is clear that individuals with autism spectrum disorders demonstrate evidence of executive type deficits not only in their behaviour, as richly described in clinical accounts of the syndrome, but also on empirical, research validated instruments of executive function" (p270), and that those functions implicated most often were mental flexibility, planning and organisational skills.

Table 1:1 Studies of Executive Function in Autism and Asperger's Syndrome

Study	Task(s) Used	Autism < Control Differences ?
Waterhouse & Fein (1982)	MFFT	Yes
Bryson (1983)	Stroop	No
Rumsey (1985)	WCST	Yes
Schneider & Asarnow (1987)	WCST	No
Rumsey & Hamburger (1988)	WCST, Trailmaking Test	Yes
Prior & Hoffmann (1990)	WCST, Milner Mazes	Yes
Rumsey & Hamburger (1990)	WCST	Yes
Szatmari et al.,. (1990)	WCST	Yes
Eskes et al.,. (1990)	Stroop	No
Ozonoff et al.,. (1991a)	WCST, Tower of Hanoi	Yes
Minshew et al.,. (1992)	WCST, Trailmaking Test,	No
	Object Sorting Test	Yes
Hughes & Russell (1993)	Windows	Yes
McEvoy et al.,. (1993)	Spatial Reversal	Yes
Hughes et al.,. (1994)	Tower of London	Yes
Ozonoff et al.,. (1994)	Go-No/Go	Yes
Ozonoff & McEvoy (1994)	WCST, Tower of Hanoi	Yes
Berthier (1995)	WCST, Tower of Hanoi	Yes
Bennetto et al.,. (1996)	WCST, Tower of Hanoi	Yes

From: Ozonoff (1998)

Since Ozonoff's (1998) review Gioia et al., (2002) have studied four disorder groups; ASD, Reading Disabilities, ADHD-I and ADHD-C, and TBI in relation to executive functioning deficits, using the Behaviour Rating Inventory of Executive Functioning (BRIEF). Table 1:2 shows the eight separate Scales of the BRIEF along with the specific executive functions they are purported to measure.

Table 1:2 Description of the BRIEF Scales

Scale Name	Behavioural Description
Inhibit	Impulse control
Shift	Mental Flexibility
Emotional Control	Modulation of emotion
Initiate	Initiation of activity/ideas
Working Memory	Hold information on line for task completion
Plan/Organise	Goal setting, strategy formulation
Organisation of Materials	Orderliness of workplace
Monitor	Self monitoring of performance

Adapted from Gioia et al., (2002)

Gioia et al., (2002) also found that ASD children had the most comprehensive deficits in relation to the control group, with "high elevations across all scales". The authors noted that the ASD group "exhibited a significantly higher elevation than any other group on the Shift scale" which is purported to measure the behavioural manifestations of mental flexibility (p131): a finding that supports the earlier views of Pennington & Ozonoff (1996) and Ozonoff (1998).

In the preschool domain, research into executive functioning deficits in ASD have been sparse, quite likely due to the limited array of tests available for this age group, together with what was the commonly held view that EF was largely non-operational in younger children. Another reason for limited research in this area may well be the difficulties encountered in testing ASD children who have limited language and communication skills, which is particularly true for younger children with ASD. Despite these limitations however, McEvoy, Rogers & Pennington (1993) identified difficulties with set shifting ability in a group of preschoolers, using a variation of the "A not B" type task. They reported that their sample of ASD preschoolers made significantly more perseverative errors than either mental or chronological age-matched controls.

1:4 Traumatic Brain Injury

A second commonly occurring disorder of childhood that may manifest with EF deficits is TBI. TBI results from trauma to the head, either closed or penetrating, which may in turn cause skull fracture, damage to brain tissue and damage to the cerebrovasular systems that provide oxygen to the brain. Secondary complications may then arise, such as bleeding into subdural and intracranial space, and tissue swelling. These events in turn lead to increases in brain pressure and may result in both temporary and permanent compromise to neurological (See Table 1:3) and subsequently to neuropsychological functioning (Taylor & Alden, 1997). TBI, particularly after closed head injury, is common in childhood and can result in a wide range of disruptions to cognitive functioning.

One area of functioning that is often implicated in the aftermath of TBI, particularly in adults and adolescents, is executive functioning. In children however, where executive functioning processes develop slowly and at different intervals, the extent of damage to these systems is not always fully recognised, or understood, often until a child reaches full maturity in late adolescence-early adulthood (Anderson, Morse, Klug, Catroppa, Haritou, Rosenfeld & Pentland,1997). In their review of age related differences in outcomes following childhood brain insult, Taylor & Alden (1997) cited a case of a 7year old girl who sustained a frontal lobe injury as a result of a brain aneurysm. They reported that "although her childhood years were relatively uneventful, a dramatic increase in social difficulties was noted in adolescence" (p558) when the processes that subserve these skills should have reached full potential.

Table 1:3 Acute Neurological Features of Traumatic Brain Injury

Presence of Coma
Coma Severity (Glasgow Coma Scale)
Coma Duration
Presence and location of focal lesions e.g., contusions
Presence of diffuse lesions
Secondary neurosurgical complications e.g., haematomas
When coma resolves, length of post traumatic amnesia (PTA)

From : Spreen, Risser & Edgell, (1995) p 282.

1:4:1 Diagnostic Criteria

Diagnostic criteria for TBI involves the identification of significant levels of altered consciousness in the child following trauma to the head. Trauma can take various forms. In young children however, the predominant cause is often the result of a fall, or as indicated more recently in child abuse statistics, as the result of physical child abuse (i.e. injuries sustained from severe shaking or from blows to the head). Altered consciousness or severity of injury is commonly rated using the Glasgow Coma Scale (GCS; Teasedale & Jennett, 1974) upon admission to hospital. On the GCS, a "severe" head injury is indicated by a score between 3 - 8 points, a "moderate" head injury by a score between 9-15 points, and a "mild" head injury, by a score between 13-15 points (See Table 1:4).

In addition, the length of time spent in Post Traumatic Amnesia (PTA) following an injury can indicate injury severity, and is highly predictive of poor neuropsychological outcome (Anderson et al., 1997). Table 1:5 shows severity estimates based on the length of time spent in PTA.

Table 1:4 Glasgow Coma Scale (Teasdale & Jennett, 1974).

Response	Coma Score
Eye Opening (E)	4
Spontaneous	3
To Speech (to any verbal approach)	2
To Pain	1
Nil	
Best Motor Response (M)	6
Obeys Commands	5
Localising Response	4
Withdrawal Response	3
Abnormal Flexion	2
Extensor Posturing	1
Nil	
Verbal Response (V)	5
Oriented (aware of self, environment, and some temporal awareness)	4
Confused Conversation	3
Inappropriate Speech (no sustained communication)	2
Incomprehensible Sounds, e.g. moaning, groaning	1
Nil	
GCS = E + M + V = score of 3-15 in total	

From Spreen et al., (1995) page 88

Table 1:5 Estimates of Severity of Injury Based on PTA Duration

PTA DURATION	SEVERITY
< 5 minutes	Very Mild
5-60 minutes	Mild
1-24 hours	Moderate
1-7 days	Severe
1-4 weeks	Very Severe
More than 4 weeks	Extremely Severe

From : Lezak (1995) page 173

1:4:2 Prevalence

Traumatic Brain Injury in children and adolescents is highly prevalent with mortality rates accounting for approximately half of all deaths during these periods of the lifespan. In early childhood, the development of motor skills efficiency and exploratory behaviour often leads to accidents that result in injuries to the head, often from falling. As the child matures sporting and recreational accidents are increasingly responsible for head injury. Additionally, as reports of child abuse rise in our society, it is becoming increasingly evident that head injury is a common outcome of physical abuse of the child (Spreen et al., 1995). In relation to severity, the most common head injury in children is mild, with an estimated 89% of all cases under the age of 19 years being within this range (Kraus, cited in Spreen et al., 1995). Research into brain injury in children has been limited. Until fairly recently, it was believed that what was true of adult populations was also true of child populations. As it becomes increasingly more clear that this not the case, research into TBI in younger and younger children is beginning to emerge. (Vargha-Khadem, Isaacs & Muter, 1994; Taylor & Alden, 1997; Mateer, Kerns, & Eso, 1996).

1:4:3 Neuropsychological Deficits

Neuropsychological deficits following TBI vary greatly and are predominantly dependent on the lesion site (i.e. focal or diffuse), and the severity of the injury. Immediate and long term effects can include the compromise of memory, language, visuospatial, and executive functioning skills, as well as more general and quite common disruptions to attention and speed of information processing. These deficits may in turn lead to changes in behaviour and personality, and in outcomes such as academic and vocational achievement (Spreen et al., 1995).

EF deficits specifically can result from both diffuse and focal damage and pure frontal lobe lesions are fairly rare. Ponsford, Sloan & Snow (1995) noted that "although attentional difficulties are reported anecdotally with great frequency following TBI in children, there have been relatively few attempts to study attentional deficits in brain injured children" (p300). They proposed that this is largely because attention is a difficult concept to define, is measured in many different ways, and is often closely linked to impulse control.

Mateer & Williams (cited in Ponsford et al.,1995) recorded evidence of attentional problems in the form of distractibility and disinhibition in two children who were followed for three to seven years post TBI. Similarly, Kaufmann, Fletcher, Levin, Miner & Ewing-Cobbs (1993) found deficits in attention in 36 children who had suffered TBI, at six months post injury.

Gratten & Eslinger (1991) reported on several single case studies identified to have EF deficits. For example, PL, a patient who sustained a penetrating right frontal lobe injury at age three years, eleven months, exhibited poor self-monitoring, planning and organisational skills, and poor impulse control. DT, a patient of age seven years, suffered damage to left pre-frontal regions following a subarachnoid haemorrhage, and despite average range intellectual functioning, specific neuropsychological deficits were recorded twenty six years later. Deficits were recorded in attention, concentration, mental flexibility, organisational skills, self-monitoring and planning ability.

Anderson, Damasio, Tranel & Damasio (2000) also identified EF deficits in their study of the long term sequelae of prefrontal cortex damage acquired in early childhood by two young adults who had sustained brain damage as toddlers. Results showed "remarkable histories of impaired decision making, behavioural dyscontrol, social defects and abnormal emotion" (p 281), in the context of primarily normal performances on a broad range of measures. One case demonstrated significant levels of perseveration on the WCST, whilst both cases showed severe impairment on two other tests, the Tower of Hanoi and on the Design Fluency test. The authors noted that although both cases described demonstrated EF deficits it was necessary to evaluate a wide range of abilities, with different EF tools, in order to determine that these specific problems existed. These findings add weight to the argument that individual executive functions are difficult to isolate and to measure discretely.

Gioia et al., (2002) also found EF deficits in their sample of 34 moderate and severely brain injured children, tested at an average of 5 years post injury. Their results showed that those children who suffered severe TBI had difficulties with behavioural regulation and metacognitive (EF) problem solving.

In relation to preschool children with TBI, EF deficits appear to have been poorly researched. Ewing-Cobbs, Fletcher, Levin, Francis, Davidson & Minor (1997) tested a range of cognitive skills in a group of 79 preschoolers with mild to moderate, and severe TBI. They found significant deficits, however their study did not extend to the specific measurement of EF. The authors identified and endorsed the need for follow-up in the investigation of "later maturing" executive functioning skills. Similarly, Gronwall, Wrightson & McGinn (1997), in their review of a long term (over a ten year period) Auckland, New Zealand study of children with a diagnosis of closed head injury, also acknowledged the need for later follow-up of EF skills/deficits in this age-group.

1:4:4 Treatment/Rehabilitation of TBI

Treatment and rehabilitation of TBI in children is critically dependent on the clear definition of underlying deficits as well as indications of individual recovery rates. In adult populations particularly, most recovery of function happens within the first six months, after which recovery rates decline gradually over a 3-5 year period. Theorists have speculated widely on what single factor might predict recovery, however it seems there are many variables that interact from both psychosocial and injury variables (Anderson et al., 1997). For children, recovery from head injury is less clear, with the ongoing maturation of brain processes and continued development of function complicating the picture enormously. As mentioned earlier, EF processes with their late maturation, are particularly prone to damage as a result of brain trauma; damage which is not always fully evident until the child reaches late adolescence/early adulthood (Mateer, et al., 1996).

1:5 Disruptive Behaviour Disorders

Disruptive Behaviour Disorder (DBD) is a term commonly used to describe a group of developmental disorders of childhood including Attention Deficit Hyperactivity Disorder (ADHD), Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Each manifests in a complex array of 'acting out' or 'externalising' behaviour that may be recognised as overactivity, inattention, and aggression towards family members and peers. These behaviours in turn, have a negative effect on many areas of a child's development, including their ongoing social and academic development, ongoing family and peer relationships, and ultimately on vocational outcomes and life experiences (Campbell, 1994).

ODD is characterised by a child's inappropriate and persistent reluctance (over a period of 6 months or more) to comply with an adult's requests or rules. It is seen outwardly as defiance, disobedience, disruptiveness and provocativeness and may be displayed either as externalising or 'acting out' behaviour, or less commonly as passive resistance. "No" is the favourite word of an oppositionally defiant child. ODD is more commonly seen in boys than in girls, and is usually diagnosed by the age of 8 or 9 years. These children often show low self-esteem, mood instability, low frustration tolerance and are likely to exhibit regular outbursts of temper. They are often angry, resentful and easily annoyed, and they tend to blame anyone else but themselves for their own mistakes or difficulties (American Psychiatric Association, 1994).

At the extreme end of the DBD spectrum, Conduct Disordered children are similarly disruptive and defiant, but it is their tendency to disrespect the law and the rights of others that sets them apart from ADHD and ODD youngsters. CD children often display high levels of aggression, excessive levels of fighting and bullying, can be destructive to property, cruel to animals, lie, cheat, steal and light fires. They are also prone to truancy, running away from home, are provocative towards others and tend to tantrum on a regular basis. As is the case for ODD, CD symptoms must have persisted for a period of at least 6 months (APA, 1994).

Children with ADHD, like CD and ODD, are often disruptive and defiant but the core features of their presentation are more of excessive activity levels and inattentiveness, with a distinctive lack of impulsive control. Unlike the CD and ODD child, the ADHD child is not necessarily disrespectful to adults in their interactions with them, but rather unable to attend long enough to register what is required of them. Their tendency to be impulsive often means they display risk taking behaviour, but they are not particularly given to acts of cruelty, firelighting or fighting, though these qualities may emerge later if CD becomes part of the diagnostic picture. As with CD and ODD, ADHD symptoms must have been present in excess of 6 months. However, diagnostic criteria requires that ADHD be identified by seven years of age, with a long history of overactivity, inattention and impulsivity dating from preschool years (APA, 1994; Barkley, 1997).

The impact of a disruptive behaviour disorder on the individual can be immense and there is longitudinal evidence to suggest that ADHD in particular is associated with long term disability (Scahill & Schwab-Stone, 2000; Miller, Koplewicz & Klein, 1997). For example, research has indicated that there is a high incidence of comorbidity between DBD and learning problems, particularly dyslexia (Pliszka, 2000; Burke, Loeber & Birmaher, 2002; Mannuzza & Klein, 2000). Silver (2000) suggests that the incidence of comorbidity between ADHD and learning disabilities may be as high as 50% in children and adolescents and that because learning problems are often lifelong, these figures may also hold true for adults with an ADHD diagnosis. Learning disability can have significant effects not only on the academic progress of a child, but also on the vocational opportunities open to that child as an adult, in turn affecting their accumulation of knowledge, their life achievements, their relationships with family, peers and workmates, and their sense of self worth. Other outcomes or by-products of a DBD, can include school refusal, antisocial personality disorders in adolescence and adulthood, and where the presentation is mixed and or chronic, a tendency towards criminal practices with a high cost to society as a result (Bennett & Offord, 2001; Mannuzza & Klein, 2000). In the late 1980s Peterson and Gannoni (1988) reported that the actual cost to society was somewhere in the vicinity of two million dollars per year in Australia at that time.

DBDs can be difficult to differentiate from each other in early childhood, and may in fact be diagnosed as comorbid disorders in the older child. Where ADHD is increasingly considered as having an organic basis, ODD and CD have in the past been thought of as predominantly functional or more specifically as behavioural disorders. This reflects perhaps the lack of systematic research into the brain correlates of CD and ODD, though some reference has been made in the past, that the outward behaviours are "symptomatic of an underlying dysfunction" (APA, 1994, p 88). Burke et al., (2002) report that neuroanatomical research on the associations between the DBDs and frontal lobe functioning is evolving slowly, with a focussed interest on the substrates underlying aggressive behaviour in DBD. Neurochemical research has also begun to flourish, with questions being raised about the part played by the neurotransmitter serotonin in DBD presentation (Burke et al., 2002).

There is some evidence to support the contention that ADHD and CD co-exist in 30-50% of ADHD patients and that similarly ODD co-exists in between 30-40% of ADHD patients. This is supported by literature that suggests in excess of 50% of children diagnosed with ADHD also suffer a parallel psychiatric condition (Hechtman, 2000). Of the DBDs, ADHD has received by far the most attention in the research domain. CD and ODD, despite their significant representation in mental health statistics (Hughes, White, Sharpen & Dunn, 2000; Hechtman, 2000), are less well researched and hence less well understood, particularly it seems from a neuropsychological perspective. Although this appears to be changing as noted above (Byrne, De Wolfe & Bawden, 1998). Thus, given the abundance of research on ADHD and the poverty of neuropsychological investigation into ODD and CD, the present thesis examines the literature on ADHD as the primary context for this study.

1:6 Attention Deficit/Hyperactivity Disorder

1:6:1 Diagnostic Criteria

The diagnosis of ADHD is based on the identification of a set of behavioural symptoms. The symptoms first appear in infancy with higher than normal activity levels, emotional lability, irregular sleep patterns, and what appears to be a reduced need for sleep. By the preschool years additional symptoms appear in the form of a short attention span, impulsivity, tantrums and peer group difficulties over and above that which would be considered normal behaviour for this age group (Pennington, 1991).

According to the Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition (APA, 1994) there are three separate types of Attention Deficit Disorder; ADHD - Predominantly Inattentive Type, where the child displays symptoms of inattention but not impulsivity and hyperactivity, ADHD - Predominantly Hyperactive-Impulsive Type where inattention is not part of the symptomotology, and ADHD - Combined Type, where the child displays inattentive, impulsive and hyperactive symptoms. Examples given by the manual for each of these three symptom domains are displayed in Table 1.6.

For all three sub-types, the level of disturbance must be present to a degree that social, occupational and academic functioning are significantly impaired. It must be present across more than one setting (i.e. school or work, and at home), and the symptoms must have been present before the age of seven years. Finally, the symptoms must not occur "during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic disorder, and are not better accounted for by another mental disorder" (APA, 1994 p85). Pennington (1991) notes that clinical diagnosis of ADHD can be confounded by causes which include high levels of anxiety, dyslexia, family dysfunction, conduct disorder and even intellectual giftedness where a child may seem inattentive and restless due to a lack of stimulation.

Table 1.6 Symptom Criteria for Inattention, Hyperactivity and Impulsivity for diagnosis of ADHD According to DSM-IV of Mental Disorders.

(1)	**INATTENTION - Six or more over a period of at least six months, to a degree that is maladaptive and inconsistent with developmental level.**
A	Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
B	Often has difficulty sustaining attention in tasks or play activities.
C	Often does not seem to listen when spoken to directly.
D	Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behaviour or failure to understand instructions).]
E	Often has difficulty organising tasks and activities.
F	Often avoids dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework).
G	Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools).
H	Is often easily distracted by extraneous stimuli.
I	Is often forgetful in daily activities.

(2)	**HYPERACTIVITY/IMPULSIVITY - Six or more over a period of at least six months, to a degree that is maladaptive and inconsistent with developmental level.**
	HYPERACTIVITY
A	Often fidgets with hands or feet or squirms in seat.
B	Often leaves seat in classroom or in other situations in which remaining seated is expected.
C	Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness).
D	Often has difficulty playing or engaging in leisure activities quietly.
E	Is often "on the go" or often acts as if "driven by a motor".
F	Often talks excessively.
	IMPULSIVITY
G	Often blurts out answers before questions have been completed.
H	Often has difficulty awaiting turn.
I	Often interrupts or intrudes on others (e.g., butts into conversations or games).

From DSM-IV (American Psychiatric Association, 1994, p83-84).

1:6:2 Prevalence

The disorder is mostly diagnosed in early childhood, where prevalence rates in primary school samples are conservatively estimated at between 5 and 10% of the population (Scahill & Schwab-Stone, 2000). Diagnosis regularly coincides with the child's entrance into formal education when they are suddenly required to conform to a more structured environment (Campbell, Szumowski, Ewing, Gluck & Breaux, 1982). ADHD children often become a behaviour management problem to teachers in the restricted environment of the classroom. Challenging behaviours may include incessant talking, frequently getting up from their seat, interrupting other children and difficulties with the completion of set tasks (Pennington, 1991).

Despite the emergence of problems with behaviour management at primary school, many children begin to show tell tale signs of dysfunction in the preschool years where symptoms of inattention, hyperactivity and impulsivity often show up between three and four years of age (Barkley 1990). Though many studies have looked at the prevalence of ADHD in primary school samples, studies that look specifically at the prevalence of ADHD in the preschool age group are quite rare. A longitudinal study of preschool children completed in the mid 1980s indicated a rate of 15% of 3 year old children had clinically significant behavioural problems (Campbell, 1985) and of these, half continued to have problems at age eight. A New Zealand project found a prevalence rate of 2% amongst a birth cohort tested for clinical levels of hyperactivity (McGee, Partridge, Williams and Silva, 1991), whilst there have been American studies that have reported statistics for prevalence ranging from 2% for ADHD characteristics, to up to 15 % for characteristics that would meet DSM-IV criteria for a DBD (Arons, Katz-Leavy, Wittg & Holden, 2001; Carey & Waschbusch, 2001). Lavigne, Cicchetti, Gibbons, Binns, Larsen & DeVito (2001) reported that "the symptoms of ODD are common among preschool children, and ODD is the most common diagnosis in this age group" (p2). A recent study conducted in the western suburbs of Melbourne sampled 19 of 32 preschools in the City of Brimbank region with a total of 743 preschoolers participating in the study. Using the Preschool Behaviour Questionnaire (Behar & Stringfield, 1974, cited in Prior White, Merrigan & Adler, 1998), results indicated that on average, 2-3 children in a preschool group of between 25 and 27 children (approx. 10%) exhibited externalising behaviour problems (Prior et al., 1998).

1:6:3 Gender Differences

Gender differences are widely reported in primary school age children diagnosed with ADHD, with the ratio between boys and girls ranging from 4:1 to 9:1, depending on whether the population is clinical or drawn from the general population (APA, 1994). In preschool samples the ratio has been reported to be much less at 1.6:1 (McGee et al., 1991) and 1.8:1 (Lavigne et al., 1996). Prior et al., (1998) indicated that the usual gender imbalance, with more boys than girls suffering with behaviour problems, was also evident in their Melbourne study of preschoolers. It is clear that further data on preschool populations is necessary to clarify and explain the significant discrepancies that exist in statistics between these two age groups, as well as to gather more information about the course and stability of the disorder from birth through to adulthood and even old age (Rose, Rose & Feldman, 1989: Campbell et al., 1982). One possible explanation for the differences between primary school and preschool groups in relation to gender, may be related to the fact that preschool children are commonly inattentive and impulsive as part of the normal developmental process at this age. This may well be clouding the clinical identification of more subtle differences in preschool populations between girls and boys.

1:6:4 Developmental Course

Many studies have shown that ADHD symptoms can, and often do persist into adulthood. However, reports indicate that in late adolescence and early adulthood it is common for the symptom pattern to change, with some sufferers experiencing a reduction in the overall severity of the disorder. This is more often explained as a growing ability to control inattention, hyperactivity and impulsivity in social and vocational situations than as a dissipation of the disorder (Barkley, 1997).

Additionally, children diagnosed with ADHD have an increased risk of developing learning disorders, conduct and substance abuse disorders (Hart, Lahey, Loeber, Applegate & Frick, 1995: Hughes et al., 2000: Kaufman, Solomon & Pfeffer, 1992), anxiety disorders, depression, and often display difficulties in relating to others (Kaufman et al.,1992). Evidence would suggest also that children who are diagnosed with ADHD at an early age, are those that are at an increased risk of developing more severe disability by eight or nine years. Early diagnosis (i.e. preschool) is also related to increased rates of comorbid CD (McGee et al., 1991: Hughes et al., 2000).

1:6:5 Treatment

For some time now, ADHD has been treated with a combination of behaviour therapy and stimulant medication with generally good results (Popper, 2000). Stimulants in the form of methylphenidate (Ritalin) and d-amphetamine (Dexedrine) are purported to effect changes in the levels of the neurotransmitters dopamine and norepinephrine by blocking their re-uptake into the pre-synaptic neuron and increasing their release into the extraneuronal space (Wilens & Spencer, 2000). Hence they affect the function of subcortical structures involved in the regulation of behaviour, namely prefrontal-striatal regions of the brain that are rich in dopamine and norepinephrine receptors (Wilens & Spencer, 2000; Connor, 2002; Barkley, 1997). Although there is a substantial literature on the effects of medication on behaviour in ADHD children of school age, literature is somewhat more scarce for the preschool age groups, and much of this is tempered with words of caution. Recently, Ghuman, Ginsburg, Subramaniam, Singh-Ghuman, Kau & Riddle (2001) studied 27 preschoolers who were diagnosed with ADHD and medicated with psychostimulants over 24 months. They concluded that although medication was seen to improve behavioural outcomes for a significant number of the children, there was also a high incidence of side effects in this age group. These findings have been supported in other literature (Handen, Feldman, Lurier, & Murray, 1999; Monteiro-Musten, Firestone, Pisterman, Bennett & Mercer, 1997). These findings strengthen the contention that research must continue to investigate the area of ADHD in preschoolers not only to regulate the use of medication but to provide for the best possible opportunities for quality outcomes for these children. In addition such research must firstly address the question of 'baseline levels' of various cognitive functions and behaviours in this particular age group.

1:6:6 Theoretical Perspectives

According to Stubbe (2000), the first modern day identification of an ADHD type disorder was made by George Still in the early 1900's. Still proposed both organic and environmental causes for the syndrome. Later research advanced towards a theory of organicity with the term 'minimal brain dysfunction' emerging as a general but unhelpful descriptor of the disorder. The 1970's saw a shift in the conceptualisation of the syndrome, with work completed by Douglas & Peters (1979), that focussed predominantly on inattention and dysinhibition as central deficits. It was at this point that the disorder became known in current literature as ADHD (Douglas & Peters, 1979). More recent theories of ADHD have begun to move away from attention dysfunction as the central deficit, with a greater emphasis on executive functioning deficits and more specifically on deficits in the regulatory systems of the brain (Barkly, 1994: Schachar, Tannock & Logan, 1993: Quay,1997a; Shallice, Marzocchi, Coser, Del Savio, Meuter & Rumiati, 2002).

1:6:7 Barkley's Theory of ADHD

One of the most clearly articulated and well studied theory on ADHD in recent times is that of Barkley (1994), who has conceptualised it as a disorder of executive functioning. In Barkley's (1994) theory, the core deficit in ADHD is an inability to inhibit prepotent or automatic responses. This in turn has a negative effect on the employment of that group of skills that follow on in the behavioural cascade; referred to in neuropsychology as executive functioning skills. Barkley proposes that the skills affected in ADHD include behavioural inhibition, non-verbal working memory, regulation of affect and motivation, and reconstitution of language. Disruption to these processes, he argues, has an ultimate affect on a child's ability to manipulate his own behaviour, to in turn have an impact on the environment around him (Barkley, 1994).

Barkley (1994) states that behavioural inhibition is the critical first step in the hierarchy of the executive functions (See Figure 1:1); critical because it is the initial cog in a chain of events that culminates in the attainment of a future goal. He argues that behavioural inhibition is required to halt a prepotent or automatic response. Barkley defines it as a

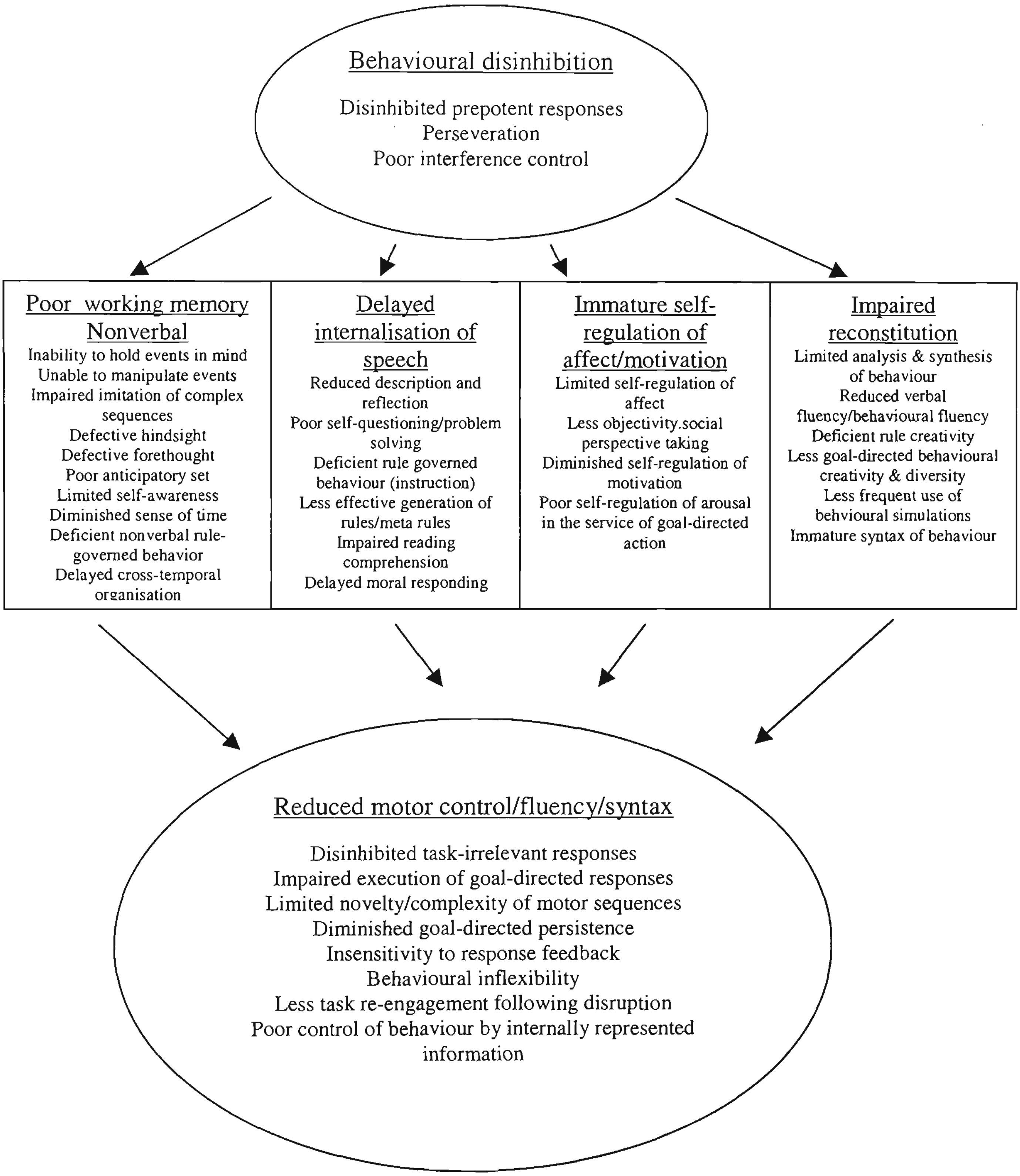


Figure 1.0 The Hybrid Model of Executive Function (Barkley 1997, p237)

combination of three interrelated processes: "(1) inhibiting the initial prepotent response to an event; (2) stopping an ongoing response or response pattern, thereby permitting a delay in the decision to respond or continue responding; and (3) protecting this period of delay and self directed responses that occur within it from disruption from competing events and responses (interference control)" (p 47-48). He has cited studies that have used the Stop Signal paradigm (Oosterlaan & Sergeant, 1995; Schachar, Tannock, Marriot and Logan, 1995), the Go/No Go task (Voeller & Heilman, 1998 cited in Barkley, 1997), the Stroop Test (Pennington, Groisser & Welsh, 1993, cited in Barkley, 1997), the Matching Familiar Figures Test (MFFT: Mariani & Barkley, 1997), and the Continuous Performance Test (CPT, Corkum & Seigal, 1993) as evidence for deficits in inhibitory control in children with ADHD. Barkley proposes that in all of these executive functioning tasks, the inability to overcome the compulsion to respond automatically, in the three ways explained above, leads to secondary deficits in non-verbal working memory, regulation of affect and motivation, and reconstitution of language.

Barkley (1997) has cited studies on the effects of stimulant medication (i.e. methylphenidate and d-amphetamine) as evidence for deficits in inhibitory control in ADHD. He has stated that vast amounts of research have indicated significant "improvements in behavioural inhibition in those with ADHD" (p299) following treatment with stimulant medication.

1:7 Measuring Inhibitory Control in ADHD

The predominance of research into children with ADHD has focused largely on the primary school age group. The reason for this appears to be that it is often once the child begins school and enters the structured environment of the classroom, that the behaviours that characterise the ADHD child become problematic. In ADHD it seems, the core deficit is specifically in faulty inhibitory control, as in Barkley's (1994) theory. Roberts and Pennington (1996) note that despite the different surface characteristics of executive functioning tasks, "they share an important underlying competitive dynamic between likely response alternatives." (p106). The competition is between the automatic response and the considered or changed response that requires the immediate employment of working memory processes. Barkley (1994) argues that this competition between responses is initially reliant on the ability to regulate ones behaviour by the inhibition of that prepotent response.

Roberts & Pennington (1996) state that "many tasks that are sensitive to prefrontal functioning pit these response alternatives against one another" (p106). Researchers have used a variety of tasks, all of which are purported to measure different aspects of executive functioning, in an attempt to characterise the nature of deficits. Some examples of tasks used to measure executive dysfunction include the Stop Signal Task (Oosterlaan et al., 1995; Schachar et al., 1995), the Go/No Go Task (Shue & Douglas, 1992), the MFFT (Mariani et al., 1997; Cornoldi et al., 1999), the Stroop Test (Pennington et al., 1993), the Winsconsin Card Sorting Test (WCST) (Shue et al., 1992), the CPT (Corkum et al., 1993; Losier, McGrath & Klein, 1996), the Tower of Hanoi/London (Cornoldi, Barbieri, Gaiani & Zocchi, 1999), and the Trailmaking Test (Shue et al., 1992). Globally, results have been supportive of deficits in EF in general and more specifically of deficits in inhibitory control. As Barkley (1997) has stated in reference to laboratory testing of primary school age children with ADHD, "evidence for impulsive responding has been repeatedly observed" (p 68).

1:8 Testing the Theory with a Preschool Population

As noted earlier, ADHD is often formally diagnosed as the child enters primary school. DSM-IV diagnostic criteria require that a history of inattention, impulsivity and hyperactivity date back to the preschool years and the usual method of eliciting this information has traditionally been via a careful retrospective history. For this reason, it has become important that research be extended to cover the preschool years, in an attempt to prospectively characterise the disorder earlier, and begin early intervention treatment before the child commences formal schooling (Campbell et al., 1982). Although the preschool age group has not been as extensively studied as the primary school age-group, the acknowledgement of the importance of research across the lifespan has meant that a growing body of information is now beginning to accumulate. Whilst it is still not clear whether a preschool child presents with ADHD in exactly the same manner as the primary school child, evidence is growing that indicates similar deficits in the regulation of behaviour.

One of the most challenging dilemmas in transposing the theory of ADHD from primary school age children to preschoolers is that children between the ages of three and five years are still developing their ability to inhibit responses and often display impulsivity in their normal range of development. Differentiating ADHD children from normal preschool children can often prove difficult particularly where diagnosis is based on observation alone, as has been the usual case. The Child Behaviour Checklist (Achenbach, 1991) is a parent report measure based on the parents' experience of the child, that has been used extensively in the past to detect behaviour problems in children. However, as Wachschlag & Keenan (1991) report the measure is not specific enough when used alone to determine "whether behaviour problems are clinically significant or impairing, and whether behaviour problems in early childhood are an early manifestation of a specific disorder" (p263). Behaviour checklists and controlled observations have produced a wealth of information on this age group in the past and will continue to contribute substantially to diagnosis and treatment planning in the future. However, there is a real need for additional objective and standardised assessment tools to complement the subjective measures that have long been used to characterise the behavioural markers of the disorder (Campbell, 1985; Wachschlag & Keenan, 2001).

A key limiting factor for the progression of research in this domain has not only been the shortage of standardised cognitive tests for the preschool age group in general, but more crucial to the understanding of ADHD, a distinctive shortage of tasks designed specifically to measure executive functioning in this age group (Anderson, 1998; Welsh et al., 1991; Gioia et al., 2002). Of those that have been produced to date, most have been adapted from primary school age or adult tests, and have not been specifically developed with the emerging skills of the preschooler in mind (Anderson, 2002). Tasks that have been subject to modifications for use with preschoolers include the MFFT (Kagan, 1966 as cited in Campbell et al., 1982; and in Mariani et al., 1997), the Tower of London (Shallice, 1982 as cited in Hughes, Dunn & White, 1998), and various versions of the CPT (Gordon, 1983 as cited in Shelton, Barkley, Crosswait, Moorehouse, Fletcher, Barrett, Jenkins & Metevia, 1998; and in Mariani et al., 1997; Connors, 1985 cited in Kerns & Rondeau, 1998).

Perhaps due to the inherent difficulties of restructuring tasks to suit different developmental stages, researchers have reported mixed results from the use of these modified tests in the preschool population. Hughes et al., (1998) found a significant difference between normal and problem children on the Tower of London task, however after controlling for verbal ability and father's occupation, the differences were not significant. Shelton et al., (1998) reported no significant differences after testing two groups of ADHD preschoolers and a control group on a preschool version of the CPT. They showed no differences on either the number of commission errors or on the number of correct responses. In contrast to Shelton's et al., (1998) report, Kerns & Rondeau (1998) found a significant difference between their clinical and control groups, with "the nature of errors for the clinically referred children clearly in the direction of impulsive and excessive responding" (p236). Campbell (1982) reported no group differences between clinical and control group performance on the MFFT as did Mariani et al., (1997) who were also unable to differentiate between ADHD and normally developing preschoolers on their adaptation of the CPT.

It is possible that sampling techniques and other procedural problems may have been partly to blame for a lack of consistently significant findings in these studies. However, it should also be considered that in modifying tasks primarily developed for older age groups, there may be a danger of overlooking the importance of developing tasks that take into consideration the unique characteristics of the preschool age group (i.e. age limited attention span, susceptibility to distraction, and age specific cognitive abilities; Welsh et al., 1991; Anderson, 1998). In order to develop a task that will engage all preschool age children for the purposes of differentiating between those with and those without ADHD, the above issues must be thoughtfully considered.

1:9 Pre-School Specific Tasks

In 1997, Espy developed an executive functioning task for preschoolers in response to the need for appropriate tests in this age group (3-5 years). The task involved four separate trials. Each trial used a variety of circles and squares of different colours and presentations. For instance in the initial trial, the child was asked to name the shapes according to their colour, the second trial according to their facial expression (happy or sad) instead of their colour, the third trial either by colour or shape according to whether or not they were wearing a hat, and the last trial with an added dimension of colour or shape dependent on whether they had a smile/frown or hat on. The task was purported to measure cognitive flexibility, and as part of this required the preschooler to use inhibitory control and set shifting skills.

Seventy children aged between 32 and 68 months participated in the study. Three different age groups of 32-41 months (3 years), 42-53 months (4 years) & 54-68 months (5 years) were formed with 13, 37 and 20 children in each respectively The control and inhibit conditions of the SST were administered to all three groups. However, the youngest of the groups, the 3 year olds, did not complete the switch or both conditions due to the inclusion of shapes as well as colours to the task. The researchers proposed that children of this age group may not yet be able to process shape names automatically, thereby increasing the possibility of greater variability in performance.

Results of the analysis indicated that the task was indeed suitable for use with children as young as 32 months (the control and inhibit conditions). It was also found to be developmentally appropriate, with all children being able to complete the task and the task itself demonstrating sensitivity "to age related differences in executive skill" (p498). The study proposed that the processes of inhibiting a response and switching mental set develop at different rates. Three year olds were less able to inhibit automatic responses than four and five year olds, and switching efficiency improved between four and five years of age. Espy (1997) also found that processing speed improved with age. She concluded that the Shape School task was a developmentally appropriate executive functioning tool to use with preschoolers.

In a later study using a larger test battery of executive functioning tasks that included the Shape School, Espy, Kaufmann, Glisky & McDiarmid (2001) sampled a group of 98 normal preschoolers. The sample was divided into 5 subgroups of 2.5, 3, 3.5, 4, and 4.5 years of age. The researchers found age-group related differences on the Shape School task that clearly reinforced the earlier findings. There were significant differences between the 3 year old and all older groups (3.5, 4.0 & 4.5 years) on both the efficiency and the time taken scores of the control and the inhibit conditions. A significant difference was also noted between the 3.5 year old group and the older groups (4.0 & 4.5 years) on both of the conditions for time and efficiency scores. The number correct score was only significantly different between the 3 year old and 4.5 year old group.

Of considerable interest, the later study utilised age increments of 6 months "allowing for a more detailed analysis" of performance in a period of growth described by Espy et al., (2001) as one of rapid cognitive development. Results supported the literature that has suggested a growth spurt early in life, and slower maturation in the middle years of childhood. In the case of the SST, improvements in mental flexibility in particular begin to slow down from around 3.5 years of age. Espy's et al., (2001) study also compared the performances of boys to girls on the SST, reporting no significant sex-related differences in EF task performance for the preschool age group. It is worth noting that a search of the literature indicates that no further documentation of studies using the SST appear to have been published at this time, either by this group or by other groups, and Espy et al., (2001) highlighted the need for continuing research into executive functioning in preschool populations.

Byrne, Bawden, De Wolfe & Beattie (1998a) also developed an executive functioning task specifically for use with preschoolers. The Picture Deletion Task for Preschoolers (PDTP) is a cancellation type task designed to assess the EF skills of sustained attention and impulse control. Initially the researchers studied a group of eight preschoolers diagnosed with ADHD and eight matched controls (between 3-5 years, mean age of participants not reported), using the PDTP amongst a larger battery of tests. As was expected, they found that the ADHD group exhibited more errors of commission than the controls, indicating higher levels of impulsivity in their performance.

A study published that same year by Byrne et al., (1998b) sampled 26 preschoolers, 13 of whom had a diagnosis of ADHD (mean age = 55.38 (SD 7.62) months), and compared them with 13 normally developing controls (mean age = 56.05 (SD 4.98) months). They used an updated version of the PDTP that utilised a more "preschooler friendly" format. The test was in booklet form with eight pages on which were printed pictures of cats, dogs, fish and roosters. At the top of each page was a target animal which the child was required to identify amongst the distracter stimuli below. Each page had 35 distracters and the target stimuli changed every second page. The child was required to spot all of the targets on each page with a bingo marker before moving on to the subsequent page. Errors of commission and omission were recorded as well as the time taken to complete the task. The task also included a motor speed trial to determine any difference in processing speed between the ADHD and control groups. Results of the study indicated significantly more errors of commission, but not omission for the ADHD children. The researchers concluded that "the use of developmentally appropriate measures holds promise in the early detection of preschoolers who present with the symptoms of ADHD" (p64). They also noted the need for larger samples and underlined the importance of undertaking longitudinal rather than cross-sectional studies of preschoolers with ADHD.

In a later study, De Wolfe, Byrne & Bawden (1999) again used their cancellation task this time with a group of 25 preschoolers with a diagnosis of ADHD and 25 normally developing matched controls (mean age = 4.82 years). The task was again modified to what is its current format, with learning, practice, test and motor speed trials. Changes to the test trial saw only one animal in different postures (cat) rather than four different animals as was previously the case. The target cat was in a standing posture and was unchanged as target over the eight pages of the test trial. Results showed significant differences between the groups on the number of errors of commission as well as on measures of latency. The authors concluded that this task in its modified form, may be useful "to facilitate longitudinal studies of the ontogeny of impaired attention and/or assist in the early assessment of treatment efficacy in young preschoolers (p467). As was the case with the SST studies, no additional published studies and no studies with normally developing youngsters either in the US or elsewhere are known to this author to date. This reinforces the need to continue work in this under researched area of child development.

1:10 Rationale for the Present Study

The diagnosis of ADHD, and indeed other disorders displaying executive dysfunction in the preschool years, is often based solely on retrospective reports by parents, teachers, carers and clinicians, with very minimal support from formal measures such as standardised cognitive tests. Research on children in the primary school age-group has determined that executive functioning deficits do exist in a variety of forms across different disorders. However these findings have yet to be substantially replicated with preschool samples. Clear and confident diagnosis of children at an early age enables the timely and accurate implementation of early intervention programs, which have proved to be so important in managing outcomes for children within these groups of disorders.

1:11 Aim of this Study

The present study will investigate the performance of normally developing preschool children on two tests of executive functioning, in order to test the utility of these instruments and to establish a baseline for future research on executive functioning deficits in preschool children in Australia. The aim is to document an objective, developmentally appropriate assessment instrument that is complementary to the subjective observational measures that are presently used by clinicians, in the early diagnosis of disorders displaying executive functioning deficits in preschool children. Although data from both the PDTP and the Shape School task have been reported on in the United States, there are no reports of performance by Australian preschoolers, or in fact by any sample of preschool children outside the United States, on these tasks at this point in time.

1:12 Hypotheses

1. It is expected that consistent with findings of studies reported by Espy (1997), Espy et al., (2001), Byrne et al., (1998) and DeWolfe et al., (1999) from the United States, the PDTP and the SST will prove to be developmentally appropriate to use with children aged between 54 and 66 months.

2. It is expected that there will be no difference between the performance of normally developing girls and boys on either task.

3. In relation to the age increments used in the Espy et al., (2001) study and in the present study, it is expected that there will be no significant differences between the younger group aged 54-59 months and the older group aged 60-66 months on all three conditions of the SST for efficiency, time, or number correct.

4. In relation to the age increments used in the Espy et al., (2001) study and in the present study, it is expected that there will be no significant differences between the younger group aged 54-59 months and the older group aged 60-66 months on errors of commission, or on measures of processing speed.

METHOD

2:1 Participants

The original sample consisted of 35 normally developing children aged between four years six months and five years eleven months of age. The group was recruited from various preschools in north central rural Victoria. An Invitation to participate was offered to all children attending each of the preschools that were approached. Participants were required to satisfy the following criteria:

(a) No history of major insult, injury or disease of the central nervous system.

(b) No uncorrected visual or auditory problems.

(c) No prior or present history of inpatient treatment for a psychological disturbance.

(d) Not presently taking psychoactive medication.

(e) No identification of intellectual disability (including borderline)
- operationalised by a prorated full scale score of > or = 80 on WPPSI-R.

(f) Each participant to be between the ages of four years six months and 5 years eleven months at date of testing and not to have begun formal schooling.

(g) Receive sub-clinical scores on the Attention Problems, Delinquent Behaviour and Aggressive Behaviour subscales of the CBCL, which are indicated to be related to a diagnosis of DBD.

Two clinical case studies were extracted from the original sample and included as clinical comparisons with the normal group. Case study # 1 did not meet the criterion (g) for inclusion, with clinically significant scores on the Attention Problems and Aggressive Behaviour subscales of the Child Behaviour Checklist. Case study # 2 was removed from the original sample for failing to complete the EF component of the test battery. Although his parent completed CBCL showed no clinically significant scores on any of the three scales used in the criteria, Case Study #2 became increasingly more distracted during the second half of the session. He was unable to concentrate on the PDTP past the practice trial and only completed the initial Control trial of the SST. Later discussion with his mother revealed that he was experiencing difficulty at preschool with sustained attention and distractibility, as he was similarly at home, though this information was somewhat difficult to extract and required careful questioning and clinical judgement.

2:2 Materials

The study used Daniel's (1983) Occupational Prestige Scale to determine socio-economic status for each child. The instrument, developed in Australia and normed on an Australian population, employs a scale from 1-7 to rank the combined occupations of each child's parents. A score nearer to 1 indicates a higher socio-economic status and nearer to 7 indicates a lower socio-economic status.

The Child Behaviour Checklist (Achenbach,1991) was used as a measure of the child's observable behaviour as perceived by the parent/s and was completed by the attending parent whilst the child participated in the testing session. This particular checklist is internationally recognised and has been used repeatedly in published studies with this particular age group across the world, and is often used as a broad indication of possible Disruptive Behaviour Disorder in children. Three separate subscales of the checklist were used as part of the selection criteria for the sample. These were Attention Problems, Delinquent Behaviour & Aggressive Behaviour.

Two subtests of the WPPSI-R (Wechsler, 1987) were used to determine a pro-rated full-scale IQ score. The Information subtest is believed to be an indication of the child's general knowledge and was used as a measure of verbal ability. The Picture Completion subtest, which is believed to indicate a child's ability to attend to visual detail was used as a measure of nonverbal ability. Both subtests have been shown to have moderate and high correlations with the full scale IQ (Picture Completion r = .60, Information r = .70; Sattler, 1992).

The test battery included the Picture Deletion Task for Preschoolers - Revised (Byrne et al.,1998b), a booklet style cancellation test specifically developed for measurement of sustained attention and impulse control in the preschool age group, and the Shape School Task (Espy, 1997), a preschool measure of impulse control and mental flexibility presented in a storybook format.

The PDTP (Byrne et al., 1998b) used in the present study was a modified version of an earlier pen and paper cancellation task developed by Corkum et al., (1995) for use with a preschool population. Byrne's modified task employed an A4 size booklet containing training, practice, test and motor speed sections, and was used in conjunction with a 'preschooler-friendly' self-inking bingo marker instead of the traditionally used pencil to mark target stimuli. The training phase presented a page of blank circles which the child was required to stamp with the bingo marker to gauge the child's dexterity with the marker for the following sections. Once competency with the bingo marker was established, the child moved on to the practice stage. This second stage required the child to detect and stamp a target stimulus (triangle) from amongst four distracter shapes (circle, square, diamond, and octagon) which were arranged over two consecutive pages in a 10 row by 6 column array. This section was used as practice for the child at detecting targets amongst distracters to ensure that the child understood the instructions for the test section that followed. The test phase consisted of 8 pages of stimuli in the form of 5 different line drawings of cats in various postures. At the top of each page was the target stimulus, followed by a 10 x 6 array of 15 randomly placed targets amongst 45 distracters. The child was required to seek and stamp all of the targets on each page as quickly as possible before moving on to complete the consecutive page. The final section of the task consisted of a 10 x 6 array of line drawn circles. The task here was to stamp each of the circles as quickly as possible to gain a measure of each child's motor speed. Errors of commission in the form of the number of distracter targets stamped are recorded and indicate a measure of impulsivity. Errors of omission in the form of the number of targets correctly stamped are also recorded and indicate inattention to task. A measure of time to completion will also be recorded to determine any differences in processing speed between the two groups. The full instructions and a sample test form are presented in Appendix A.

The Shape School task (Epsy, 1997) was developed specifically for the preschool population as a measure of a child's ability to switch set and inhibit a learned or automatic response. Presented in storybook format, the task requires the child to name a series of different colored shapes according to predetermined rules. There are four separate conditions in the task: Control, Inhibit, Switch and Both. For the purposes of this study only the Control, Inhibit and Switch conditions were administered. The "Both" condition was trialed in an earlier pilot study where it was found that the instructions were not clearly and consistently understood by the children.

At the beginning of the storybook the child was introduced to the Shape School, its teachers and the children who attend the two separate classes. In the Control condition the child was required to identify each of the class members by color as quickly as possible without making any errors. In the Inhibit condition the class members wore either a sad facial expression or a happy facial expression according to whether or not they were ready to go to lunch. The child was asked to identify those class members who were ready for lunch by calling out the color of those with happy faces and ignore those who wore sad facial expressions (those not ready to go for lunch). In the third condition, the Switch condition, the child was instructed that a new class had joined the others. This class wore hats, and were identified not by color, but by their shape. The child was then required to name those class members without hats by color, and those with hats by shape, as quickly as possible without making any errors. In all conditions the task was timed and errors of commission and omission recorded to be used later to calculate an efficiency score for each performance (Efficiency = # Correct - # Errors / Total Time). The full test instructions used and sample test forms are presented in Appendix B.

2:3 Procedure

In the first instance, permission was granted by the preschool manager, after discussions with the committee of management, for the distribution of information packages. The packages outlined the aims of the study, the requirements of participation, administration of the test battery, and details of proposed feedback. Parents and their preschoolers were invited to participate following which interested parties completed a parent consent form and a brief developmental/medical history (see Appendix C). Forms were returned via the preschool teacher. Contact was then made by phone to the parents in order to answer any further questions about the project and to arrange an appropriate appointment time for testing. Parents were informed that they were free to withdraw from the study at any time and there was no monetary gain offered for participation.

All participants were tested in quiet rooms free from distraction, at various locations across the region. This was necessary due to the diversity of residential locations of the participants and the issue of potential costs for the parents in transporting their children to a central location. All sessions were conducted before 2pm to minimise the effects of fatigue that are common in children of this age-group. Each child was given a participant number upon registration and this was used as the only form of identification for that particular child from that point onwards. A summary sheet with the child's identification number on it was used to record scores from all tests (See Appendix D). Registration forms (Consent Form, Background History Form, and CBCL) were stored separately from performance data for confidentiality reasons.

The use of a strictly counterbalanced order of testing proved to be a very difficult issue, following a pilot study prior to commencement of the main study. Indications were that to counterbalance tasks may unduly affect performance outcomes given the nature of the tasks being used. The PDTP is a long and arduous task for the preschooler and it was considered best presented earlier in the battery to ensure a higher probability that each child would complete the whole test battery, including the PDTP. Hence, the order of testing was fixed for each child as follows: WPPSI – Information & Picture Completion, Cancellation Task, Shape School Task. The examiner sat beside the participant at a desk to enable a similar view as the child of the task being completed at the time. The entire battery of tests took approximately 40 minutes to administer to each child with the younger participants generally taking a few minutes longer and the older participants taking a few minutes less overall. Engaging children of this age group is inherently difficult given their natural tendency to become distracted and their limited attention spans. Short breaks were factored into the test session where necessary to keep the children motivated to proceed. A container of sweets and novelty items was used as encouragement for the children to complete the tasks. Each child chose one item following the completion of part 1 (WPPSI) and again on completion of part 2 (PDTP & Shape School) of the session.

2:3:1 Administration of WPPSI-R Subtests

The Information and Picture Completion subtests were administered according to instructions in the manual of the WPPSI-R (Wechsler, 1987). A five minute break was taken following the completion of both tests and the child was given the opportunity to chose a sweet or novelty item as encouragement at this point.

2:3:2 Administration of PDTP

The WPPSI subtests were followed by administration of the PDTP (Byrne et al., 1998b). The child was presented with a booklet which contained four separate sections. Section I, the 'Training Phase' of the booklet consisted of one A4 size sheet printed with nine circles in a 3 x 3 format. The child was asked to use the bingo marker to put a spot in each of the nine circles. The examiner demonstrated the technique on the first two circles to enable the child to witness how the task should be undertaken. When the child demonstrated proficiency with the marker, he/she was guided to the next section.

Section II, the 'Practice Phase' of the task was in two parts and required the child to detect a target stimulus (triangle) amongst a group of three different distracters on an A4 page positioned randomly in a 6 x 3 array of shapes (circle, square & octagon). The child was instructed to stamp all of the triangles as quickly as possible without making any mistakes. When it was demonstrated that the child had a clear understanding of the task requirements, they were moved on to complete part two of the section. They were then instructed to complete the following two pages (a 6 x 10 array of randomly placed shapes printed on A4 sheets) in the same manner, alerting the examiner when they had completed a page before turning to complete the next.

Section III, the 'Test Phase' also consisted of two parts. The first required the child to identify a line drawing of a cat standing amongst four distracter stimuli of cats in various other postures (i.e. sitting down and facing straight ahead, sitting down and facing to one side, lying down, and pouncing). Again the child's ability to understand the instructions determined progression to the second part. Part two of Section III, required the child to detect the same cat posture (standing) amongst the four distracters on eight A4 pages printed in randomly placed 6 x 10 arrays. As an addition to the original instructions (See Appendix A) a short introduction story asking the child if they owned a cat as a pet, or alternatively if they knew someone who owned a cat as a pet, was used to engage the child in the task. The cat's name was then utilised as a familiar name with which the child could identify as they moved through the eight pages of the test trial, spotting the 15 target cats on each page. For those children who could not identify a cat's name, the name "Sylvester" was used instead. The child was asked to stamp all the target cats as quickly as possible without making any mistakes, and to inform the examiner when they were satisfied that they had completed each page. The task was timed, and later scored for the total number of omission and commission errors respectively. These scores were then entered on to the summary sheet of scores for each participant.

Section IV, the 'Motor Speed Phase' required the participant to stamp each one of a 6 x 10 array of circles as quickly as possible without mistakes. The trial was timed to give a measure of the child's motor speed. Scores from the 'Test Phase' and the 'Motor Speed Phase' were then entered onto a summary sheet of scores for each participant.

2:3:3 Administration of the Shape School Task

This test was administered in three parts; (1) the Control Condition, (2) the Inhibit Condition and (3) the Switch Condition. To begin with the child was introduced to the Shape School and its pupils.

The Control Condition began with the introduction of Mr. Circle's class whose names were their colors. The child was then asked to name each of three circles according to its color before moving on to the following test page where an array of 15 circles of random colors was displayed. The child was directed to name all of the children (circles) according to their color as quickly as they could without missing any or making any mistakes. Children were stopped if they made a mistake and directed back to their error until the correct answer was provided. The trial was timed and the number of errors and correct namings recorded on the test form.

The Inhibit Condition explained to the children that the shape school students who were ready for lunch were happy (smiling faces) and those who were not (sad faces). The child was instructed then to name the students (by color) that were ready to go out for lunch beginning at the top of the 3 x 5 array and working as quickly and accurately as possible to the end of the page. This trial was also timed and the number of errors and correct namings recorded.

In the Switch Condition a new group of students wearing hats were introduced to the story. This group was known as Mr. Hat's Class. These student's names were not their colors, but their shapes. After a practice trial where the child was instructed to name the students in the combined classes, the child moved on to the test trial. The child was again instructed to name each of the students according to the rules, as quickly as they could without making any mistakes. The trial was timed and the number of errors and correct namings recorded on a score sheet.

The formula (Efficiency Score), number of correct minus number of errors/time to completion, was used for recording scores. The Efficiency Scores were then recorded on a summary sheet for each child.

2:4 *Ethics Approval*

Research ethics approval was granted by the Ethics Committee of the Psychology Department, Victoria University on 22nd December 1998 (See Appendix E). Additional approval was sought from each of the Preschool Managers prior to distributing information and contacting parents. This usually involved the Manager consulting with the Preschool Parent's Group prior to consenting for the information to be distributed to parents (See Appendix E).

RESULTS

3:1 Group Results

An alpha level of .05 was set for all data analysis unless otherwise specified. Sample characteristics showing means and standard deviations for the overall sample and for the two age groups are presented in Table 3.1. Thirty-three of the thirty-five children tested were able to satisfactorily complete the full battery of tests. The two children unable to complete the full battery will be discussed later as single case studies.

Table 3.1 ***Sample Characteristics.***

VARIABLE	OVERALL SAMPLE (N = 33)	GROUP 1 54 - 59 MTHS (N = 17)	GROUP 2 60 - 66 MTHS (N = 16)
GENDER	Males = 15 Females = 17	Males = 7 Females = 10	Males = 8 Females = 8
SES	4.86 (0.78)	5.07 (0.73)	4.63 (0.79)
IQ	112.45 (11.47)	116.70 (11.48)	107.93 (9.8)
AGE	58.85 (3.77)	-	-

- Mean Scores with Standard Deviations noted in parenthesis

Figures 3.1, 3.2, and 3.3 are visual representations of the distribution of scores for the full sample on each of the variables, SES, IQ and AGE.

Figure 3.1

Socio Economic Status - SES

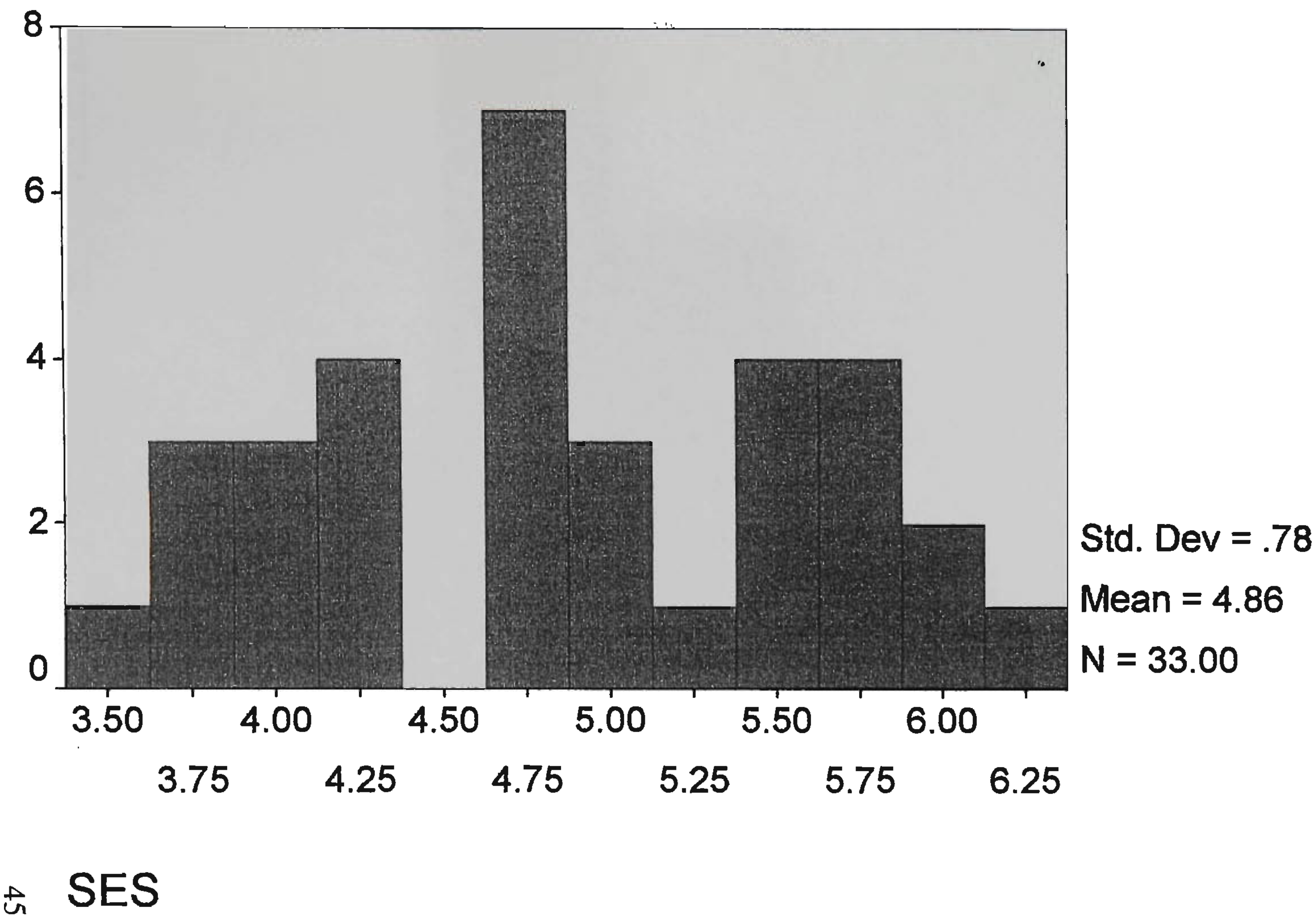


Figure 3.2

Intellectual Functioning - IQ

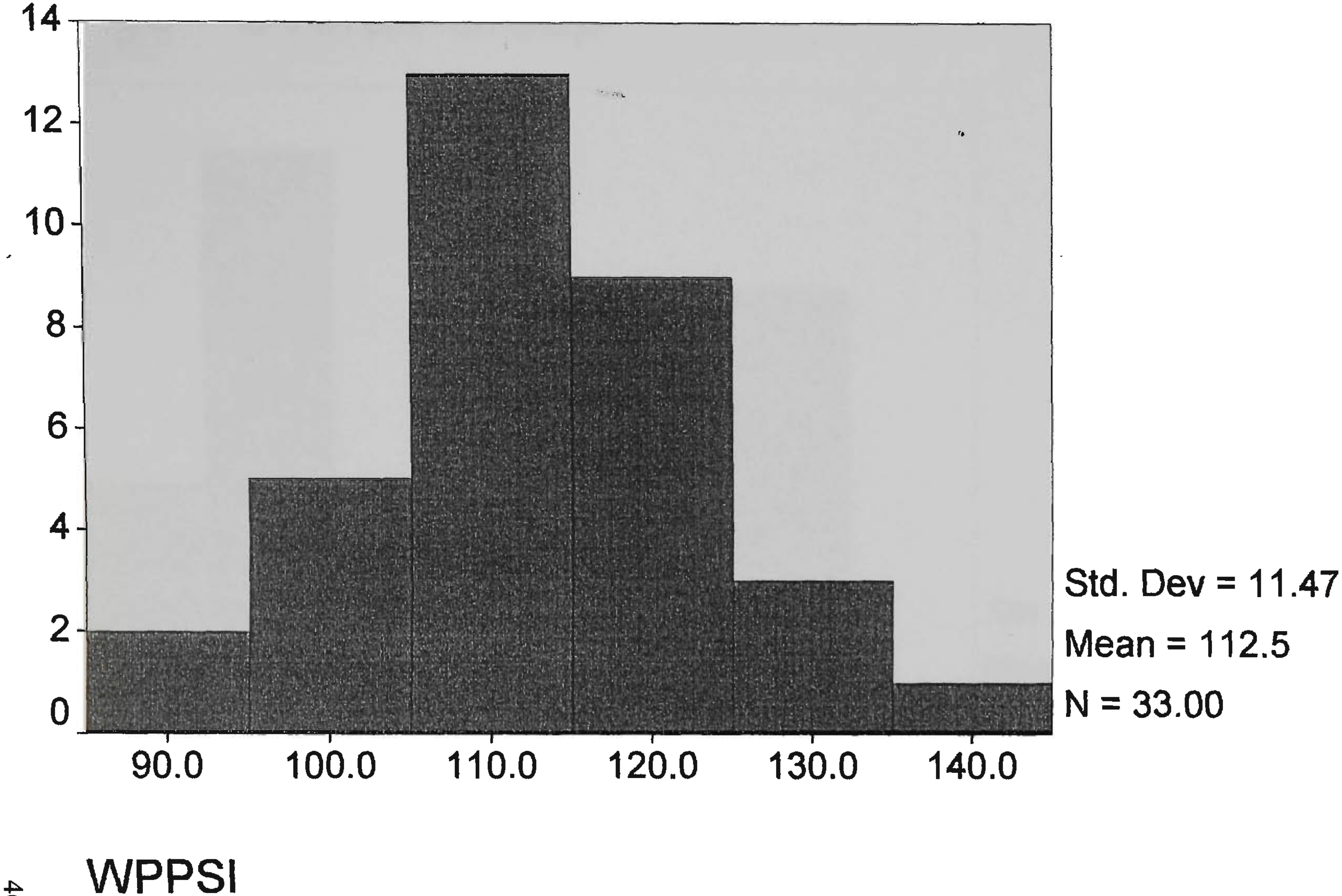
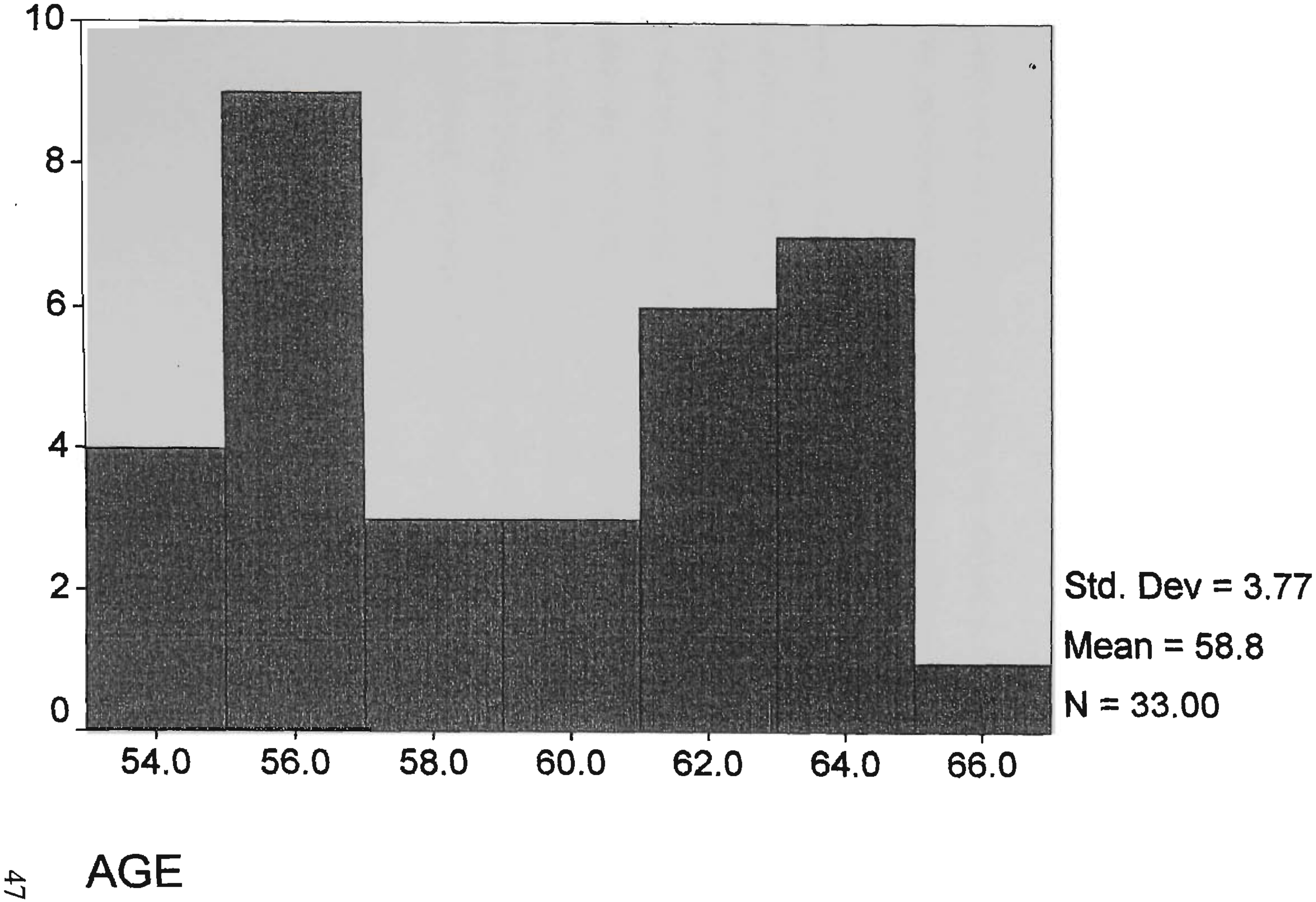


Figure 3.3

Age - Overall Group



Independent t-tests were conducted on data for SES, Gender and IQ to determine if there were any differences between the two age groups. Results of these analyses showed that there were no significant differences between groups on measures of SES ($t(31)=1.63, p=.114$) or Gender ($t(31)=.495, p=.624$). However, there was a significant difference between the younger and older groups on measures of IQ ($t(31)=2.34, p=.026$). IQ was therefore entered as covariate in later multivariate analysis of variance.

Data for the PDTP was scored as errors of commission, and errors of omission, an overall time taken to task completion score, and a motor speed score. This created a total of 4 dependent variables for the PDTP. Raw data for the Shape School Task was entered for time taken to task completion, number of correct responses, and an overall efficiency score, for each of the three trials (Control, Inhibit & Switch); a total of 9 dependent variables for the Shape School Task. An overall total of 13 dependent variables were generated. These are listed in Table 3.2.

Table 3.3 shows means and standard deviations for the overall group, and additionally for both groups of the independent variable 'AGE' across all thirteen dependent variables.

Comparisons between US and Australian data on all variables generated from the SST and the PDTP are shown in Tables 3.4, & 3.5. Comparison between the present study and that of Espy (1997) indicate similar results on all measures, with the exception of time on task on the Switch trial where the Australian sample was more than two standard deviations slower than the US mean for time. Comparison of results from the present study and Espy et al., (2001) show similar trends with Australian mean scores within one standard deviation of US scores on both the Control and Inhibit conditions across time, number correct and efficiency variables. The Switch condition was not reported on in the 2001 study.

3.2 List of Dependent Variables

TASK	VARIABLE NAME	DESCRIPTION
PDTP	PDTPCOM	Commission Errors
	PDTPOMM	Omission Errors
	PDTPTIME	Time to Task Completion
	PDTPMOTR	Motor Speed
SST	SSTCONTR	Efficiency Control trial
	SSTINHIB	Efficiency Inhibit Trial
	SSTSWITC	Efficiency Switch Trial
	TIMECONT	Time Taken Control Trial
	TIMEINHIB	Time Taken Inhibit Trial
	TIMESWITC	Time Taken Switch Trial
	CORRCONT	Number Correct Control Trial
	CORRINHIB	Number Correct Control Trial
	CORRSWITC	Number Correct Control Trial

3.3 Means & Standard Deviations for Dependent Variables Overall & by Age Group

DEPENDENT VARIABLES	OVERALL SAMPLE		GROUP 1 54 - 59 MTHS		GROUP 2 60 - 66 MTHS	
PDTPCOM (Frequency)	2.48	(2.09)	3.12	(2.15)	1.81	(1.87)
PDTPOMM (Frequency)	4.00	(3.61)	4.18	(3.97)	3.81	(3.31)
PDTPTIME (Seconds)	626.75	(169.17)	628.17	(174.44)	625.25	(169.09)
PDTPMOTR (Seconds)	55.33	(12.47)	54.41	(12.86)	56.31	(12.37)
SSTCONTR (Efficiency)	0.73	(0.21)	0.70	(0.16)	0.76	(0.26)
SSTINHIB (Efficiency)	0.75	(0.22)	0.72	(0.15)	0.77	(0.28)
SSTSWITC (Efficiency)	0.24	(0.14)	0.21	(0.14)	0.28	(0.13)
TIMECONT (Seconds)	21.67	(5.54)	22.35	(4.84)	20.94	(6.28)
TIMEINHIB (Seconds)	21.55	(6.37)	21.65	(5.10)	21.44	(7.68)
TIMESWIT (Seconds)	79.33	(4.99)	94.00	(5.48)	63.75	(39.88)
CORRCONT (Frequency)	14.72	(0.62)	15.00	(0.00)	14.44	(0.81)
CORRINHIB (Frequency)	14.87	(0.41)	15.00	(0.00)	14.75	(0.58)
CORRSWIT (Frequency)	12.63	(2.49)	12.41	(3.04)	12.87	(1.82)

- Standard Deviations are noted in parentheses

Table 3.4 Comparison of Espy (1997) & Espy et al., (2001) to Present Study

VARIABLE	TRIAL	ESPY (1997)	ESPY (2001)	PRESENT STUDY
TIME (seconds)	Control	23.70 (13.35)	23.75 (9.88)	21.67 (5.54)
	Inhibit	23.65 (8.51)	22.56 (7.02)	21.55 (6.37)
	Switch	44.53 (15.20)	N/R	79.33 (4.99)
# CORRECT	Control	14.80 (0.52)	14.94 (0.25)	14.72 (0.62)
	Inhibit	14.80 (0.70)	14.81 (0.54)	14.87 (0.41)
	Switch	14.38 (1.09)	N/R	12.63 (2.49)
EFFICIENCY	Control	0.73 (0.25)	0.72 (0.26)	0.73 (0.21)
	Inhibit	0.70 (0.22)	0.71 (0.21)	0.75 (0.22)
	Switch	0.36 (0.13)	N/R	0.24 (0.14)

N/R = not reported

Table 3.5 Comparison of Byrne et al., (1998) & DeWolfe et al., (1999) to Present Study

VARIABLE	BYRNE et al., (1998)	DeWolfe et al., (1999)	PRESENT STUDY
COMMISSIONS	1.88 (2.30)	1.31 (1.64)	2.48 (2.09)
OMISSIONS	13.63 (9.58)	13.07 (11.62)	4.00 (3.61)
TIME	N/R	667.00 (354.00)	626.75 (169.17)

N/R = not reported

Comparisons with Byrne et al., (1998b) and De Wolfe et al., (1999) results on the PDTP, were less clear due to substantial levels of variability within both US and Australian samples. Time on task appeared to be the only variable worthy of direct comparison, with the Australian mean well within one standard deviation of the US mean, and also showing much less variability than the US scores. It should be noted that formal statistical comparisons between US and Australian data on both tasks were not undertaken as the original US data were not available.

3:2 Australian Sample Group Differences

Multivariate analysis of variance (MANOVA) was performed with Group as independent variable and IQ as covariate. No significant difference was noted between the younger and the older groups using Wilks Lambda (Wilks λ = .553, $f(13,18)$ = 1.121, p = .403*)* which is considered to be the most powerful of the test statistics available in MANOVA (Coakes & Steed, 2001). Multivariate analysis was also performed with gender as independent variable and with IQ as covariate. Again, no significant difference between the two groups was noted (Wilks λ = .446, $f(13,18)$ = .141, p=*.141*).

In order to determine if a relationship existed between the two sets of measures, that is if they were measuring similar constructs, a Pearson Product Moment Correlation was performed entering all variables, to investigate possible relationships between the tasks. Results of the correlational analysis revealed that there were no significant relationships between any of the SST variables and those generated from the PDTP. (Table 3.6) As might be expected, correlations were noted between efficiency scores and several other variables. However, given that the efficiency score uses both time and number correct variables in its formula, these relationships should be considered redundant. The only correlation of significance therefore being between time and number correct scores on the Switch trial (r=.36).

3.6 ***Correlation Co-efficients for SST and PDTP Variables.***

Measure	PDTPCOM	PDTPOMM	PDTPMOT	PDTPTIME	SSTCONT	SSTINHIB	SSTSWIT	TIMCONT	TIMINHIB	TIMSWIT	CORCONT	CORINHIB	CORSWIT
PDTPCOM	1.00												
PDTPOMM	.11	1.00											
PDTPMOT	.09	.68	1.00										
PDTPTIME	..22	.01	.14	1.00									
SSTCONT	.13	.09	.08	.25	1.00								
SSTINHIB	.12	.24	.18	.12	.29	1.00							
SSTSWIT	.26	.04	.20	.27	.24	.09	1.00						
TIMCONT	.18	.01	.07	.33	.96	.31	.32	1.00					
TIMINHIB	.16	.24	.18	.00	.29	**.94***	.03	.32	1.00				
TIMSWIT	.21	.02	.28	.08	.32	.25	**.78***	**.35***	.18	1.00			
CORCONT	.12	.17	.18	.00	.21	**.34***	.16	.19	.16	.20	1.00		
CORINHIB	.17	.08	.12	.16	.43	.12	.21	.32	.08	.25	.10	1.00	
CORSWIT	.20	.16	.14	.34	.04	.04	**.72***	.10	.01	**.36***	.03	.02	1.00

* Denotes significance @ $p \geq .05$

3:3 Clinical Case Studies

Two children were extracted from the original sample (n = 35) and considered as single case comparisons with both the US data and data from the present study. Characteristics of the single case studies are shown in Table 3:7 alongside those for the full sample (Australian data).

Case # 1 did not fulfill part (g) of the selection criteria (see Method/Participants) having scored in the clinical range on both the Attention Problems subscale of the CBCL (score of 13) and on the Aggressive Behaviour subscale of the CBCL (score of 26). He completed both subtests of the WPPSI-R, and all three trials of the SST, however he was unable to attend to the full test trial of the PDTP. Results from the SST for case study # 1

Table 3.7 Sample Characteristics of Single Case Studies and Full Sample

VARIABLE	CASE # 1	CASE # 2	FULL SAMPLE (n = 33)
GENDER	Male = 1	Male = 1	Male = 15 Females = 17
SES	5.7	3.5	4.86 (0.78)
IQ	89	92	112.45 (11.47)
AGE (months)	60.00	62.00	58.85 (3.77)

are presented in Table 3:8 for comparison with mean scores and standard deviations of the overall sample, and additionally for comparison with US mean scores and standard deviations from Espy's 1997 and et al., 2001 studies.

Case # 1's time on task on the inhibit trial was considerably longer (> 2 standard deviations above the mean) than the mean time for the overall group. It was also longer in comparison to means and standard deviations for both the US studies. On the Switch trial, Case # 1's Time on task score was greater than two standard deviations slower than the mean score for the Espy (1997) sample, but was consistent with the mean score for the Australian sample. All other scores for Case # 1 appeared within the normal range based on results of the overall group and results from the US.

Table 3.8 Comparisons of Clinical Case Studies 1 & 2 with Full Sample and Espy (1997; et al., 2001) SST Results

	Case # 1	**Case # 2**	**Full Sample**	**Espy (1997)**	**Espy (2001)**
Control					
Time (sec)	22.00	87.00	21.67 (5.54)	23.70 (13.35)	23.75 (9.88)
# Correct	15.00	13.00	14.72 (0.62)	14.80 (0.52)	14.94 (0.25)
Efficiency	0.68	0.12	0.73 (0.21)	0.73 (0.25)	0.72 (0.26)
Inhibit					
Time (sec)	40.00	-	21.55 (6.37)	23.65 (8.51)	22.56 (7.02)
# Correct	14.00	-	14.87 (0.41)	14.80 (0.70)	14.81 (0.54)
Efficiency	0.32	-	0.75 (0.22)	0.70 (0.22)	0.71 (0.21)
Switch					
Time (sec)	77.00	-	79.33 (4.99)	44.53 (15.20)	-
# Correct	14.00	-	12.63 (2.49)	14.38 (1.09)	-
Efficiency	0.16	-	0.24 (0.14)	0.36 (0.13)	-

Case # 2 was excluded from the main sample due to a failure to complete the PDTP and the inhibit and switch trials of the SST. Results for the control trial, which was the only completed SST trial for this participant, are also presented in Table 3:8.

Case # 2 was only comparable on the Control trial of the SST. Time on task was approaching three standard deviations above the mean in comparison to the full Australian sample and the US studies. The number correct was also greater than two standard deviations above the mean score of the overall Australian sample and both the US study results, as was the efficiency score for the Control trial.

DISCUSSION

4:1 Interpretation of Results

The main aim of this study was to document Australian data on two developmentally appropriate assessment tools normed in the United States, to assist in the clinical diagnosis of executive dysfunction in preschool children. To this end it was hypothesised that the results of this study would be consistent with findings of studies in the US that used the SST and the PDTP to measure specific components of executive functioning. In addition, it was expected that, consistent with previous research using these tests, girls and boys would perform similarly, and there would be no evidence of a developmental trend between the younger and the older groups, over this relatively brief period in the emergence of executive functioning. Outcomes for each of the tests will be discussed individually.

4:2 The Shape School Task

4.2.1. US and Australian Study Comparisons

Consistent with earlier studies (Espy, 1997; Espy et al., 2001) the SST proved to be a developmentally appropriate assessment tool, with all thirty-three of the normally developing preschool children ranging in age from 54-66 months, satisfactorily completing the task. Mean scores for the Australian sample appeared consistent with US data on both the control and inhibit conditions of the SST. However on the Switch condition, the Australian sample appeared to be significantly slower than the US sample (Espy, 1997) with more than two US standard deviations difference between the mean scores of the two groups. Additionally, both the Number Correct and Efficiency scores on the Switch condition showed trends that the Australian sample was less accurate and therefore less efficient than the US sample. Although it is tempting to look to sample characteristics for an explanation of these discrepencies, this was made difficult given that neither of the published US studies provided complete detail of the methodology that was used. The Espy (1997) study did not report on the formal measurement of IQ, and was vague in its reports on SES. Espy et al., (2001) samples were reported to have had similar IQs (measured using the PPVT-R, standard score X=110.57, SD=10.78) to the

Australian sample (measured using the WPPSI-R, standard score X=112.45, SD 11.47), but the Switch condition was not administered in this study. These shortfalls in reporting make comparisons between studies difficult and purely speculative in relation to these variables.

It may be more useful to interpret the differences in the light of administration style on this particular condition of the SST. The Switch trial is arguably the most difficult of the three trials. The Control trial asks the child to name shapes by their colour which requires an automatic response. The Inhibit trial is more complicated asking the participants to firstly inhibit the automatic response and apply a simple rule where only the happy faced shapes are named by their colour. In the Switch trial, the response is dependent on 2 rules (i.e. colours without hats, and shapes with hats). Participants must firstly inhibit an automatic response, then make a decision on their new response, dependent on their memory of the rules given in the instructions. It could be argued that this trial has an additional working memory component with the participant required to hold information 'on line' before making a momentary decision about which option to take. The Australian sample was able to complete the task, but rather were slower, less accurate and overall less efficient at this than their US counterparts. It may be that a greater number of practice trials is required for the child to become proficient at the Switch condition, which were not afforded to the Australian sample in the administration of this trial. There were no clear instructions in the test itself, nor in the published literature that suggested a standard for the administration of practice trials. This is one of the few weaknesses of the task and may well be the reason for variability between results from one study to another, particularly on the more difficult of the trials. It is noted however, that the task is relatively new and to this author's knowledge has not been used in any other studies that have reached publication. It therefore requires further fine-tuning to minimise problems such as this and make administration standard, from study to study.

4.2.2 Gender Differences

As expected, there were no gender differences noted on SST performance between girls and boys of this age group. These results were largely consistent with those of Espy et al., (2001) who found gender differences on only one of the executive functioning tasks used in the full battery; the "A not B" task. Amongst other skills that it is reported to measure, the "A not B" task shares the ability to inhibit a prepotent response with the SST. The authors reported that the gender differences they found on this one task, were modest but still significant (a finding that is supported by Gillberg's (1995) observation that there is little measurable difference between girls and boys in the preschool years). It may be that larger groups of children are required, with the use of more sensitive and discrete executive functioning tests, to detect differences in executive functioning between genders in the preschool age group. Continued investigation is necessary, particularly since some of the more prevalent disorders that display executive functioning deficits, such as ADHD, Autism and even TBI, have a predominance of male sufferers.

4.2.3 Developmental Trends

Also as expected, no significant differences were noted between the younger age group (54-59 months) and the older age group (60-66 months) on the SST. These findings would suggest that children at 54 months of age have already developed the ability to use mental flexibility as measured by the Shape School Task, and that changes slow down considerably beyond this age. These results are largely consistent with those published by Espy (1997) who found that the ability to inhibit an automatic response had largely developed by three years of age, and that the ability to use mental flexibility (set shifting) was developed by four to five years of age in their sample of 70 normally developing preschoolers. The present findings indicate that the development of set shifting ability may either stagnate or slow down considerably during this period of maturation and hence be more difficult to measure at a significant level. This is in support of theories that postulate that cognitive growth spurts are most evident from zero to two years of age, and then resurge again between seven and nine years of age (Piaget 1950, cited in Groth Marnat, 1997; Pennington, 1991; Thatcher, 1991). Findings also support Anderson's (2002) view that set shifting and cognitive flexibility are relatively well established by three to four years of age.

4.2.4 Strengths and Weaknesses of the SST

One of the major strengths of this task is its ability to differentiate between two specific executive functioning skills, those of inhibitory control and set shifting ability. The Inhibit condition measures a child's ability to stop "instinctive" or automatic behaviours without asking them to change the type of response. The Switch condition also employs this strategy, as well as asking the child to change the type of response once they have stopped the automatic behaviour. The difference between the two conditions is made evident in the time it takes the child to complete the trial; the Switch condition taking more than three times as long as the Inhibit condition for the Australian sample, and almost twice as long for the US sample. Further research using a longitudinal design and other similar executive functioning tests for comparison would reinforce the usefulness of this test in relation to the differentiation of inhibitory control skills and set shifting skills.

Similarly, studies that look at these skills in clinical populations would also be informative. For instance, the core symptom in Attention Deficit Hyperactivity Disorder is reportedly impulsivity (Barkley, 1997). Traumatic Brain Injury, where the frontal lobes are implicated, can similarly manifest in impulsivity and also in cognitive inflexiblity (Gratten & Eslinger, 1991; Anderson et.al., 2000). Perhaps most notably, cognitive flexibility is reported to be significantly affected in Autism Spectrum Disorder (Gioia et.al., 2002; McEvoy et.al., 1993), to the point where Pennington and Ozonoff (1996) maintain that it is a central deficit in the disorder across the spectrum. The SST Inhibit and Switch conditions appear to be developmentally appropriate measures of both these executive functioning skills and the SST may prove to be a useful, complementary tool, in the clinical diagnosis of these disorders in the future.

A second strength of this task and one which is most important for this age group, is the task's ability to engage the preschooler for the full three trials administered in this study. All thirty-three children were able to complete the three trials satisfactorily indicating that the task is not only developmentally appropriate, but goes a long way to successfully avoiding the pitfalls of floor and ceiling effects. The task does this firstly by setting the scene for the child in a familiar environment; that of the preschool playground. For all thirty-three children there was an immediate engagement in the task as the child related the cover page picture of the Shape School playground to their own experience at preschool. The examiner was able to use this picture to embark on a short but effective conversation with the child that enabled the development of rapport with the preschooler. Each child was then eager to continue with the task, including the two children who were later removed from the main group and included as case studies (although only one of the two progressed past the first trial). Additionally, the task is short and not overly demanding of the child's attention span, which also assists in engaging them through to the end of the three trials.

The task also engages the children by using a storyline that progresses through to the end of the three trials. This would appear to be an important part of the development of tasks for this age group as preschool children often demonstrate short attention spans and can be easily distracted as part of their normal development (Anderson, 2002). The storyline which allows them to draw from their own experience as a preschooler, keeps them interested in the task and allows for variability in performance, which is usual in this age group, without the complications of floor and ceiling effects. The language used in the storyline is also quite generic (does not use language that is specific to the US), and could easily be related to by the Australian sample.

Another strength of the SST is its use of content that is appropriate for the preschool age group. The ability to name shapes and colours is usually well learned by developmentally normal children, by the age of four years (Schopler, Reichler, Bashford, Lansing & Marcus, 1990), making the utilisation of shapes and colours in this task an excellent choice where automatic processing of information is required.

Also important in the development of preschool tasks is the physical presentation of the task itself. The SST is presented in an appealing format that helps to keep the child engaged. It uses large images that are simple in design with clear outlines and bright colours. Only the primary colours of blue, red and yellow have been used. This ensures that there is no confusion with colours that may not be overlearned by some children and hence not processed automatically or instinctively. It is important to note also that if the test is to be used with Autistic children, one of the first things taught to an autistic child in early intervention programmes is often the identification of shapes and colours. The test may also appeal to the Autistic child who engages in such repetitive play behaviours as the lining up of objects (i.e. cars, blocks etc), as in SST trials the child is encouraged to follow the shapes across the rows with their finger.

To aid with clarity for the preschooler, the expressions on the targets are also kept simple with ambivalent expressions used in the Control and Switch trials and distinctly happy or sad faces used in the Inhibit trial. The physical characteristics of a task, though they may seem trivial, are actually critical to the success of a task. If a normal child is not engaged by the test, the chances of engaging a child with executive functioning deficits such as the ADHD, Autistic or brain injured child, is rendered much more unlikely.

One possible weakness in the physical presentation of the task may be the actual size of the booklet. At times during the administration of the task, the size of the test book became prohibitive, particularly where space was limited in the test setting. The booklet measures 30cm x 42cm and opens from right to left. At times this was quite awkward to administer and also to transport to and from testing sessions. The test would most definitely benefit from downsizing and perhaps from ring binding on the top edge rather than at the side, so that it opens away from the examiner and the child.

The Shape School Task may also benefit from a review of instructions to enable them to be more concise and easily understood by the preschooler. By the age of 3.5 to 4 years a child should be reasonably proficient at carrying out two step instructions (Schopler, et al., 1990) however, at times the instructions in the SST become quite wordy and may benefit from being condensed. For example, the original instructions (Espy 1997) for the Inhibit trial read as follows.

"Good job! Now all of the children from all of the classes are here. I want you to tell me the names of the children with happy faces as fast as you can without making any mistakes. Start here and tell me the names of the children one at a time, across the rows, without skipping any. Remember, tell me the names of the children with happy faces, and do not tell me the names of the children with sad faces. Do you understand? Get ready, GO!"

The original instructions could easily be modified to a shortened, more concise version that reads:

"Well done! Now all the classes are here. I want you to tell me the names of the children who have happy faces, but not the children with sad faces, just like you did in the practice. Start at the top and tell me the children with happy faces as fast as you can without missing any. Do you understand? Get ready, GO!"

to aid with clear understanding of the task. Although normal preschoolers of four years should be able to grasp two stage instruction, children with executive functioning deficits may not, and simpler instructions would significantly aid administration to these clinical groups. It may also be useful to have a separate manual complete with instructions, and a test booklet with practice and test trial pages. This would enable a neater presentation and would enable the examiner to read the last instruction for each trial as the page is turned to begin. In the test's present format the child is instructed to respond before the actual test page is sighted, which places a greater demand on memory skills and hence complicates the measurement of discrete executive functioning behaviour.

Similarly, the test record form for the SST is large and complicated. There are presently four pages of forms, with each trial assigned to a separate page. The form also has several lines for scoring performances that appear to be redundant, and not described anywhere in the literature, and it could be made more succinct and clear by the removal of these. In the author's experience the three trials used in this study could be condensed onto one page with each trial having space to record the overall time, the number correct and the efficiency score. Smaller shape figures to record errors could also be incorporated onto one page for ease of administration and maximisation of resources.

The SST would benefit greatly from planned comparisons with other tests of similar executive functioning skills. This would assist in answering questions raised about the actual constructs being measured and how other factors such as sustained attention and working memory for example, impact on the skills being investigated. As more emphasis is placed on early intervention and subsequently on the diagnosis of executive functioning disorders in the preschool age range, it is hoped that greater interest will be placed on the development of a wider range of tasks for this age group, that will enable the "cross checking" of constructs of executive functioning.

4.3 The Picture Deletion Task for Preschoolers

4.3.1 US and Australian Study Comparisons

Consistent with earlier research (Byrne et al., 1998a; Byrne et al., 1998b; Corkum et al., 1995; De Wolfe et al., 1999) the PDTP proved its developmental appropriateness, with all thirty three of the main sample of children completing the full test. It is worth noting however, that both of the single case studies were unable to remain focussed on the task to its completion, raising concerns about whether the task is suitable for use with clinical samples as the developers of the task suggest. One of the single case studies included here was unable to progress past the shape trial (practice trial) and the other child began the test trial but completed only two pages, before refusing to continue with the task. Guidelines for dealing with these situations are not included in the methodology in any of the PDTP papers, but it is presumed that the US sample children were encouraged in some way to continue, since clinical data is available in the reports on these studies.

It is interesting to note from the De Wolfe et al., (1999) study, that time to completion for the clinical group was significantly greater than for their matched controls and the author's note that the behaviour of the ADHD group "elicited significantly more examiner commands" (p465). It would seem then that the children were encouraged to return to the task until its completion, a practice that is difficult to quantify in order to standardise performance on any task. The scope to continue to coax inattentive, distractible, disruptive, or oppositional children to complete the task leaves performances open to significant variability between participants, which is plainly evident in the data from all studies, where in some cases the standard deviations are quite large in relation to the mean score for time on task, commission errors, and omission errors (refer Table 3.5). At what point does the examiner abandon the task and report that the child is unable to complete it? Additionally, where the examiner continually encourages the child to proceed, it is debatable just how much of that child's performance score actually reflects their true unassisted abilities. In contrast, the SST easily engages children throughout the three trials, with no pressure placed on the administrator to continually encourage the child to continue. Although it seems that the PDTP is appropriate for use with normal preschoolers, who have less difficulty with sustaining attention and impulsivity than ADHD (Barkley, 1997) or TBI (Gratten & Eslinger, 1991; Gioia et.al., 2002) children for instance, it appears that more work is needed to standardise administration techniques if the results are to be replicated by other research groups, and the task subsequently validated and made reliable.

4.3.2 Gender Differences

As was expected, the present study demonstrated no differences between boys and girls on commission errors or any of the other measures from the PDTP. Research has shown some evidence of gender differences between boys and girls on the number of commission errors on CPTs, where preschool boys were found to be more impulsive than girls (Corkum et al., 1995; Pascualvaca et al., 1997). However, the Pascualvaca et al., (1997) study sample group consisted of slightly older children with a mean age of 7.9 years. The Corkum et al., (1995) study sampled children in a comparative age range (3-5 years), but their findings related only to commission errors on a visual continuous performance task and not to performance on the original version of the Picture Deletion Task. This would suggest that CPT's and Cancellation tasks though both purporting to be measuring inhibitory control, are indeed tapping into different elements of this component of executive functioning .

4.3.3 Developmental Trends

As with the Shape School Task there were no significant differences between the younger and the older age groups in this study, on any of the PDTP measures. This would suggest that consistent with past research, the ability to inhibit a prepotent response is developed prior to the age of 4.5 years (Corkum et al., 1995) and changes in impulse control and sustained attention over this brief period of the lifespan, though probably not stagnant, are less than significant. Further research is required with the current format of the PDTP, and using normal populations, to determine that this is in fact the case.

4.3.4 Strengths and Weaknesses of the PDTP

Continuous performance tests and cancellation tasks are renowned to be boring for the child, but are necessarily designed that way to enable the measurement of sustained attention and inhibitory control. However, in designing these tasks it is necessary to be able to develop them to accommodate both clinical and normal performance, along a continuum of performance. In other words the ADHD or brain injured child should still be able to complete the task, with performance scores that are less efficient, but still placed somewhere on that continuum. The experience gleaned from this study is that the PDTP does not allow for this. If the task is administered according to the given directions, there would be many clinical cases who would not complete even the first few pages of the test trial, as was the situation with Case studies #1 and #2. If the task is administered as it is assumed to have been administered (with as much encouragement as necessary to complete the task), then it raises serious concerns about what is actually being measured for these children. Does sustained attention span cease when the child is no longer able to complete the task of their own volition? Or is the span measured by the length of time it takes to complete the task with 1:1 assistance. It seems that many such questions must be answered if the task is to be considered a valid and reliable measurement of sustained attention and impulsivity in preschool children with executive functioning disorders.

On a positive note, the task is well within the capabilities of normally developing preschool children who are more than able to perform the physical requirements of the test. The Bingo stamper is an appealing instrument to this age group and they seem to enjoy the task's requirement to stamp each of the target cats. Cancellation tasks and thus the PDTP also have good ecological validity because they are similar to the type of tasks children often undertake in preschool and in primary school.

The task however, lacks the inclusion of a storyline to engage the children at the start. It would be enhanced by a short introduction that initially motivates the child and draws them into the task. This would ensure that their attention has been secured to begin with, and that if or when the child begins to lose concentration and make errors, that there is a baseline of attention and motivation to start with. We can not say that we are measuring a decline in performance if we have not secured a baseline performance beforehand. Following a pilot run that indicated that preschoolers may have difficulty completing such a long task as part of a larger battery of tests, the present study employed such an introduction to the task. The instructions used during the administration of the PDTP for the present study can be found in Appendix A.

Additionally, it is proposed that the task may benefit from a more colourful presentation. Although many researchers would argue that a test of sustained attention and impulse control must necessarily be boring, an attractively presented test that is interesting to the child to begin with, ensures their initial participation even if they do succumb to moments of impulsivity, and lapses in attention that result in errors of commission and omission.

4.4 Correlations Between the SST & PDTP

Correlational analysis between the SST and the PDTP revealed there to be an absence of relationships between the variables extracted from either of the tasks. This would suggest that the SST and the PDTP are measuring different facets of executive functioning, even though both tasks reportedly measure the ability to inhibit a prepotent response. One possible way of understanding this, may be that the involvement of other elements of executive functioning, for example sustained attention in the PDTP, produce a slightly different form of dysinhibition than that used in the SST. One could also speculate that the SST allows for some modification of performance due to the provision of feedback over the course of the task. Children are alerted when they make an error and are required to correct their response before moving on. Errors are still counted and time on task increases with every error. The PDTP has no such 'feedback loop' and hence no allowances for behaviour self modification, which may in turn have some influence on the manner in which impulse control is employed over the length of the task. As would be expected, correlations were noted, between certain variables of the SST, however interestingly, there were no correlations between variables of the PDTP.

4.5 <u>Single Case Studies</u>

4.5.1 Case #1

Case study #1 was a male, aged 5 years, 7 months at the time of testing. He demonstrated a significantly lower pro-rated full scale IQ, with a scaled score of 89, than the overall sample mean of a scaled score of 112.45 (SD=11.47), but was within the range for age at 60 months (X = 58.85 sd = 3.77). He was excluded from the main group for failing to meet the selection criteria (Criterion g = participant must receive sub-clinical scores on the Attention Problems, Delinquent Behaviour and Aggressive Behaviour scales of the CBCL). Comparisons between Case Study #1 and the full Australian sample on the SST yielded some interesting results (see Table 3.8). On the Control trial, scores were very similar for time, number correct and efficiency, indicating that the child was able to name automatically by colour and hence provided a baseline for further trials. On the Inhibit trial however, Case Study #1 was more than two standard deviations slower, and less accurate, and approached two standard deviations lower in efficiency than the normal sample of preschoolers. Interestingly, however, Case Study #1 was consistent with time on task with the Australian sample on the Switch condition, had more correct namings and was overall as efficient. In comparison to the US data (Espy1997) Case Study #1 was greater than two standard deviations slower but was within the normal range for the number correct, and was greater than one but less than two standard deviations less efficient on the task. These comparisons highlight the need for the replication of study findings and the employment of large samples to ensure that the norms for tests used in further research and in standardised formal assessment are as accurate as possible and reflect the population being described.

4.5.2 Case #2

Case Study #2 was also male and within the age range of the full sample, with a pro-rated full scale IQ that approached two standard deviations below the group mean (see Table 3.8). Unlike Case Study #1, Case Study #2 was unable to complete either the SST nor the PDTP in their entirety. In the only trial he did manage to complete, (the Control trial of the SST), his performance was significantly slower, significantly less accurate and significantly less efficient overall than both the US and the Australian samples.

Case Study #2 was excluded from the main sample as the result of clinical judgement at the time of testing for significant displays of inattentive and oppositional behaviour that led to an inability to complete either of the tasks. This highlights the need for the development and implementation of multifaceted assessment protocols prior to diagnosis. Case Study #2 passed the selection criteria with no clinical scores on any of the three CBCL subscales. However, later discussion with his mother evidenced that the child was indeed more disruptive, inattentive, and difficult to manage both at home and at school than she had indicated on the parent report form. Had the only form of assessment for this child been based on parent report, without the administration of a task such as the SST or PDTP, this child may have gone undiagnosed and thus untreated for a considerable time. The child was to begin school the following year, so early diagnosis could have aided in providing assistance for the parents and the school in behaviour management, a chance to trial medications if this form of treatment was deemed necessary, and the avoidance of negative experiences for the child at school whilst the problems remained undiagnosed and untreated.

4.6 Strengths and Limitations of the Present Study

4.6.1 Sample Characteristics

This study was somewhat limited by the small overall sample size, and the fact that only two age groups could be used to investigate evidence of developmental trends. In the MANCOVA analysis between the age groups, the samples did not meet the criterion that there be twenty or more in each group, which is recommended in the literature for multivariate analysis (Coakes & Steed, 1996). The groups did however satisfy the qualification that they have *'n'* values greater than the number of dependent variables (Tabachnick & Fidell, 1996). Small sample size can mean that the analysis lacked power and that there may not be a satisfactory representation of the population in each group, and in deed in the overall sample. Certainly, the high mean IQ score for the individual groups and for the sample as a whole, is evidence of this, indicating that the power was again reduced by the need to factor in IQ as covariate in the analysis. The high IQ for the sample raises an interesting issue in that when the study was begun, the newly revised version of the WPPSI (i.e WPPSI -III) was not yet available for use. The version used in this study was at that point approximately ten years old and due for revision of the norms. Thus, the inflated IQ of the present sample may well represent the trend seen with intelligence tests where mean scores become inflated as the test ages. It should be noted that at the time when the new test was available, a considerable number of children had already been tested, and it was not feasible to change instruments within the time frame of the study.

There is also a question of the relationship between IQ and executive functions. A scan of the literature suggests there to be no clear relationship between IQ and executive functions and what impact the high IQ may have on executive functioning scores in this study if at all. For instance Welsh et al., (1991) tested 110 subjects from age three to twenty-eight years on a range of executive functioning tasks. They concluded that their study provided "preliminary evidence that executive function skills, as operationalised here, are not synonymous with general intelligence in 6-12 year old children" (p145) and that "executive function is a domain of cognition in normal human development which is relatively independent of IQ" (p146).

Later research by Pascualvaca et al., (1997) did however identify links between IQ and sustained attention where children with lower intelligence quotients did less well on tests of continuous performance. However, they went on to note that "although children with mental retardation tend to do worse on attention tests than children with normal IQs, our results suggest that these children may have particular difficulties only on tasks with high processing demands" (p24) and not specifically on sustained attention. From what we know of executive functioning and the difficulties of definition and discrete measurement of these skills, it seems fair to suggest that further research is required in this domain.

It must also be noted that the Australian sample was not fully representative of the population as a whole on the measure of socioeconomic status. Despite a good spread of scores that ranged from 3.3 (eg. Police Inspector, Physiotherapist) to 6.4 (eg. Process Worker, Kitchenhand) with a mean score of 4.8 (eg. Drafting Assistant, Bookeeper) there were no children representing the socioeconomic range of 4.3 to 4.6 on the Daniel Scale (see Figure 3.1). Given the constraints of time, it was not possible to rectify this problem in the present study, however this is one of the drawbacks of small sample sizes and could be corrected with greater numbers in the group.

4.6.2 Clinical Comparison Groups

This study would have been expanded by the inclusion of a clinical group with which to compare the normative data. However, idiosyncratic difficulties inherent in assembling a group of preschool children with Autism Spectrum Disorder, Traumatic Brain Injury or ADHD type presentations precluded this from happening. A discussion was undertaken with several paediatricians in both the Western Region of Melbourne and in the Goulburn Valley Region of rural Victoria in relation to assembling an ADHD group. It was decided that the inclusion of a clinical group was not feasible in the available time. Several of the paediatricians expressed a reluctance to diagnose ADHD at a preschool age, preferring to wait until the child began formal schooling, and was clear of that period of development where impulsivity and inattention are a normal part of a child's presentation. Although these children were still presenting to paediatricians in the preschool age-group, clinicians were tending to give the parents strategies and asking them to return in 6-12 months, if symptoms and behavioural difficulties had not remitted. Corkum and colleagues noted in 1995 that "approximately 60% of the preschoolers with a diagnosis of ADHD do not retain this diagnosis into the school age period" suggesting "a high false positive rate for early diagnosis of this disorder" (p17). This factor together with the concerns of paediatricians, highlights the need for the incorporation of a broader range of assessment tools to make the process of diagnosis easier and more accurate in this age group.

In relation to the inclusion of a clinical group representing the Autism Spectrum Disorders, the absence of a service providing ASD assessment in the region of interest meant that children have historically travelled to metropolitan services for assessment and diagnosis. Tracking of these children was equally as difficult as for the ADHD children, for once they had been referred to metropolitan based services, usually at an early age (2-3 years), they were lost to paediatricians for considerable periods of time. Towards the conclusion of this study, an Autism Assessment Service commenced practice in the Goulburn Valley Region and now presents as a possible platform for further research into executive functioning in Autism in this age group.

Traumatic Brain Injury is unique in the difficuties it presents for the assembly of a clinical group. Whilst access to children with TBI may well be possible through connections with major regional hospitals, it would take a much larger study, and a much longer time frame than the present one, to test all children who present to Accident and Emergency wards with the intention of assembling a group of children with purely frontal lobe head injuries. It was decided at the onset of the study that a clinical TBI was beyond the scope of this study, but none the less an important consideration for future research.

The difficulties set out above, though some unique to each disorder and others common to all, suggests that research with preschoolers may need to be located in clinics that deal specifically with ADHD, TBI and Autism. This would enable larger samples to be assembled and tested more efficiently and as time and funding permits.

4.6.3 Methodological Issues

Whilst this study goes a long way towards bridging an enormous gap between the predominance of urban based studies as opposed to those using rural samples, some considerable obstacles had to be addressed in order to gather a rural sample. The largest of these was that of distance. Initially the families were asked to attend a central testing centre, located in the most sizable of the towns in the region. However, it became apparent as the study progressed that even before replying to the initial invitation, parents were not expressing interest in participating due to having to travel in some instances up to 40 kilometres to have their child be part of the study. Attempts were then made to find alternative sites in outer localities. This was not possible, and hence some children were tested in a quiet room at their own homes. The change in venue appeared to have no impact on the children's performance, as it was made clear to parents that a quiet room was imperative to the success of the testing session. Future research with rural communities, where it is deemed necessary to bring participants to a central location, would do well to consider payment of a nominal amount that would assist in covering the costs of travelling such long distances.

In addition to the 'tyranny of distance', problems were also encountered with travel time. Where parents were willing to drive considerable distances, some had difficulty with time constraints. Many of the parents had other commitments with small and school age children, who also needed assistance in day to day activities. There were several instances where parents would book an appointment time and then fail to attend, due to a conflict of responsibilities. Many re-booked, but several also failed to turn up the second time around. This problem highlights the idiosyncratic difficulties of working with this particular age-group, where parents are required to attend the session with the child. For instance working with primary school age children can be made easier for parent and researcher alike by utilising the school setting as the place of testing. This effectively means that the parent is only required to consent to their child's participation in the study, and arrangements can then be made with the school for a time of testing. Future work with this age group may be better situated in the preschool environment, using a quiet vacant room on site, so that parents are not required to make special efforts to attend with their child, outside of preschool hours. This would require substantial liaison with the Preschool Manager and Parents Committee in the foundation stages of the study.

4.7 Practical Implications

This study has moved a long way towards replicating the developmental appropriateness of both of these tests of executive functioning in the preschool age-group, and in particular, that of the SST. It is the opinion of the author however, that both tasks require further refinement before they can be considered appropriate for use in clinical studies of preschool children with executive functioning deficits. The SST appears to be closer to this mark than the PDTP with much more concise instructions for administration and closer comparisons with Australian data. The PDTP is in need of several physical changes to both presentation and administration techniques, before it can be considered a tool worth using in replica studies. Once validity and reliability have been established by groups outside the tasks developers, then it would be hoped that the tasks could be employed to complement existing diagnostic tools and lead to earlier and more accurate diagnosis.

This study has taken important steps towards the establishment of norms for both tasks. However, it remains that refinement of the tasks is necessary before these can be judged to be useful in further clinical work. The employment of much larger sample sizes and if possible, a longitudinal design would also add to the usefulness of future data. A longitudinal study would assist in teasing out the patterns of emerging executive functioning skills that cross-sectional studies are unable to do. Certainly, it was noted in the present study that observationally, many of the children used strategy in their responses, however where some were using a particularly strategy on one task, others were using another and vice versa. Longitudinal data would help to illuminate these differences between children in the development of executive skill and add to our knowledge of executive functioning across childhood. The study has also now provided an Australian baseline for further task modifications.

Once modifications to the tests have been made, there will be a need for further work with clinical groups with both pure and co-morbid diagnoses, which Espy (2001) notes is important for the discriminative validity of tasks. It will also be important for the SST and the PDTP to be compared with other executive functioning tasks to test whether they are measuring the constructs they are reported to be measuring. Future research could also look at performance following pre and post medication (as Byrne and colleagues have already undertaken), at the recovery period in TBI (Corkum et al., 1995), and at various points of early intervention programs for children with Autism Spectrum Disorders.

It is important to note here that several difficulties were encountered by this study due to the sparseness of detail in the published literature. The differences noted in the comparisons between US and Australian data may have been avoided had the detail provided been more thoroughly presented. It is important for a task to be trialed outside those groups who have developed it, as a preliminary test of its ability to be administered in a standardised manner by other clinicians. Without sufficient detail, the process of producing, trialing, fine-tuning, validating and replicating newly developed tasks, becomes protracted, inefficient and ultimately expensive, and hindering the accumulation of further knowledge.

4.8 Conclusion

Neuropsychologically driven studies of executive functioning in children have been quietly gathering momentum as we enter the twenty first century. However, despite this ever expanding knowledge base, and our heightened interest in the value of early intervention practices, minimal focus has been placed on the early detection of executive functioning disorders in the preschool years. At present, early detection and characterisation of disorders like ADHD and Autism, and characterisation and monitoring of deficits in TBI, is compromised by a shortfall of developmentally appropriate, standardised tests that complement clinical diagnosis and review. As Anderson (2002) notes, there is an urgent need for developmentally appropriate, valid, reliable and standardised tests, if we are to further our knowledge of executive functioning in children, and that to do this effectively "a micro analytic approach to assessment should be adopted incorporating quantitative, qualitative, and cognitive-process techniques" (p79). The present study has considered these observations with the seriousness they deserve and attempted to address all three of Anderson's necessary ingredients, in the hope that we are now one small step closer to increasing the number of standardised executive functioning tasks available for the assessment of the preschool age child.

REFERENCES

Achenbach, T.M. (1991). Child Behaviour Checklist for Ages 4-18. Burlington VT: University of Vermont, Department of Psychiatry.

American Psychiatric Association, (1994). Diagnostic and Statistical Manual of Mental Disorders (4th ed.) Washington, D.C: American Psychiatric Association.

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. Child Neuropsychology, 8(2), 71-82.

Anderson, V. (1998). Assessing executive functioning in Children: Biological, psychological, and developmental considerations. Neuropsychological Rehabilitation, 8(3), 319-349.

Anderson, C.V., Bigler, E.D., & Blatter, D.D. (1995). Frontal lobe lesions, diffuse damage and neuropsychological functioning in traumatic brain injured patients. Journal of Clinical and Experimental Neuropsychology, 17(6), 900-908.

Anderson, S.W., Damasio, H., Tranel, D. & Damasio, A.R. (2000). Long-term sequelae of prefrontal cortex damage acquired in early childhood. Developmental Neuropsychology, 18(3), 281-296.

Anderson, V.A., Morse, S.A., Klug, G., Catroppa, C., Haritou, F., Rosenfeld, J. & Portland, L. (1997). Predicting recovery from head injury in young children: A prospective analysis. Child Neuropsychology 3, 568-580.

Arons, B.S., Katz-Leavy, J.M., Wittg, A.C. & Wayne-Holden, E. (2002). Too young for ADHD: The potential role of systems care. Journal of Developmental Behavioural Paediatrics, 23(0) Supplement, S57-S63.

Bailey, A., Phillips, W. & Rutter, M. (1996). Autism: Towards an integration of clinical, genetic, neuropsychological, and neurobiological perspectives. Journal of Child Psychology and Psychiatry, 37(1), 89-126.

Barkley, R.A. (1990). Attention Deficit Hyperactivity Disorder: A Handbook for Diagnosis and Treatment. New York: Guildford Press.

Barkley, R.A. (1994). Impaired delayed responding. In D.K. Routh (Ed.), Disruptive behaviour disorders in childhood. New York: Plenium Press.

Barkley, R.A. (1997). Behavioural inhibition, sustained attention and executive functions: Constructing a unifying theory of ADHD. Psychological Bulletin, 121(1), 65-94.

Barkley, R.A. (1997). ADHD and the Nature of Self Control. New York: Guildford Press.

Bennett, K.J. & Offord, D.R. (2001). Screening for conduct problems: Does the predictive accuracy of conduct disorder symptoms improve with age? Journal of the American Academy of Child and Adolescent Psychiatry, 41(11), 1418-1425.

Benson, F. (1994). The neurology of higher mental control disorders. The Neurology of Thinking, New York: Oxford University Press.

Burke, J.D., Loeber, R. & Birmaher, B. (2002). Oppositional defiant disorder and conduct disorder: A review of the past 10 years, part II. Journal of the American Academy of Child and Adolescent Psychiatry, 41(11), 1275-1293.

Byrne, J.M., Bawden, H.N., DeWolfe, N.A. & Beattie, T.L. (1998a). Clinical assessment of psychopharmacological treatment of preschoolers with ADHD. Journal of Clinical and Experimental Neuropsychology, 20(5), 613-627.

Byrne, J.M., De Wolfe, N.A. & Bawden, H.N. (1998b). Assessment of attention deficit hyperactivity disorder in preschoolers. Child Neuropsychology, 4(1), 49-66.

Campbell, S.B. (1985). Hyperactivity in preschoolers: Correlates and prognostic implications. Clinical Psychology Review, 5, 405-428.

Campbell, S.B. (1994). Behaviour problems in preschool children: A review of recent research. Journal of Child Psychology & Psychiatry, 36(1), 113-149.

Campbell, S.B., Szumowski, E.K., Ewing, L.J., Gluck, D.S. & Breaux, A. (1982). A multidimensional assessment of parent-identified behaviour problem toddlers. Journal of Abnormal Child Psychology, 10(4), 569-592.

Carey, N. & Waschbusch, D. (2001). An intensive summer day treatment program for children with disruptive behaviour disorder. Canadian Psychiatric Research Foundation, p1-2.

Case, R. (1992). The role of the frontal lobes in the regulation of cognitive development. Brain and Cognition, 20, 51-73.

Coakes, S.J. & Steed, L.G. (1996). SPSS for Windows: Analysis Without Anguish. Milton: John Wiley & Sons.

Connor, D. (2002). Preschool attention deficit hyperactivity disorder: A review of prevalence, diagnosis, neurobiology, and stimulant treatment. Journal of Developmental & Behavioural Pediatrics, 23(0), S1-S9.

Corkum, P.V. & Siegel, L.S. (1993). Is the continuous performance task a valuable research tool for use with children with Attention Deficit Hyperactivity Disorder? Journal of Child Psychology and Psychiatry, 34(7), 1217-1239.

Corkum, V., Byrne, J.M. & Ellsworth, C. (1995). Clinical Assessment of sustained attention in preschoolers. Child Neuropsychology, 1(1), 3-18.

Cornoldi, C., Barbieri, A., Gaiani, C. & Zocchi, S. (1999). Strategic memory deficits in attention deficit disorder with hyperactivity participants:The role of executive processes. Developmental Neuropsychology, 15(1), 53-71.

Daniel, A.E. (1983). Power, Privilege, Prestige. Melbourne: Longman Cheshire.

De Wolfe, N.A., Byrne, J.M. & Bawden, H.N. (1999). Early clinical assessment of attention. The Clinical Neuropsychologist, 13(4), 458-473.

Denkla, M.B. (1996). Research on executive function in a neurodevelopmental context: Application of clinical measures. Developmental Neuropsychology,12(1),5-15.

Dennis, M. (1991). Frontal lobe function in childhood and adolescence: A heuristic for assessing attention regulation, executive control, and the intentional states important for social discourse. Developmental Neuropsychology, 7, 327-358.

Douglas, V.I. & Peters, K.G. (1979). A clearer definition of attentional deficit. In G.A. Hale & M. Lewis (Eds.) Attention and Cognitive Development. New York: Plenium Press.

Eslinger, P.J. & Grattan, L.M. (1991). Perspectives on the developmental consequences of early frontal lobe damage: Introduction. Developmental Neuropsychology, 7(3), 257-260.

Espy, K.A. (1997). The shape school: Assessing executive function in preschool children. Developmental Neuropsychology, 13, 495-499.

Espy, K.A., Kaufmann, P.M., Glisky, M.L. & McDiarmid, M.D. (2001). The Clinical Neuropsychologist, 15(1), 46-58.

Ewing-Cobbs, L., Fletcher, J.M., Levin, H.S., Francis, D.J., Davidson, K. & Miner, M.E. (1997). Longitudinal neuropsychological outcome in infants and preschoolers with traumatic brain injury. Journal of the International Neuropsychological Society, 3, 581-591.

Ghuman, J.K., Ginsburg, G.S., Subramaniam, G., Ghuman, H.S., Kau, A. & Riddle, M.A. (2001). Psychostimulants in preschool children with attention-deficit/hyperactivity disorder: Clinical evidence from a developmental disorders institution. Journal of the American Academy of Child and Adolescent Psychiatry, 40(5), 516-524.

Gillberg, C. (1995). Clinical Child Neuropsychiatry. New York: Cambridge University Press.

Gioia, G.A., Isquith, P.K., Kenworthy, L. & Barton, R.M. (2002). Profiles of everyday executive function in acquired and developmental disorders. Child Neuropsychology, 8(2), 121-137.

Goldman-Rakic, P.S. (1987). Development of cortical circuitry and cognitive function. Child Development, 58, 601-622.

Gormly, A.V. & Brodzinsky, D.M. (1993). Lifespan Human Development. Orlando: Harcourt Brace.

Grattan, L.M. & Eslinger, P.J. (1991). Frontal lobe damage to children and adults: A comparative review. Developmental Neuropsychology, 7(3), 283-299.

Gronwall, D., Wrightson, P. & McGinn, V. (1997). Effect of mild head injury during the preschool years. Journal of the International Neuropsychological Society, 3, 592-597.

Groth Marnett, G. (1997). Handbook of Psychological Assessment - Third Edition. New York: John Wiley & Sons, Inc.

Hart, E.L., Lahey, B.B., Loeber, R., Applegate, B. & Frick, P.J. (1995). Developmental change in attention deficit hyperactivity disorder in boys: A four year longitudinal study. Journal of Abnormal Child Psychology, 23(6), 729-750.

Handen, B.L., Feldman, H.M., Lurier, A. & Murray, P.J.H. (1999). Efficacy of methylphenidate among preschool children with developmental disabilities and ADHD. . Journal of the American Academy of Child and Adolescent Psychiatry, 38(7), 805-812.

Hechtman, L. (2000). Assessment and diagnosis of attention-deficit/hyperactivity disorder. Child and Adolescent Psychiatric Clinics of North America, 9(3), 481-498.

Hughes, C., Dunn, J. & White, A. (1998). Trick or treat?: Uneven understanding of mind and emotion and executive dysfunction in "hard to manage" preschoolers. Journal of Child Psychology and Psychiatry, 39(7), 981-994.

Hughes, C., White, A., Sharpen, J. & Dunn, J. (2000). Antisocial, angry and unsympathetic: "Hard-to-manage" preschoolers' peer problems and possible cognitive influences. Journal of Child Psychology and Psychiatry, 41(2), 169-179.

Kaufman, D.M., Solomon, G.E. & Pfeffer, C.R. (Eds.) (1992). Child and adolescent neurology for psychiatrists. Maryland: Williams and Wilkins.

Kaufmann, P.M., Fletcher, J.M., Levin, H.S., Miner, M.E. & Ewing-Cobbs, L. (1993). Attentional disturbance after pediatric closed head injury. Journal of Child Neurology, 8, 348-353.

Kerns, K.A. & Rondeau, L.A. (1998). Development of a continuous performance test for preschool children. Journal of attention disorders, 2(4), 229-238.

Lavigne, J.V., Cicchetti, C., Gibbons, R.D., Binns, H.J., Larsen, L. & DeVito, C. (2001). Oppositional defiant disorder with onset in preschool years: Longitudinal stability and pathways to other disorders. Journal of the American Academy of Child and Adolescent Psychiatry, 40(12), 1393-1400.

Lezak, M.D. (1995). Neuropsychological Assessment. New York: Oxford University Press.

Losier, B.J., McGrath, P.J. & Klein, R.M. (1996). Error patterns on the continuous performance test in non-medicated and medicated samples of children with and without ADHD: A meta-analytic review. Journal of Child Psychology and Psychiatry, 36(4), 971-986.

Luna, B., Minshew, N.J., Garver, K.E., Thulborn, K.R., Eddy, W.F. & Sweeney, J.A. (2002). Neocortical system abnormalities in autism: An fMRI study of spatial working memory. Neurology, 59(6), 834-840.

McEvoy, R.E., Rogers, S.J. & Pennington, B.F. (1993). Executive function and social communication deficits in young autistic children. Journal of Child Psychology and Psychiatry, 34, 563-578.

McGee, R., Williams, S. & Feehan, M. (1992). Attention deficit disorder and age of onset of problem behaviours. Journal of Abnormal Child Psychology, 20(5). 487-502.

McGee, R., Partridge, F., Williams, S. & Silva, P.A. (2001). A twelve year follow-up of preschool hyperactive children. Journal of the American Academy of Child and Adolescent Psychiatry, 30, 224-232.

Mannuzza, S. & Klein, R.G. (2000). Long term prognosis in attention deficit/hyperactivity disorder. Child and Adolescent Psychiatric Clinics of North America, 9(3), 711-726.

Mariani, M.A. & Barkley, R.A. (1997). Neuropsychological and academic functioning in preschool boys with attention deficit hyperactivity disorder. Developmental Neuropsychology, 13(1), 111-129.

Mateer, C.A., Kerns, K.A. & Eso, K.L. (1996). Management of attention and memory disorders following TBI. Journal of Learning Disabilities, 29(6), 618-632.

Miller, L.S., Koplewicz, H.S. & Klein, R.G. (1997). Teacher ratings of hyperactivity, inattention and conduct problems in preschoolers. Journal of Abnormal Child Psychology, 25(2), 113-119.

Montiero-Musten, L., Firestone, P., Pisterman, S., Bennett, S. & Mercer, J. (1997). Effects of methylphenidate on preschool children with ADHD: Cognitive and behavioural functions. Journal of the American Academy of Child and Adolescent Psychiatry, 36(10), 1407-1415.

Oosterlaan, J. & Sergeant, J.A. (1996). Inhibition in ADHD, aggressive, and anxious children: A biologically based model of child psychopathology. Journal of Abnormal Child Psychology, 24(1), 19-36.

Ozonoff, S. (1998). Assessment and remediation of executive dysfunction in autism and asperger syndrome. Asperger Syndrome or High Functioning Autism? Ed. Schopler et al., New York: Plenium Press.

Pascualvaca, D.M., Anthony, B.T., Arnold, L.E., Rebok, G.W., Ahearn, M.B., Kellam, S.G., Mirsky, A.F. (1997). Attention performance in an epidemiological sample of urban children: The role of gender and verbal intelligence. Child Neuropsychology 3(1), 13-27.

Pennington, B.F. (1991). Attention deficit hyperactivity disorder. In Pennington (1991), Diagnosing Learning Disorders: A Neuropsychological Framework. New York.: Guildford Press.

Pennington, B.F., Groisser, D. & Welsh, M.C. (1993). Contrasting deficits in attention deficit hyperactivity disorder versus reading disability. Developmental Psychology, 29, 511-523.

Pennington, B.F. & Ozonoff, S. (1996). Executive functions and developmental psychopathology. Journal of Child Psychology and Psychiatry, 37(1), 51-87.

Peterson, L. & Gannoni, A.F. (1992). Teacher's manual for training social skills while managing student behaviour - Stop Think Do. Camberwell: ACER.

Pliszka, S.R. (2000). Patterns of psychiatric comorbidity with attention deficit/hyperactivity disorder. Child and Adolescent Psychiatric Clinics of North America, 9(3), 525-540.

Ponsford, J., Sloan, S. & Snow, P. (1995). Traumatic Brain Injury: Rehabilitation for Everyday Adaptive Living. East Sussex: Lawrence Erlbaum Associates Ltd.

Popper, C.W. (2000). Pharmacologic alternatives to psychostimulants for treatment of attention deficit/hyperactivity disorder. Child and Adolescent Psychiatric Clinics of North America, 9(3), 605- 646.

Prior, M., White, J., Merrigan, C. & Adler, R. (1998). Preschool behaviour problems in a multicultural urban area. Journal of Paediatric Child Health, 34, 64-169.

Quay, H.C. (1997). Inhibition and attention deficit hyperactivity disorder. Journal of Abnormal Child Psychology, 25(1), 7-13.

Roberts, R.J. & Pennington, B.F. (1996). An interactive framework for examining prefrontal cognitive processes. Developmental Neuropsychology, 12(1), 105-126.

Rose, S.L., Rose, S. A., & Feldman, J. F. (1989). Stability of behaviour problems in very young children. Development and Psychopathology, 1, 5-19.

Sattler, J. (1992). Assessment of Children: Revised and Updated Third Edition. San Diego: Jerome M. Sattler, Publishers, Inc.

Scahill, L. & Schwab-Stone, M. (2000). Epidemiology of attention deficit/hyperactivity disorder in school-aged children. Child and Adolescent Psychiatric Clinics of North America, 9(3), 541-555.

Schachar, R.J., Tannock, R. & Logan G. (1993). Inhibitory control, impulsiveness and attention deficit hyperactivity disorder. . Clinical Psychology Review, 13, 699-720.

Schachar, R.J., Tannock, R., Marriott, M. & Logan G. (1995). Deficient inhibitory control in attention deficit hyperactivity disorder. Journal of Abnormal Child Psychology, 23(4), 411-437.

Schopler, E., Reichler, R.J., Bashford, A., Lansing, M.D. & Marcus, L.M. (1990). Psychoeducational Profile Revised. Austin: Pro-Ed Inc.

Schultz, R.T. & Klin, A. (2002). Genetics of childhood disorders: XLIII. Autism, Part 2: Neural foundations. Journal of the American Academy of Child and Adolescent Psychiatry, 41(10), 1259-1262.

Shallice, T., Marzocchi, G.M., Coser, S., Del Savio, M., Meurter, R.F. & Rumiati, R.I. (2002). Executive function profile of children with attention deficit hyperactivity disorder. Developmental Neuropsychology, 2(1), 43-71.

Shelton, T.L., Barkley, R.A., Crosswait, C., Moorehouse, M., Fletcher, K., Barrett, S., Jenkins, L. & Metevia, L. (1998). Psychiatric and psychological morbidity as a function of adaptive disability in preschool children with aggressive and hyperactive-impulsive-inattentive behaviour. Journal of Abnormal Child Psychology, 26(6), 475-494.

Shue, K.L. & Douglas, V.I. (1992). Attention deficit hyperactivity disorder and the frontal lobe syndrome. Brain & Cognition, 20, 104-124.

Silver, L.B. (2000). Attention-deficit/hyperactivity disorder in adult life. Child and Adolescent Psychiatric Clinics of North America, 9(3), 511-523.

Spreen, O., Risser, A.H. & Edgell, D. (1995). Developmental Neuropsychology. New York: Oxford University Press.

Stubbe, D.E. (2000). Attention-deficit/hyperactivity disorder: An overview and historical perspective. Child and Adolescent Psychiatric Clinics of North America, 9(3), 469-480.

Stuss, D.T. (1992). Biological and psychological development of executive functions. Brain and Cognition, 20, 8-23.

Stuss, D.T. & Benson, F. (1984). Neuropsychological studies of the frontal lobes. Psychological Bulletin, 95(1), 3-28.

Tabachnick, B.G. & Fidell, L.S. (1996). Using Multivariate Statistics (2nd ed.). New York: Harper Collins.

Taylor, H.G. & Alden, J. (1997). Age-related differences in outcomes following childhood brain insults: An introduction and overview. Journal of the International Neuropsychological Society, 3, 555-567.

Teasdale & Jennett (1974). Assessment of coma and impaired consciousness. Lancet, ii, 81-84.

Thatcher, R.W. (1991). Maturation of the human frontal lobes: Evidence for staging. Developmental Neuropsychology, 7(3), 397-419.

Vargha-Khadem, F., Isaacs, E., & Muter, V. (1994). A review of cognitive outcome after unilateral lesions sustained during childhood. Journal of Child Neurology, 9(2), 67-73.

Wachschlag, L.S. & Keenan, K. (2001). Clinical significance and correlates of disruptive behaviour in environmentally at-risk preschoolers. Journal of Clinical Child Psychology, 30(1), 262-275.

Wechsler, D. (1989). Wechsler Preschool and Primary Scale of Intelligence - Revised. San Antonio: The Psychological Corporation: Harcourt Brace Jovanovich, Inc.

Welsh, M.C., Pennington, B.F. & Groisser, D.B. (1991). A normative developmental study of executive function: a window on prefrontal function in children. Developmental Neuropsychology, 7(2), 131-149.

Wilens, T.E. & Spencer, T.J. (2000). Stimulants and attention-deficit/hyperactivity disorder. Child and Adolescent Psychiatric Clinics of North America, 9(3), 573-604.

APPENDIX A

Instructions for Administration of the PDTP

1. **" Child's name" you can take this stamper and put a spot in each of these circles, just like this.**

   (Examiner marks two circles with bingo stamper and then passes it to the child. When child has completed this task satisfactorily, move on to phase 2).

2. **Now "child's name" this time I want you to just mark the shapes that look the same as this one.**

   (Examiner points to the triangle at the top of the page, and hands the bingo stamper to the child. When the child has satisfactorily completed the page, give the following instruction.)

3. **Now we have two more pages of shapes. This time I want you to stamp all the shapes that look the same as this one. When you have stamped all of these shapes you need to turn the page and stamp all these shapes on the next page too. Try to stamp as quickly as you can without missing any, and let me know as soon as you are finished.**

   (If the child satisfactorily completes the task, move on to the Test Trial Phase. If the child makes 6 or more consecutive errors on this task then they should be returned to the initial shape page for further instruction).

4. **Now tell me "child's name", do you have a pussy cat at home, or do you know someone who has a pussy cat at home? Can you tell me the name of the pussy cat? Well now on this next page we have a picture of ".........." the pussy cat. See how ".........." Is standing up and the others are sitting or bending down? I want you to stamp all of the "..........." pussy cats as fast as you can without missing any. When you have stamped all of the ".........." on each page, turn the page over and stamp all of the ".............." pussy cats on the next page, and then the next page until we reach the end. Do you understand? Then lets start.**

   (Examiner begins timing following last instruction. If the child does not have a name for the target cat, use the name Sylvester as a substitute for the task. If the child makes in excess of six errors on the first page of the test trial, return to the practice trial and begin again with instructions. If the child does not automatically proceed with consecutive pages give the instruction " turn the page over and stamp all of the "..........." pussy cats on the next page and then the next page until we reach the end". This reminder may only be given twice. On completion of the test trial proceed to the motor speed trial).

5. **Now "Child's name" could you finish off by stamping each one of these circles as quickly as you can without missing any?**

SCORE SHEET FOR PDTP

Participant #

Completion Time

Motor Speed

Commission Errors

Omission Errors

APPENDIX B

Instructions for Administration of the SST

1. Here is the Shape School

   CONTROL CONDITION

2. **There are two classes in the Shape School**
   Mr. Circle has three children in his class

   The children's names are their colors. Can you tell me the name of the children in Mr. Circle's class? Who is this (examiner points to Red)? **What is her name?** (examiner points to Yellow)? **What is his name** (examiner points to Blue)?

3. **Ms. Square also has three children in her class.**

   Can you tell me the name of the children in Ms. Square's class? Who is this (examiner points to Yellow)? **What is his name** (examiner points to Blue)? **What is her name** (examiner points to Red)?

4. **All of the children from both classes are in line to play on the playground. I want you to tell me the names of the children who are going out to play as fast as you can without making any mistakes. Start here and tell me the names of the children one at a time, across the rows, without skipping any. Okay, get ready, GO!**

   (Begin timing. On scoring sheet, examiner writes C's response in each circle, in order said. Examiner notes total time to complete page).

   INHIBIT CONDITION

5. **Now it is time for lunch. Not all of the children are ready for lunch. The ones who have happy faces, like these, are ready for lunch.**

   Can you tell me the names of who is ready for lunch; who has a happy face? (If child misses, examiner points to Yellow then Red) **Yellow and Red have happy faces. They are ready for lunch, so you told me their names.**

6. **These children are not ready for lunch. They have sad faces.**

   When we play the next game, do NOT call the names of the children with sad faces. So if Blue was in line, would call his name? NO, he is sad, you would not say the names of the children with sad faces.

7. **Now, a few of the children are here for a practice. I want you to tell me the names of the children with happy faces. The ones with the sad faces are not ready for lunch, so DO NOT tell me their names. Do you understand? Lets practice a few.**

8. **Good job! Now all of the children from all of the classes are here. I wantyou to tell me the names of the children with the happy faces as fast as you can without any mistakes. Start here and tell me the names of the children one at a time, across the rows, without skipping any. Remember, tell me the names of the children with happy faces, and do NOT tell me the names of the children with sad faces. Do you understand? Get ready, GO!**

(Begin timing. On scoring sheet, E writes C's response in each circle, in order said. E notes time to complete page).

<u>SWITCH CONDITION</u>

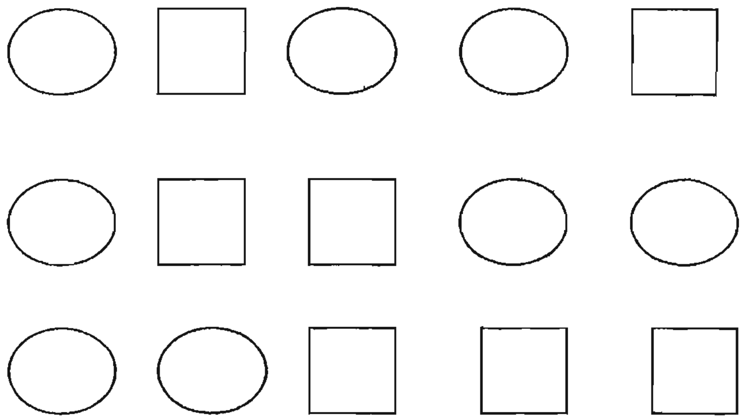
9. **All of the children finished lunch. Now it is story time. Ms. Hats class are going to read stories too. Children from Ms. Hats class have hats on. Their names are their shapes. All of the children are lined up to go to story time. You tell me the names of the children who are going to story time. Remember the color is the name of the children without the hats and the shape is the name of the children with the hats. Do you understand? Lets practice a few.**

10. **Good job! It is story time. The children from all of the classes are in line. I want you to tell me the names of the children who are going to story time as fast as you can without making any mistakes. Start here and tell me the names of the children one at a time, across the rows, without skipping any. Okay, get ready, GO!**

(Begin timing. On scoring sheet, E writes C's response in each circle, in order said. E notes total time to complete page).

THE SHAPE SCHOOL

CONTROL CONDITION



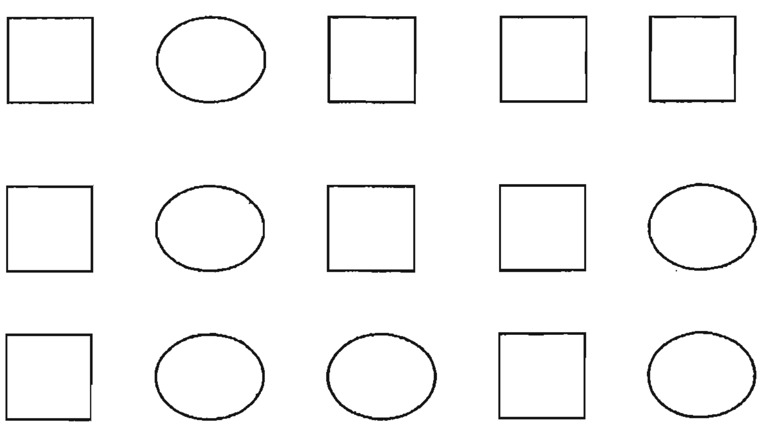
TIME __________

CORRECT ________

ERRORS _________

EFFICIENCY _________

INHIBIT CONDITION



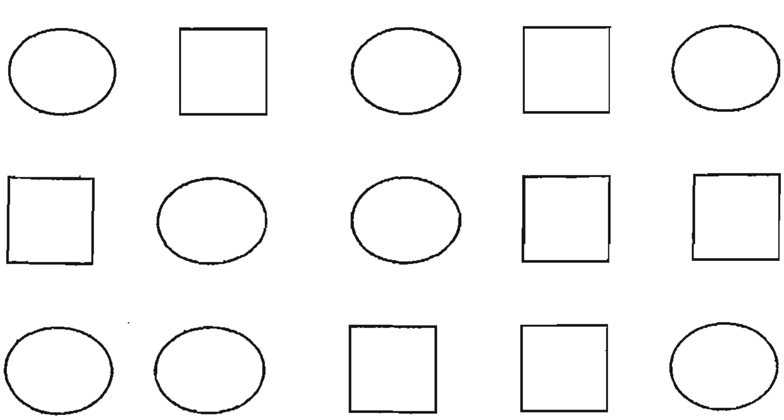
TIME ______________

CORRECT__________

ERRORS ___________

EFFICIENCY ________

SWITCH CONDITION



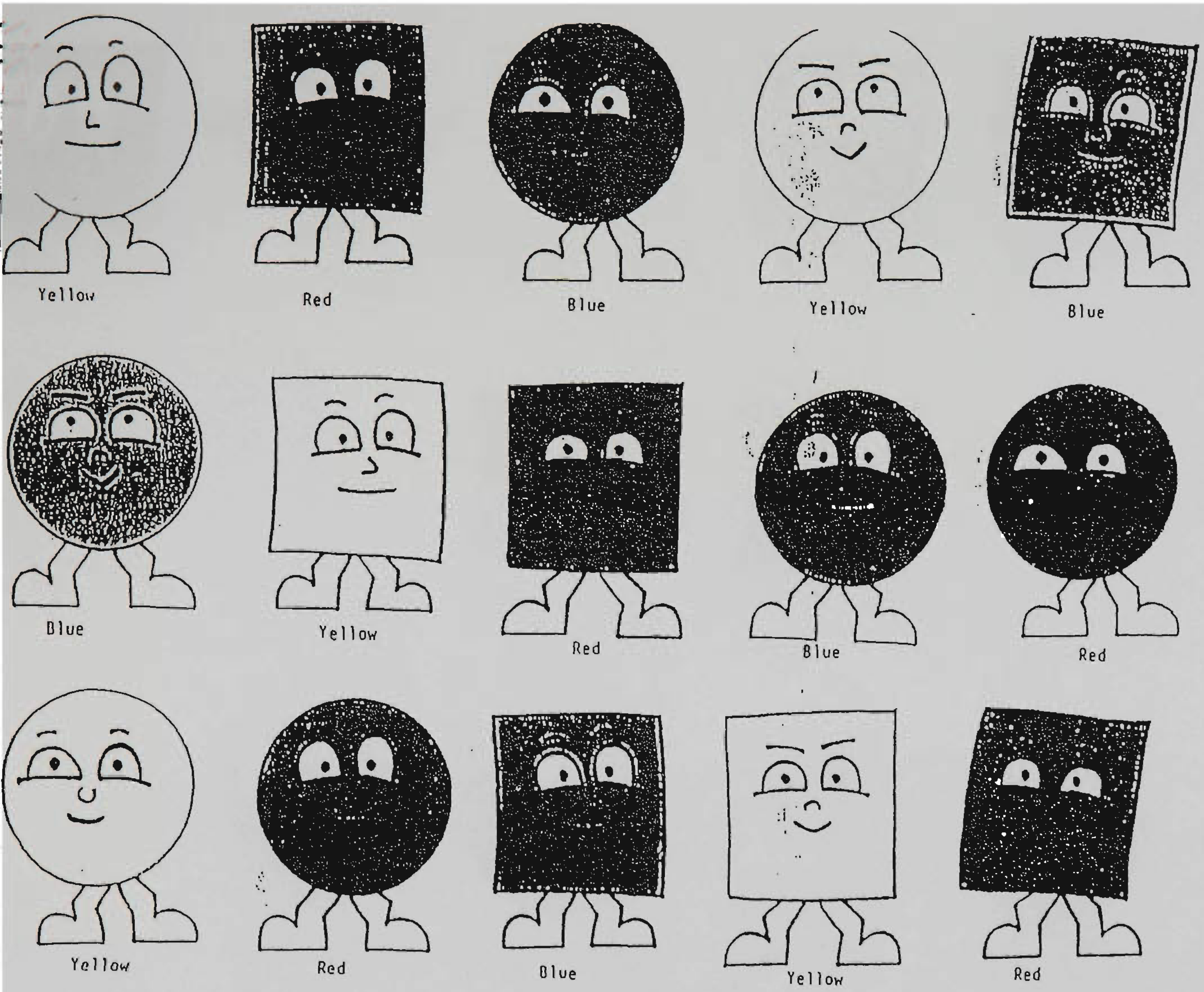
TIME ______________

CORRECT __________

ERRORS ____________

EFFICIENCY ________

THE SHAPE SCHOOL
Control Condition



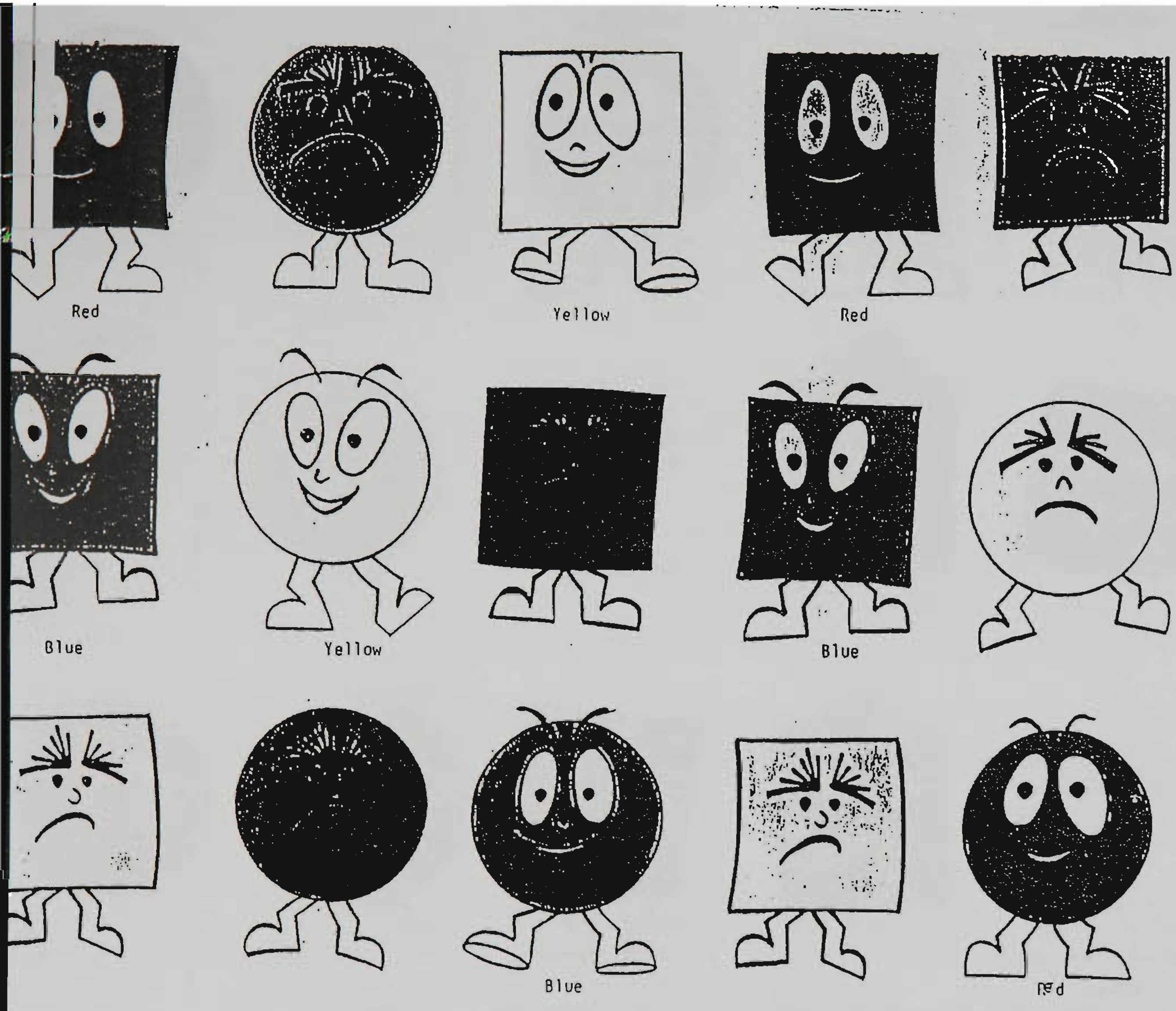
Time:__________(secs)

Correct:__________

Errors:__________

Efficiency:__________
(correct - errors/time)

THE SHAPE SCHOOL
Inhibit Condition



Time:__________(secs)

ICorrect:__________

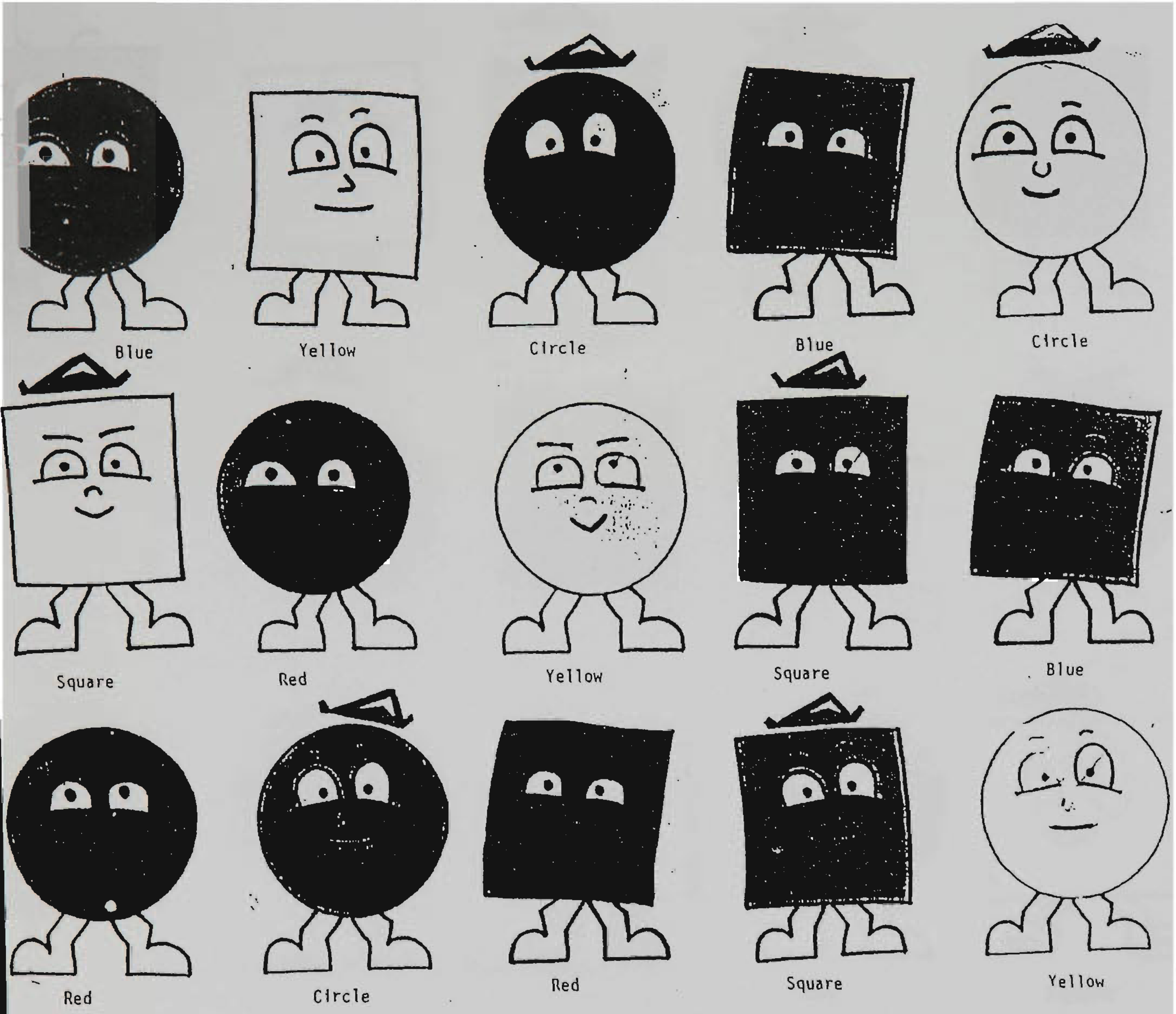
NCorrect:__________

IErrors:__________

NErrors:__________

Efficiency:__________
(correct-errors/time)

THE SHAPE SCHOOL
Switch Condition



Time:__________(secs)

SCorrect:__________

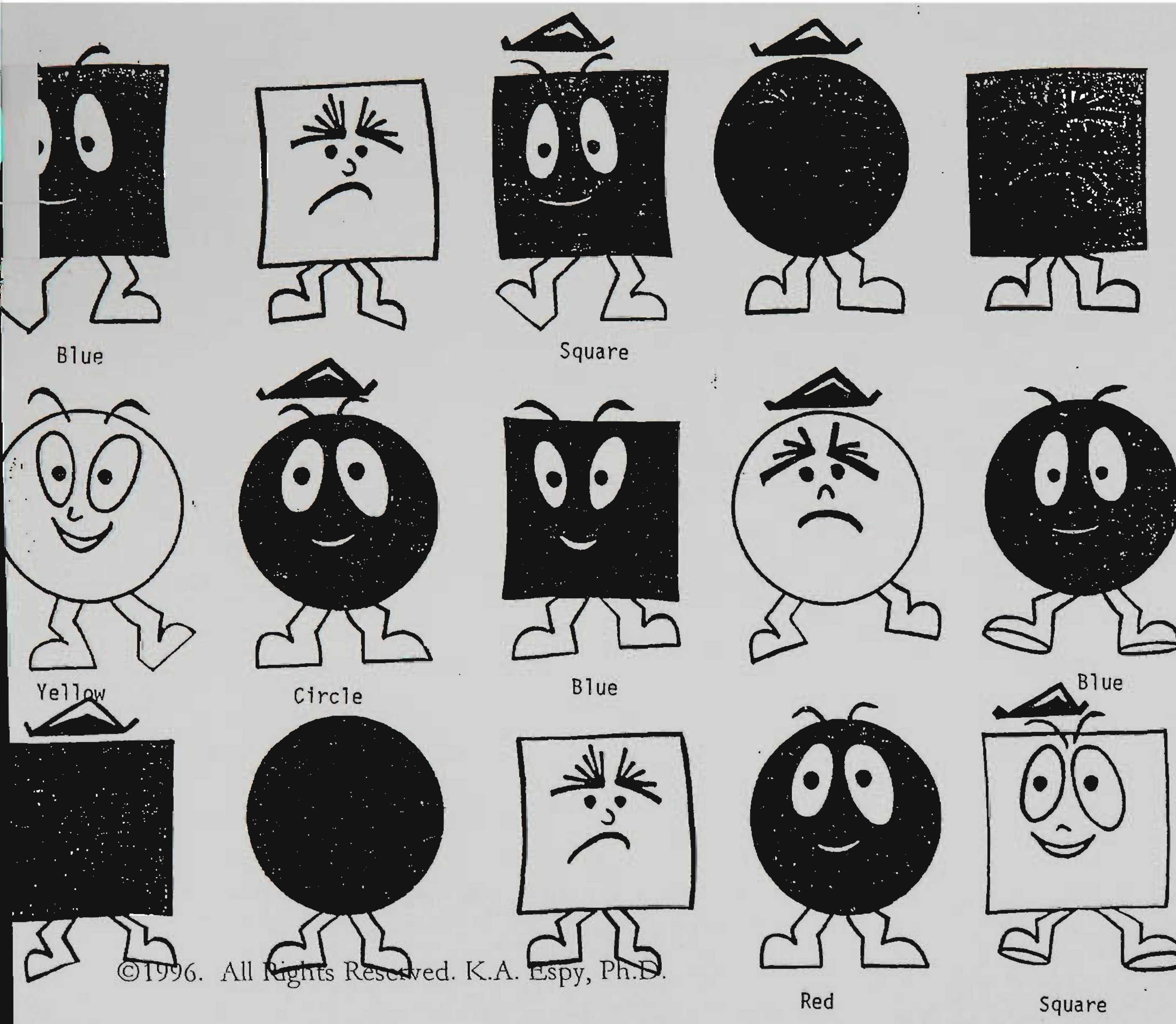
NCorrect:__________

SErrors:__________

NErrors:__________

Efficiency:__________
(correct-errors/time)

THE SHAPE SCHOOL
Both Condition



Time:__________(secs)

ICorrect:__________

SCorrect:__________

NCorrect:__________

IErrors:__________

SErrors:__________

NErrors:__________

Efficiency:__________

APPENDIX C

Victoria University of Technology

PO Box 14428
Melbourne City
MC 8001 Australia

Telephone:
(03) 9688 4000
Facsimile:
(03) 9689 4069

VICTORIA UNIVERSITY OF TECHNOLOGY

28th October 2002,

Re: Research Project - Inattention and Dysinhibition in Preschoolers at Risk of Disruptive Behaviour Disorder

Dear Parent,

As a Doctoral student of Victoria University, I am currently researching executive functioning in normally developing preschool age children. Your Kindergarten Teacher has generously agreed to allow me to approach parents, with the aim of recruiting a sample of preschool children to participate in this study. It is anticipated this study will provide valuable information, that will in turn promote further investigations into this under-researched area of child development.

Each child and their parent/s would be required to participate in a testing session of approximately 40 minutes. A total of four separate tasks would be administered over the session, with short breaks in between each task. The tasks are tailored to the abilities of preschool children and each takes approximately 10 minutes to complete. A description of each of the tasks and an outline of the testing program is attached for your information.

All data collected from this study will be held in strict confidence and parents will be offered if desired, an assessment report on their child's development as reflected in the measures used in this study. Parent's may also request a copy of this report be sent to their Preschool/School Teacher for consideration in their child's ongoing education.

If after reading the details of the study you would like to volunteer the participation of your preschooler, please complete the attached consent form and questionairre and return it to your preschool, where it will be placed in a sealed envelope. In due course I will contact you by telephone to discuss a convenient appointment time and place for the testing session.

Any further questions may be directed to Ms. Karen Parker on 0412 640 263 or Dr. Alan Tucker at Victoria University Psychology Clinic on 9365.2353. Thankyou for your consideration of this project

Yours sincerely,

Karen Parker
Clinical Neuropsychology Intern
Victoria University

Executive Functioning in Preschool Children - Utility of Two New Instruments

Details of Procedure

- The sample will consist of 40 normally developing children aged between 4 years and 5 years 11 months.

- Participation is voluntary and participants are free to withdraw at any stage.

- On receipt of signed consent form, parents will be contacted by telephone to gather details of their child's developmental and medical history. Appointments will be negotiated for initial testing session. Appointment times, a map for locating the testing location, and a copy of the Child Behaviour Checklist (to be completed by parent/s and returned at first appointment) will subsequently be mailed to all participants.

- After a brief introduction and outline of proceedings two tests of general intellectual functioning will be administered to each child. The first is a measure of verbal ability and the second is a measure of non-verbal ability. These tasks help us to determine a child's ability to comprehend and carry out the instructions on the following tasks. Each of these initial task takes approximately 10 minutes to administer, and will be followed by a short play break of 5 minutes.

- The first task will be a pencil and paper task where each child will be asked to detect a target picture amongst a series of distracter pictures. This task measures a child's ability to sustain attention and inhibit an automatic response to a visual task. The task takes approximately 15 minutes to administer, and will be followed by a short play break of 5 minutes.

- The second task takes the form of a storybook through which the child progresses, responding to questions that tap into the child's ability to inhibit a learned response and switch between specific ways of thinking.

PARENT CONSENT FORM

Participants name ____

DOB ___/___/____

Age __________

Parent/s name/s 1. ________________________________

2. ________________________________

Occupation 1. ________________________________

2. ________________________________

Telephone/Contact Number __________________________

Most Appropriate Contact Time _______________________

I/we ____ agree to my/our

son/daughter ___________________________participating in the above study.

Signed ____ Date ___/___/___

Signed ____ Date ___/___/___

Please return signed consent form with completed questionairre to your preschool teacher.

Inattention & Dysinhibition in Preschoolers
Doctor of Clinical Neuropsychology – Research Thesis

Parent Questionnaire

Demographic Information

Child's Name ………………………………………………………………………………… Reference No. ____________

Date of Birth ……/……/…… Age ……yrs ……mths ……dys Gender M / F

Parent/s Name/s 1. ……………………… 2. ……………………… Contact Number/s ………………………

Occupation/s 1. ……………………… 2. ……………………… ………………………

Years of Education 1. ……………………… 2. ………………………

Date questionnaire completed ……/……/……

Developmental History

1. Were there any complications with the birth of your child? (pre-mature delivery, hypoxia, pre-eclampsia, jaundice etc.) If so, please give details.
____
2. At what age did your child begin walking?
____
3. At what age did your child begin talking? That is combining two or more words meaningfully.
____
4. At what age did he/she begin to dress unassisted? (not shoelaces, belts or buckles)
____

Medical History

1. Has your child ever suffered from any illnesses or disorders affecting the central nervous system? (epilepsy,hydrocephalus,meningitis,encephalitis,toxin exposure)
____
2. Has your child ever been treated for a psychological disorder?
____
3. Has your child had any major accidents or injuries?
____
4. Is your child on any medication? If so,

    a. What is the name of the medication? (I) ________ (ii) ________ (iii) ________

    b. What is the dosage? (I) ________ (ii) ________ (iii) ________

    c. How long has your child been taking this medication? (I) ________ (ii) ________ (iii) ________

5. Does your child have any uncorrected visual problems?
____
6. Does your child have any behaviour problems or developmental differences not already covered by the earlier questions?
____

APPENDIX D

DISRUPTIVE BEHAVIOUR DISORDERS/PRESCHOOLERS
PARTICIPANT SUMMARY SHEET

GROUP 1 2 ID # ☐ ☐ ☐

SES RATING ☐

CBCL SCORE ☐

WPPSI

INFORMATION ☐

PICTURE COMPLETION ☐ PRO-RATED ☐

PPVT

	SHAPE		CAT	MOTOR
SPEED				
TIME	☐	TIME	☐	☐
COMISSION	☐	COMISSION	☐	
OMISSION	☐	OMISSION	☐	

SHAPE SCHOOL

CONTROL

TIME ☐

EFFICIENCY ☐

INHIBIT

TIME ☐

EFFICIENCY ☐

SWITCH

TIME ☐

EFFICIENCY ☐

BOTH

TIME ☐

EFFICIENCY ☐

APPENDIX E

VICTORIA UNIVERSITY

Psychology Department Ethics Committee

Approval Form

Name of Student:	Karen Parker
Name of Supervisor:	Alan Tucker
Title of Project:	Disruptive bhv disorders ....

Recommendations:

APPLICATION APPROVED

Comments:

Name of Chair of Ethics Committee *Brett Furlonger*

Signature: [redacted] ..... Date: 22.12.98

Victoria University
Department of Psychology
Human Research Ethics Committee
Chair: Heather Gridley

PO Box 14428
MELBOURNE CITY MC VIC 8001
Australia

Telephone:
(03) 9688 5224

Facsimile:
(03) 9365 2218
Email:
Heather.Gridley@vu.edu.au

Footscray Campus

TO WHOM IT MAY CONCERN

Tuesday, 18th March, 2003

Thank you for notifying us of the changes to your original application.

The project titled "Disruptive Behaviour Disorders in Preschool Children – Inattention or Dysinhibition?" conducted by Ms. Karen Parker under the supervision of Dr. Alan Tucker received ethics approval for the changes in her project from the Department of Psychology's Human Research Ethics Committee on the18/03/03.

This project is been undertaken as part of the Master of Psychology (Clinical Neuropsychology) program conducted at Victoria University.

Yours Sincerely
Heather Gridley

Chair
Department of Psychology
Human Research Ethics Committee

Victoria University of Technology

PO Box 14428
Melbourne City
MC 8001 Australia

Telephone:
(03) 9365 2111
Facsimile:
(03) 9366 4852

St Albans Campus
McKechnie Street
St Albans

VICTORIA UNIVERSITY OF TECHNOLOGY

Securing your Future

The Manager

12th Ocober 2002,

Dear Sir/Madam,

As a Doctoral student of Victoria University, I am presently undertaking a research project investigating executive functioning skills in normally developing preschool. The project is part of course requirement for the Doctor of Psychology-Clinical Neuropsychology and I am being supervised in this project by Dr. Alan Tucker of Victoria University, a registered Clinical Neuropsychologist and Co-Director of the University Psychology Clinic.

There are many disorders of childhood that display difficulties in executive functioning (goal directed behaviour). Often the extent of these difficulties is not fully apparent until early adulthood when underlying structures and cognitive skills are fully developed. The importance of early diagnosis and intervention is imperitive to maximise the learning experiences for these children. Thus, there is an immediate need to implement systematic and prospective research that examines executive functioning in the younger child. The present study aims to address this important issue. A greater understanding of the normal development of preschool children and the disorders of executive functioning is a step closer to establishing strategies for intervention, prevention and cure.

The study aims to recruit a sample of 40 normally developing children. The age group of interest to the present study consists of children between the age of 4.5 and 5.9 years who have not begun formal schooling. Interested participants would be issued an 'information pack' containing full details of the study, along with a parent consent form. Upon return of the signed consent form, parent/s would be contacted by telephone to gather background information pertaining to their child. An appointment would then be made for the initial testing session. Participation is on a voluntary basis and participants are free to withdraw at any stage.

Each child and their parent/s would be required to attend a centre (yet to be finalised) within close proximity, to participate in a testing session of approximately 40 minutes duration. A total of four separate tasks measuring verbal and non verbal abilities, attention and inhibitory control, would be administered over the 40 minute session. The tasks are tailored to preschool abilities and each takes less than 10 minutes to complete. Play breaks are scheduled between each task and all data collection will take place before 2pm, to allow for the effects of fatigue. A description of each of the tasks and an outline of the testing program is attached for your information.

All data collected from this study will be held in strict confidence.

Parents will be offered an assessment report on their child's development as reflected in the measures used in this study. Parent's may also request a copy of this report be sent to their Kindergarten Teacher for consideration in their child's ongoing education.

Due to the size of the control group, the participation of any number of preschool children from your kindergarten as part of the full sample, would remain a valuable contribution to this study. I will be in contact by telephone in the next few days to discuss with you the possibility of your kindergarten's participation in this research.

Thankyou for your consideration,

Yours sincerely,

Karen Parker
Clinical Neuropsychology Intern

APPENDIX F

T-Test

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
SES	1.00	17	5.0706	.7346	.1782
	2.00	16	4.6375	.7949	.1987

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
SES	Equal variances assumed	.017	.898	1.627	31	.114	.4331	.2662	-.1099	.9761
	Equal variances not assumed			1.623	30.396	.115	.4331	.2669	-.1117	.9779

T-Test

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
WPPSI	1.00	17	116.7059	11.4878	2.7862
	2.00	16	107.9375	9.8757	2.4689

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
WPPSI	Equal variances assumed	.317	.578	2.344	31	.026	8.7684	3.7402	1.1402	16.3966
	Equal variances not assumed			2.355	30.761	.025	8.7684	3.7227	1.1735	16.3633

T-Test

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
GENDER	1.00	17	1.5882	.5073	.1230
	2.00	16	1.5000	.5164	.1291

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
GENDER	Equal variances assumed	.483	.492	.495	31	.624	8.824E-02	.1782	-.2753	.4518
	Equal variances not assumed			.495	30.801	.624	8.824E-02	.1783	-.2756	.4521

General Linear Model

Between-Subjects Factors

		N
GROUP	1.00	17
	2.00	16

Descriptive Statistics

	GROUP	Mean	Std. Deviation	N
PDPTCOM	1.00	3.1176	2.1472	17
	2.00	1.8125	1.8697	16
	Total	2.4848	2.0935	33
PDPTOMM	1.00	4.1765	3.9723	17
	2.00	3.8125	3.3110	16
	Total	4.0000	3.6142	33
PDPTMOTR	1.00	54.4118	12.8698	17
	2.00	56.3125	12.3759	16
	Total	55.3333	12.4716	33
PDPTTIME	1.00	628.1765	174.4417	17
	2.00	625.2500	169.0943	16
	Total	626.7576	169.1747	33
SSTCONTR	1.00	.6982	.1561	17
	2.00	.7563	.2584	16
	Total	.7264	.2106	33
SSTINHIB	1.00	.7212	.1523	17
	2.00	.7775	.2766	16
	Total	.7485	.2197	33
SSTSWITC	1.00	.2059	.1428	17
	2.00	.2837	.1256	16
	Total	.2436	.1384	33
TIMECONT	1.00	.2235	4.847E-02	17
	2.00	.2094	6.277E-02	16
	Total	.2167	5.543E-02	33
TIMEINHI	1.00	.2165	5.098E-02	17
	2.00	.2144	7.677E-02	16
	Total	.2155	6.374E-02	33
TIMESWIT	1.00	.9400	.5488	17
	2.00	.6375	.3988	16
	Total	.7933	.4987	33
CORRCONT	1.00	15.0000	.0000	17
	2.00	14.4375	.8139	16
	Total	14.7273	.6261	33
CORRINHI	1.00	15.0000	.0000	17
	2.00	14.7500	.5774	16
	Total	14.8788	.4151	33
CORRSWIT	1.00	12.4118	3.0426	17
	2.00	12.8750	1.8212	16
	Total	12.6364	2.4977	33

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df
Intercept	Pillai's Trace	.989	123.880[a]	13.000	18.000
	Wilks' Lambda	.011	123.880[a]	13.000	18.000
	Hotelling's Trace	89.469	123.880[a]	13.000	18.000
	Roy's Largest Root	89.469	123.880[a]	13.000	18.000
WPPSI	Pillai's Trace	.249	.459[a]	13.000	18.000
	Wilks' Lambda	.751	.459[a]	13.000	18.000
	Hotelling's Trace	.331	.459[a]	13.000	18.000
	Roy's Largest Root	.331	.459[a]	13.000	18.000
GROUP	Pillai's Trace	.447	1.121[a]	13.000	18.000
	Wilks' Lambda	.553	1.121[a]	13.000	18.000
	Hotelling's Trace	.809	1.121[a]	13.000	18.000
	Roy's Largest Root	.809	1.121[a]	13.000	18.000

Multivariate Tests[b]

Effect		Sig.	Eta Squared
Intercept	Pillai's Trace	.000	.989
	Wilks' Lambda	.000	.989
	Hotelling's Trace	.000	.989
	Roy's Largest Root	.000	.989
WPPSI	Pillai's Trace	.922	.249
	Wilks' Lambda	.922	.249
	Hotelling's Trace	.922	.249
	Roy's Largest Root	.922	.249
GROUP	Pillai's Trace	.403	.447
	Wilks' Lambda	.403	.447
	Hotelling's Trace	.403	.447
	Roy's Largest Root	.403	.447

a. Exact statistic

b. Design: Intercept+WPPSI+GROUP

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
Corrected Model	PDPTCOM	14.157[a]	2	7.078
	PDPTOMM	1.469[b]	2	.734
	PDPTMOTR	122.799[c]	2	61.400
	PDPTTIME	141534.822[d]	2	70767.411
	SSTCONTR	3.184E-02[e]	2	1.592E-02
	SSTINHIB	2.638E-02[f]	2	1.319E-02
	SSTSWITC	6.611E-02[g]	2	3.305E-02
	TIMECONT	1.810E-03[h]	2	9.050E-04
	TIMEINHI	9.714E-05[i]	2	4.857E-05
	TIMESWIT	.903[j]	2	.451
	CORRCONT	2.608[k]	2	1.304
	CORRINHI	.534[l]	2	.267
	CORRSWIT	9.014[m]	2	4.507
Intercept	PDPTCOM	.935	1	.935
	PDPTOMM	2.268	1	2.268
	PDPTMOTR	1516.794	1	1516.794
	PDPTTIME	499390.621	1	499390.621
	SSTCONTR	.103	1	.103
	SSTINHIB	.146	1	.146
	SSTSWITC	1.085E-05	1	1.085E-05
	TIMECONT	1.620E-02	1	1.620E-02
	TIMEINHI	1.132E-02	1	1.132E-02
	TIMESWIT	.643	1	.643
	CORRCONT	60.743	1	60.743
	CORRINHI	64.341	1	64.341
	CORRSWIT	16.167	1	16.167
WPPSI	PDPTCOM	.116	1	.116
	PDPTOMM	.377	1	.377
	PDPTMOTR	93.021	1	93.021
	PDPTTIME	141464.232	1	141464.232
	SSTCONTR	4.098E-03	1	4.098E-03
	SSTINHIB	2.334E-04	1	2.334E-04
	SSTSWITC	1.613E-02	1	1.613E-02
	TIMECONT	1.586E-04	1	1.586E-04
	TIMEINHI	6.094E-05	1	6.094E-05
	TIMESWIT	.149	1	.149
	CORRCONT	5.355E-05	1	5.355E-05
	CORRINHI	1.904E-02	1	1.904E-02
	CORRSWIT	7.246	1	7.246

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
GROUP	PDPTCOM	11.029	1	11.029
	PDPTOMM	.525	1	.525
	PDPTMOTR	1.655	1	1.655
	PDPTTIME	23623.608	1	23623.608
	SSTCONTR	3.181E-02	1	3.181E-02
	SSTINHIB	2.401E-02	1	2.401E-02
	SSTSWITC	6.519E-02	1	6.519E-02
	TIMECONT	1.793E-03	1	1.793E-03
	TIMEINHI	6.328E-06	1	6.328E-06
	TIMESWIT	.902	1	.902
	CORRCONT	2.207	1	2.207
	CORRINHI	.511	1	.511
	CORRSWIT	5.154	1	5.154
Error	PDPTCOM	126.086	30	4.203
	PDPTOMM	416.531	30	13.884
	PDPTMOTR	4854.534	30	161.818
	PDPTTIME	774307.239	30	25810.241
	SSTCONTR	1.387	30	4.624E-02
	SSTINHIB	1.518	30	5.061E-02
	SSTSWITC	.547	30	1.823E-02
	TIMECONT	9.652E-02	30	3.217E-03
	TIMEINHI	.130	30	4.331E-03
	TIMESWIT	7.056	30	.235
	CORRCONT	9.937	30	.331
	CORRINHI	4.981	30	.166
	CORRSWIT	190.622	30	6.354
Total	PDPTCOM	344.000	33	
	PDPTOMM	946.000	33	
	PDPTMOTR	106016.000	33	
	PDPTTIME	13879069.00	33	
	SSTCONTR	18.830	33	
	SSTINHIB	20.032	33	
	SSTSWITC	2.572	33	
	TIMECONT	1.648	33	
	TIMEINHI	1.662	33	
	TIMESWIT	28.728	33	
	CORRCONT	7170.000	33	
	CORRINHI	7311.000	33	
	CORRSWIT	5469.000	33	

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.	Eta Squared
Corrected Model	PDPTCOM	1.684	.203	.101
	PDPTOMM	.053	.949	.004
	PDPTMOTR	.379	.687	.025
	PDPTTIME	2.742	.081	.155
	SSTCONTR	.344	.711	.022
	SSTINHIB	.261	.772	.017
	SSTSWITC	1.813	.181	.108
	TIMECONT	.281	.757	.018
	TIMEINHI	.011	.989	.001
	TIMESWIT	1.919	.164	.113
	CORRCONT	3.937	.030	.208
	CORRINHI	1.609	.217	.097
	CORRSWIT	.709	.500	.045
Intercept	PDPTCOM	.222	.641	.007
	PDPTOMM	.163	.689	.005
	PDPTMOTR	9.373	.005	.238
	PDPTTIME	19.349	.000	.392
	SSTCONTR	2.238	.145	.069
	SSTINHIB	2.883	.100	.088
	SSTSWITC	.001	.981	.000
	TIMECONT	5.034	.032	.144
	TIMEINHI	2.614	.116	.080
	TIMESWIT	2.733	.109	.084
	CORRCONT	183.377	.000	.859
	CORRINHI	387.523	.000	.928
	CORRSWIT	2.544	.121	.078
WPPSI	PDPTCOM	.028	.869	.001
	PDPTOMM	.027	.870	.001
	PDPTMOTR	.575	.454	.019
	PDPTTIME	5.481	.026	.154
	SSTCONTR	.089	.768	.003
	SSTINHIB	.005	.946	.000
	SSTSWITC	.885	.354	.029
	TIMECONT	.049	.826	.002
	TIMEINHI	.014	.906	.000
	TIMESWIT	.632	.433	.021
	CORRCONT	.000	.990	.000
	CORRINHI	.115	.737	.004
	CORRSWIT	1.140	.294	.037

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.	Eta Squared
GROUP	PDPTCOM	2.624	.116	.080
	PDPTOMM	.038	.847	.001
	PDPTMOTR	.010	.920	.000
	PDPTTIME	.915	.346	.030
	SSTCONTR	.688	.413	.022
	SSTINHIB	.474	.496	.016
	SSTSWITC	3.576	.068	.107
	TIMECONT	.557	.461	.018
	TIMEINHI	.001	.970	.000
	TIMESWIT	3.837	.059	.113
	CORRCONT	6.662	.015	.182
	CORRINHI	3.079	.089	.093
	CORRSWIT	.811	.375	.026
Error	PDPTCOM			
	PDPTOMM			
	PDPTMOTR			
	PDPTTIME			
	SSTCONTR			
	SSTINHIB			
	SSTSWITC			
	TIMECONT			
	TIMEINHI			
	TIMESWIT			
	CORRCONT			
	CORRINHI			
	CORRSWIT			
Total	PDPTCOM			
	PDPTOMM			
	PDPTMOTR			
	PDPTTIME			
	SSTCONTR			
	SSTINHIB			
	SSTSWITC			
	TIMECONT			
	TIMEINHI			
	TIMESWIT			
	CORRCONT			
	CORRINHI			
	CORRSWIT			

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.	Eta Squared
Corrected Total	PDPTCOM			
	PDPTOMM			
	PDPTMOTR			
	PDPTTIME			
	SSTCONTR			
	SSTINHIB			
	SSTSWITC			
	TIMECONT			
	TIMEINHI			
	TIMESWIT			
	CORRCONT			
	CORRINHI			
	CORRSWIT			

a. R Squared = .101 (Adjusted R Squared = .041)

b. R Squared = .004 (Adjusted R Squared = -.063)

c. R Squared = .025 (Adjusted R Squared = -.040)

d. R Squared = .155 (Adjusted R Squared = .098)

e. R Squared = .022 (Adjusted R Squared = -.043)

f. R Squared = .017 (Adjusted R Squared = -.048)

g. R Squared = .108 (Adjusted R Squared = .048)

h. R Squared = .018 (Adjusted R Squared = -.047)

i. R Squared = .001 (Adjusted R Squared = -.066)

j. R Squared = .113 (Adjusted R Squared = .054)

k. R Squared = .208 (Adjusted R Squared = .155)

l. R Squared = .097 (Adjusted R Squared = .037)

m. R Squared = .045 (Adjusted R Squared = -.019)

General Linear Model

Between-Subjects Factors

		N
GENDER	1.00	15
	2.00	18

Descriptive Statistics

	GENDER	Mean	Std. Deviation	N
PDPTCOM	1.00	2.2000	1.5213	15
	2.00	2.7222	2.4925	18
	Total	2.4848	2.0935	33
PDPTOMM	1.00	3.1333	2.0999	15
	2.00	4.7222	4.4432	18
	Total	4.0000	3.6142	33
PDPTMOTR	1.00	61.2000	14.6930	15
	2.00	50.4444	7.7020	18
	Total	55.3333	12.4716	33
PDPTTIME	1.00	709.1333	174.9718	15
	2.00	558.1111	132.9798	18
	Total	626.7576	169.1747	33
SSTCONTR	1.00	.6680	.2157	15
	2.00	.7750	.1991	18
	Total	.7264	.2106	33
SSTINHIB	1.00	.7380	.2300	15
	2.00	.7572	.2170	18
	Total	.7485	.2197	33
SSTSWITC	1.00	.2073	.1253	15
	2.00	.2739	.1449	18
	Total	.2436	.1384	33
TIMECONT	1.00	.2353	5.514E-02	15
	2.00	.2011	5.212E-02	18
	Total	.2167	5.543E-02	33
TIMEINHI	1.00	.2173	6.006E-02	15
	2.00	.2139	6.835E-02	18
	Total	.2155	6.374E-02	33
TIMESWIT	1.00	.9240	.5553	15
	2.00	.6844	.4319	18
	Total	.7933	.4987	33
CORRCONT	1.00	14.7333	.5936	15
	2.00	14.7222	.6691	18
	Total	14.7273	.6261	33
CORRINHI	1.00	14.8000	.5606	15
	2.00	14.9444	.2357	18
	Total	14.8788	.4151	33
CORRSWIT	1.00	12.1333	2.6150	15
	2.00	13.0556	2.3880	18
	Total	12.6364	2.4977	33

Box's Test of Equality of Covariance Matrices[a]

Box's M	231.421
F	1.345
df1	91
df2	2797.418
Sig.	.018

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept+WPPSI+GENDER

Multivariate Tests[b]

Effect		Value	F	Hypothesis df
Intercept	Pillai's Trace	.991	149.941[a]	13.000
	Wilks' Lambda	.009	149.941[a]	13.000
	Hotelling's Trace	108.290	149.941[a]	13.000
	Roy's Largest Root	108.290	149.941[a]	13.000
WPPSI	Pillai's Trace	.269	.508[a]	13.000
	Wilks' Lambda	.731	.508[a]	13.000
	Hotelling's Trace	.367	.508[a]	13.000
	Roy's Largest Root	.367	.508[a]	13.000
GENDER	Pillai's Trace	.554	1.722[a]	13.000
	Wilks' Lambda	.446	1.722[a]	13.000
	Hotelling's Trace	1.243	1.722[a]	13.000
	Roy's Largest Root	1.243	1.722[a]	13.000

Multivariate Tests[b]

Effect		Error df	Sig.
Intercept	Pillai's Trace	18.000	.000
	Wilks' Lambda	18.000	.000
	Hotelling's Trace	18.000	.000
	Roy's Largest Root	18.000	.000
WPPSI	Pillai's Trace	18.000	.891
	Wilks' Lambda	18.000	.891
	Hotelling's Trace	18.000	.891
	Roy's Largest Root	18.000	.891
GENDER	Pillai's Trace	18.000	.141
	Wilks' Lambda	18.000	.141
	Hotelling's Trace	18.000	.141
	Roy's Largest Root	18.000	.141

a. Exact statistic

b. Design: Intercept+WPPSI+GENDER

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
PDPTCOM	4.395	1	31	.044
PDPTOMM	2.722	1	31	.109
PDPTMOTR	7.090	1	31	.012
PDPTTIME	3.365	1	31	.076
SSTCONTR	.044	1	31	.835
SSTINHIB	.106	1	31	.747
SSTSWITC	.336	1	31	.567
TIMECONT	.126	1	31	.725
TIMEINHI	.439	1	31	.513
TIMESWIT	.631	1	31	.433
CORRCONT	.023	1	31	.881
CORRINHI	4.431	1	31	.044
CORRSWIT	.113	1	31	.739

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+WPPSI+GENDER

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
Corrected Model	PDPTCOM	4.630[a]	2	2.315
	PDPTOMM	20.715[b]	2	10.358
	PDPTMOTR	984.219[c]	2	492.110
	PDPTTIME	263654.203[d]	2	131827.102
	SSTCONTR	9.676E-02[e]	2	4.838E-02
	SSTINHIB	6.418E-03[f]	2	3.209E-03
	SSTSWITC	3.624E-02[g]	2	1.812E-02
	TIMECONT	9.988E-03[h]	2	4.994E-03
	TIMEINHI	2.238E-04[i]	2	1.119E-04
	TIMESWIT	.478[j]	2	.239
	CORRCONT	.420[a]	2	.210
	CORRINHI	.178[k]	2	8.906E-02
	CORRSWIT	9.396[l]	2	4.698
Intercept	PDPTCOM	2.091E-02	1	2.091E-02
	PDPTOMM	3.943	1	3.943
	PDPTMOTR	1427.726	1	1427.726
	PDPTTIME	404132.426	1	404132.426
	SSTCONTR	.216	1	.216
	SSTINHIB	.232	1	.232
	SSTSWITC	1.872E-02	1	1.872E-02
	TIMECONT	1.077E-02	1	1.077E-02
	TIMEINHI	1.235E-02	1	1.235E-02
	TIMESWIT	.132	1	.132
	CORRCONT	59.485	1	59.485
	CORRINHI	69.768	1	69.768
	CORRSWIT	31.276	1	31.276
WPPSI	PDPTCOM	2.398	1	2.398
	PDPTOMM	5.953E-02	1	5.953E-02
	PDPTMOTR	37.730	1	37.730
	PDPTTIME	77045.654	1	77045.654
	SSTCONTR	3.085E-03	1	3.085E-03
	SSTINHIB	3.395E-03	1	3.395E-03
	SSTSWITC	8.909E-08	1	8.909E-08
	TIMECONT	4.062E-04	1	4.062E-04
	TIMEINHI	1.268E-04	1	1.268E-04
	TIMESWIT	8.674E-03	1	8.674E-03
	CORRCONT	.419	1	.419
	CORRINHI	7.409E-03	1	7.409E-03
	CORRSWIT	2.437	1	2.437

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
GENDER	PDPTCOM	1.502	1	1.502
	PDPTOMM	19.772	1	19.772
	PDPTMOTR	863.075	1	863.075
	PDPTTIME	145742.990	1	145742.990
	SSTCONTR	9.673E-02	1	9.673E-02
	SSTINHIB	4.049E-03	1	4.049E-03
	SSTSWITC	3.532E-02	1	3.532E-02
	TIMECONT	9.971E-03	1	9.971E-03
	TIMEINHI	1.330E-04	1	1.330E-04
	TIMESWIT	.478	1	.478
	CORRCONT	1.831E-02	1	1.831E-02
	CORRINHI	.155	1	.155
	CORRSWIT	5.535	1	5.535
Error	PDPTCOM	135.613	30	4.520
	PDPTOMM	397.285	30	13.243
	PDPTMOTR	3993.114	30	133.104
	PDPTTIME	652187.857	30	21739.595
	SSTCONTR	1.322	30	4.407E-02
	SSTINHIB	1.538	30	5.127E-02
	SSTSWITC	.577	30	1.922E-02
	TIMECONT	8.834E-02	30	2.945E-03
	TIMEINHI	.130	30	4.326E-03
	TIMESWIT	7.481	30	.249
	CORRCONT	12.126	30	.404
	CORRINHI	5.337	30	.178
	CORRSWIT	190.241	30	6.341
Total	PDPTCOM	344.000	33	
	PDPTOMM	946.000	33	
	PDPTMOTR	106016.000	33	
	PDPTTIME	13879069.00	33	
	SSTCONTR	18.830	33	
	SSTINHIB	20.032	33	
	SSTSWITC	2.572	33	
	TIMECONT	1.648	33	
	TIMEINHI	1.662	33	
	TIMESWIT	28.728	33	
	CORRCONT	7170.000	33	
	CORRINHI	7311.000	33	
	CORRSWIT	5469.000	33	

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square
Corrected Total	PDPTCOM	140.242	32	
	PDPTOMM	418.000	32	
	PDPTMOTR	4977.333	32	
	PDPTTIME	915842.061	32	
	SSTCONTR	1.419	32	
	SSTINHIB	1.545	32	
	SSTSWITC	.613	32	
	TIMECONT	9.833E-02	32	
	TIMEINHI	.130	32	
	TIMESWIT	7.959	32	
	CORRCONT	12.545	32	
	CORRINHI	5.515	32	
	CORRSWIT	199.636	32	

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
Corrected Model	PDPTCOM	.512	.604
	PDPTOMM	.782	.467
	PDPTMOTR	3.697	.037
	PDPTTIME	6.064	.006
	SSTCONTR	1.098	.347
	SSTINHIB	.063	.939
	SSTSWITC	.943	.401
	TIMECONT	1.696	.201
	TIMEINHI	.026	.974
	TIMESWIT	.959	.395
	CORRCONT	.519	.600
	CORRINHI	.501	.611
	CORRSWIT	.741	.485
Intercept	PDPTCOM	.005	.946
	PDPTOMM	.298	.589
	PDPTMOTR	10.726	.003
	PDPTTIME	18.590	.000
	SSTCONTR	4.898	.035
	SSTINHIB	4.534	.042
	SSTSWITC	.974	.332
	TIMECONT	3.656	.065
	TIMEINHI	2.855	.101
	TIMESWIT	.530	.472
	CORRCONT	147.169	.000
	CORRINHI	392.172	.000
	CORRSWIT	4.932	.034
WPPSI	PDPTCOM	.531	.472
	PDPTOMM	.004	.947
	PDPTMOTR	.283	.598
	PDPTTIME	3.544	.069
	SSTCONTR	.070	.793
	SSTINHIB	.066	.799
	SSTSWITC	.000	.998
	TIMECONT	.138	.713
	TIMEINHI	.029	.865
	TIMESWIT	.035	.853
	CORRCONT	1.035	.317
	CORRINHI	.042	.840
	CORRSWIT	.384	.540

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
GENDER	PDPTCOM	.332	.569
	PDPTOMM	1.493	.231
	PDPTMOTR	6.484	.016
	PDPTTIME	6.704	.015
	SSTCONTR	2.195	.149
	SSTINHIB	.079	.781
	SSTSWITC	1.838	.185
	TIMECONT	3.386	.076
	TIMEINHI	.031	.862
	TIMESWIT	1.916	.176
	CORRCONT	.045	.833
	CORRINHI	.872	.358
	CORRSWIT	.873	.358
Error	PDPTCOM		
	PDPTOMM		
	PDPTMOTR		
	PDPTTIME		
	SSTCONTR		
	SSTINHIB		
	SSTSWITC		
	TIMECONT		
	TIMEINHI		
	TIMESWIT		
	CORRCONT		
	CORRINHI		
	CORRSWIT		
Total	PDPTCOM		
	PDPTOMM		
	PDPTMOTR		
	PDPTTIME		
	SSTCONTR		
	SSTINHIB		
	SSTSWITC		
	TIMECONT		
	TIMEINHI		
	TIMESWIT		
	CORRCONT		
	CORRINHI		
	CORRSWIT		

Tests of Between-Subjects Effects

Source	Dependent Variable	F	Sig.
Corrected Total	PDPTCOM		
	PDPTOMM		
	PDPTMOTR		
	PDPTTIME		
	SSTCONTR		
	SSTINHIB		
	SSTSWITC		
	TIMECONT		
	TIMEINHI		
	TIMESWIT		
	CORRCONT		
	CORRINHI		
	CORRSWIT		

a. R Squared = .033 (Adjusted R Squared = -.031)

b. R Squared = .050 (Adjusted R Squared = -.014)

c. R Squared = .198 (Adjusted R Squared = .144)

d. R Squared = .288 (Adjusted R Squared = .240)

e. R Squared = .068 (Adjusted R Squared = .006)

f. R Squared = .004 (Adjusted R Squared = -.062)

g. R Squared = .059 (Adjusted R Squared = -.004)

h. R Squared = .102 (Adjusted R Squared = .042)

i. R Squared = .002 (Adjusted R Squared = -.065)

j. R Squared = .060 (Adjusted R Squared = -.003)

k. R Squared = .032 (Adjusted R Squared = -.032)

l. R Squared = .047 (Adjusted R Squared = -.016)

Estimated Marginal Means

GENDER

Dependent Variable	GENDER	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
PDPTCOM	1.00	2.248[a]	.553	1.119	3.377
	2.00	2.682[a]	.504	1.653	3.712
PDPTOMM	1.00	3.141[a]	.946	1.208	5.074
	2.00	4.716[a]	.863	2.954	6.478
PDPTMOTR	1.00	61.009[a]	3.000	54.882	67.137
	2.00	50.603[a]	2.736	45.016	56.190
PDPTTIME	1.00	700.516[a]	38.344	622.207	778.824
	2.00	565.293[a]	34.962	493.892	636.694
SSTCONTR	1.00	.666[a]	.055	.555	.778
	2.00	.776[a]	.050	.675	.878
SSTINHIB	1.00	.736[a]	.059	.616	.856
	2.00	.759[a]	.054	.649	.868
SSTSWITC	1.00	.207[a]	.036	.134	.281
	2.00	.274[a]	.033	.207	.341
TIMECONT	1.00	.236[a]	.014	.207	.265
	2.00	.201[a]	.013	.174	.227
TIMEINHI	1.00	.218[a]	.017	.183	.253
	2.00	.214[a]	.016	.182	.245
TIMESWIT	1.00	.927[a]	.130	.662	1.192
	2.00	.682[a]	.118	.440	.924
CORRCONT	1.00	14.753[a]	.165	14.416	15.091
	2.00	14.705[a]	.151	14.398	15.013
CORRINHI	1.00	14.803[a]	.110	14.579	15.027
	2.00	14.942[a]	.100	14.738	15.146
CORRSWIT	1.00	12.182[a]	.655	10.844	13.519
	2.00	13.015[a]	.597	11.796	14.235

a. Evaluated at covariates appeared in the model: WPPSI = 112.4545.