EXECUTIVE FUNCTION AND SOCIAL COMPETENCE IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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DECLARATION

I declare that this thesis was written by me and that I conducted the work detailed herein. This work has not been submitted for, or accepted in, any previous degree.

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ABSTRACT

Executive function deficits have been implicated in the difficulties experienced by children with attention deficit hyperactivity disorder (ADHD) (Pennington & Ozonoff, 1996). In particular, impairments in inhibition and self-regulation (Barkley, 1997).

In addition, many children with ADHD experience social difficulties (Barkley, 1998) and this may influence the generally poor long-term outcome experienced by many of these children (Taylor, Chadwick, Hepinstall & Danckarets, 1996).

It is argued that the cognitive and social difficulties are not unrelated. Problems with impulsive or disinhibited responding may disrupt the information processing system for socially relevant information.

This study aims to investigate the association between executive function and social competence in everyday life in children with ADHD and compare their results to a control group. In addition, to investigate whether children with ADHD have emotion recognition deficits, in comparison to a control group.

Twenty-one children with a diagnosis of ADHD and twenty-one children with no diagnosis of ADHD were assessed using a battery of executive function tasks and were asked to complete a questionnaire related to their social competence. In addition, parents and teachers were asked to complete two questionnaires regarding the child's social competence in everyday life.

This study found that children with ADHD performed equally well on executive function tasks, measuring inhibition and cognitive flexibility. However, there was a significant difference between the groups on measures of social competence. There was evidence of an association between the executive function tasks and social competence measures for the control group, but not the ADHD group. Children with ADHD performed as well as the control group on an emotion recognition task.

It is argued that a decrease in disinhibited behaviour results in improved peer relationships (Barkley, 1990). However, the findings from this study contradict this hypothesis. It is suggested that earlier intervention and the provision of effective social skills training may help alleviate some of the difficulties experienced by individuals with ADHD.

The limitations of this study and implications for future research are discussed.

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CHAPTER 1: INTRODUCTION

For many individuals with attention deficit hyperactivity disorder (ADHD) the prognosis is poor (Hinshaw, 1994). Academic and relationship difficulties are common. Children with ADHD often underachieve at school. Impulsivity and aggression may result in difficulties making and maintaining an appropriate and supportive peer group. Children with ADHD are often in conflictual relationships with their parents and teachers and there is evidence that children with ADHD become risk-taking adolescents, with a higher incidence of drug taking, road traffic accidents and leaving school at an earlier age (Carr, 2002). Despite extensive research into the aetiology of ADHD, its cause remains unclear and only recently have researchers begun to address the social difficulties experienced by many with the disorder[1].

1.1 Attention Deficit Hyperactivity Disorder (ADHD)

Attention deficit hyperactivity disorder (ADHD) is one of the most common chronic disorders of childhood, with a prevalence rate of 1% in the UK (Hinshaw, 1994). Boys are over-represented, on average, approximately 3:1 (Barkley, 1990). It is a syndrome characterised by persistent overactivity, impulsivity and difficulties sustaining attention (Hinshaw, 1994; Barkley, 1990).

The age of onset is usually in toddler-hood, with a 'peak age of onset' between the ages of 3 and 4 (Palfrey, Levine, Walker & Sullivan, 1985). However, symptoms of ADHD may appear earlier, even in utero (Pennington & Ozonoff, 1996). ADHD is a chronic disorder across the life span (Gittelman, Mannuzza, Shenker & Gonagura, 1985), persisting into

[1] Electronic literature searches using OVID were undertaken, involving a number of databases. The following key words were used –Attention Deficit Hyperactivity Disorder/ ADHD/ Attention Deficit Disorder/ Children/ Executive Function/ Stroop/ Color-Word Interference/ Verbal Fluency/ Twenty Questions/ Social/ Social Competence/ Social Skills/ Stimulant Medication/ Methylphenidate – combined and individually. In addition, citations in relevant articles were reviewed.

adolescence in 50-80% of cases and into adulthood in 30-50% of these same cases (Barkley, Fischer, Edelbrock & Smallish, 1990b). The clinical pattern observed in adults is similar to that observed in school-aged children (Pennington & Ozonoff, 1996).

Over the last decade, there has been considerable progress in examining the genetics of ADHD and there is now evidence that it is familial and moderately heritable (Pennington & Ozonoff, 1996). Biederman, Faraone, Keenan, Knee & Tsuang (1990) reported that the rate of ADHD in families of fathers with ADHD is over seven times the rate of the disorder in non psychiatric control families; and a later study reported a similar increase in risk among relatives of females with ADHD (Faraone, Biederman, Chen, Krifcher, Moore, Sprich & Tsuang, 1992).

The earliest description of a disorder, later to be classified as ADHD, was at the beginning of the last century. Still (1902) identified a group of children he described as having difficulties in 'moral control'. He believed these difficulties were due to constitutional or inherited factors, not parental or environmental factors and postulated that the central deficit was volitional inhibition. Later, hyperactivity, inattention and impulsivity were identified as central features of the disorder (Laufer & Denhoff, 1957; Douglas, 1972).

Subsequently, Douglas (1983) argued that the clinical presentation of ADHD was the result of four major deficits: (a) poor investment and maintenance of effort, (b) deficient modulation of arousal to meet situational demands, (c) a strong inclination to seek immediate reinforcement, along with (d) the originally proposed difficulties with impulse control. Douglas (1988) later concluded that these four deficiencies arise from a more central impairment in self-regulation.

Carr (2002) describes the clinical features of ADHD in the domains of cognition, affect, behaviour, physical health and interpersonal development. With regard to cognition, reduced attention span, distractibility and a lack of insight into the consequences of actions are the core features and there is usually poor internalisation of the rules of social conduct.

In terms of affect, often the individual exhibits excitability associated with poor impulse control. In addition, low self-esteem is common in children with ADHD and consequently, difficulties with low mood and depression may develop (Barkley, 1990). The behavioural aspects of ADHD include increased activity, often co-morbid aggressive, antisocial behaviour, excessive risk-taking and poor school performance (often associated with inattention). Physical health problems in ADHD may involve injuries or medical complications associated with antisocial behaviour, such as fighting or drug taking.

With regard to interpersonal adjustment problems, relationship problems with parents, teachers and peers dominate. Difficulties with impulsivity often make children with ADHD poor playmates. In addition, poor social conduct at home and school leads to difficult and unhappy relationships with parents and teachers.

The International Classification of Diseases and Related Health Problems (ICD-10) refers to this condition as 'hyperkinetic disorder'. ICD-10 prefers this term as they argue there is not sufficient knowledge regarding the psychological processes to identify the disorder as 'attention deficit'. ICD-10 describes the characteristic features of the disorder as overactivity, poorly modulated behaviour with marked inattention and a lack of persistent task involvement. The Diagnostic and Statistical Manual of Mental Disorders, fourth edition, (DSM-IV) classifies hyperactivity and impulsivity together as one impairment with three subtypes, (i) predominately inattentive, (ii) predominately hyperactive-impulsive and (iii) combined inattentive and hyperactive-impulsive. DSM-IV lists a number of characteristics of inattention and hyperactivity/impulsivity that may be exhibited by children with ADHD (Appendix I).

1.2 Executive Function and ADHD

Lezak (1995) defined the executive functions as 'those capacities that enable a person to engage successfully in independent, purposive, self-serving behaviour' (p.42). Evidence of executive impairment includes reduced capacity for self-control or self-direction, a heightened tendency to irritability and excitability, impulsivity, erratic carelessness, rigidity, and difficulty in making shifts in attention and in ongoing behaviour (Lezak, 1995). This clinical description of executive impairment is similar to the clinical description of ADHD provided by Carr (2002), as discussed above.

Barkley (2001) described the executive functions as being 'composed of the major classes of behaviour toward oneself used in self-regulation. An executive act is any act towards oneself that functions to modify one's own behaviour so as to change the future outcomes for that individual.' (p.5). He took an evolutionary perspective on executive functioning and argued that the executive functions are forms of behaviour-to-the-self that evolved from overt (public) to covert (private) responses as a means of self-regulation. This became necessary given the interpersonal conflict that arises within species living in groups. He hypothesised that the executive functions may have evolved to solve primarily social adaptive problems, among them being social exchange, imitation and vicarious learning.

Children need executive control to choose, construct, execute, and maintain optimal strategies for performing a task, as well as inhibit strategies that become inappropriate when goals or task demands change or errors occur (Logan, 1985). Deficient inhibitory control is indicated by impulsive behaviours such as responding before the task is understood, answering before sufficient information is available, allowing attention to be captured by irrelevant stimuli (i.e. distractibility), or failing to correct obviously inappropriate responses (Schacher & Logan, 1990).

1.2.1 Neurological studies and ADHD

It has been observed that frontal lesions, particularly in the orbital-frontal regions and caudate nucleus (Boucagnani & Jones, 1989; Mattes, 1980), in both experimental animals and human patients sometimes produce hyperactivity, distractibility or impulsivity, alone or in combination (Fuster, 1989; Stuss & Benson, 1986).

Although focal frontal lesions are rare in children, there are a limited number of case studies outlining the cognitive and behavioural effects. Pennington & Ozonoff (1996) reviewed these case studies and concluded that the effect of frontal lesions in childhood is not radically different to adults. There is evidence of executive function deficits on cognitive testing and problems with attention (including over-attention to detail) and temporal integration, as well as poor peer relations and a lack of empathy.

Due to the similar presentation of individuals with ADHD, a number of researchers have implicated frontal lobe dysfunction and executive impairments in ADHD (Gualtieri & Hicks, 1978; Mattes, 1980; Pontius, 1973; Rosenthal & Allen, 1978).

With regard to neurological studies involving participants with ADHD, studies have found evidence of reduced perfusion of blood flow in the central white matter of the frontal lobes and in the caudate nucleus relative to the normal perfusion observed in control subjects (Lou, Henrikson & Bruhn, 1984), diminished blood glucose metabolism as detected by PET scan (Ernst, Liebenauer, King, Fitzgerald, Cohen & Ramekin, 1994), and other neuroanatomical differences suggestive of anterior dysfunction (Hynd, Hern, Novey, Eliopulos, Marshall & Gonzalez, 1993) in subjects with ADHD compared to control groups.

Lou, Henrikson, Bruhn, Borner & Nielson (1989) found that diminished perfusion to the striatum and orbital prefrontal regions in children with ADHD is observed more in the right hemisphere than the left hemisphere. They argue that these findings implicate a central nervous system mechanism located in the connections between the prefrontal regions and the limbic systems, resulting in orbito-frontal and orbital-limbic impairments.

Magnetic resonance imaging (MRI) produces results consistent with these findings, revealing that the brains of ADHD children do not show the normal frontal asymmetry with the right being larger than the left (Hynd, Semrud-Clikeman, Lorys, Novey & Eliopolous, 1990). Instead, individuals with ADHD exhibit a smaller right frontal width resulting in symmetrical frontal lobes. There is evidence that the right hemisphere plays a significant role in attention and concentration (Branch, Cohen & Hynd, 1995), in maintaining motor behaviour (Kertesz, Nicholson, Cancelliere, Kassa & Black, 1985) and in emotion perception (Corbett & Glidden, 2000).

However, other studies have not found such neurological differences (Matochik, Liebenauer, King, Szymanski, Cohen & Zametkin, 1994; Shaywitz, Shaywitz, Byrne, Cohen & Rothman, 1983). Corbett & Glidden (2000) pointed out that it is important to remember that ADHD is a disorder with numerous aetiologies, behavioural correlates and severity of presentation. The neurobiological foundations of attention are vast, arising from the reticular activating system of the brain stem to the basal ganglia and on into the frontal cortex (Mirsky, Anthony, Duncan, Ahearn & Kellam, 1991). Posner (1987) highlighted that the processes of attention are part of a multi-level, hierarchical system. Thus, it is not possible to assume that ADHD can be exclusively localised to one area of the brain.

Barkley (1997) argued that the widely accepted clinical view of ADHD (i.e. that of DSM-IV) is purely descriptive of two behavioural deficits (inattention and hyperactivity-impulsivity) and cannot readily account for the full range of cognitive and behavioural deficits often present in ADHD. In particular, Barkley (1997) suggested that most of the cognitive difficulties found in ADHD are related to executive function and self-regulation and are not included in the DSM-IV classification. In addition, identifying attention as the primary deficit may be misleading, as, for example, Schacher, Tannock and Logan (1993) found that children with ADHD had consistent deficits in inhibition on tasks where attentional requirements varied.

1.2.2 Neuropsychological assessment in ADHD

Although neuropsychological studies of ADHD using tasks to assess executive functions often find impairment compared to a control group, there is still debate about the precise nature of such impairments (Pennington & Ozonoff, 1996). For example, some studies using the Wisconsin Card Sorting Test (WCST) have reported deficits in attentional set shifting in children with ADHD (Shue & Douglas, 1989; Gorenstein, Mammato & Sandy, 1989) while others have found no such impairments (Grodinsky & Diamond, 1992).

In addition, while studies of ADHD often report poor performance on measures of impulsivity or response inhibition on the Continuous Performance Test (CPT) (Corkum & Siegal, 1993), on the Go-No-Go test (Shue & Douglas, 1992) and on time slowness for Trails B (Boucugnani & Jones, 1989; Shue & Douglas, 1992), others find no impairment on these tests (Grodinsky & Diamond, 1992). Furthermore, some researchers have reported impairments of visuospatial processing (Robbins & Sahakian, 1983; Grodinsky & Diamond, 1992) while others have found no impairments on these functions (Korkman & Pesonen, 1994). In addition, some studies have found impairments in planning ability, measured with the Tower of Hanoi task and the WCST (e.g. Weyandt & Willis, 1994).

Pennington & Ozonoff (1996) reviewed 18 studies of executive functioning in ADHD. Fifteen of the 18 studies found a significant difference between ADHD participants and controls on one or more executive function measures. The following tests appeared to be especially sensitive to ADHD - The Tower of Hanoi (a planning task), Stroop (an inhibition task), Matching Familiar Figures Task (a task measuring impulsivity) and the Trail Making Test, Part B (a task measuring flexible set shifting). Purer measures of motor inhibition (Go-No-Go, Stopping, Anti-Saccade, Conflict Motor task, and NEPSY Inhibition) also consistently found group differences. ADHD groups also performed significantly worse on two working memory measures (Sequential Memory task and Self-Ordered Pointing task).

However, more recently, Speltz, DeKlyen, Calderon, Greenberg & Fisher (1999) administered two executive function tasks (motor planning and verbal fluency) and found

no difference on the motor planning task between the ADHD group and the control group. However, they found a significant difference on the verbal fluency task.

More recently still, Charman, Carroll & Sturge (2001) found no difference between the ADHD and control group on the Tower of Hanoi (a planning task), but did on the Go-No-Go task (an inhibition task). However, Perner, Kain & Barchfeld (2002) found the converse, with the planning task (the Tower of Hanoi) posing a severe problem for their 'at risk of ADHD' group and not the inhibition tasks (Go-No-Go, Knock & Tap). They point out that this may be due to a difference in the scoring systems used and a re-analysis of the Go-No-Go task results revealed a slightly greater (but not significant) difference between the 'at risk' group and the control group, reducing the discrepancy between the studies. These differences may also be attributed to the selection criteria used in these studies, i.e. the Charman, Carroll & Sturge (2001) study included children with a confirmed diagnosis of ADHD, whereas the Perner, Kain & Barchfeld (2002) study included children that were 'at risk' of ADHD.

Grodzinsky & Barkley (1999) evaluated a battery of executive function tests for their accuracy in classifying children as having ADHD. They found that abnormal scores on the Continuous Performance Test, Controlled Oral Word Association Test (COWAT), Hand Movements Scale and the Stroop Colour-Word Association Test were all predictive of the presence of ADHD. However, they warned that normal scores on these tests could not reliably rule out the disorder. The authors concluded that while the neuropsychological tests used in this study may have some value in clinical evaluations of children's neuropsychological abilities, they are not useful as the sole criteria for the diagnostic classification of children as having ADHD.

Although deficits on executive function tasks are often found in children with ADHD, further experimental studies are indicated due to the equivocal nature of the findings from neuropsychological studies of ADHD. The lack of clarity in the findings may be due to the use of executive function tests that have been validated in adult humans with focal brain lesions (e.g. WCST) and may, therefore, have limited validity for use in children (Kempton, Vance, Maruff, Luk, Costin & Pantelis, 1999).

In addition, the relationship between performance on many tests of executive function and the normal maturation of the central nervous system is not well understood (Diamond, 1990). Therefore, Kempton and colleagues (1999) argued that impaired performance on some tests of executive function in ADHD merely reflects a normal but immature central nervous system rather than ADHD-related pathology. They suggested that in order to overcome such problems, future research should select neuropsychological tests that have an established reliability and validity for measuring executive function and have a well-understood developmental trajectory in normal children.

1.2.3 Stimulant medication, ADHD and executive function

The complex nature of executive function impairments in children with ADHD is also evident when stimulant medication is considered. Neurobiological theories of ADHD emphasise brain catecholamine function because of the established clinical response to stimulant medication of children with ADHD (Gualtieri & Hicks, 1985). However, psychopharmacological studies of both normal humans and animals have found that stimulant medication can impair executive function (Dyme, Sahakian, Golinko & Rebe, 1982). Robbins & Sahakian (1979) have suggested that stimulant medication may impair executive function by inducing 'over-focusing and perseveration'.

However, in ADHD, there is some evidence to suggest that stimulant medication improves performance on some tests of executive function, especially when they are highly structured measures of attention such as continuous performance tests (Rappoport, Buchsbaum, Weingarter, Zahn, Ludlow & Mikkelsen, 1980). Douglas & Parry (1983) suggested that the improvements seen on some measures of executive functioning may be because children with ADHD require 'over-focusing and perseveration' to perform within normal limits on tests that require sustained and organised effort.

Interestingly, Douglas, Barr, O'Neill & Britton (1986) found that methylphenidate can increase the flexibility of performance and reduce perseverative responses on the WCST in children with ADHD. Everitt, Thomas, Cote, Levesque & Michaud (1991) also found that

children with ADHD who were given stimulant medication for a year had improved scores on the WCST. However, performance did not improve on the Stroop Colour-Word Association Test (an inhibition task) and they concluded that this test was more resistant to the effects of stimulant medication.

However, Tannock, Schacher, Carr, Chajczyk & Logan (1989) found that improvements in behaviour and academic performance, resulting from treatment with methylphenidate, were strongly associated with improvements in inhibitory control as measured by the stop-signal paradigm.

Kempton, Vance, Maruff, Luk, Costin & Pantelis (1999) investigated executive function in medicated and unmedicated children with ADHD using the Cambridge Neuropsychological Test Automated Battery (CANTAB). This computerised assessment measures attentional set shifting, memory and planning. They found that unmedicated children with ADHD were impaired on tasks of executive function, including planning ability, movement time, attentional set shifting and spatial working memory. The group of medicated ADHD children showed no impairment on any of the executive function tasks, but did perform poorly on the spatial recognition memory task.

Therefore, there appears to be limited evidence that stimulant medication improves an ADHD child's performance on some measures of executive functioning, in particular measures of cognitive flexibility and tasks requiring sustained attention. However, with regard to inhibition, the effect of stimulant medication is less clear.

In sum, there has been much research into the cognitive deficits and aetiology of ADHD with no clear conclusion. To address this, Barkley (1997) proposed a biopsychosocial model of ADHD that specifies poor behavioural inhibition as the central deficiency in ADHD, affecting the ADHD child's executive functioning and ability to self-regulate. But, also taking into account the child's social experience, for example, past experience of consequences from actions and ongoing reinforcement of behaviour.

1.2.4 Barkley's (1997) biopsychosocial model of ADHD

According to Barkley (1997) behavioural inhibition refers to three interrelated processes: (a) inhibition of the initial prepotent response[2] to an event; (b) stopping of an ongoing response, which thereby permits a delay in the decision to respond; and (c) the protection of this period of delay and the self-directed responses that occur within it from disruption by competing events and responses (interference control). Barkley (1997) argued that the first of these (inhibition) is the most important, for without a delay in the prepotent response, the remaining goal-directed actions are pointless, if they can, in fact, occur at all.

Barkley (1997) argued that a deficiency in inhibition disrupts four executive systems: (1) working memory; (2) internalisation of speech; (3) self-regulation of affect-motivation-arousal; and (4) reconstitution (behavioural analysis and synthesis), as they depend on inhibition for their efficient execution. He suggested that inhibition of response is the first executive function required when confronted with a stimulus, allowing a necessary delay so that actions can be considered in the light of information from other executive processes. The four executive functions listed above are dependent on effective inhibition for control of their functioning and, essentially, the ability to self-regulate. Barkley (1997) suggested that deficient inhibition, as a central feature of ADHD, results in poor self-regulation.

Self-regulation is any self-directed behaviour, not necessarily observable, which contributes to the likelihood of an individual's response and as a consequence to the outcome of that response (Barkley, 1997). In early development, many of these behaviours will be observable. However, as the child's cognitive skills develop, they may become progressively more private, or internal-cognitive, in form. Self-regulation includes self-directed behaviours such as organisation of behaviour across time, the use of internal speech and consideration of rules and plans. Tasks that involve delays in consequence,

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[2] The prepotent response is the response for which immediate reinforcement (positive or negative) is available within a particular context or which has been previously associated with that response in that context.

resistance to temptation, delayed gratification or require novel responses are likely to require self-regulation skills. In children with ADHD, problems with self-regulation present as a tendency to be influenced by the immediate environment and imminent consequences (Barkley, 1997). Children without ADHD, however, are more influenced by internal information including past experience, predictions about the future, plans and rules.

Barkley (1997) suggested that the executive functions involved in self-regulation arise from the development of neural networks within the prefrontal lobes, past experience of consequences from actions, ongoing reinforcement and the social experience of the individual. Due to limited processing resources (e.g. poor planning, poor use of past experience and restricted ability to make predictions about the future), children with ADHD may develop maladaptive behavioural responses and strategies that are difficult for the child to modify.

Barkley (1997) argued that poor sustained attention should be viewed as a secondary symptom rather than primary. Difficulties with inattention are likely to be the consequence of an underlying impairment in goal-directed persistence arising from poor inhibition and the effect this has on self-regulation. He described two distinct forms of sustained attention or persistence, (1) persistence that is contingency-shaped and (2) persistence that is self-regulated and goal directed. The first involves immediate contextual (external) factors, whereas the second arises from the executive functions that permit self-regulation and control over the motor system and requires self-motivation. Barkley (1997) suggested that it is the self-regulatory type of sustained attention that is probably developmentally delayed in children with ADHD, not the type that is contingency or environmentally shaped.

1.3 Social Competence and ADHD

Beyond the cognitive level of analysis, Barkley (1998) has argued that the social difficulties experienced by children with ADHD are central to the psychopathology of ADHD, and may influence the generally poor long-term outcomes experienced by many of these children (Taylor, Chadwick, Hepinstall, Danckarets, 1996). Prior to 1993, impairments in the social domain were not mentioned in the diagnostic criteria for ADHD in the Diagnostic and Statistical Manuals, despite the existence of a substantial body of literature documenting the interpersonal difficulties experienced by children with ADHD. However, the advent of DSM-IV and the inclusion of the criteria that 'there must be evidence of clinically significant impairment in social, academic or occupational functioning' (p.48) indicated that these interpersonal difficulties were now being given serious consideration. Studies have shown that children with ADHD have significant difficulties in social relationships with their peer group, with their teachers and with family members (Mash & Johnston, 1983; Henker & Whalen, 1989).

1.3.1 Assessment of social competence

Dodge (1993) proposed a social information processing model to explain poor social competence in aggressive children and children with conduct disorder. According to this model, the steps involved in processing socially relevant information are encoding, mental representation, response accessing, response evaluation and enactment. Such processing is demanding for any child because social encounters involve encoding, processing and acting on several different cues simultaneously. Problems with impulsive or disinhibited responding such as those shown by children with ADHD could disrupt the information processing system for socially relevant information at several, if not all, points.

There is no clear-cut operational definition of social competence, for, according to Dodge (1985), the 'number of definitions of social competence...today approaches the number of investigators in the field.' (p.3). However, there is consensus that social competence entails effective functioning within social contexts (Dodge & Murphy, 1984).

Three distinct indices of social competence have been identified: social functioning (performance of skills or specific behaviours associated with competence), requisite cognitive skills (internal cognitive structures related to competent behaviour) and outcomes of social functioning (products of social functioning or judgements of competence) (Dodge & Murphy, 1984; Greenspan, 1981; Cavell, 1990). The social competence of children is usually investigated using these indices (Nixon, 2001).

Cavell (1990) argued that a distinction is required between skills and functioning. This distinction is one of competence versus performance (McFall, 1982). Although individuals may respond in a particular way to a given situation, their requisite skills conceivably would allow for a variety of responses. Cavell (1990) and McFall (1982) argued that the assessment of social functioning should focus on individuals' current or typical social behaviour and not their potential or optimal level of performance.

Barkley (1990) suggested that the most reliable and valuable method for determining a child's social status is the use of sociometric measures. Sociometrics are procedures that directly involve children in rating their peer's social competence. For example, each child in the classroom selects three children that they 'like the most' and three they 'like the least'. The number of positive nominations received is an index of popularity, while the number of negative nominations received is an index of social rejection. Barkley (1990) pointed out that these assessment methods are usually unavailable to the clinician as they are not only impractical but also due to ethical considerations (e.g. confidentiality).

Barkley (1990), therefore, suggested interviewing the parent, child and teacher in order to determine a child's general rate of social interactions with peers, reciprocity with others (e.g. sharing, taking turns), ability to resolve conflicts with others, number of friends and duration of friendships. Barkley (1990) highlighted that the child's view on his or her social status and friendships should be interpreted cautiously. He also pointed out that parents tend to be poor judges of the quality of the child's peer relationships. However, classroom teachers will have had the opportunity to observe the child in a variety of

situations with their peers and will probably have a good sense of the child's social status within the classroom (Barkley, 1990).

Social competence deficits in ADHD children have been reported in a number of distinct areas, which include behavioural (or social functioning difficulties) and social cognitive difficulties. Among these difficulties, intrinsic to the disorder, are high rates of intrusive, overt and aggressive behaviours (Wheeler & Carlson, 1994). In addition, children with ADHD have been shown to have deficient skills in communication and reciprocity, and biased social cognitive performance (Saunders & Chambers, 1996; Guervrement & Dumas, 1994).

1.3.2 Social functioning and children with ADHD

Many of the behavioural symptoms exhibited by children with ADHD have been found to be reliable correlates of peer rejection (Landau & Moore, 1991). Researchers have sought to identify those critical behaviours associated with social rejection by comparing those children who experience interpersonal difficulties with those who do not. Newcomb, Bukowski & Pattee (1993) carried out a meta-analysis to evaluate the empirical support for behavioural differences among groups of children who experience social rejection. The results indicated that children who are popular and those who are rejected have distinct behavioural repertoires that affect the quality of their interactions. Behaviours that have been reliably associated with peer rejection include: verbal and physical aggression, disruptive attempts to enter new groups and negative classroom behaviours (such as being off-task), noisy, violating rules, arguing and being quick-tempered (Guervrement & Dumas, 1994). Children with ADHD often display higher rates of off-task, disruptive, noisy and rule-violating behaviours and are, therefore, at risk of being rejected (Landau & Moore, 1991).

Further evidence of this is found in Klein & Young's (1979) study. They observed boys with ADHD in their classroom and found that these boys were involved in significantly more off-task behaviour and were more disruptive than the boys in the control group. It

was reported that their peers frequently reinforced their behaviour, and it may be this reinforcement that maintains such aversive behaviour.

Studies have reported that about half of all ADHD children also present with aggressive conduct (Loney & Milich, 1982). Up to 40% of ADHD children meet diagnostic criteria for Oppositional Defiant Disorder (ODD); and in 30% to 50% of cases ADHD co-occurs with Conduct Disorder (Kuhne, Schacher & Tannock, 1997). These disorders are characterised by disruptive, defiant and aggressive behaviour patterns (Barkley, 1990). This frequent co-morbidity is significant, given that aggression is the most common reason given by children for disliking someone (Coie & Dodge, 1983).

In addition, aggressive children often serve as targets of peer aggression (Whalen & Henker, 1985). Lacking the social cognitive skills to negotiate with an aggressive peer, the child with ADHD is likely to respond with aggression. Thus increasing the child's experience of aversive social situations. Children with ADHD are often excluded from social activities and are denied many opportunities for positive learning experiences (Whalen & Henker, 1985).

It has been found that children with ADHD are more likely to be rejected than simply aggressive children (Walker, Lahey, Hynd & Frame, 1987). Mothers, teachers and peers report hyperactive children to be significantly more aggressive, disruptive, domineering, intrusive, noisy and socially rejected than aggressive children without ADHD, especially if they are male (Campbell & Paulauskas, 1979; Milich & Landau, 1982; Pelham & Bender, 1982).

As social rejection seems to occur quickly, the child with ADHD also experiences fewer opportunities for social learning. It is likely that by behaving aggressively, the ADHD child evokes negative reactions from peers, which renders the child less amenable to performing appropriate behaviours (Wheeler & Carlson, 1994). It may be that as rejected children experience negative interactions with their peers, their expectations for future negative interactions increase. As a consequence, these biased expectations may activate a

vicious cycle between a rejected child and the peer group, with each having negative expectations of the other (Waas, 1988).

Children with poor peer adjustment are at risk for later life difficulties, in particular leaving school early and criminality (Parker & Asher, 1987). Johnson (1980) argued that, 'student-student relationships are an absolute necessity for healthy cognitive and social development' (p.125). This argument is partly derived from earlier theories that child-child interaction is central in facilitating children's development (Piaget, 1932; Mead, 1934; Sullivan, 1953).

Parker and Asher (1987) argued that if peers contribute to the development of social competence, low accepted children might become more vulnerable to later life problems. Limited opportunities for positive peer interaction could result in a lack of opportunity to learn normal, adaptive modes of social conduct and social cognition. In addition, they argued that as academic pursuit takes place in a social context, poor peer relationships might undermine academic progress as well.

Social interaction deficits in children with ADHD have also been identified by Hubbard & Newcomb (1991). They assessed the frequency and patterns of play duration and verbal behaviour of boys with ADHD in a social encounter with a normal peer of the same age. The ADHD/normal dyads engaged in less cooperative play than normal/normal dyads and their interactions were characterised by lower levels of reciprocity. Similarly, Clarke, Cheyne, Cunningham & Siegal (1988) found that non-ADHD dyads engage in better reciprocal verbal interaction than dyads consisting of an ADHD and a non-ADHD child.

In terms of social communication, Landau & Milich (1988) found that boys with ADHD seemed to be less adaptive in their ability to adjust their social communication patterns according to task cues. They suggested that this is related to an inability to respond to social or environmental cues for role-appropriate behaviours. Landau & Milich (1988) also found that the response style employed by the ADHD child appeared to have a reciprocal effect on the behaviour of the non-ADHD child with whom they were paired. Specifically, the non-ADHD partners elicited more controlling interactions, perhaps to

compensate for their partner and maintain a balance in the conversation. It is likely that this is unsatisfying for both children and prevents the child with ADHD experiencing and establishing more positive relationships with their peers.

Children with ADHD tend to present as 'socially busy', expressing increased rates of interpersonal interest and engagement (Whalen, Henker, Castro & Granger, 1987). However, social activity per se is not directly related to peer liking or disliking (Burhmeister, Whalen & Henker, 1992). An elevated rate of social activity heightens social visibility and it may be this that leads to their engagement in a disproportionate number of aversive social exchanges (Whalen & Henker, 1985). Atypical levels of intensity in the behaviour of ADHD children have been documented, where intensity refers to behaviours that are characterised as loud, energetic or forceful (Whalen & Henker, 1992). It is possible that the intensity of the child's behaviour may cause interpersonal difficulties because such intensity is likely to clash with the needs and activities of others (Whalen & Henker, 1985).

In their communication patterns, children with ADHD have been found to talk more but to be less efficient in organising and communicating information to peers with whom they are asked to work (Cunningham & Siegal, 1987). In addition, despite talking more, ADHD children are less likely to respond to the questions or verbal interactions of their peers. Hence there is less reciprocity in the social exchanges of hyperactive children and their peers (Cunningham & Siegal, 1987).

The research, therefore, suggests that children with ADHD have social communication difficulties, demonstrated by problems responding appropriately to the continuous changes in demands and cues that characterise the flow of social interactions (Landau & Moore, 1991).

1.3.3 Social cognition and children with ADHD

Effective functioning in social situations requires a variety of social-cognitive skills (Erwin, 1994). These skills include the ability to interpret and understand the social

behaviours of others, to recognise social problems, to generate effective solutions, and to appreciate the consequences of actions.

Studies have shown that unpopular children often make inaccurate interpersonal inferences that may lead to inappropriate behavioural decisions. For example, Dodge (1980) investigated social cognition and children's aggressive behaviour. Aggressive and non-aggressive boys were exposed to a frustrating negative outcome, which was instigated by an unknown peer who had acted with either a hostile intent, a benign intent or an ambiguous intent. All groups responded with more aggression in the hostile condition than in the benign condition. Aggressive and non-aggressive participants differed only in the ambiguous condition. Aggressive children responded as if the peer had acted with a hostile intent. Non-aggressive children responded as if the peer had acted with benign intent.

Linn & Hodge (1982) found that children with ADHD tend to have a more external locus of control than normal children and are, therefore, more likely to view events that happen to them as outside of their personal control or due to 'fate'. There may also be the additional tendency to misinterpret the actions of others toward them as hostile and therefore respond aggressively over minimal provocation (Milich & Dodge, 1984). Such difficulties are likely to result in peer rejection. Studies have noted that it takes very few social exchanges over a very short time (20 to 30 minutes) for normal children to find the ADHD children disruptive, unpredictable and aggressive and react to them with aversion, criticism, rejection and sometimes counteraggression (Milich & Landau, 1982; Pelham & Bender, 1982; Pelham & Milich, 1984).

Hughes, Dunn & White (1998) suggested that sociocognitive abnormalities in aggressive children appear more readily in specific social contexts. For example, most strikingly when information is incomplete or ambiguous, as discussed above, or when there is a perceived threat to self (Dodge & Somberg, 1987). They argue that contrasting sociocognitive demands are placed by different social situations. Consequently, automatic responses may be sufficient for routine social interactions, but novel or ambiguous social

situations may require higher-order social information processing and may be beyond the cognitive ability of children with ADHD.

Whalen & Henker (1985) also investigated ADHD children's ability to make social judgements. A group of ADHD children and a control group were asked to fit each other into a number of descriptive categories, e.g. 'causes trouble', 'fun to be with'. Children with ADHD were as effective as the control group in describing the social behaviour of their peers. However, for the control group, the perception of negative behaviour (e.g. 'causes trouble') and nomination of 'liking' was highly negatively correlated, but this was not the case for the ADHD group. This may indicate that the ADHD group has greater tolerance of deviant behaviours in others. It may also suggest a difference in social goals and agendas of these children. Melnick & Hinshaw (1996) found that the social goals of boys with ADHD and a control group differ. The boys with ADHD, particularly those with high levels of aggression, tended to seek domination and 'trouble making' to a greater extent than the boys in the control group.

Whalen & Henker (1985) found that children with ADHD are able to evaluate the effectiveness of given solutions to hypothetical social problems as well as a control group. However, the ADHD group was less effective at generating solutions to the problems. Other research has found differences in the social problem-solving skills of accepted and rejected children in actual peer provocation situations, but not in hypothetical situations. This, therefore, suggests the importance of establishing a child's knowledge of appropriate social behaviour in real-life situations and in hypothetical situations (Vitaro & Pelletier, 1991).

Grenell, Glass and Katz (1987) investigated hyperactive children's social cognitive skills using the Social Knowledge Interview (Geraci & Asher, 1980). Participants were asked to imagine they were in a social situation and describe what they *should* do, rather than *would* do. They found that hyperactive participants had deficits in knowledge of how to maintain relationships and handle interpersonal conflict. These are complex skills, which may only be learnt after substantial friendships have been formed and experience in relationship maintenance and conflict resolution has been gained. As previously discussed, children

with ADHD may not have experienced 'substantial friendships' and may, therefore, lack experience in negotiating conflicts with their peers.

The research previously discussed suggests that children with ADHD have a number of difficulties in social interactions. Peterson & Siegal (1995) argued that social communication deficits in children with ADHD make it less likely for adults to discuss their thoughts and intentions with them, and may result in children with ADHD not having the opportunity to develop the ability to understand the minds of others or 'theory of mind'.

The following section examines the concept of theory of mind and the research involving theory of mind and children with ADHD.

1.3.4 Theory of Mind and ADHD

It may be that children with ADHD have difficulty interpreting and understanding social behaviour. It is interesting that even when aggressive children perceive intentions as non-hostile, they are more likely to propose an aggressive response (Dodge, 1980). Therefore, misattribution of hostile intent does not explain their social difficulties. However, it may be that they fail to recognise the emotional consequences of their aggressive behaviour and consequently engage in aggressive behaviour more frequently (Arsenio & Fleiss, 1996). One explanation for this may be that these children have difficulty attributing thoughts and beliefs to another person or have 'theory of mind' deficits.

Piaget (1962) made the first attempt to propose a theory of the development of the ability to understand others' thoughts and feelings. He proposed that cognitive development in children involves four stages. In the second stage of development, termed pre-operational, he suggested that children aged between two and seven years develop the cognitive ability to symbolise and this is apparent in their capability to engage in pretend play. At this stage, children are 'egocentric', that is they do not understand that other people have a different perspective and believe that other people see, think and feel as they do.

Premack & Woodruff (1978) first used the term 'theory of mind' in their research into the ability of chimpanzees to attribute mental states to others. Theory of mind has been defined by Tager-Flusberg, Baron-Cohen & Cohen (1993) as:

> the ability of normal children to attribute mind states (such as beliefs, desires, intentions, etc.) to themselves and other people, as a way of making sense of and predicting behaviour (p.3).

The ability to describe what others think about events is termed first-order theory of mind. However, interaction between people is to a large extent based on an interaction of minds. This can only be properly understood when one takes into account what people think about other people's thoughts. This is termed second-order theory of mind (Perner & Wimmer, 1985). Thus, theory of mind requires the ability to understand that others have minds and mental states, which influence their behaviour. Theory of mind is the ability to make inferences about a person's expectations and beliefs and use this information to anticipate and understand their behaviour.

There is much research involving theory of mind tasks and, in particular, children with autistic spectrum disorder. Much of the research has concentrated on examining whether children are able to understand that another person can hold a belief that differs from their own and from reality, i.e. a belief that is false. Wimmer & Perner (1983) were the first to investigate false belief in children. They developed a paradigm, which can be used with very young children where the child's own belief is different from someone else's belief. In order to succeed on the task the child has to be aware that different people can have different beliefs about a situation.

The age at which children acquire this ability is still debated and varies depending on the type of task or measure used (Happe, 1999). During the preschool years, critical development in theory of mind ability takes place (Carlson & Moses, 2001). Three-year-olds typically perform very poorly on measures assessing their understanding that beliefs can be false (Wimmer & Perner, 1983), that appearances may not reflect reality (Flavell, Flavell & Green, 1983) and that different individuals may perceive the same scene in different ways (Flavell, Everett, Croft & Flavell, 1981). However, Wimmer & Perner

(1983) and Carlson & Moses (2001) demonstrated that theory of mind ability is within the capacity of a normal four year-old child.

The most common interpretation of these findings is that younger children lack concepts of belief and mental representation. Consistent with this account are the findings that performance is highly resistant to task simplification and that various theory of mind tasks are intercorrelated, suggesting the presence of a common conceptual core (Flavell, Green & Flavell, 1989; Carlson & Moses, 2001).

1.3.5 Theory of mind, executive functioning and ADHD

Carlson & Moses (2001) argued that executive functioning plays a critical role in the emergence and expression of theory of mind. They suggested that children require a certain level of executive ability before they could begin to construct the complex concepts of 'mental life'. That is, without some capacity to distance themselves from immediate stimuli, children would be unable to reflect on representations of those stimuli. In addition, they argued that successful performance on theory of mind tasks requires children to override the prepotent, habitual response.

Carlson & Moses (2001) found that development in executive functioning was closely interwoven with the ability to perform theory of mind tasks in the preschool period. They highlighted several reasons why inhibitory control may be related to the development of theory of mind. Firstly, significant developmental changes occur in children's inhibitory control and language during the preschool years, the same time that advances are made in their theory of mind. Secondly, brain-imaging studies implicate the frontal lobes in theory of mind ability (Baron-Cohen, Ring, Moriarty, Schmitz, Costa & Ell, 1994). Thirdly, in addition to theory of mind deficits, some children with autistic spectrum disorder also show impairments on executive functioning tasks (Ozonoff, Pennington & Rogers, 1991).

Finally, Carlson & Moses (2001) argued that successful performance on theory of mind tasks would seem to require well-developed inhibitory control. For example, on false-belief, appearance reality and deception tasks, children clearly must inhibit their own

knowledge of current reality to respond in terms of less salient representations of reality. So, rather than failing to take account of false beliefs, they react impulsively and fail to disengage from the prepotent response (Carlson, Moses & Hix, 1998).

Carlson & Moses (2001) argued that as a child's inhibitory control develops during the preschool period, they become better at resisting interference from salient, immediate stimuli and as a consequence their theory of mind performance improves.

Research involving people with head injury has provided supportive evidence for the theories on the role of neurological systems in theory of mind. Happé, Brownell & Winner (1999) investigated theory of mind in people with right hemisphere damage who often present with social and communication problems similar to high functioning individuals with autistic spectrum disorder. They found that patients with right hemisphere damage performed significantly worse on theory of mind tasks than those with left hemisphere damage and a control group. This suggests that right hemisphere functioning may have a role in theory of mind.

Functional imaging studies have, however, had mixed results. Baron-Cohen, Ring, Moriarty, Scmitz, Costa & Ell (1994) found that the right orbito-frontal regions were activated when participants were asked to identify words associated with the mind. However, other research has found brain activity in the temporal lobes, left superior gyrus and posterior cingulated cortex (Fletcher, Happé, Frith, Baker, Dolan, Frackowiak & Frith, 1995).

Although a number of researchers agree that a primary inhibitory impairment underlies the behavioural and social difficulties that characterise ADHD (Barkley, 1997; Schacher & Logan, 1990), Charman, Carroll & Sturge (2001) argued that we should not necessarily conclude that all the socially disruptive and difficult behaviour shown by children with ADHD is merely secondary to the primary defining and core impairment of inhibition. They suggested that some aspects of the social information processing system may be impaired or disrupted in children with ADHD and that, in combination with the inhibition deficits, leads to the characteristic behaviour that defines the disorder.

Charman and colleagues (2001) pointed out that although there is much research into the basic cognitive processes in children with ADHD, the higher-level, more conceptual processes have been somewhat overlooked in the past ten years of research into the disorder.

Happé & Frith (1996) investigated the relationship between impaired social functioning and theory of mind in children with conduct disorder, a group of children with a similar presentation to children with ADHD and frequent co-morbidity. This study used an adaptive behaviour scale in order to assess social functioning in everyday life. The children with conduct disorder showed marked social impairments on this measure. However, they passed the theory of mind tasks. Happé & Frith (1996) acknowledged that this finding could be attributed to their choice of standard false belief task (Wimmer & Perner, 1983), as these are passed by typically developing children before the age of 5 years and are developmentally inappropriate for the 6- to 12-year-old children studied.

Happé & Frith (1996) concluded that although children with conduct disorder do not demonstrate the same delay in theory of mind as some children with autistic spectrum disorder, they hypothesised that the low social competence ratings could be interpreted as some delay in theory of mind development in this group. However, they conceded that an alternative explanation could be difficulties with impulsivity and the group's low verbal IQ (85).

Hughes, Dunn & White (1998) also investigated the relationship between theory of mind and executive function in another related group of children – young 'hard to manage' preschoolers, identified by high scores on a scale measuring hyperactivity and inattention. They found differences between 'hard to manage' children and controls on some, but not all, theory of mind tasks. The 'hard to manage' children also demonstrated impairments on tasks measuring inhibitory control and planning ability. The authors suggested that their group's poor peer relations develop from a combination of impaired executive skills and impairments in social understanding.

Whyte (2000) investigated theory of mind and social understanding in children with ADHD and found that children with ADHD do not have difficulty with first order theory of mind tasks. However, passing first order theory of mind tasks did not imply good social abilities (Whyte, 2000). Likewise, children with autistic spectrum disorder often pass first order theory of mind tasks, but are still found to have social difficulties (Frith, Happé & Siddons, 1994).

Whyte (2000) found that significantly more children with ADHD failed second-order theory of mind tasks. Consistent with this finding are the results from Buitelaar, van der Wess, Swaab-Barneveld & van der Gaag's (1999) study. Children with ADHD made up half of a clinical control group in a study designed to investigate theory of mind and emotion recognition in children with autistic spectrum disorder. An unexpected finding was that children with ADHD performed significantly worse on second-order theory of mind tasks, measuring beliefs about beliefs, than the control group (Perner & Wimmer, 1985).

Charman, Carroll & Sturge (2001) investigated the associations between social competence, theory of mind ability and the inhibition and planning aspects of executive function in a sample of boys with ADHD. The first measure of real-life social competence was the socialisation domain of an adaptive behaviour scale. The second measure of real-life social ability was two 16-item scales devised and used by Frith et al. (1994), designed to assess what they term 'active' and 'interactive' sociability. The Active Sociability Scale refers to behaviours that can be performed without the ability to mentalise (e.g. shares toys when asked, says please when asking for something), and the Interactive Sociability Scale to social behaviour dependent on mental state insight (e.g. supplies important missing information, plays hide and seek or cheats appropriately).

Charman and colleagues (2001) used the Happé Strange Stories as a measure of higher-order theory of mind reasoning (Happé, 1994) and the Tower of Hanoi (a planning task) and the GoNoGo paradigm (an inhibition task) as measures of executive functioning.

They found that the children with ADHD did not demonstrate a deficit in theory of mind competence. They did, however, show impairments compared to controls on executive measures, in particular on the inhibition task. In addition, the typically developing controls were rated as more socially competent than the boys with ADHD on all three scales. Charman and colleagues (2001) pointed out that the laboratory theory of mind measures might not reflect their ability to access and utilise these competences in everyday interactions – possibly due to the differences between the relatively controlled environment in the laboratory and more complex social information processing situations in the real world.

As there is limited research into this area, Charman and colleagues (2001) suggested that further investigation is warranted. In accordance with the study by Happé & Frith (1996), Whyte (2000) found a discrepancy between the ADHD children's ability to perform theory of mind tasks and the responses by parents in a questionnaire used to measure social ability in real life. She also suggested a closer examination of ADHD children's social ability in real life and a more rigorous assessment of executive functioning.

1.4 Social Competence and Executive Functioning

As discussed above, effective functioning in social situations requires a number of skills including the ability to recognise social problems, generate and evaluate effective solutions and appreciate the longer-term consequences of actions. From a neuropsychological perspective, children with ADHD may have difficulties with these skills. For example, it is likely that impulsivity, disinhibition and a lack of cognitive flexibility would impede problem-solving and the ability to generate effective solutions.

One explanation for the social difficulties experienced by children with ADHD could be the well-documented lack of behavioural inhibition. As previously described, Barkley (1997) has argued that all the problems experienced by children with ADHD (e.g. academic, social, mental, language and emotional impairments) stem from their inability to inhibit their behaviour. Barkley (1997) argued that due to a deficit in inhibition a number of executive functions are disrupted.

Barkley, Cunningham & Karlsson (1983) found that children with ADHD talk more than their peers and Whalen et al. (1987) described children with ADHD as 'socially busy'. It has also been found that children with ADHD demonstrate increased levels of intensity in their behaviour, where intensity refers to behaviours that are characterised as loud, energetic or forceful (Whalen & Henker, 1992). Barkley (1990) argued that this type of overt behaviour is due to deficits in executive functioning, affecting the ability to organise and monitor social communication.

Grenell et al. (1987) found that ADHD children had more difficulty considering long-term consequences and were more influenced by short-term reward. This is consistent with Barkley's suggestion that ADHD children respond to immediate consequences and have difficulty with goal directed behaviour. Therefore, it is possible that executive functioning may influence social competence, for example, when selecting socially appropriate responses whilst interacting with others.

Whalen & Henker (1985) found that although children with ADHD were able to evaluate solutions to social problems as effectively as a control group, they had difficulty generating novel solutions. It is possible that poor cognitive flexibility impedes their social problem solving.

1.4.1 Social learning and children with ADHD

As discussed above, if executive deficits are implicated in some of the social difficulties experienced by children with ADHD, then it is possible to hypothesise that executive functioning may have an impact on the development of social skills. Camarata & Gibson (1999) theorised on how the features of ADHD may affect the development of pragmatic communication skills.

Deficits in pragmatic communication skills include inappropriate eye contact, failure to effectively monitor conversation, poor turn taking, excessive talking, poor response to shifts of topic, poor assessment of body language and facial cues, frequent interruption and failure to take account of others needs in conversation (Camarata & Gibson, 1999).

They discussed the hypothesis that the interactions between mother and child facilitate language development. The child's language instigates certain types of response from their parent and these responses facilitate language advances in the child. More advances in language, prompt a more advanced response from their parent. The essential pragmatics a child needs at this stage of language learning involve the ability to initiate interaction, respond appropriately and attend to the interaction.

Camarata & Gibson (1999) suggested that these skills are compromised in children with ADHD, adversely affecting the quality of the interaction between the parent and child. For example, the characteristics associated with ADHD include failure to attend to instructions, difficulty sustaining attention in play, susceptibility to distraction and a tendency not to listen. Consequently, the parent-child interaction may be affected in several areas. A distracted child may disrupt the flow of conversation at the point where a non-ADHD child would be initiating the next parental response. In addition, the child may not pay close

attention to his parent's response and therefore miss the cues that prompt the next advance in language. Parents may also be influenced by this apparent lack of interest and stop interacting sooner. Also, disrupted interaction may result in fewer completed conversations leading to impoverished experiences that would normally advance language skills (Camarata & Gibson, 1999).

Children with ADHD may frequently change topic due to susceptibility to distraction during the course of the interaction, physically leave the scene before the conversation is complete or interrupt or talk over the parent's attempts to reciprocate. This is likely to be unsatisfying for the parent who may become disheartened and reduce attempts to effectively engage the child. In addition, due to overactivity and impulsive behaviour, interactions are more likely to be controlling and directive and therefore less encouraging of language development (Camarata & Gibson, 1999).

Some evidence of this is found in a study conducted by Clark, Feehan, Tinline & Vostanis (1999). They investigated the prevalence of features commonly associated with autistic spectrum disorder in children with ADHD. Most of the parents of children with ADHD who participated in the study reported that their child had 'a lack of awareness of the feelings of others', 'difficulty forming relationships', 'difficulty knowing how to sustain a conversation' and 'a lack of desire to interact with others'.

Clark and colleagues (1999) suggested that these difficulties could be the result of the characteristic symptoms of ADHD. For example, difficulties waiting in turn taking, interruption of others and being easily distracted could be interpreted as a lack of willingness to interact and give the impression of being unaware of the feelings of others, impacting significantly on the quality of the relationship with others.

Clark and colleagues (1999) also observed that poor eye contact, failure to greet others and a lack of awareness of the need for others' personal space were frequently reported behaviours in children with ADHD. From a very early age, the features of ADHD may affect the quality of social interaction with others and this may influence the development of successful social functioning. Children with ADHD may, therefore, have less

opportunity to experience appropriate interaction and learn social skills and as a result may develop deficits in several areas of social competence.

Other socially relevant skills, such as the ability to perceive emotion in others, are not as easily explained in terms of executive dysfunction. However, a number of studies have found that children with ADHD have some difficulty in identifying emotion in other people.

1.5 Emotion Recognition and ADHD

Emotions, and emotional communication, are of critical importance in human functioning. There are three primary means of emotional communication: facial expression, gestures and speech prosody (Etcoff, 1986). The ability to identify emotion from vocal and facial cues appears to be related to social competence as early as the preschool ages (Nowicki & Mitchell, 1998). 'Hard-to-manage' preschool children have difficulties understanding emotions in comparison with matched control groups (Hughes, Dunn & White, 1998). Children who have difficulty encoding nonverbal cues are less accepted by their peers and are judged to be more deviant in their classroom behaviour (Goldman, Corsini & Dehrioste, 1980). In addition, children who incorrectly perceive nonverbal cues may be at risk for many unfavourable social sequelae, such as fewer friends and lower self-esteem (Whalen, Henker & Granger, 1990).

The perception of nonverbal cues is also important in the first stage of Dodge's (1993) social information processing model: encoding. Although socially appropriate responses depend on proficiency at all stages, cue encoding and recognition of affect are especially salient because failure at this stage can disrupt the final stage of the model: enactment (Milch-Reich, Campbell, Pelham, Connelly & Geva, 1999).

Barkley (1997) argued that the perception of emotion in other people would not be affected by ADHD because such perception is non-executive in nature. However, poor inhibitory control, he argued, will result in deficient self-regulation of affect. Consequently, Barkley (1997) posited that children with ADHD will have decreased empathy, increased emotional responsivity to provoking situations, diminished ability to anticipate emotional reactions to future events and decreased capacity to regulate emotional states.

Research has, however, found that children with ADHD do have difficulty identifying emotion. Studies have found that children with ADHD have difficulty identifying emotional expression and content in speech (Shapiro, Hughes, August & Bloomquist, 1993) and problems recognising facial expression of emotion (Singh, Ellis, Winton, Singh,

Leung & Oswald, 1998). Contrary to Barkley's (1997) view, there is an argument that skills involved in successful emotional recognition are similar to those required in executive function tasks. For example, both require internal representation of concepts when choosing an appropriate response, self-monitoring, impulse control, and flexibility of thought and action.

In a study to investigate the ability of children with ADHD to process emotional stimuli, Shapiro et al. (1993) found significant differences between children with ADHD and a control group on two measures. The first involved children matching the prosody and content of speech and the second matching audio to visual emotional stimuli. Shapiro et al. (1993) suggested that this is due to a difficulty with auditory processing and working memory. However, there was no difference between the ADHD and control group on working memory tasks.

Whyte (2000) provided an alternative explanation. The ADHD children were able to process emotional information of one type, e.g. matching facial expressions, but had difficulties when there was conflicting information requiring two types of processing (auditory and visual). These tasks placed more demands on executive functioning, as they required more internal organisation, the processing of conflicting information and inhibiting a response in preference for another. This explanation concurs with the evidence that children with ADHD perform more poorly than controls on inhibition tasks, such as the Stroop test (Grodinsky & Diamond, 1992).

Shapiro and colleagues (1993) reported significant deficits in discriminating facial affective stimuli in a subgroup of younger ADHD children. They concluded that young ADHD children may be impaired in their ability to process emotional cues. The longer-term consequences on social functioning may be significant. Deficits in effective processing of emotional stimuli may result in impoverished social interaction with peers at a young and influential age, perhaps preventing the development of positive internal working models of peer relationships.

In Cadesky, Mota & Schacher's (2000) study, children were required to interpret emotional cues from pictures of facial expressions and recordings of voices. They found that children with ADHD were significantly less accurate at interpreting emotions than a control group. Analysis of the type of error revealed that the errors made by children with ADHD were random in nature, suggesting a deficit at the encoding stage. This stage involves the ability to internally manipulate and match the facial expression, which may involve working memory.

Cadesky and colleagues (2000) concluded that the social difficulties faced by children with ADHD originate from a failure to attend to the appropriate cues of affect. There is a wide range of competing stimuli present in social situations, and it may be that as a result of poor internal organisation and a lack of inhibition, children with ADHD struggle to attend to the most salient cues of affect in others.

1.5.1 Emotion Recognition and the Right Hemisphere

Right hemisphere dysfunction has a profound effect on a child's ability to perceive the emotional states of others and to respond appropriately in social situations (Corbett & Glidden, 2000). Investigations indicate that neocortical structures significantly contribute to the processing of emotional stimuli (Borod, 1992). Research has indicated that the right cerebral hemisphere is involved in the perception and expression of facial emotion (Borod, 1992; Etcoff, 1984) and the emotional aspects of communication (Bell, Davis, Morgan-Fischer & Ross, 1990). The results of a study using positron emission tomography (PET), found activation of the right prefrontal regions during emotional prosody recognition in neurologically healthy participants (George, Priti, Rosinky, Ketter, Kimbrell, Heilman, Herscovitch & Post, 1996).

As discussed earlier, in neurological research involving individuals with ADHD, Lou and colleagues (1989) found diminished perfusion to the striatum and orbital frontal regions in the right hemisphere of children with ADHD. In addition, MRI revealed that the brains of ADHD children have symmetrical frontal lobes, rather than the usual asymmetry where the right is larger than the left (Hynd, et al., 1990).

Cicone, Wapner & Gardner (1980) suggested that right hemisphere injured patients frequently exhibit inappropriate social behaviour which, they concluded, was partly related to their difficulty understanding emotion communicated in facial expressions. In accordance with this, Heilman & Valenstien (1993) suggested that the development of an appropriate emotional state is interactional and may rely on the accurate perception and comprehension of visual stimuli, such as facial expression. There is evidence that the impaired ability to interpret emotion is associated with inappropriate behaviour.

Corbett & Glidden (2000) investigated the relationship between ADHD and emotional perception, one aspect of right hemisphere functioning. They found significant differences between children with and without ADHD on indices of attention, perception of affect and behavioural inhibition. Children with ADHD demonstrated mild-to-moderate deficits in their ability to perceive facial expression and prosody, providing support for the hypothesis that the right cerebral hemisphere, which is important in the perception and expression of emotional stimuli, may be dysfunctional in ADHD.

An additional explanation may be that individuals with ADHD exhibit deficits in verbal and nonverbal attention, which may contribute to inaccurate or incomplete encoding of stimulus properties. Therefore, they may only attend to the most conspicuous stimuli in the environment. Consequently, the more subtle aspects of communication and expression may be missed and, therefore, are not encoded by the child, impacting on the later stages of social information processing, such as enactment (Dodge, 1993).

Corbett & Glidden (2000) suggested that the results of their study might have implications for treatment of children with ADHD. Recent approaches tend to focus on the enhancement of attention through the use of stimulant medication and inhibition of inappropriate behavioural responses through, for example, differential response training. The misperception of social information suggests that other interventions may be warranted. Participants in Corbett & Glidden's (2000) study were asked to abstain from stimulant medication during the assessment. They suggested that it would be interesting to

determine if the provision of medication enhances performance on the perception of emotional stimuli.

1.6 Summary

Psychological models of attention deficit hyperactivity disorder are converging on a consensus that executive function deficits, in particular impairments in inhibition and self-regulation, are the primary cognitive impairments in children with ADHD (Pennington & Ozonoff, 1996).

It has been observed that frontal lesions sometimes result in hyperactivity, distractibility or impulsivity (Fuster, 1989; Stuss & Benson, 1986). Due to the similar presentation of individuals with ADHD, a number of researchers have implicated frontal lobe dysfunction and executive impairment in ADHD (Gualtieri & Hicks, 178; Mattes, 1980; Pontius, 1973; Rosenthal & Allen, 1978). In accordance with this, studies have found neuroanatomical differences suggestive of anterior dysfunction in individuals with ADHD compared to control groups (Hynd, et al., 1993).

In addition, Barkley (1998) has reported that many children with ADHD experience social difficulties and this may influence the generally poor long-term outcome experienced by these children (Taylor, Chadwick, Hepinstall & Danckarets, 1996; Parker and Asher, 1987). It is reported that children with ADHD have significant difficulties in social relationships with other children, with their teachers and with family members (Henker & Whalen, 1989; Mash & Johnston, 1983).

It is argued that the cognitive and social difficulties experienced by children with ADHD are not unrelated. A social information processing model proposed by Dodge (1993) describes the significant processing demands made on children in social situations, i.e. having to process and act on several different cues simultaneously. Problems with impulsive or disinhibited responding as shown by children with ADHD could disrupt the information processing system for socially relevant information.

Despite evidence that individuals with ADHD frequently struggle to maintain healthy interpersonal relationships in social and work domains into adulthood, it remains a

relatively under-researched area (Friedman, Rapport, Lumley, Tzelepis, van Voorhis, Stettner & Kakaati, 2003).

1.7 Aims

The main aim of this study is to investigate the association between performance on executive function tasks and measures of social competence in everyday life in children with ADHD and compare their performance on these tasks to a control group. Consequently, it was decided that the children with ADHD, who were currently taking stimulant medication, should take their medication as prescribed. This would provide a more accurate picture of the child's functioning in everyday life. In addition, ethically, it was also felt to be more appropriate for children to remain medicated.

In addition, to investigate whether children with ADHD have emotion recognition deficits, in comparison to a control group, and whether difficulties with emotion recognition are associated with social competence in everyday life.

1.8 Hypotheses

Performance on Executive Function Tasks

1. Children with ADHD will demonstrate significantly greater impairment on executive function tasks, as measured by the Color-Word Interference Test, Twenty Questions and Verbal Fluency from the Delis-Kaplan Executive Function System, in comparison to a control group.

Performance on Social Competence Measures

2. Children with ADHD will demonstrate significantly greater deficits in social competence, as measured by the Adaptive Behaviour Assessment System and the Social Competence with Peers Questionnaires, in comparison to a control group.

3. There will be a positive correlation between performance on executive function tasks and social competence measures in both the ADHD group and the control group.

Performance on the Emotion Recognition Task

4. Children with ADHD will demonstrate significantly greater impairment of emotion recognition, as measured by the Assessment of Perception of Emotion, in comparison to a control group.

5. There will be a positive correlation between performance on the Assessment of Perception of Emotion, the Social Competence with Peers Questionnaires and the Adaptive Behaviour Assessment System in children with ADHD and the control group.

CHAPTER 2: METHOD

2.1 Design

A cross-sectional between subjects design was used to investigate the performance of children with ADHD and a control group on measures of executive function, social competence and an emotion recognition task.

Within subjects comparisons were made comparing executive function tasks, measures of social competence and an emotion recognition task.

2.2 Participants

The children in the ADHD group were current patients of the Child and Family Mental Health Service, Royal Aberdeen Children's Hospital (R.A.C.H.). All the ADHD group children had been given a diagnosis of ADHD by a consultant psychiatrist prior to taking part in this study and were taking stimulant medication.

The children in the control group were recruited from Cults Primary School, Aberdeen, had had no previous contact with the Child and Family Mental Health Service and had no diagnosis of ADHD.

2.2.1 Inclusion criteria

To be included in the study, the children in the ADHD group had to meet the following criteria:

1. Between the ages of 8 years and 16 years inclusive.
2. A primary diagnosis of ADHD.
3. An age equivalent of 8 years or more on the British Picture Vocabulary Scale (Short Form), a measure of receptive vocabulary.

The children in the control group had to meet the following criteria:

1. Between the ages of 8 years and 16 years inclusive.
2. No diagnosis of ADHD.
3. An age equivalent of 8 years or more on the British Picture Vocabulary Scale (Short Form), a measure of receptive vocabulary.

2.2.2 Exclusion criteria

Children with a diagnosis of autistic spectrum disorder or Asperger's syndrome were excluded from the study. The characteristic features of autistic spectrum disorder and Asperger's syndrome include specific social interaction difficulties and would, therefore, be a confounding variable in this study.

2.2.3 Recruitment

ADHD group

Based on the above criteria, suitable participants for the ADHD group were identified by consultant psychiatrists from R.A.C.H. and their parents/guardians were contacted by letter inviting participation (Appendix II). They were sent two information sheets, one for the parents/guardians and one written in age appropriate language for the child (Appendix III) and two consent forms, one for the parents/guardians and one for the child (Appendix IV). Parents/Guardians were asked to indicate where they would prefer their child to be seen and were given the choice of school, home or at the Children's Hospital. Once consent was received, arrangements were made to see the child.

Control group

The head teacher of a local primary school was contacted regarding the study and agreed to distribute the letters across the years, inviting parents/guardians and their child to

participate (Appendix V). They were also sent two information sheets, one for the parents/guardians and one written in age appropriate language for the child (Appendix VI) and two consent forms, one for the parents/guardians and one for the child (Appendix VII). Parents/Guardians were asked to indicate where they would prefer their child to be seen and were given the choice of school, home or at the Children's Hospital. Once consent was received, arrangements were made to see the child.

2.3 Ethical Approval

Ethical approval was granted by the Grampian Research Ethics Committee. See Appendix VIII.

2.4 Materials

Where possible, due to copyright legislation, copies of the materials are included in the Appendices. Each child was assessed using the following tasks:

British Picture Vocabulary Scale (Short Form) (Dunn, Dunn & Whetton, 1985).

The British Picture Vocabulary Scale (BPVS) is designed to measure an individual's receptive vocabulary for standard English. It is not a comprehensive test of general intelligence.

The BPVS (short form) was standardised on 3334 randomly selected school pupils from the ages of 3 years to 18 years 11 months. The internal consistency of the test was examined by calculating split-half reliability. The median value for split-half reliability was 0.8 with a range of 0.41 to 0.86 (Dunn et al., 1985). The authors do not provide statistical evidence for the validity of the BPVS. However, they argue that its validity may be seen as deriving from its content as the stimulus words can be regarded as covering a wide breadth of vocabulary whilst still being relevant to children. They also point out the validity of more established tests using hearing vocabulary such as the Wechsler Intelligence Scale for Children – third edition (Wechsler,) and the finding that vocabulary

correlated highly with Full Scale IQ (Wechsler, 1974), as evidence that the BPVS measures scholastic aptitude.

This measure was chosen due to its brevity and ease of administration along with useful normative data. It was used as a screening task to ensure that the children have sufficient comprehension skills to understand the experimental tasks.

Delis-Kaplan Executive Function System (Delis, Kaplan & Kramer, 2001).

The Delis-Kaplan Executive Function System (D-KEFS) is a set of nine standardised tests for assessing a wide spectrum of verbal and nonverbal executive functions in both children and adults. Each test is designed to be a stand-alone instrument that can be administered individually or along with other D-KEFS tests (Delis et al., 2001).

The D-KEFS was standardised in the USA on a nationally representative, stratified sample of 1750 children, adolescents, and adults, ages 8-89 years. Stratification was based on age, sex, race/ethnicity, years of education and geographic region.

Three sub-tests were chosen from the D-KEFS battery, the Twenty Questions Test, Color-Word[3] Interference Test, and Verbal Fluency. Each sub-test provides age corrected scaled scores.

D-KEFS Twenty Questions Test

The Twenty Questions Test involves participants identifying, from a range of objects presented pictorially, the object the experimenter has chosen. However, the participant can only ask questions that the experimenter can answer 'yes' or 'no'. The main objective is to ask the fewest number of questions to figure out which object the experimenter has chosen.

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[3] When referencing the Color-Word Interference Test, the present study will use the spelling used by the authors of the D-KEFS battery.

The twenty-questions task was adapted for use in experimental studies of the development of concept-formation skills in normally functioning children (Mosher & Hornsby, 1966). It has also been used in the neuropsychological investigation of children with closed head injury (Levin, Song, Scheibel, Fletcher, Harward, Lilly & Goldstein, 1997) and the study of adults with chronic alcoholism (Heindel, Salmon & Butters, 1991). Delis and colleagues (2001) modified the task in terms of the stimulus objects and how they are presented pictorially, and the method of scoring, to enhance the assessment of the component processes tapped by this task.

The test is composed of four trials using the same stimulus objects. The feedback provided to the examinee for early items often results in more effective problem-solving strategies for later items. As a result, responses across the four trials have some degree of interdependence. Delis and colleagues (2001) suggested that the nature of this interdependence is analogous to that found on memory tests involving repeated trials of the same stimuli, because learning typically occurs across trials for both types of task. Internal consistency values for this test were derived by dividing the test into two equivalent half tests, using even-odd methodology. The initial abstraction score had moderate to high correlations, with most reliability values in the high range (range 0.72 to 0.87). The weighted achievement scores had moderate to low coefficients, which Delis and colleagues (2001) suggested might be related to item-interdependence (range 0.26 to 0.55).

Table 2.1 provides the test-retest data for the D-KEFS Twenty Questions Test. The Total Weighted Achievement Score refers to a scaled score derived from the total number of questions asked over the four trials and the Initial Abstraction Score refers to a scaled score derived from the number of items excluded by the first question over the four trials. In terms of test-retest reliability, performance improved from the first to second time of testing for the total weighted achievements score. However, interestingly the mean initial abstraction score was stable across test times. Correlations between the first testing and second testing were in the moderate range for the initial abstraction score and lower for the weighted achievement score.

	Ages 8-19				
	First testing		Second testing		
Measures	**Mean**	**SD**	**Mean**	**SD**	**R12**
Total Weighted Achievement Score	9.36	2.84	10.16	2.87	0.06
Initial abstraction score	9.64	2.34	9.61	2.63	0.62

Table 2.1 Test-Retest Reliability Coefficients for D-KEFS Twenty Questions for age group 8-19.

The executive functions tapped by this test include the individual's ability to identify the various categories and subcategories and the ability to flexibly problem-solve by formulating abstract, yes/no questions that eliminate the maximum number of objects, regardless of the examiner's answer.

D-KEFS Verbal Fluency Test

The D-KEFS Verbal Fluency Test taps the individual's ability to generate words fluently in an effortful, phonetic format (Letter Fluency), from overlearned concepts (Category Fluency), and while simultaneously shifting between overlearned concepts (Category Switching).

The D-KEFS Verbal Fluency Test is based on one of the most commonly used letter fluency tests, the *Controlled Oral Word Association Test* (COWAT). The COWAT was developed by Benton and his colleagues (Benton & Hamsher, 1976; Spreen & Benton, 1969) and has been one of the most useful and commonly used neuropsychological instruments in both research and clinical practice. Newcombe (1969) and Rosen (1980) were among the first to introduce category-fluency procedures in experimental studies of patients with brain damage. Newcombe (1969) also devised a procedure involving category fluency with simultaneous switching between two semantic categories.

In the D-KEFS Verbal Fluency, performance is assessed within four time intervals for each condition. Internal consistencies for many of the total scores were computed by comparing specific half tests by interval. Internal consistency for the specific time periods and error

measures was derived by computing half tests by alternating conditions. The internal consistency values for the age group 8-19 years range from 0.68 to 0.81 for Letter Fluency, 0.53 to 0.75 for Category Fluency, 0.37 to 0.62 for Category Switching Total Correct and 0.53 to 0.76 for Category Switching Total Switching.

The test-retest reliability correlations were consistent with those reported for the internal consistency values. The test-retest measures for both Letter Fluency and Category Fluency conditions had good to high reliability. Category Switching had lower correlations than those for Letter Fluency and Category Fluency.

D-KEFS Color-Word Interference Test

The D-KEFS Color-Word Interference Test is based on the widely known Stroop test. Stroop (1935) developed this procedure for studying verbal interference effects. The primary executive function measured by the Stroop procedure is the *inhibition* of a more automatic verbal response (reading) in order to generate a conflicting response of naming the ink colour. Numerous experimental studies have employed variants of this task. However, the norms are based on relatively small sample sizes. Bohnen, Twijnstra & Jolles (1992) demonstrated that a switching procedure added to the interference condition enhanced the sensitivity of the task to mild brain damage.

There are four conditions in the D-KEFS Color-Word Interference Test, two baseline conditions (Color Naming and Word Reading) and two higher-level conditions (Inhibition and Inhibition/Switching). The Inhibition task is the same as the original Stroop task. However, the Inhibition/Switching Task involves naming the ink colour on some items (inhibition) and reading the word on others (switching). The 'rule' being that if the word is in a box, the participant reads the word, rather than name the ink colour.

Table 2.2 presents test-retest data for the D-KEFS Color-Word Interference Test. The test-retest reliability scores indicated some improved performance after being exposed to the test. The test-retest correlations were in the moderate to high range for the key colour-word variables.

	Ages 8-19				
	First testing		Second Testing		
Measures	**Mean**	**SD**	**Mean**	**SD**	**R12**
Condition 1: Color Naming Seconds to complete	9.96	2.43	11.04	2.76	0.79
Condition 2: Word Reading Seconds to complete	10.04	2.82	10.04	3.60	0.77
Condition 3: Inhibition Seconds to complete	10.07	3.01	11.54	2.78	0.90
Condition 4: Inhibition/Switching Seconds to complete	9.75	2.94	11.57	3.25	0.80

Table 2.2 Test-Retest Reliability Coefficients for the D-KEFS Color-Word Interference Test for the age group 8-19

Although this assessment has not been standardised on a British population, the Delis-Kaplan Executive Function System was chosen due to the provision of normative data for children as young as 8 years old.

Children with ADHD, who participated in this study, were asked to continue taking stimulant medication as prescribed. There is limited evidence that stimulant medication improves performance on some executive function tasks in children with ADHD (Kempton et al., 1999). However, there is evidence that performance on inhibition tasks, such as the Stroop Colour-Word Association Test, is not improved by stimulant medication (Everitt, et al., 1991). Therefore, the Color-Word Interference Test was chosen. To the author's knowledge, there is no evidence to suggest that stimulant medication improves performance on Twenty Questions or Verbal Fluency. Although, there is limited evidence that stimulant medication improves cognitive flexibility (Douglas et al., 1986).

From a clinical perspective, it was felt that the three subtests chosen were appropriate for the aims of the study and, in particular, would be suitable and engaging for the children participating.

The Autism Screening Questionnaire (ASQ) (Berument, Rutter, Lord, Pickles & Bailey, 1999)

Parents were asked to complete the ASQ. The ASQ was designed to be completed by the primary caregiver on individuals who might have a pervasive developmental disorder (PDD). The selection of questions was based on the revised version of Autism Diagnostic Interview (ADI-R; Lord, Rutter& Le Couteur, 1994) used for ICD-10 and DSM-IV diagnosis of autism. These provide an operational diagnosis, which is based on the behavioural item scores in three areas of functioning: reciprocal social interaction, language and communication and repetitive and stereotyped patterns of behaviours.

Two versions of the questionnaire were designed: one for individuals under six years of age and the other for individuals aged six years and over.

The ASQ questionnaires were standardised on 200 individuals. This included 160 individuals with pervasive developmental disorder (PDD) (83 with autism, 49 with atypical autism, 16 with Asperger syndrome, 7 with Fragile X but not autism and 5 with Rett syndrome). There were 40 individuals with non-PDD diagnoses.

In terms of internal consistency, the alpha reliability coefficient for the total scale was 0.90. All individual item to total score correlations were positive and mainly substantial, in the range 0.26 to 0.73 (23 of the 39 exceeding 0.50). With regard to the validity of the individual ASQ items, of the 39 items, 33 showed statistically significant differentiation. Correlations between the ADI-R and the ASQ were calculated for the total score and the ADI-R domain (social, communication and repetitive behaviour) totals. Correlation coefficients were highly significant for all comparisons both within and across domains. In addition, the disciminant ability of the ASQ is high in differentiating PDD (including autism) from non-PDD conditions and differentiating between autism and other PDDs.

However, there was substantial overlap and the differentiation was less clear-cut as both the sensitivity (0.75) and specificity (0.6) were low.

A score of 1 is given for the presence of the abnormal behaviour and a score of 0 for its absence. Thus, the total score ranges from 0 to 39. The authors recommended that a score of 15, or more, provided the best differentiation of pervasive developmental disorder from other diagnoses. A score of 22 provides the best differentiation between autism and other PDDs.

This measure was chosen as it has good reliability and validity and is frequently used in clinical settings as a screening measure for ASD. It was used for this purpose in the present study.

See Appendix IX for a copy of the ASQ.

Social Competence with Peers Questionnaires (Spence, 1995)

Spence (1995) developed a series of questionnaires related to children's social functioning in response to a need for psychometrically sound instruments. These questionnaires were designed to focus on the consequences of social interaction with peers, given that there is evidence that the quality of peer relationships has a strong impact upon long-term adjustment (Spence, 1995). The child version covers both home and school social competence and has 10 questions. The parent and teacher versions of the questionnaires include nine items in each scale.

Parents, children and their teachers were asked to complete the following questionnaires developed by Spence (1995).

Social Competence with Peers Questionnaire – Parent(s) (SCPQ-P)

The psychometric properties of the scale were investigated with 187 parents. With regard to internal consistency, a Guttman split-half reliability coefficient was 0.87 and coefficient

alpha was 0.81. All item to total correlation coefficients exceeded 0.40. Factor analysis revealed a single factor accounting for 42 per cent of the variance in responses.

The normative data did not show any significant differences in scores across different age groups or genders. The mean rating was found to be 14.82 (Standard deviation = 3.12). The SCPQ-P was found to correlate significantly with the teacher rating of social competence with peers (r = 0.40) and the child's rating of his/her own social competence with peers (r = 0.54).

See Appendix X for a copy of the SCPQ-P.

Social Competence with Peers Questionnaires – Pupil (SCPQ – Pu)

The psychometric properties of the scale were investigated with a sample size of 386. With regard to internal consistency, a Guttman split-half reliability coefficient was 0.77 and coefficient alpha was 0.75. All item to total correlations exceeded 0.40. Factor analysis revealed a single factor structure accounting for 32 per cent of the variance in test scores.

The normative data showed no significant differences across age groups and gender, with the mean total score being 15.53 (Standard deviation = 3.17).

See Appendix XI for a copy of the SCPQ-Pu.

Social Competence with Peers – Teachers (SCPQ – T)

The psychometric properties of this scale were investigated using the responses from 313 teachers. With regard to internal consistency, a Guttman split-half reliability coefficient was 0.94 and coefficient alpha was 0.95. All item to total correlations exceeded 0.50. Factor analysis revealed a single factor accounting for 73 per cent of the variance in responses. Investigation of normative data revealed significant differences across the age bands and between genders, indicating the need to use separate age and gender norms (see

Table 2.3). In general, girls were rated as more socially competent with peers than their male counterparts. There was also a trend for teachers to rate children as being less socially competent with increasing age. Spence (1995) is unclear as to why this should be the case and questions whether this reflects an actual change in the quality of peer relationships, changes in teacher expectations with increasing age of the child, or a reduced awareness of pupils' social relationships as they reach adolescence.

Age	Female		Male		Total male and female	
	Mean	SD	Mean	SD	Mean	SD
8-11	16.83	3.21	15.00	4.52	16.13	3.84
12-14	14.76	4.52	14.11	4.32	14.44	4.42
15-17	15.28	4.02	13.29	4.89	14.05	4.66
Total (8-17)	15.61	4.08	14.07	4.56	14.85	4.39

Table 2.3 Means and Standard Deviations for the Social Competence with Peers Questionnaire - Teacher

See Appendix XII for a copy of SCPQ-T.

These three questionnaires were chosen as they reflected the participants' functioning in everyday life and have adequate reliability and validity. They are also quick and easy to complete and require minimal instruction.

Assessment of Perception of Emotion (Spence, 1995)

Facial Expression

This assessment involves participants identifying the emotion depicted in 24 photographs of individuals' faces. Spence (1995) developed a series of vignettes that described a situation likely to trigger emotional reactions. These vignettes were then read out to models. The models were asked to imagine how they would feel in that situation,

demonstrate what their facial expression would be and a photograph was taken. There are six different emotions depicted: sad, afraid, happy, disgusted, nicely surprised and angry. (Appendix XIII)

Posture Cues

This assessment involves participants identifying the emotion depicted in body posture, where the models faces are covered. There are six emotions depicted: happy/excited, puzzled/thinking, welcoming, angry, sad and rejecting. (Appendix XIV)

Spence (1995) does not provide normative data for either of these assessments. However, she refers to her own previous research involving 8-12 year olds, where most children over the age of eight were able to decode facial expressions and postures correctly (Milne and Spence, 1987). There was, however, a ceiling effect in that the majority of older children achieved maximum scores. Nevertheless, Spence (1995) argued that this assessment could be used to identify those children who have specific difficulties with social perception.

There is a lack of standardised measures available for the assessment of emotion recognition, particularly with regard to children. More rigorous assessment methods require extensive training and materials and were, therefore, not available within the confines of the present study. The Assessment of Perception of Emotion was deemed suitable for the aims of this study.

The Assessment of Perception of Emotion was included to ascertain if children with ADHD had more difficulty identifying emotion, than a control group.

Adaptive Behaviour Assessment System (ABAS) (Harrison & Oakland, 2000)

The ABAS is a norm-referenced assessment of the adaptive skills of individuals who are school-aged to adulthood. The ABAS allows assessment with multiple informants, evaluates functioning across multiple settings and contributes to a complete assessment of the daily, functioning skills of an individual.

The parent form was developed for parents or other primary caregivers of children, age 5-21 years. The teacher form was developed for teachers of children, age 5-21 years.

The authors of the ABAS argue that every person requires a repertoire of skills in order to meet the daily demands and expectations of his or her environment. For example, skills related to eating, dressing, making purchases, interacting with peers, following a schedule, communicating with other people and practicing safety. Adaptive skills, as measured by the ABAS, are defined as those practical, everyday skills needed to function and meet environmental demands, including the skills necessary to effectively and independently take care of oneself and the skills necessary to interact with other people (Harrison & Oakland, 2000). The ten specific adaptive skill areas measured by the ABAS are: Communication, Community Use, Functional Academics, Home/School Living, Health and Safety, Leisure, Self-Care, Self-Direction, Social and Work.

The ABAS was standardised on a US population involving 1045 parents and 980 teachers. The internal consistency was estimated using coefficient alpha. Average reliability coefficients of the Adaptive Skill Areas across age groups are mostly in the 0.90s, ranging from 0.86 to 0.97, suggesting a high degree of internal consistency in the items. Test-retest reliability coefficients fall in the range 0.77 to 0.98. With regard to validity, the authors argue that the ABAS includes the assessment of skills widely accepted as relevant to successful and independent functioning. In addition, an initial pool of more than 1000 items was developed and then reviewed by individuals knowledgeable in developmental psychology, education, learning disabilities and other related areas. Eventually this lead to the identification of 272 and 242 items for the parent and teacher forms, respectively. The ABAS provides age-corrected scaled scores.

Although this assessment does not have normative data for the British population, it was considered appropriate for the present study. The standardisation was rigorous albeit on a U.S population. The domains in the ABAS were highly pertinent and relevant to the area being researched and previous research had utilised a similar adaptive behaviour scale in assessing social competence in everyday life (Charman et al., 2001). In addition, the use

of this assessment with regard to children with ADHD has been investigated. Harrison & Oakland (2000) found that children with ADHD exhibited significant deficits compared to a control group in adaptive skills.

Parents and teachers were asked to complete the domains of Communication, Leisure, Self-Direction and Social of the respective parent/teacher version of the form.

2.5 Procedure

The children were tested in a quiet room, either at their home, at school or in the Children's Hospital. Children and their parents were asked to decide who else was present during the assessment. Where adults other than the experimenter were present, they did not contribute to the assessment.

The tasks were administered to each child in the order presented below.

British Picture Vocabulary Scale (Short form)

The BPVS was administered according to the instructions in the manual (Dunn et al., 1985). The children were asked to point to one of four pictures that showed the meaning of the word said by the experimenter. Testing finished when the child failed four out of six items in succession or on reaching the final item.

D-KEFS Color-Word Interference Test

The D-KEFS Color-Word Interference Test was administered according to the instructions in the manual (Delis et al., 2001). This subtest includes two baseline conditions for evaluating key component skills of the higher-level tasks: basic naming of colour patches (Condition 1) and basic reading of words that denote colours printed in black ink (Condition 2). Condition 3 is the traditional interference task, where the examinee must inhibit reading the words denoting colours in order to name the dissonant ink colours in which those words are printed. The fourth condition requires the examinee to switch back and forth between naming the dissonant ink colours and reading the conflicting words, measuring both inhibition and cognitive flexibility.

In all four conditions, the appropriate page of the stimulus book is laid flat on the table in a horizontal position directly in front of the participant.

In Condition 1 (Color Naming), participants are asked to name the colours as quickly as they can, without skipping any or making any mistakes. There are two practice lines to ensure they have understood the task. The experimenter asks if they are ready, then says begin and starts the stopwatch. The experimenter stops the stopwatch when the child says the last colour, green, and records the time.

In Condition 2 (Word Reading), participants are asked to read the words (printed in black) aloud, without skipping any or making any mistakes. There are two practice lines to ensure the participant has understood the task. The experimenter then asks if they are ready, says begin and starts the stopwatch. The experimenter stops the stopwatch when the child says the last word, green, and records the time.

Participants are advised that Condition 3 (Inhibition) is harder because the colour names are printed in different coloured ink. The experimenter points out the word *red* is printed in *green* and that they have to name the colour of the ink that the letters are printed in and not read the word. There are two practice lines to ensure the participant has understood the task. The experimenter then asks if they are ready, says begin and starts the stopwatch. The stopwatch is stopped when the child says the last word, red, and the time is recorded.

In Condition 4 (Inhibition/Switching), participants are advised that for many of the words they will do the same as they just did: Name the colour of the ink, not read the words. But, if a word is inside a little box, they should read the word and not name the ink colour. There are two practice lines to ensure they have understood. The experimenter asks if they are ready, says begin and starts the stopwatch. The stopwatch is stopped when the child says the last word, red, and time is recorded.

D-KEFS Twenty Questions Test

In this test, the child is presented with a stimulus page depicting pictures of 30 common objects, such as an apple, a knife and a goldfish. The child tries to ask the fewest number of yes/no questions in order to identify the unknown target object. The objects can be subsumed into various categories and subcategories that include varying numbers of

objects. For example, the category *living things* has 15 objects, *animals* has 8 and *birds* has 3 objects. The most effective problem-solving strategy on this task is for the individual to ask yes/no questions that eliminate the maximum number of objects whether the examiner's answer is yes or no. Successfully eliminating a high number of objects with the initial question reflects a high level of abstract thinking.

The participant is told that the experimenter has picked one of the pictures from the stimulus page and the task involves figuring out which one it is by asking the experimenter questions. However, the participant is told to only ask questions that the experimenter can answer yes or no and to ask the fewest number of questions to figure out the picture the experimenter has selected. The same procedure is repeated four times.

The questions are recorded and a raw score is obtained with regard to the total number of questions asked, an initial abstraction score and a weighted achievement score.

D-KEFS Verbal Fluency Test

The D-KEFS Verbal Fluency Test is composed of three conditions: Letter Fluency, Category Fluency and Category Switching. For the Letter Fluency condition, the participant is asked to say words that begin with the letters F, A and S as quickly as possible in three trials of 60 seconds each. There are a number of 'rules' read out to the participants. These are: No names of people, no names of places and no numbers. In addition, participants are asked not to give the same word with lots of different endings. Examples are provided orally and the 'rules' are presented in written format and positioned in front of the participant throughout the Letter Fluency condition.

In the Category Fluency condition, the examinee is asked to say words that belong to a designated semantic category (Animals and Boy's Names) as quickly as possible in two trials of 60 seconds each. The last condition, Category Switching, is a means of evaluating the participants' ability to alternate between saying words from two different semantic categories (Fruits and Furniture) as quickly as possible for 60 seconds.

Assessment of Perception of Emotion

Facial Expression

This assessment was carried out according to the instructions in the manual (Spence, 1995). Participants were presented with the first stimulus page with six faces depicting different emotions (Appendix XIII).

Participants were told:

'Each of these faces shows a particular feeling or emotion. I would like you to look closely at each face and tell me how you think that person is feeling. For each face, I will ask you if the person feels happy, sad, angry, afraid, disgusted or nicely surprised. Wait until I have finished speaking before you decide...Now look carefully at this first face (assessor points to face 1). Does this person look happy, sad, angry, afraid, disgusted or nicely surprised?'

This procedure was followed for the remaining three stimulus pages.

A score of 1 was given if the answer was correct and 0 if incorrect. The maximum achievable score was 24.

Posture cues

This assessment was carried out according to the instructions in the manual (Spence, 1995). Participants were presented with the fifth stimulus page, with six photographs of a model depicting an emotion from his body posture (Appendix XIV).

Participants were told:

'Each of these people shows a particular feeling or emotion from the position of their body. I would like you to look closely at each body and tell me how you think the person is

feeling. For each picture, I will ask you if the person feels sad, welcoming, rejecting and doesn't want you, happy and excited, angry, or puzzled and thinking. Wait until I have finished speaking before you decide...Now look carefully at this first person (assessor points to posture 1). Does this person look sad and unhappy, welcoming, rejecting and doesn't want you, happy and excited, angry or puzzled and thinking?'

The same procedure is followed for the remaining three stimulus pages.

A score of 1 was given if the answer was correct and 0 if incorrect. The maximum achievable score is 24.

Social Competence with Peers Questionnaire – Pupil (SCPQ-Pu)

The Social Competence with Peers Questionnaires – Pupil version was then administered (Appendix XI). Participants were asked to read the first sentence aloud (to ensure they had adequate reading ability) and then circle Not True, Sometimes True or Mostly True. Participants were then instructed to complete the questionnaire, but to ask questions if they were unsure how to respond.

A score of 0 is given for the response Not True, 1 for Sometimes True and 2 for Mostly True. The maximum score is 20.

Parent/Teacher Questionnaires

If the child was seen at home or in the Children's Hospital, parents/guardians were asked to complete the *Autism Screening Questionnaire* (Appendix IX), *Social Competence with Peers – Parent version* (Appendix X) and the specified domains of the *Adaptive Behaviour Assessment Schedule – Parent Form,* while their child was being assessed. Teachers were sent the *Social Competence with Peers Questionnaire – Teacher version* (Appendix XII) and the specified domains of the *Adaptive Behaviour Assessment Schedule – Teacher Form.* Written instructions for these questionnaires were provided.

If the child was seen at school, the questionnaires were sent to the parents/guardians and the teacher was asked to complete the questionnaires while the child was being assessed.

Adaptive Behaviour Assessment System (ABAS) - Parent

Parents/Guardians were asked to rate their child according to how often he or she correctly performs a behaviour, when the behaviour needs to be displayed. The rating chosen should reflect the frequency with which his or her child performs the behaviour when it is needed. For each item, the parent/guardian was asked to record their response by circling one of the following:

0 Is Not Able
1 Never or Almost Never When Needed
2 Sometimes When Needed
3 Always or Almost Always When Needed

For each domain, a raw score is calculated and then converted to an age corrected scaled score.

Adaptive Behaviour Assessment System (ABAS) – Teacher

The instructions for the teacher version of the ABAS were the same as the parent version. Teachers were asked to rate the child according to how often he or she correctly performs a behaviour, when it needs to be displayed. Teachers were asked to choose a rating that reflects the frequency with which the student performs the behaviour when it is needed. For each item, the teacher was asked to record their response by circling one of the following:

0 Is Not Able
1 Never or Almost Never When Needed
2 Sometimes When Needed
3 Always or Almost Always When Needed

For each domain of the *Adaptive Behaviour Assessment Schedule – Teacher Form*, a raw score is calculated and then converted to an age corrected scaled score.

2.6 Data Analysis

Data were analysed using SPSS Version 11.5 for Windows. Non-parametric tests were used throughout as non-parametric tests make relatively few assumptions about the nature of the data population and are appropriate for small data sets where assumptions of normality may not be met, and where tests of normality lack power.

Chi-square and Mann-Whitney (2 independent groups) tests were used for between group analyses. The exact version of the Mann-Whitney significance level in SPSS is likely to be more accurate than the asymptotic version and was therefore used. The Spearman correlation test was used when associations between variables were examined.

In order to try to avoid making a Type I error, where multiple analyses were performed, a Bonferroni correction was used to conserve the family wise alpha level of 0.05. The individual alpha was taken as 0.05 divided by the number of comparisons. Therefore, for the Mann-Whitney analyses and Spearman correlations, the alpha level became 0.003. However, this may be too conservative an approach (Clark-Carter, 2001). Therefore, when the probability for a given analyses reached $p < 0.05$, but did not reach the adjusted level, Clark-Carter (2001) recommended that it should not be automatically dismissed as not statistically significant. Rather, such a result, treated with caution, might indicate an area where further research is warranted (Clark-Carter, 2001).

Where significant results were found following Mann-Whitney U analyses, effect sizes were calculated using the formula, as recommended by Clark-Carter (2001):

$$Z/\mathrm{SQRT}(N)$$

Where N is the total number of participants in the study.

Cohen (1992) suggested that an effect size of 0.20 is small, 0.50 is medium and 0.80 is large.

Where significant results were found following correlation analyses, a correlation coefficient of 0.10 is considered small effect size, 0.30 is medium and 0.50 is large (Cohen, 1988).

CHAPTER 3: RESULTS

3.1 Participants

3.1.1 Response rate

ADHD group

Of the seventy-two children and parents contacted, twenty-nine replied to the initial contact letter. Three of those subsequently dropped out. Therefore, twenty-six children with ADHD participated in this study. Following completion of the Autism Screening Questionnaire (ASQ), five children were excluded due to the possibility of a co-morbid diagnosis of autistic spectrum disorder or Asperger's Syndrome, based on scores of above 22 on the ASQ and subsequent discussion with the Consultant Psychiatrist responsible for their care. Therefore, twenty-one children with ADHD were included in the analysis for this study.

Control group

Of the one hundred children and parents contacted, twenty-two replied to the initial contact letter. One of those subsequently dropped out. Therefore, twenty-one children with no diagnosis of ADHD participated in this study.

3.1.2 Demographic characteristics

Gender of Participant

Of the seventy-two children with ADHD invited to participate, five were female. Of those who agreed to participate, nineteen were male and two were female.

In the control group, there were seven males and fourteen females.

Chi-squared analysis, x^2 (df = 1, N=42) = 14.54, p = <0.001), indicated a significant difference with regard to the numbers of males and females in each of the two groups, with the ADHD group having a greater number of males compared to the control group. See Table 3.1.

	Male N (%)	**Female N (%)**
ADHD group (n=21)	19 (90)	2 (10)
Control group (n=21)	7 (33)	14 (67)

Table 3.1 Gender of Participant

Chronological Age

Table 3.2 details the range and median of participants' ages. A Mann-Whitney U test analysis, u = 130.500, z = -2.405, p = 0.015, indicated a significant difference between the ages of the participants in the two groups, with the ADHD group being significantly older.

	Minimum (years)	**Maximum (years)**	**Median (years)**
ADHD group	8	14	11
Control group	9	10	9

Table 3.2 Age of Participant

3.2 British Picture Vocabulary Scale (Short Form) (BPVS)

Table 3.3 details the median and range of the participants' raw scores on the BPVS.

Mann-Whitney U test analysis, $u = 215.000$, $z = -0.139$, $p = 0.896$, indicated no significant difference between the participants' raw scores on the BPVS.

All participants had a receptive vocabulary age equivalent above 8 years.

	Minimum (raw score)	**Maximum (raw score)**	**Median (raw score)**
ADHD group	15	28	23
Control group	16	28	22

Table 3.3 Median and range of the raw scores on the BPVS

A post-hoc analysis was conducted between the groups on their BPVS score in order to ensure that executive function performance and the social competence measures were not correlated with receptive vocabulary. A Spearman correlation analyses of the data revealed no significant correlations between BPVS score and executive function tasks or social competence measures for either group.

3.3 Autism Screening Questionnaire (ASQ)

Table 3.4 presents the median and range of the participants' scores on the ASQ.

	Minimum	**Maximum**	**Median**
ADHD group	1	20	12
Control group	0	10	2

Table 3.4 Median and range of scores on the ASQ

Mann-Whitney U test analysis, $u = 39.500$, $z = -4.572$, $p = <0.001$, indicated a significant difference between the participants' scores on the ASQ, with the ADHD group scoring significantly higher.

3.4 Performance on Executive Function Tasks

3.4.1 Twenty Questions

The range and medians of the participants' scores on the Twenty Questions sub-test from the Delis-Kaplan Executive Function System are illustrated in Table 3.5.

	Initial Abstraction Score			Total Questions Asked			Total Weighted Achievement Score		
	Min	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**
ADHD group	6	13	8	4	15	11	5	15	11
Control group	7	16	10	9	14	11	7	14	11

Table 3.5 The range and medians of participants' scores on Twenty Questions

Table 3.6 shows the results of the Mann-Whitney U test analysis between the ADHD and control group on the Twenty Questions sub-test, indicating no significant differences between the groups on the subscores for Total Questions Asked and the Total Weighted Achievement Score. Although the result for the Initial Abstraction score does not reach the stringent, adjusted level of significance, (u = 131.00, z = -2.277, p = 0.022), it would suggest there is a difference between the groups, with the ADHD group not performing as well as the control group (see section 2.6; Clark-Carter, 2001).

	U	*z*	*p*
Twenty Questions			
- Initial Abstraction	131.00	-2.277	0.022
- Total Questions Asked	180.00	-1.034	0.308
- Total Weighted Achievement Score	177.00	-1.107	0.274

Table 3.6 Mann-Whitney U test analyses between groups on Twenty Questions

3.4.2 Color-Word Interference Test

Table 3.7 illustrates the range and medians of participants' scores on the Color-Word Interference Test from the Delis-Kaplan Executive Function System.

	Inhibition			**Inhibition/Switching**		
	Min	**Max**	**Median**	**Min**	**Max**	**Median**
ADHD group	4	13	11	4	14	11
Control group	8	16	12	8	16	13

Table 3.7 The range and medians of scores on Color-Word Interference Test

Table 3.8 shows the results of the Mann-Whitney U test analysis between the ADHD and control group on the Color-Word Interference sub-test, indicating no significant differences between the groups on the Inhibition subscore. Although the result for the Inhibition/Switching score does not reach the adjusted level of statistical significance (u = 132.00, z = -2.255, p = 0.023), it would suggest there is a difference between the groups, with the ADHD group not performing as well as the control group.

	U	*z*	*p*
Color-Word Interference			
- Inhibition	152.00	-1.747	0.082
- Inhibition/Switching	132.00	-2.255	0.023

Table 3.8 Mann-Whitney U test analyses between groups on Color-Word Interference

3.4.3 Verbal Fluency

The range and medians of participants' scores on the Verbal Fluency sub-test from the Delis-Kaplan Executive Function System are shown in Table 3.9.

	Letter			**Category**		
	Min	**Max**	**Median**	**Min**	**Max**	**Median**
ADHD group	5	19	13	8	19	14
Control group	4	16	12	5	19	12

Table 3.9 The range and medians of scores on Verbal Fluency

Table 3.10 shows the results of the Mann-Whitney U test analysis between the ADHD and control group on the Verbal Fluency sub-test, indicating no significant differences between the groups on the Letter condition. Although the result for the Category condition does not reach adjusted level of statistical significance ($u = 139.00$, $z = -2.067$, $p = 0.038$), it would suggest there is a difference between the groups, with the ADHD group not performing as well as the control group.

	U	*z*	*p*
Verbal Fluency			
- Letter	178.00	-1.079	0.287
- Category	139.00	-2.067	0.038

Table 3.10 Mann-Whitney U test analyses between groups on Verbal Fluency

3.5 Performance on Social Competence Measures

3.5.1 Social Competence with Peers Questionnaires (Spence, 1995)

The range and medians of participants' scores on the Social Competence with Peers Questionnaires are presented in Table 3.11. The respective version of this questionnaire was administered to the child (SCPQ-Pu), parent (SCPQ-P) and teacher (SCPQ-T). Figure 3.1 illustrates the medians of the SCPQ-Pu, SCPQ-P and SCPQ-T for both groups.

	SCPQ-Pu			SCPQ-P			SCPQ-T		
	Min	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**
ADHD group	2	19	12	0	17	5	0	18	5
Control group	7	20	14	11	24	17	10	18	18

Table 3.11 Range and medians of scores on the Social Competence Questionnaires

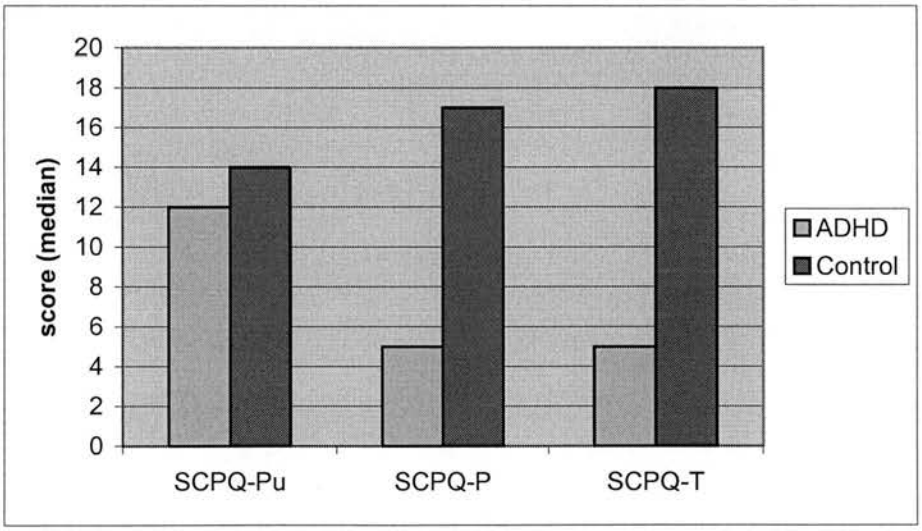

Figure 3.1 Medians for SCPQ-Pu, SCPQ-P and SCPQ-T for the ADHD group and Control group

Table 3.12 shows the results of the Mann-Whitney U test analysis on the Social Competence with Peers Questionnaires, indicating a significant difference between the

ADHD group and the control group on the Parent and Teachers version, with the ADHD group scoring significantly lower. However, there was no difference between the groups on the self-report measure of social competence.

	U	*z*	*p*	Effect Size
SCPQ-Pu	166.000	-1.377	0.172	
SCPQ-P	19.000	-5.098	<0.001	0.79
SCPQ-T	26.500	-5.025	<0.001	0.77

Table 3.12 Mann-Whitney U test analyses between groups on the Social Competence Questionnaires

3.5.2 Adaptive Behaviour Assessment System (ABAS)

Parents and teachers were asked to complete the following domains of the respective ABAS questionnaire: communication, leisure, self-direction and social.

The range and medians of the scores on this measure are presented in Table 3.13 to Table 3.16.

COMMUNICATION						
	Parent			Teacher		
	Min	Max	Median	Min	Max	Median
ADHD group	1	9	5	1	11	7
Control group	3	14	10	7	12	12

Table 3.13 Range and medians of scores on the Communication domain of the ABAS (Parent and Teacher)

LEISURE						
	Parent			Teacher		
	Min	Max	Median	Min	Max	Median
ADHD group	1	9	5	1	12	6
Control group	4	15	12	8	13	13

Table 3.14 **Range and medians of scores on the Leisure domain of the ABAS (Parent and Teacher)**

SELF-DIRECTION						
	Parent			Teacher		
	Min	Max	Median	Min	Max	Median
ADHD group	1	10	3	1	9	3
Control group	1	16	9	9	12	11

Table 3.15 **Range and medians of scores on the Self-Direction domain of the ABAS (Parent and Teacher)**

SOCIAL						
	Parent			Teacher		
	Min	Max	Median	Min	Max	Median
ADHD group	1	10	3	1	10	2
Control group	1	14	10	9	12	12

Table 3.16 **Range and medians of scores on the Social domain of the ABAS (Parent and Teacher)**

Figure 3.2 illustrates the medians for each domain completed by parents and teachers for both groups.

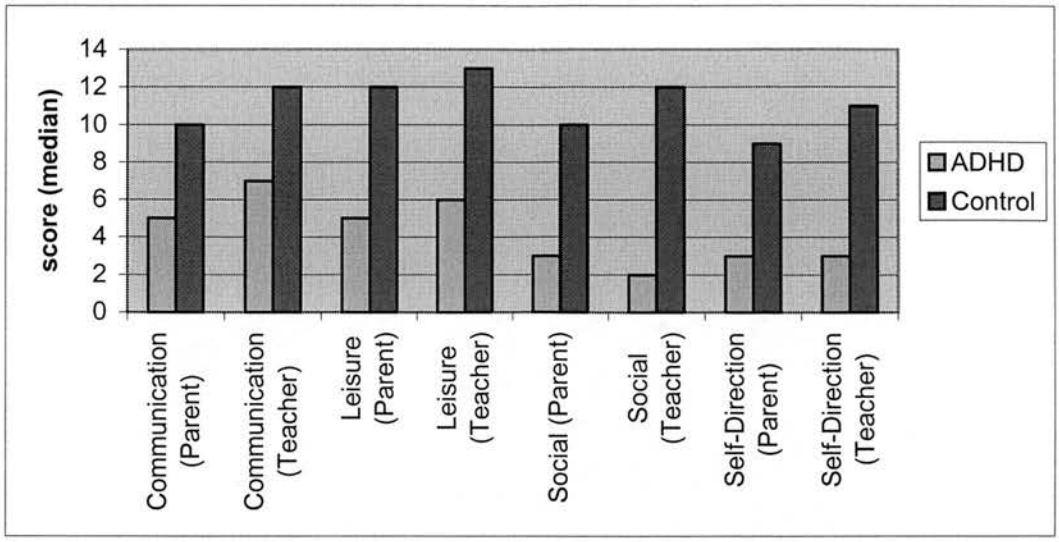

Figure 3.2 **Medians for ABAS–Parent and ABAS–Teacher for the ADHD group and the Control group**

Table 3.17 and Table 3.18 show the results of a Mann-Whitney U test analysis on the ABAS-Parent and ABAS-Teacher, indicating a significant difference between the ADHD and control group on all domains, with the ADHD scoring significantly lower.

	U	*z*	*p*	**Effect Size**
Communication	51.000	-4.284	<0.001	0.66
Leisure	43.000	-4.484	<0.001	0.69
Self-Direction	63.000	-3.984	<0.001	0.61
Social	64.500	-3.964	<0.001	0.61

Table 3.17 **Mann-Whitney U test analyses between groups on the ABAS–Parent**

	U	*z*	*p*	**Effect Size**
Communication	44.000	-4.518	<0.001	0.70
Leisure	16.000	-5.236	<0.001	0.81
Self-Direction	2.000	-5.537	<0.001	0.85
Social	7.000	-5.440	<0.001	0.84

Table 3.18 **Mann-Whitney U test analyses between groups on the ABAS–Teacher**

3.6 Correlation Between Executive Function Tasks and Social Competence Measures

Spearman correlation analyses were performed on the scores from the executive function tasks and social competence measures for both the ADHD group and the control group.

ADHD group

For the ADHD group, there were no significant positive correlations between the executive function tasks and the measures of social competence. See Appendix XV.

Control group

However, there were a number of significant positive correlations between executive function tasks and social competence measures completed by teachers for the control group. See Appendix XV.

In particular, the Communication domain of the ABAS – Teacher was found to have a strong association with Twenty Questions. There was a positive correlation between the Communication domain of the ABAS – Teacher and the Initial Abstraction Score (rho = 0.606, N = 21, p = 0.002, one-tailed), Total Questions Asked (rho = 0.602, N = 21, p = 0.002, one-tailed) and Total Weighted Achievement Score (rho = 0.592, N = 21, p = 0.002, one-tailed).

In addition, the Category score from Verbal Fluency was found to have a strong association with a number of domains from the ABAS - Teacher.

The Category score from Verbal Fluency correlated positively with the Communication domain of the ABAS – Teacher (rho = 0.631, N = 21, p = 0.001, one-tailed), the Leisure domain of the ABAS – Teacher (rho = 0.524, N = 21, p = 0.007, one-tailed), the Self-Direction domain of the ABAS – Teacher (rho = 0.643, N = 21, p = 0.001, one-tailed) and

the Social Competence with Peers Questionnaire-Teacher (rho = 0.594, N = 21, $p = 0.002$, one-tailed).

3.7 Performance on the Assessment of Perception of Emotion

The range and medians of the scores for the ADHD and control group on the Assessment of Perception of Emotion (Facial Expression and Posture Cues) are presented in Table 3.19.

	Facial Expression			Posture Cues		
	Min	**Max**	**Median**	**Min**	**Max**	**Median**
ADHD group	12	23	19	15	24	21
Control group	13	24	21	17	24	23

Table 3.19 Range and medians of scores on the Assessment of Perception of Emotion (Facial Expression and Posture Cues)

3.7.1 Comparison between groups on the Assessment of Perception of Emotion

A Mann-Whitney U analyses revealed no significant differences between the ADHD and control group on the Assessment of Perception of Emotion (Facial Expression and Posture Cues) (Table 3.20).

	U	*z*	*p*
Assessment of Perception of Emotion			
- Facial Expression	162.000	-1.495	0.138
- Posture Cues	190.500	-0.770	0.448

Table 3.20 Mann-Whitney U analyses of scores on the Assessment of Perception of Emotion (Facial Expression and Posture Cues)

3.7.2 Correlation between the Assessment of Perception of Emotion and Social Competence Measures

A Spearman correlation was performed on the scores from the Assessment of Perception of Emotion and the Adaptive Behaviour Assessment System (Parent and Teacher) and the Social Competence with Peers Questionnaire (Pupil, Parent and Teacher).

ADHD group

For the ADHD group, the results indicated there was a significant positive correlation between the Facial Expression task and the Social Competence with Peers Questionnaire-Parent (rho = 0.540, N = 21, p = 0.006, one-tailed), and the Facial Expression task and the Social domain from the ABAS - Parent (rho = 0.610, N = 21, p = 0.002, one-tailed). All other analyses failed to reach statistical significance. See Appendix XVI.

Control group

For the control group, the results indicated there was a significant positive correlation between the Facial Expression task and the Social domain from the ABAS – Parent (rho = 0.515, N = 21, p = 0.008). All other analyses failed to reach statistical significance. See Appendix XVI.

3.8 Correlation Between Social Competence Measures

Post-hoc analyses were conducted on the social competence measures to investigate the association between the participants' self-report measure of social competence (SCPQ-Pu) with the parent (SCPQ-P) and teacher (SCPQ-T) ratings of social competence.

A Spearman correlation was performed on the scores from the Social Competence with Peers Questionnaires (Pupil, Parent and Teacher).

ADHD group

For the ADHD group, the results indicated there was a significant positive correlation between Pupil and Teacher versions of the Social Competence with Peers Questionnaire (rho = 0.549, N = 21, p = 0.005, one-tailed).

There was a weaker association between Pupil and Parent versions (rho = 0.402, N = 21, p = 0.036, one-tailed).

See Table 3.21.

		Parent	Teacher
Pupil	**rho**	0.402*	0.549**
	Sig (1-tailed)	0.036	0.005
	N	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Table 3.21 Spearman correlation analyses between scores on Social Competence with Peers Questionnaires (Pupil, Parent and Teacher versions) for the ADHD group

Control group

However, for the control group, there was no significant correlation between Pupil and Teacher versions (rho = 0.008, N = 21, p = 0.487, one-tailed) and Pupil and Parent versions (rho = 0.225, N = 21, p = 0.164, one-tailed).

See Table 3.22.

		Parent	Teacher
Pupil	**rho**	0.225	0.008
	Sig (1-tailed)	0.164	0.487
	N	21	21

Table 3.22 Spearman correlation analyses between scores on Social Competence with Peers Questionnaires (Pupil, Parent and Teacher versions) for the control group

CHAPTER 4: DISCUSSION

This study aimed to examine the association between performance on executive function tasks and measures of social competence in everyday life in children with ADHD and compare their performance on these tasks to a control group. The children were assessed using a battery of executive function measures and were asked to complete a questionnaire about their social competence. In addition, parents and teachers were asked to complete two questionnaires regarding the child's social competence in everyday life.

In order to ensure that participants had sufficient comprehension to understand the experimental tasks, children were screened using the BPVS, a measure of receptive vocabulary. In addition, parents were asked to complete a screening questionnaire of behaviours commonly associated with autistic spectrum disorder. The characteristic features of autistic spectrum disorder include specific social interaction difficulties and would, therefore, be a confounding variable in this study.

4.1 Summary of Findings

The main findings of this study were:

i. Children with ADHD performed as well as a control group on executive function tasks, as measured by the Color-Word Interference Test, Twenty Questions and Verbal Fluency from the Delis-Kaplan Executive Function System. However, there were some differences between the groups on individual subscores within the subtests, albeit they were not statistically significant.

ii. There was a significant difference between the ADHD group and the control group on measures of social competence, with the ADHD group scoring significantly lower, as measured by the Adaptive Behaviour Assessment System and the Social Competence with Peers Questionnaires.

iii. For the control group, there was evidence of an association between executive function tasks and social competence measures completed by teachers. However, for the ADHD group, there was no evidence of an association between executive function tasks and social competence measures.

iv. There was no difference between the performance of children with ADHD and a control group on the Assessment of Perception of Emotion.

v. There was limited evidence regarding an association between the performance on the Assessment of Perception of Emotion and parent ratings of social competence.

vi. Post-hoc analyses revealed a significant positive correlation between the self-report measure for social competence (SCQP-Pu) and the Social Competence with Peers Questionnaire – Parent and Teacher versions, for the ADHD group, but not the control group.

The above findings are now discussed in relation to the hypotheses proposed in the introduction, with reference to the literature review and clinical observations made during the assessment procedure. The theoretical and clinical implications are then considered. A case example will be provided to illustrate the discussion of the findings. Finally, the methodology of this study and indications for further research are reviewed.

4.2 Discussion of Hypotheses

The hypotheses are numbered as they are in the introduction.

1. **Children with ADHD will demonstrate significantly greater impairment on executive function tasks, as measured by the Color-Word Interference Test, Twenty Questions and Verbal Fluency from the Delis-Kaplan Executive Function System, in comparison to a control group.**

This study did not find a statistically significant difference between the children with ADHD and the control group on the executive function measures. However, there were differences between the groups on some sub-scores, albeit they did not reach the adjusted level of significance. However, Clark-Carter (2001) recommended that following a Bonferroni correction, when the probability reached $p < 0.05$, but did not reach the adjusted level, it should not be automatically dismissed. Instead, he suggested that such a result might indicate where further research is warranted. Although there are a number of studies implicating executive dysfunction in ADHD (Pennington & Ozonoff, 1996), the specificity of the executive difficulties in individuals with ADHD is not yet agreed upon and contradictory findings are often reported in the literature. It may be that the findings from the present study provide some direction for future research into the specificity of the deficits.

All of the children with ADHD who took part in this study were taking stimulant medication. Stimulant medication, such as methylphenidate, has been shown to have positive effects on the ability of children with ADHD to sustain attention to assigned tasks and to reduce their task-irrelevant restlessness and motor-activity (Barkley, 1977b). In addition, problems with aggression, impulsive behaviour, noisiness, noncompliance and disruptiveness have also been shown to improve with stimulant medication (Barkley, 1990).

In a non-clinical population, stimulant medication has been found to impair executive function by inducing 'over-focusing and perseveration' (Robbins & Sahakian, 1979). However, stimulant medication has been found to improve performance on some tests of executive function in individuals with ADHD, particularly if they are highly structured measures of attention such as continuous performance tests (Rappoport, Buchsbaum, Weingarter, Zahn, Ludlow & Mikkelsen, 1980).

Douglas, Barr, O'Neill & Britton (1986) found that methylphenidate can increase the flexibility of performance and reduce perseverative responses on the WCST in ADHD. Everitt and colleagues (1991) found similar results with methylphenidate improving performance on the WCST in children with ADHD, but no improvement on the Stroop (an inhibition task). Due to its similarity to the Stroop, the Color-Word Interference Test of the Delis-Kaplan Executive Function System was used in this study. Although no difference was found between the ADHD and control group on the Inhibition subscore of this task, there was a difference between the groups on the Inhibition/Switching subscore, albeit this did not reach the adjusted level of significance.

The Inhibition/Switching condition of the Color Word-Interference Test involves participants switching back and forth between naming the dissonant ink colours and reading the words, and places significant cognitive demands on the participant. This condition is a measure of both inhibition and cognitive flexibility. Bohnen, Twijnstra & Jolles (1992) demonstrated that a switching procedure added to the interference condition enhanced the sensitivity of the task to mild brain damage.

There was also a difference between the groups on the Initial Abstraction Score from Twenty Questions. This score is derived from the participants' first question, which can reflect a high level of abstract thinking, flexibility and inhibition. Again, this is a particularly cognitively demanding task.

Some of the contradictory evidence presented in the literature relating to executive dysfunction in children with ADHD may be due to the insensitivity of the tests used to specify the executive deficits. It could be argued that the subscores from the tests utilised

in the present study were more sensitive to the specific deficits experienced by children with ADHD.

It may be that the highly structured nature of this type of assessment may be improving performance on these tasks. In this study, the children were assessed in a quiet room, relatively free from distraction. In addition, the one-to-one nature of the assessment procedure results in frequent reinforcement of desirable behaviour. It is possible that performance on the executive function measures was therefore enhanced and may not reflect the ADHD child's executive functioning in everyday life. In everyday life, the ADHD child may find the competing stimuli present a drain on higher-level cognitive skills, finding it difficult to focus on the most pertinent stimuli and respond appropriately. It may be that the Initial Abstraction score and Inhibition/Switching score might accurately reflect the cognitive load placed on children with ADHD when in social situations.

Although the quantitative finding from this study indicated no significant impairment with regard to inhibition, clinical observation would suggest otherwise, with many of the children with ADHD presenting behaviourally as disinhibited and impulsive. This will be discussed in more detail later.

The contradictory evidence reported in the literature regarding executive deficits in individual's with ADHD might be due to the use of neuropsychological assessments that either have no standardised normative data or have normative data gathered from an adult population (Kempton et al., 1999). This study employed a battery of executive function measures that has standardised normative data for the age group 8 years to 89 years, therefore, taking into consideration developmental differences in executive function. This may provide one explanation for the finding in the present study.

Another explanation may be that as the children with ADHD were current patients of Child and Family Mental Health Service, Royal Aberdeen Children's Hospital, they may have experience of this type of assessment. Consequently, the ADHD group may have been more at ease with the assessment procedure and were, therefore, less anxious than the

control group. It is possible that anxiety regarding the assessment procedure may have impeded the control group's performance on the executive function tasks.

2. **Children with ADHD will demonstrate significantly greater deficits in social competence, as measured by the Adaptive Behaviour Assessment System and the Social Competence Questionnaires, in comparison to a control group.**

With regard to the measures of social competence, there was a significant difference between the ADHD and control group, with the ADHD group scoring significantly lower, indicating a degree of impairment. As discussed in the literature review, deficits in social competence are common in individuals with ADHD and are often associated with poor longer-term adjustment (Taylor et al., 1996).

This study attempted to measure 'everyday life' social competence through the administration of questionnaires regarding behaviours one would expect to see in a socially well-functioning individual.

Whalen and colleagues (1987) discuss their observation that children with ADHD present as 'socially busy', expressing increased rates of interpersonal interest and engagement. During the assessment procedure in this study, in general, it was relatively easy to quickly build rapport with many of the ADHD children. They often engaged in conversation without much prompting and were keen to provide information about themselves. There is evidence that children with ADHD talk more than their peers (Barkley, Cunningham & Karlsson, 1983). In comparison, the control group were more reserved in their approach to the assessment procedure and the experimenter. Again, this may be related to the ADHD group having more experience of this type of assessment procedure and, therefore, feeling less anxious.

It is interesting to note the correlation between the participants' self-report measure of social competence (SCPQ-Pu) and the questionnaires completed by parents and teachers (SCPQ-P and SCPQ-T) rating the child's social competence for the ADHD group. This would suggest a degree of insight into their social difficulties. It may be that the 'loud,

energetic and forceful' social communication often observed in children with ADHD is an over-zealous effort to unsuccessfully remedy this. Being aware of their social difficulties may also be impacting on their longer-term adjustment particularly through the development of low self-esteem and a sense of helplessness when they see no gain from their efforts. There is well-documented evidence that children with ADHD will often suffer emotional disorders in later life (Freidman et al., 2003).

3. **There will be a positive correlation between performance on executive function tasks and social competence measures in both the ADHD group and the control group.**

There was evidence of an association between executive function tasks and social competence measures for the control group, but not the ADHD group. In particular, there was a stronger association between performance on executive function tasks and teacher ratings of social competence than parent ratings of social competence.

This suggests that executive functioning is involved in successful social functioning in children without ADHD, but not for the ADHD group? This seems unlikely. It is possible that the circumstances of the assessment procedure, i.e. free from distraction, immediate reinforcement, and stimulant medication resulted in improved performance on formal assessment of executive function. However, the cognitive demands in real-life social functioning may outweigh the executive capabilities of an ADHD child, therefore, impacting on the quality of the relationship with peers. This will be discussed in more detail later.

4. **Children with ADHD will demonstrate significantly greater impairment of emotion recognition, as measured by the Assessment of Perception of Emotion, in comparison to a control group.**

No evidence was found in this study to support the hypothesis that children with ADHD have more difficulty identifying emotion in other people than a control group. However, although Spence (1995) does not provide any normative data for this assessment, she

reported that most children perform this task with very little difficulty. It may be that this assessment of emotion recognition was not sensitive enough to establish a difference between the groups. The results from the control group suggest they had more difficulty with the task than Spence (1995) would have predicted.

In addition, Spence (1995) based her recommendations on her previous research (Milne & Spence, 1987) investigating social perception in 8-12 year olds. Spence (1995) advised that most children over 8 years have no difficulty on this assessment and the older children in the group produced a ceiling effect, with the majority scoring perfectly. The results on the Assessment of Perception of Emotion in the present study may be due to the significant difference between the ages of the ADHD and control group, with the ADHD group being significantly older. It may be that younger children with ADHD would have demonstrated more difficulty on this assessment. In accordance with this, Shapiro et al. (1993) found that younger children with ADHD had significant deficits in discriminating facial affective stimuli compared to older children with ADHD.

5. **There will be a positive correlation between performance on the Assessment of Perception of Emotion, the Social Competence with Peers Questionnaires and the Adaptive Behaviour Assessment System in children with ADHD and the control group.**

There was limited evidence found of an association between the performance on the Assessment of Perception of Emotion and the parent ratings of social competence. The Facial Expression task was positively correlated with the Social domain of the Adaptive Behaviour Assessment Schedule – Parent form for both groups, and the Social Competence with Peers Questionnaires – Parent version for the ADHD group. All other analyses failed to reach statistical significance. Nevertheless, this finding is interesting.

As mentioned above, teacher ratings of social competence and adaptive behaviour were more strongly associated with executive function than parent ratings. In contrast, there appears to be a stronger association between perception of emotion in children and their parents' rating of social competence and adaptive behaviour. This may be related to the

different type of relationship parents and teachers have with the children and a different type of behaviour or skill being important and being observed in home and school. For example, the ability to empathise may be a more desirable behaviour at home, whereas inhibitory control is more important in a classroom. Teachers also have more opportunity to observe children in cognitively demanding social situations, e.g. cooperative play in unstructured time such as playtime and negotiating skills in partner work in the classroom.

4.3 Theoretical and Clinical Implications

4.3.1 Executive function and ADHD

There is a substantial evidence-base implicating executive dysfunction in the cognitive and behavioural symptoms of ADHD. However, the specificity of these executive difficulties remains unclear, as research has presented conflicting evidence.

For example, as referred to in the introduction, some studies using the WCST have reported deficits in attentional set shifting in children with ADHD (Chelune et al. 1986; Gorenstien et al. 1989) while others have found no such impairments (Loge et al. 1990; Grodinsky & Diamond, 1992). A number of studies have investigated response inhibition in individuals with ADHD (e.g. Barkley, Grodinsky & DuPaul, 1992; Goodyear & Hynd, 1992; Grodinsky & Diamond, 1992; Charman, Carroll & Sturge, 2001) and found a deficit when compared to a control group. However, Perner, Kain & Barchfeld (2002) found that children 'at risk' of ADHD found the planning task problematic, but not the inhibition task.

Grodinsky and Barkley (1999) evaluated a battery of executive function tests for their accuracy in diagnosing ADHD and found that inhibition tasks such as the Continuous Performance Test, COWAT, Hand Movements Scale and the Stroop Colour-Word Association Test were all predictive of the presence of ADHD. However, normal scores on these tests could not reliably rule out the disorder.

It has been suggested that the equivocal nature of the findings of neuropsychological assessment of children with ADHD may be due to the use of executive function tests that

have been validated on adult humans with focal brain lesions (e.g. WCST) and may, therefore, have limited validity for use in children (Kempton, Vance, Maruff, Luk, Costin & Pantelis, 1999). It may be that tasks sensitive to executive function in adults may not consistently tap those functions at younger ages (Welsh & Pennington, 1988).

Previous research has been unable to elucidate whether impaired performance on some tests of executive function in ADHD may reflect a normal but immature central nervous system rather than ADHD-related pathology (Kempton, et al., 1999). It may be that there is a delay in the maturation of the prefrontal cortex in children with ADHD. Grondinsky & Barkley (1999) suggested that differences between children with ADHD and children without the disorder only emerge when relevant substrates of the frontal region have reached maturity in children without the disorder.

Adding to this debate, Barkley (1997) also suggested that a developmental delay accounted for some of the difficulties experienced by individuals with ADHD. He argued that problems with self-regulation present as a tendency to be influenced by the immediate environment and imminent consequences. Evidence of this will be presented in the case example of David[4], who during testing found it difficult to suppress his behaviour and not respond to the environmental stimuli. It is this type of behaviour that those caring for and teaching children with ADHD probably refer to as distractibility or inattention.

However, Barkley (1997) argued that poor sustained attention should be viewed as a secondary symptom rather than primary. He argued that poor attention is the result of an underlying impairment in goal-directed persistence arising from a deficit in inhibition and the effect this has on self-regulation.

Barkley (1997) described two forms of sustained attention. The first involves persistence that is contingency-shaped and the second is self-regulated and goal-directed. Barkley (1997) suggested that it is the second type of sustained attention that is developmentally delayed in children with ADHD. This theory may explain why children with ADHD often

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[4] Not his real name.

respond well to structured environments, for example, when being assessed for research purposes! The one-to-one nature of the assessment procedure, in quiet surroundings, results in immediate, positive reinforcement for desirable behaviour. Unfortunately, the stimuli present in a classroom and playground may be overwhelming for a child with ADHD and without immediate, positive reinforcement for desirable behaviour and lacking internal self-regulation and goal-directed behaviour, patterns of behaviour are likely to develop that teachers and peers find challenging.

In addition, Tannock, Schacher, Carr, Chajczyk & Logan (1989) found that improvements in behaviour and academic performance resulting from treatment with methylphenidate were strongly associated with improvement in inhibitory control as measured by the stop-signal paradigm. Although the present study did not compare participants' performance on the executive function measures with and without stimulant medication, the evidence from the current study tentatively supports these results. The present study found no significant difference between the ADHD group (who were all being treated with stimulant medication) and the control group on the Inihibition condition of the Color-Word Interference Test. It may be that the combination of treatment with stimulant medication and the one-to-one nature of the assessment procedure providing immediate reinforcement for desirable behaviour, results in children with ADHD performing comparably to the control group in the present study.

Alternatively, it may be that the measures frequently used in the investigation of executive dysfunction in children with ADHD are not sufficiently sensitive to discriminate the specific deficit. This present study found a difference between the groups on the Inhibition/Switching condition of the Color-Word Interference Test. The addition of this condition to the subtest has been shown to enhance sensitivity to mild brain damage (Bohnen, et al., 1992).

The improvement in performance through the use of immediate reinforcement for desirable behaviour is evidenced in the literature relating to behavioural interventions in the treatment of ADHD. As discussed in the introduction, there is a view that the behaviour problems of ADHD stem from an underlying motivational or self-regulation deficit

(Douglas, 1988; Barkley, 1990). Barkley (1990) argued that the drive towards this conceptualisation of ADHD comes from the observed variability in ADHD symptomatology across situations.

From a clinical perspective, parents often report that children with ADHD can pay attention to certain activities, for example, when playing computer games or watching their favourite television programme. This can be confusing for parents and teachers.

However, the behavioural symptoms of ADHD vary a great deal as a function of the situational demands placed on the child and educating the parents and teacher about the nature, course, outcome and causes of the disorder is one of the first steps in treatment.

In the management of behaviour problems at home, Anastopoulos & Barkley (1990), therefore, highlighted the importance of parents providing ADHD children with ongoing external motivation, particularly in situations they do not find intrinsically interesting, through the use of contingency management techniques.

However, the success of this type of intervention relies on the active participation of parents and this may not always be straightforward. There is evidence that ADHD is inherited (Pennington & Ozonoff, 1996; Biederman et al., 1990). Consequently, some parents of children with ADHD may, themselves, have ADHD and, therefore, find it difficult to implement a structured, behavioural programme. In addition, children with ADHD often place a tremendous strain upon family functioning. Some parents may be experiencing depression, anxiety, health problems, marital difficulties or financial strains (Anastopoulos & Barkley, 1990), resulting in parents having to direct much of their time and effort into coping with these difficulties. Anastopoulos & Barkley (1990) recommended that in conjunction with parent training, individual, marital and/or family therapy should be provided.

With regard to behaviour in the classroom, a similar approach is suggested, with the focus of the intervention being on providing ongoing external motivation for the child with ADHD. Pfiffner & Barkley (1990) recommended displaying signs of the 'rules' in the

classroom, for example, 'stop, look and listen', in order to provide the child with ADHD with external representation of the rules, as these tend to be more influential at regulating behaviour in children with ADHD than internally represented ones.

In addition, Pfiffner & Barkley (1990) recommended that consequences used to manage behaviour should be delivered swiftly and frequently as feedback for ongoing task performance delivered more often may help the child with ADHD shape and regulate behaviour.

Barkley (1990) also discussed the benefits of stimulant medication on behaviour in children with ADHD and suggested that medication can help with the social difficulties experienced by children with ADHD, through reducing the incidence of impulsive, disinhibited behaviour. However, evidence from the present study contradicts this. Despite no difference between groups on the executive function tasks measuring inhibition and impulsivity, significant differences were apparent between the groups on measures of social competence.

4.3.2 Social Competence and ADHD

Many parents of children with ADHD report that 'they always knew there was something different' about their child from a very early age. The age of onset is usually in toddler-hood, with a 'peak age of onset' between the ages of 3 and 4 (Palfrey, Levine, Walker & Sullivan, 1985). However, the parents who participated in this present study often spoke of a substantial delay in the diagnosis and treatment of their child. It is possible that this delay impacts on the current social functioning of the child with ADHD.

Children begin to develop internal working models of relationships from a very early age, based on the relationship with their primary caregiver (Bowlby, 1988). There is some evidence that the features of the disorder adversely affect the quality of the relationship between the mother and child with ADHD. Camarata & Gibson (1999) postulated that the characteristics associated with the disorder interrupt the flow of interaction and interfere with the development of social communication. It may be that parents of children with

ADHD misinterpret distractibility and restlessness as disinterest and make fewer attempts to engage the child in social interaction. Consequently, the child with ADHD experiences an impoverished social world, affecting his social learning.

The present study found a significant difference between the ADHD group and control group on the Autism Screening Questionnaire (Berument et al., 1999). Clark, Feehan, Tinline & Vostanis (1999) also found that many parents of children diagnosed with ADHD reported features commonly associated with autistic spectrum disorders. Most of the parents of children with ADHD who participated in the Clark et al. (1999) study reported that their child had 'a lack of awareness of the feelings of others', 'difficulty forming relationships', 'difficulty knowing how to sustain a conversation' and 'a lack of desire to interact with others'.

Finding it difficult to wait in turn taking, interruption of others and being easily distracted, all typical features of ADHD, could be interpreted as a lack of willingness to interact and produce the impression of being unaware of the feelings of others, impacting significantly on the quality of the relationship with others. Qualitative evidence from the present study concurs with this. During the assessment procedure, the children with ADHD presented as more verbose and energetic, than the control group. However, at times, it was possible to describe this verbosity as 'a lack of awareness of the feelings of others' or a fumbled attempt to sustain conversation. Further evidence of this is illustrated in the case example.

Clark and colleagues (1999) also observed that poor eye contact, failure to greet others and a lack of awareness of the need for others' personal space were frequently reported behaviours in children with ADHD. From a very early age, the features of ADHD affect the quality of social interaction with others and this may influence the development of successful social functioning. Children with ADHD may, therefore, have less opportunity to experience appropriate interaction, learn social skills and, as a result, may develop deficits in several areas of social competence.

A number of the parents of children with ADHD, who participated in the present study, reported that it had taken a number of years for their child to be diagnosed and treated. It

may be that earlier intervention could help these families and children overcome some of these difficulties, thus preventing some of the longer-term difficulties experienced by individuals with ADHD.

Social skills training programmes have been developed in the past 15 years in an attempt to directly alter the peer relations and longer-term outcomes of children who are socially rejected or isolated from their peer group (Guevremont, 1990). Most social skills training programmes have two goals: (1) to increase the child's awareness and sensitivity of how their social behaviour affects others (social knowledge); and (2) to teach new prosocial behaviours believed to be deficient in the child's social repertoire (skill acquisition).

However, there is limited research into the efficacy of such training programmes. Although, it would seem that the two basic goals are accomplished with children becoming more knowledgeable about appropriate and inappropriate social behaviour and learning the specific social skills targeted in the programme. It is often the case that the participants' original behaviour does not change in their normal environments, as the behaviour does not generalise.

In addition, and potentially more damaging, is that often when the new social skills are demonstrated in their own environments, the social status of the child does not change. Thus, disliked children may continue to be rebuffed by peers, despite their use of more appropriate interpersonal behaviours (Guevremont, 1990). This is particularly problematic in children with ADHD, who may already have low self-esteem and insight into their difficulties. As discussed previously, children with ADHD tend to have a more external locus of control and are therefore more likely to view events that happen to them as outside their personal control (Linn & Hodge, 1982). Feelings of helplessness may develop, further lowering their self-esteem.

Guevremont (1990) pointed out that social skills training programmes have rarely included active strategies to promote generalisation to the natural environment or directly influence the social status of the child. Therefore, programmes that are too narrow in scope and do

not actively address issues of generalisation and social status are not likely to have a positive impact on the child's immediate or longer-term peer interactions.

Guevremont's (1990) social skills programme for children with ADHD has a number of components which includes social entry skills, conversation skills, conflict resolution and problem solving and anger control training as well as tackling the issue of generalisation through increasing the training length, using real-life scenarios and incorporating self-monitoring homework exercises. Guevremont (1990) also suggested involving the ADHD child's actual peers in the training programme, thereby influencing the peer interaction. Bierman & Furman (1984) found that the structured guidance of adults results in children getting along better and liking each other more.

A significant correlation was found between the self-report measure of social competence completed by the children with ADHD and their teachers' rating of social competence. This finding suggests a degree of insight into their difficulties and it may be this insight, as mentioned above, that leads to the development of low self-esteem often reported in the literature (Carr, 2002). It may be that low self-esteem is playing an important role in the maintenance of their difficulties, both currently and in the future.

Low self-esteem may prevent children with ADHD attempting to engage appropriately in social situations for fear of rejection, thus lowering their self-esteem further. Defiant, aggressive behaviour and negative assumptions about other's motives may serve to protect their self-esteem. In the longer-term, low self-esteem may result in the development of emotional disorders such as depression and anxiety.

Melnick & Hinshaw (1996) found that the social goals of boys with ADHD and a control group differed. The boys with ADHD, particularly those with high levels of aggression, tended to seek domination and 'trouble making' to a greater extent than the boys in the control group. Whalen & Henker (1985) investigated ADHD children's ability to make social judgements and asked the children to categorise their peers, e.g. 'causes trouble', 'fun to be with'. They found that the children with ADHD were as able as the control group to describe the social behaviour of their peers. However, for the control group, the

perception of negative behaviour (e.g. 'causes trouble') and 'liking' was highly negatively correlated, but this was not the case for the ADHD group. This could be interpreted as the boys with ADHD attempting to protect their self-esteem and assert that their aggressive behaviour is acceptable rather than a lack of awareness of their social difficulties.

During the assessment procedure of this study, clinical observation revealed a distinct difference between the ADHD and control group with regard to their approach to the tasks. A number of the children with ADHD were keen to know how well they were performing and frequently asked if their score was better than the last. This was in marked contrast to the control group, who presented as less concerned about their performance. There was a sense of competition in the ADHD group and it may be that self-esteem in children with ADHD depends on success in situations where they compete with others. Of course, this qualitative difference between groups may be the consequence of a gender bias, with boys being over-represented in the ADHD group.

4.3.3 Social competence, executive function and ADHD

The present study did not find a significant positive correlation between the measures of social competence and executive function tasks for the ADHD group. However, there was evidence of an association between these measures for the control group. As previously discussed, this seemed unlikely and a number of explanations for this finding were explored. For example, it may be that the conditions of the assessment procedure improved the performance of children with ADHD on the measures of executive function. However, this type of situation may not accurately reflect the executive demands in social situations in everyday life, where competing stimuli are present in continuously changing circumstances and modification of response is expected.

Whalen and Henker (1985) found that children with ADHD were able to evaluate the effectiveness of given solutions to hypothetical social problems as well as a control group. However, when presented with the problematic social situation they were less effective at generating solutions to the problems. There could be a number of interpretations of this finding. For example, due to pervading social difficulties from an early age, children with

ADHD may not have experienced relationships with other children, where negotiation and problem solving are necessary skills in the development of substantial friendships. Therefore, the ability to generate solutions to social problems may be hampered by a lack of experience. In addition, as previously discussed, it may be that low self-esteem and a developing sense of helplessness may result in children with ADHD not feeling able to generate solutions.

Alternatively or additionally, deficits in executive functioning, through impaired cognitive flexibility and a lack of inhibitory control, may be hindering the ADHD child's ability to generate solutions. In the Carlson & Moses (2001) study investigating executive function and theory of mind, they argued that the executive functions play a role in the development of theory of mind. They postulated that without some capacity to distance themselves from the immediate stimuli, children are unable to reflect on representations of those stimuli. In particular, the ability to override the prepotent, habitual response (inhibitory control) is necessary to perform successfully on theory of mind tasks.

Similarly, in Whalen & Henker's (1985) study, children with ADHD would need to be able to distance themselves from their immediate circumstances, in order to consider the hypothetical social problem and then be able to think flexibly in order to generate and appraise the problem.

Dodge (1980) investigated social cognition and children's aggressive behaviour. Aggressive and non-aggressive children responded with more aggression in the hostile condition than the benign condition. However, it was in the ambiguous situation where the groups differed. Aggressive children responded as if the peer had acted with hostile intent, whereas non-aggressive children responded as if the peer had acted with benign intent.

Both these studies suggest that children with ADHD, particularly those who behave aggressively, have reduced cognitive flexibility and impaired inhibitory control. It may be that children with ADHD find social communication difficult as responding appropriately requires the ability to attend to and appraise the continuously changing demands and cues that characterise the flow of social interactions (Landau & Moore, 1991).

Demands made on cognitive processes depend on the social situation. It may be that automatic responses are sufficient for routine social interactions (Hughes, et al., 1998). However, when an ADHD child is faced with a novel or ambiguous social situation, the cognitive demands may outweigh the child's social information processing ability (Dodge, 1980). The child may then resort to a more 'automatic' behaviour that is inappropriate for the situation. It may be that the Inhibition/Switching task in the Color-Word Interference Test and the Initial Abstraction score from Twenty Questions, used in the present study, more accurately reflect the cognitive demands made in novel or ambiguous social situations.

In the present study, participants' self-report measures of social competence (SCPQ-Pu) were positively correlated with teachers' ratings of social competence (SCPQ-T) and to a lesser degree, parents' ratings of social competence (SCPQ-P). It is likely that teachers observe children in more demanding social situations and have a good awareness of the social status and interactions both within the classroom and in less structured activity such as gym and in the playground. It is in these more socially demanding situations it could be argued that executive functioning plays a more significant role in successful or unsuccessful peer interaction.

However, it may be that executive regulation of behaviour is more transparent in school settings than home due to the degree of structure or more specifically the demands made on children to restrict behaviour (Barkley, 1990). Barkley (1990) highlighted evidence that children with ADHD are less distinguishable from normal children in free-play or low-demand settings than in highly restrictive settings (Luk, 1985). He argued that the symptoms of ADHD only become disabling when the demands exceed the child's capacity to sustain attention, regulate activity and restrain impulses. Basically, the more complicated the task, the greater its demand for planning, organising and cognitive flexibility, increasing the likelihood that ADHD children will perform poorly (Douglas, 1983).

In the present study, there may be several factors that contributed to the finding that the ADHD group performed as well as the control group on the executive function tasks. It may be that the circumstances of the assessment procedure did not 'exceed their capacity to sustain attention, regulate activity and restrain impulses' (Luk, 1985). The measures were selected on the basis that they appeared game-like. In the same way that parents often report that children with ADHD are able to sustain attention for long periods of time when playing computer games, it may be that the measures were engaging and appealed to their sense of competition. During the assessment procedure, the participants had to interact with only one person, the conditions of testing were relatively free from distraction and immediate reinforcement for desirable behaviour was provided. This type of situation is very different to environments where social interaction occurs, e.g. in the playground, where a range of competing stimuli is present.

4.3.4 Emotion Recognition and ADHD

The ability to identify emotion from vocal and facial cues appears to be related to social competence as early as the pre-school years (Nowicki & Mitchell, 1998). It has been shown that children who have difficulty encoding nonverbal cues are less accepted by their peers (Goldman, et al., 1980) and tend to have fewer friends and lower self-esteem (Whalen, Henker & Granger, 1990).

Barkley (1997) argued that the ability to perceive and recognise emotion in other people would not be compromised in children with ADHD, as emotion recognition is non-executive in nature. However, some argue that emotion recognition is executive in nature and there is evidence that children with ADHD have difficulty identifying emotion in others. Studies have found that children with ADHD have difficulty identifying emotional expression and content in speech (Shapiro et al., 1993) and problems recognising facial expression of emotion (Singh, et al., 1998).

Shapiro and colleagues (1993) found significant deficits in a younger group of children with ADHD compared to an older group when asked to match the prosody and content of speech and matching audio to visual emotional stimuli. Whyte (2000) argued that these

tasks placed significant demands on executive functioning. For example, both require internal representation of concepts, the ability to attend to and discriminate the relevant stimuli, self-monitoring, the ability to inhibit a response, impulse control and flexibility of thought and action.

In accordance with this, Cadesky and colleagues (2000) found that the errors made by children with ADHD in interpreting emotion were random in nature. They hypothesised that this was a deficit at the encoding stage and may, therefore, involve executive functioning as the encoding stage involves the ability to internally manipulate and match the facial expression. They argued that children with ADHD find it difficult to attend to the appropriate cues of affect, due to the range of competing stimuli in social situations.

As discussed previously, it may be that children with ADHD have delayed executive skills that mature and develop later than children who do not have ADHD. This results in a mismatch between young ADHD children and their non-ADHD peers. For example, with regard to emotion recognition and the ability to communicate empathy, in normal development, approximately age 4, children will begin to demonstrate the ability to make inferences about another person's expectations and beliefs and use this information to anticipate and understand their behaviour (Perner & Wimmer, 1985).

It is likely that this has a positive impact on the development of their social skills. Those around them are encouraged by their social interaction and will interact more, encouraging further development in the child, in the same way language develops as discussed earlier.

However, if young children with ADHD find it difficult to perceive emotion and give the impression of being disinterested, social skill development will be hampered. It is possible that relationships with parents and peers will lack the intrinsic satisfaction, experienced by their 'normal' peers.

Barkley (1997) argued that children with ADHD would have decreased empathy due to deficient self-regulation of affect. There is a paucity of research exploring the concept of empathy in children with ADHD. However, Braaten & Rosen (2000) investigated

empathic responding in boys with ADHD, using an empathy response task. The results indicated that boys with ADHD were less empathic than those without ADHD. In addition, boys with ADHD exhibited more outward signs of sadness, anger and guilt than those without ADHD.

It may be that although older children with ADHD are able to identify emotion, they have difficulty knowing how to respond appropriately to that emotion or to empathise with those around them.

4.3.5 Case example

The following case example illustrates a number of the issues raised and discussed above.

David is eight years old and was seen at home for the assessment. David has an older brother (12 years) and a younger sister (1 year). David's mother reported that she had been aware that David was much more active than his brother from a very early age and that, as a family, they had found his behaviour very difficult. However, he was only recently diagnosed with ADHD by the Consultant Child Psychiatrist at R.A.C.H. and was currently being treated with methylphenidate.

David's mother reported that since starting the medication, she had noticed a significant decrease in his more impulsive, over-active behaviour and there were good reports from school. However, she continued to have concerns about his social skills. She had noticed that he did not mix well with other children in the playground and was often in disagreements with his peers. She felt that he found it very difficult to play cooperatively and preferred play to be 'on his terms'. His difficulties in social interaction had prompted her to participate in this research.

In completing the Autism Screening Questionnaire (ASQ), David's mother positively the endorsed a number of statements, including:

'Has he ever used odd phrases or said the same thing over and over in almost exactly the same way?'

'Has he ever used socially inappropriate questions or statements? For example, has he ever regularly asked personal questions or made personal comments at awkward times?'

She negatively endorsed the following statements:

'Does he have any particular friends or a best friend?'

'When he was 4- to 5- did he usually look at you directly in the face when doing things with you or talking with you?'

'When he was 4- to 5- did he ever seem to want you to join in his enjoyment of something?'

'Between the ages of 4- to 5- did he show a normal range of facial expression?'

David's score on the ASQ was 15.

On formal assessment, David's BPVS raw score was 19 (receptive vocabulary age equivalent 8 years 11 months). David's scaled scores for the executive function tasks (Color-Word Interference Test, Twenty Questions and Verbal Fluency) from the Delis-Kaplan Executive Function System (D-KEFS) are shown in Table 4.1 to Table 4.3. In the scoring of the D-KEFS subtests, raw scores are converted to age-corrected scaled scores. Scaled scores have a mean of 10 and a standard deviation of 3.

	Age Corrected Scaled Score
Initial Abstraction Score	8
Total Questions Asked	6
Total Weighted Achievement Score	7

Table 4.1 Case Example: Twenty Questions

	Age Corrected Scaled Score
Inhibition	10
Inhibition/Switching	14

Table 4.2 Case Example: Color-Word Interference Test

	Age Corrected Scaled Score
Letter	12
Category	12
Category Switching (total correct responses)	16
Category Switching (total switching accuracy)	16

Table 4.3 Case Example: Verbal Fluency

David's results on the Color-Word Interference Test and Verbal Fluency were average to well-above average. These results would suggest that David has no difficulty with higher-level cognitive skills such as inhibition and cognitive flexibility. However, his performance on Twenty Questions was below average and might suggest some difficulty with problem solving and abstract thinking. In addition, this subtest assesses an individual's ability to use feedback to monitor one's own behaviour and moderate that behaviour in light of the information received. This may be where David's difficulties lie.

Throughout the assessment procedure David presented as disinhibited and impulsive. Poor inhibitory control is often indicated by impulsive behaviours such as responding before the task is understood, answering before sufficient information is available, allowing attention to be captured by irrelevant stimuli or failing to correct obviously inappropriate responses (Schacher and Logan, 1990).

Barkley's (1997) model of ADHD predicted that individuals with ADHD are less well controlled by internally represented information, but respond to external stimuli. Barkley (1997) referred to behaviour often observed in patients with prefrontal lobe injuries, where objects in the environment elicit a response that is appropriate for the object but inappropriate for the situation (this is termed 'utilisation behaviour').

David became distracted by items in the living room where testing was taking place and had to be repeatedly asked to return to the table to continue with the assessment. For example, without encouragement from the experimenter, David insisted on playing his violin for the experimenter before proceeding with the next task on one occasion and, on another, after spotting postcards on the mantelpiece, left the room for a few minutes to look for a postcard from a friend who was holidaying in France with his family. This behaviour could be described as 'utilisation behaviour'.

Barkley (1990) argued that this type of overt behaviour is due to impairments in executive functioning, which affects the ability to organise and monitor social communication, as indicated in David's performance on Twenty Questions.

Nevertheless, when he was engaged with the task, he was highly motivated to do well and frequently asked if his current score or time was better than the last, asking the experimenter, 'Am I in a competition?' He was also interested to know if he was 'better than the other children who'd done it'. During the administration of Verbal Fluency, David ran around the living room and into the kitchen to look for items beginning with the letters F, A and S, becoming breathless in the process.

The measures of social competence completed by his parents and teacher indicate some difficulty and are presented in Table 4.4 and Table 4.5. Scaled scores are derived from the raw scores, allowing comparison with other individuals in the same age group. The distribution of scaled scores has a mean of 10 and a standard deviation of 3. In general, a scaled score of 10 defines the average performance of a given age group.

	Scaled Score
Communication	5
Leisure	6
Self-Direction	8
Social	4

Table 4.4 Case Example: Adaptive Behaviour Assessment Schedule (Parent)

	Scaled Score
Communication	6
Leisure	5
Self-Direction	7
Social	5

Table 4.5 Case Example: Adaptive Behaviour Assessment Schedule (Teacher)

	Raw score
Assessment of Perception of Emotion	
- Facial Expression	22
- Posture Cue	21

Table 4.6 Case Example: Assessment of Perception of Emotion

	Raw score
SCPQ-Pupil	10
SCPQ-Parent	9
SCPQ-Teacher	9

Table 4.7 Case Example: Social Competence with Peers Questionnaires

As can be seen in Table 4.4 and Table 4.5, David's parents and teacher rate him as below average on all the domains, particularly Communication, Leisure and Social. The

Communication domain looks at behaviours such as appropriately greeting people, looking at other people's faces when they are talking, ends conversations appropriately, taking turns in conversations, nodding and smiling to encourage others' when they are talking. The Leisure domain queries behaviours such as playing with toys or games with other people, waiting for his turn in games, invites other people to join in with fun activities and the Social domain covers friendship and social interaction. For example, has one or more friend, has good relationships with parents and other adults, laughs in response to funny comments or jokes, stands a comfortable distance from others during conversation, shows sympathy when others seem sad or upset, congratulates others when something good happens to them.

David performed well on the Assessment of Perception of Emotion, easily recognising the emotions depicted (Table 4.6).

It is interesting to note that the score on David's self-report measure of social competence (SCPQ-Pu) is 10 (Table 4.7). The maximum score for this questionnaire is 20 and the mean score is 15.53. In completing this questionnaire, participants have a choice of three responses (Not true, Sometimes True, Mostly True) and are instructed to circle the response that best describes them. David circled 'Sometimes True' for all statements on this questionnaire. It may be that David has some awareness of his difficulties in social situations, as indicated by his parents' and teachers' ratings. An alternative interpretation may be that he responded impulsively without properly reading and processing the questions.

During the assessment, David's behaviour indicated a lack of awareness for the appropriate behaviour for the situation. He was keen to show the experimenter things he was interested in and did not wait for encouragement. It was a one-sided interaction with the experimenter working hard to engage David in the task.

Speculating about these findings, the author has observed in clinical practice that children with ADHD often respond very positively to the one-to-one nature of the assessment procedure and as a consequence can be highly motivated to undertake the assessment, once

engaged with the task. There was a qualitative difference between the ADHD group and control group with regard to the manner in which they engaged in the assessment for this study. Many of the ADHD children presented as enthusiastic (sometimes overly enthusiastic!) and keen to demonstrate their aptitude at the tasks. Whereas, the control group, in comparison to the ADHD group, were less forthcoming in their responses and appeared less motivated to engage in the assessment procedure. As discussed previously, it may be that the control group were more anxious than the ADHD group.

Whalen and Henker (1984) point out that this higher rate of sociability may lead to increased visibility and in turn may lead to more aversive social exchanges. Whalen and Henker (1992) reported increased levels of intensity in children with ADHD, where intensity refers to loud, energetic and forceful social communication. This may be at odds with their peer group and put them at risk of rejection.

As discussed in the introduction, children with ADHD have been found to talk more but find it more difficult to organise and pass on information to peers with whom they are asked to work (Cunningham & Siegal, 1987). In addition, despite talking more, children with ADHD are less likely to respond to the questions or verbal interactions of their peers. Hence there is less reciprocity in the social exchanges of hyperactive children and their peers (Cunningham & Siegal, 1987). Evidence of this is illustrated in the case example presented above.

4.4 Limitations of Study

The conclusions of this study are limited due to the relatively small sample size. In addition, there are potentially a number of confounding variables making firm conclusions difficult. As with many studies, it is difficult to ascertain if the sample are representative of the population. For example, the control group was possibly not representative of a 'normal' sample. They were recruited from one primary school, in a predominately high socio-economic area of Aberdeen, and were all in the same year at school.

Although the head teacher had been asked to distribute the invitations to participate across the school years, it may be that the majority of participants from one year, was due to peer influence, i.e. when one child agreed to participate, others also decided to participate. However, due to time constraints, being able to assess a number of children in one location was beneficial. Nevertheless, with hindsight, it may have been preferable to recruit participants from different schools and in different years.

No measures were taken of the age at which children with ADHD started taking methylphenidate or the length of treatment. Therefore, a more long-term effect of medication on social competence was not investigated. It has been suggested by a number of theorists that social learning is affected by ADHD (Peterson & Siegal, 1995; Camarata & Gibson, 1999), therefore the length of time a child has been taking stimulant medication or the age at which the began taking stimulant medication may affect their social ability.

Also, with regard to medication, it was decided that participants should continue to take their medication as prescribed. It was felt this would provide a more accurate picture of the child's functioning in everyday life. However, as the ADHD children were medicated, and no comparisons were made with an unmedicated control group or the same participants unmedicated, it is difficult to draw firm conclusions regarding their performance on the executive function tasks, as it is unclear whether their performance was influenced by the stimulant medication.

Although the majority of scores obtained in this study were age-corrected scaled scores (Delis-Kaplan Executive Function System and the ABAS), it may have been appropriate to match the ADHD group and control group for age and gender. This had been intended. However, as discussed above, it was unfortunate that those who agreed to participate in the control group were in the same year at school. The experimental group sample reflects the over-representation of males to females in children with ADHD seen at R. A. C. H. and as indicated in prevalence rates of the disorder. It may be that the differences in age and gender between the groups influenced the results. For example, it is possible that the results of the Assessment of Perception of Emotion and social competence measures were influenced by the significant difference in age and gender between the groups.

The emotion recognition task used in the current study is not as rigorous as those used in the other studies investigating emotion recognition in children with ADHD. In addition, no normative data was available for this assessment, making it difficult to ascertain if the ADHD group had significant difficulties with emotion recognition. However, there is a lack of appropriate measures to assess emotion perception and of those that are available there is a lack of information regarding their reliability and validity, particularly with regard to their use with children. In addition, some assessment methods require substantial training and materials and were unavailable within the confines of the present study. Due to constraints on resources and time, the assessment method was determined as the most appropriate.

4.5 Future Research

The present study did not find a statistically significant difference between the ADHD group and control group on executive function measures. However, there were some differences between the groups on subscores within the tasks, e.g. Inhibition/Switching from the Color-Word Interference Test and the Initial Abstraction Score from Twenty Questions. There continues to be speculation in the literature regarding specificity of the executive deficits in children with ADHD. Further investigation involving these tests may be indicated.

As suggested by Kempton and colleagues (1999), a battery of executive function measures (the Delis-Kaplan Executive Function System) validated on children and adults and providing normative data for children as young as 8 years old was employed. Previous research has tended to use measures validated on an adult population. Also, the sample in this study were all over eight years old, some were as old as fourteen. It was not an aim of this study to investigate the development of inhibitory control but the results may suggest further investigation is warranted in order to ascertain if children under eight years old with ADHD differ from older children and adults with the disorder.

In addition, due to clinical observation of impulsive, sometimes disinhibited behaviour, in many of the participants with ADHD, it may be appropriate to include a motor inhibition task, such as the Stop-Signal Paradigm (Logan, Cowan & Davis, 1984). It may be that motor impulsivity and its consequences are more strongly associated with deficits in social competence.

Further research is also indicated with regard to the effects stimulant medication has on executive function, social competence and emotion recognition. As discussed above, it may be that the critical stage for the development of effective social functioning for an individual may be before many children with ADHD have been diagnosed and treated. Intervention at an earlier age may alleviate some of these difficulties and thus prevent

some of the longer-term social difficulties. A longitudinal study designed to investigate this may be indicated.

This study found a positive correlation between participants' self-report measure of social competence and the teachers' rating of their social competence and to a lesser extent their parents' ratings. This suggests a degree of insight into their difficulties. However, Arsenio & Fliess' (1996) hypothesis that disruptive children have a delayed understanding of the emotional consequences of socio-moral transgressions would suggest that children with ADHD lack insight into the consequences of their behaviour. Investigation into how low self-esteem and insight may be playing a role in social competence may also be appropriate.

Although no differences were found between the ADHD group and the control group on the emotion recognition task, further investigation of the concept of empathy and its role in social competence in children with ADHD is also indicated.

4.6 Conclusion

This study found no difference between the ADHD group and control group with regard to performance on the measures of executive function. It may be that 'laboratory' executive function measures do not accurately reflect their ability to access and utilise these skills in everyday social interactions. The relatively controlled environment where the assessment was administered is very different to the more complex social information processing demands in the real world.

In addition, all the children in the ADHD group were taking stimulant medication. There is limited evidence that stimulant medication improves executive functioning in children with ADHD. This, along with the conditions of testing, may provide an explanation as to why the children in this study performed as well as the control group on the measures of executive functioning.

This study did, however, find a significant difference between the ADHD group and the control group on measures of social competence, with the ADHD group scoring significantly lower.

It has been reported that aggressive, noisy, loud, disruptive behaviour is a reliable predictor of peer rejection (Landau & Moore, 1991). Research into the treatment of ADHD with stimulant medication would suggest that a decrease in this type of behaviour is one of the benefits (Barkley, 1990). Indeed, Tannock and colleagues (1989) found that improvements in behaviour and academic performance resulting from treatment with methylphenidate were strongly associated with improvement in inhibitory control. It would, therefore, seem reasonable to hypothesise that social competence should improve with stimulant medication treatment, as has been suggested in the literature related to the treatment of ADHD with medication (Barkley, 1990). However, this present study contradicts this hypothesis and indicates that further investigation into the underlying nature of the social difficulties experienced by individuals with ADHD is warranted.

There is evidence that behavioural and psychological interventions are beneficial in the treatment of ADHD. Evidence from this study suggests that this type of intervention may help children with ADHD overcome some of their cognitive deficits. In addition, earlier intervention is indicated, which may prevent some of the longer-term social difficulties, and their consequences, experienced by many individuals with ADHD.

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Appendix I DSM-IV criteria for the diagnosis of Attention Deficit Hyperactivity Disorder

DSM-IV Diagnostic Criteria for Attention Deficit/Hyperactivity Disorder

A. Either (1) or (2)

(1) Six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level.

Inattention

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) Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 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) 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 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).

B. Some hyperactive-impulsive or inattentive symptoms that cause impairment were present before age 7.
C. Some impairment from the symptoms is present in two or more settings (e.g. at school (or work) and at home).
D. There must be clear evidence of clinically significant impairment in social, academic or occupational functioning.
E. The symptoms do not occur exclusively during the course of a pervasive developmental disorder, schizophrenia or other psychotic disorder and are not better accounted for by another mental disorder (e.g. mood disorder, anxiety disorder, dissociative disorder or personality disorder).

Appendix II Invitation to Participate (ADHD group)

Child and Family Mental Health Service
Royal Aberdeen Children's Hospital
Westburn Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Dear Parent/Guardian,

A Trainee Clinical Psychologist in the Child and Family Mental Health Service, Royal Aberdeen Children's Hospital, is doing a research project looking at the thinking skills and social skills of children with/out attention deficit hyperactivity disorder (ADHD).

I wondered if you and your child would like to participate in the project.

I have enclosed some information to help you decide whether or not you'd like to take part. If your child has reading difficulties, please read out the enclosed 'Information for Children' sheet to him/her.

If you decide to participate, please sign the enclosed consent forms and return them in the enclosed SAE. You will then be contacted by Leonie Carter (Trainee Clinical Psychologist) and invited to attend an appointment at a time and place convenient to you.

If you do not wish to participate, your treatment will not be affected in any way.

Yours sincerely,

Consultant Psychiatrist

Appendix III Information Sheet (ADHD group)

Child and Family Mental Health Service
Royal Aberdeen Children's Hospital
Westburn Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Dear Parent/Guardian,

We are conducting a study involving children with attention deficit hyperactivity disorder (ADHD). Children with ADHD often have difficulties with overactivity, impulsivity and attention.

We would like to look at their thinking skills and how this relates to their social skills.

We are writing to invite your child to take part.

Aim. The aim of the study is to find out if they have difficulties in these areas and if they are linked.

What does the study involve? Children taking part in the study will be helped to fill in a questionnaire about their social skills. They will be asked to name objects in some pictures to look at their vocabulary skills and do some tasks that look at different thinking skills. Parents/Guardians will be asked to fill in three short questionnaires about their child's social behaviour. Your child's teacher will also be asked to complete two questionnaires regarding his/her social behaviour.

How long will it take? To complete all the tasks will take about one hour. Your child will only be seen on one occasion.

Where will my child be seen? You will choose whether your child is seen at school, home, or the Children's Hospital.

Will I find out how it went? You will be sent information about the results of the study. Further queries can be discussed with your psychiatrist/psychologist.

Confidentiality. All the information in the study is confidential. Copies of the tasks completed in the study will be kept in your child's psychiatry file unless you have any objection to this. As a result of the assessment, some information may be discussed with your child's psychiatrist. However, this will be discussed with you beforehand.

The study is part of a research project designed to promote medical knowledge, but may be of no benefit to you personally.

If you have no objections to your child's participation in this project, please sign the enclosed consent form and return it in the SAE provided.

If you do agree to participate you can change your mind at any time and withdraw your child from the study. You are under no obligation to take part.

Thank you for considering taking part in this study. If you have any questions or wish to discuss any aspects of the study, please do not hesitate to contact us.

Yours faithfully,

Leonie Carter
Trainee Clinical Psychologist

Dr. Lynn Buntin
Chartered Clinical Psychologist

Child and Family Mental Health Service
Royal Aberdeen Children's Hospital
Westburn Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Information sheet for children

Would you like to take part in a project we are doing at the moment? Please read this sheet to help you make up your mind.

We would like you to do some puzzles, look at some photographs of people and ask you some questions about your friends.

We will see you once and it will take about an hour.

All the information you give us will be private.

You don't have to take part if you don't want to. If you don't want to take part, it will not change the way the doctors look after you.

If you would like to take part, it is ok to say no later. No one will mind.

Your parent(s)/guardian(s) have been told all about the project and you can talk to them about it. If you would like to talk to me before you make up your mind, we can do that.

Leonie Carter
Trainee Clinical Psychologist

Dr. Lynn Buntin
Chartered Clinical Psychologist

Appendix IV Consent Forms (ADHD group)

CONSENT FORM

CONSENT BY PARENT/GUARDIAN FOR THEIR CHILD TO PARTICIPATE IN:

A study to investigate the relationship between executive function (impulsivity and inhibition) and social competence in children with attention deficit hyperactivity disorder (ADHD).

Name of Child: .....

Name of Parent/Guardian: .....

I have read the information sheet on the above study and have had the opportunity to contact Leonie Carter, Trainee Clinical Psychologist, to discuss the details.

I have agreed to my child taking part in the study as it has been outlined to me. I understand that I am completely free to withdraw my child from the study or any part of the study at any time I wish, without having to give a reason, and that this will not affect my child's continuing treatment in any way.

I understand that these assessments are part of a research project designed to promote knowledge regarding ADHD, which has been approved by the Grampian Research Ethics Committee, and may be of no benefit to me personally.

I understand that some information may be passed to my child's psychiatrist. However, this will be discussed with me beforehand.

I hereby fully and freely consent to my child participating in the study, which is outlined on the enclosed information sheet.

Signature of Parent/Guardian: .....

Date: .....

Contact telephone number: .....

I wish my child to be seen (please tick the box)

at school

at home

at the Children's Hospital

CONSENT FORM FOR CHILDREN

(please circle your answer)

Have you read the project information sheet? Yes No

Have you been able to ask questions about the project? Yes No

Do you understand that if you don't want to take part in the project you don't have to? Yes No

Do you understand that even if you say yes now, you can change your mind at any time and you don't have to give a reason? Yes No

Do you understand that if you don't want to take part in the project it won't affect how the doctors look after you? Yes No

Do you want to take part in this project? Yes No

Your signature: .....

Your name: .....

Date: .....

Appendix V Invitation to Participate (Control group)

Department of Clinical Psychology
Royal Aberdeen Children's Hospital
Cornhill Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Dear Parent/Guardian.

We are conducting a research project looking at the thinking skills and social skills of children with/out attention deficit hyperactivity disorder (ADHD).

I wondered if you would like your child to participate in the project.

I have enclosed some information to help you decide whether or not you'd like to take part. If your child has reading difficulties, please read out the enclosed 'Information for Children' to him/her.

If you decide to participate, please sign the enclosed consent forms and return them in the enclosed SAE. You will then be invited to attend an appointment at a time and place convenient to you.

Yours faithfully,

Leonie Carter
Trainee Clinical Psychologist

Appendix VI Information Sheet (Control Group)

Child and Family Mental Health Service
Royal Aberdeen Children's Hospital
Westburn Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Dear Parent/Guardian,

We are conducting a study involving children with attention deficit hyperactivity disorder (ADHD) and those without the disorder. Children with ADHD often have difficulties with overactivity, impulsivity and attention.

We would like to look at their thinking skills and how this relates to their social skills.

Aim. The aim of the study is to find out if children with ADHD have difficulties in these areas and if they are linked. We would like to compare these results with children who do not have ADHD.

We are writing to invite your child to take part.

What does the study involve? Children taking part in the study will be helped to fill in a questionnaire about their social skills. They will be asked to name objects in some pictures to look at their vocabulary skills and do some tasks that look at different thinking skills. Parents/Guardians will be asked to fill in three short questionnaires about their child's social behaviour. Your child's teacher will also be asked to complete two questionnaires regarding his/her social behaviour.

How long will it take? To complete all the tasks will take about one hour. Your child will only be seen on one occasion.

Where will my child be seen? You will choose whether your child is seen in school, at home, or the clinical psychology department.

Will I find out how it went? You will be sent information about the results of the study.

Confidentiality. All the information in the study is confidential. As a result of the assessment, some information may be passed on to your child's GP. However, this will be discussed with you beforehand.

The study is part of a research project designed to promote knowledge about ADHD, but may be of no benefit to you personally.

If you have no objections to your child's participation in this project, please sign the enclosed consent form and return it in the SAE provided.

If you do agree to participate you can change your mind at any time and withdraw your child from the study. You are under no obligation to take part.

Thank you for considering taking part in this study. If you have any questions or wish to discuss any aspects of the study, please do not hesitate to contact us.

Yours faithfully,

Leonie Carter
Trainee Clinical Psychologist

Dr. Lynn Buntin
Chartered Clinical Psychologist

Child and Family Mental Health Service
Royal Aberdeen Children's Hospital
Westburn Road
Aberdeen AB25 2ZG
Tel: 01224 552234

Information Sheet for Children

Would you like to take part in a project we are doing at the moment? Please read this sheet to help you make up your mind.

We would like you do some puzzles, look at some photographs of people and ask you some questions about your friends.

We will see you once and it will take about an hour.

All the information you give us will be private.

You don't have to take part if you don't want to.

If you would like to take part, it is ok to say no later. No one will mind.

Your parent(s)/guardian(s) have been told all about the project and you can talk to them about it. If you would like to talk to me before you make up your mind, we can do that.

Leonie Carter
Trainee Clinical Psychologist

Dr. Lynn Buntin
Chartered Clinical Psychologist

Appendix VII Consent Forms (Control Group)

CONSENT FORM

CONSENT BY PARENT/GUARDIAN FOR THEIR CHILD TO PARTICIPATE IN:

A study to investigate the relationship between executive function (impulsivity and inhibition) and social competence in children with/out attention deficit hyperactivity disorder (ADHD).

Name of Child: .....

Name of Parent/Guardian: .....

Address:.....

Contact telephone number: .....

I have read the information sheet on the above study and have had the opportunity to contact Leonie Carter, Trainee Clinical Psychologist, to discuss the details.

I have agreed to my child taking part in the study as it has been outlined to me. I understand that I am completely free to withdraw my child from the study or any part of the study at any time I wish, without having to give a reason.

I understand that these assessments are part of a research project designed to promote knowledge regarding ADHD, which has been approved by the Grampian Research Ethics Committee, and may be of no benefit to me personally.

I understand that some information may be passed to my child's GP. However, this will be discussed with me beforehand.

I hereby fully and freely consent to my child participating in the study, which is outlined on the enclosed information sheet.

Signature of Parent/Guardian: .....

Date: .....

I wish my child to be seen (please tick the box)

at school

at home

at the Children's Hospital

CONSENT FORM FOR CHILDREN

(please circle your answer)

Have you read the project information sheet? Yes No

Have you been able to ask questions about the project? Yes No

Do you understand that if you don't want to take part in the project you don't have to? Yes No

Do you understand that even if you say yes now, you can change your mind at any time and you don't have to give a reason? Yes No

Do you want to take part in this project? Yes No

Your signature: .....

Your name: .....

Date: .....

Appendix VIII Ethical Approval

NHS GRAMPIAN
AND
UNIVERSITY OF ABERDEEN

GRAMPIAN RESEARCH ETHICS COMMITTEE

Chairmen

Committee One
Dr John Dean
Consultant
Department of Medical Genetics
Medical School
Foresterhill
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AB25 2ZD

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Clerk to the Committee

Mrs Diane Murray
Dept of Public Health
NHS Grampian
Summerfield House
2 Eday Road
ABERDEEN, AB15 6RE
Email:**diane.murray@ghb.grampian.scot.nhs.uk**

Tel: (01224) 558503
Fax: (01224) 558609

17th December 2003

Project No: 03/0295

Mrs Leonie J Carter
Trainee Clinical Psychologist
Dept of Clinical Psychology
Royal Aberdeen Children's Hospital
Cornhill Road
Aberdeen

Dear Mrs Carter

A cross-sectional study to investigate the relationship between executive function and social competence in children with attention deficit hyperactivity disorder (ADHD)

Thank you for your letter of 10th December 2003, which we received on the 10th December 2003. I am pleased to confirm that full ethical approval has now been granted for the above numbered project, patient information sheet, information sheet for children ADHD group and consent form.

With regards to medical indemnity, I enclose a form, which should be completed and returned to the Research & Development Offices, Grampian University Hospitals Trust, Westburn House, Foresterhill, Aberdeen.

We would be very glad to receive in due course, copies of any publications arising from this research. Thank you for bringing this study to the Committee's attention.

Yours Sincerely

Mrs Muray

PP Mrs Kellie MacLeod
Grampian Research Ethics Committee Manager

Please quote project number in all correspondence

Appendix IX Autism Screening Questionnaire

CONFIDENTIAL

QUESTIONNAIRE ON BEHAVIOUR AND SOCIAL COMMUNICATION FOR **BOYS** AGED **SIX and OVER**

Requesting Psychologist:_____

Thank you for taking the time to complete this questionnaire. A few questions ask about several related types of behaviour; please tick YES if <u>any</u> one of these was present. Although you may be uncertain about whether some behaviours were present or not, please do answer "yes" or "no" to every question on the basis of what you think.

		YES	**NO**
1.	Is he now able to talk using short phrases or sentences?	☐	☐
	If **NO**, Proceed to question 9		
2.	Does he ever talk with you just to be friendly (rather than to get something)?	☐	☐
3.	Can you have a to and fro "conversation" with him that involves taking turns or building on what you have said?	☐	☐
4.	Has he ever used odd phrases or said the same thing over and over in almost exactly the same way? That is, either phrases he has heard other people use or the ones he has made up?	☐	☐
5.	Has he ever used socially inappropriate questions or statements? For example, has he ever regularly asked personal questions or made personal comments at awkward times?	☐	☐
6.	Does he ever get his pronouns the wrong way round, ie saying you or he for I?	☐	☐
7.	Has he ever used words that he seems to have invented or made up himself, or ever put things in odd, indirect ways, or metaphorical ways of saying things? For example, saying "hot rain" for steam	☐	☐

		YES	NO
8.	Has he ever said the same thing over and over in exactly the same way, or insist on you saying the same things over and over again?	☐	☐
9.	Has he ever had things that he seemed to have to do in a very particular way or order, or rituals that he has to have you do?	☐	☐
10.	Does his facial expression usually seem appropriate to the particular situation, as far as you can tell?	☐	☐
11.	Has he ever used your hand as a tool, or as if it were part of his own body (e.g. pointing with your finger, putting your hand on a door knob to get you to open the door)?	☐	☐
12.	Has he ever had any interests that pre-occupy him and might seem odd to other people (e.g. traffic lights, drainpipes or timetables)?	☐	☐
13.	Has he ever seemed to be more interested in a certain part of a toy (e.g. spinning the wheels of a car) or an object rather than using the object as intended?	☐	☐
14.	Has he ever had any special interests that were unusual in their intensity but otherwise appropriate for his age and peer group (e.g. trains, dinosaurs)?	☐	☐
15.	Has he ever seemed to be unusually interested in the sight, feel, sound, taste or smell of things or people?	☐	☐
16.	Has he ever had any mannerisms or odd ways of moving his hands or fingers, such as flapping, or moving his fingers in front of his eyes?	☐	☐
17.	Has he ever had any complicated movements of his whole body, such as spinning or repeatedly bouncing up and down?	☐	☐
18.	Does he ever injure himself deliberately, such as biting his arm or banging his head?	☐	☐
19.	Does he have any objects (other than a soft toy or comfort blanket) that he has to carry around with him?	☐	☐
20.	Does he have any particular friends or a best friend?	☐	☐

For some behaviours it is most helpful to focus on the time between the child's fourth and fifth birthday. You may find it easier to remember how things were at that time by fixing it in your mind in relation to key happenings such as starting school, moving house , Christmas time, or any events that are particularly memorable for you as a family.

		YES	NO
21.	When he was 4- to 5- did he ever spontaneously copy you (or other people), or what you were doing (such as hoovering, gardening, mending things)?	☐	☐
22.	When he was 4- to 5- did he ever spontaneously point to things around him just to show you things (not because he wanted them)?	☐	☐
23.	When he was 4- to 5- did he ever use gestures, other than pointing or pulling your hand, to let you know what he wanted?	☐	☐
24.	When he was 4- to 5- did he nod his head to mean "yes"?	☐	☐
25.	When he was 4- to 5- did he shake his head to mean "no"?	☐	☐
26.	When he was 4- to 5- did he usually look at you directly in the face when doing things with you or talking with you?	☐	☐
27.	When he was 4- to 5- did he smile back when someone smiled at him?	☐	☐
28.	When he was 4- to 5- did he ever show you things that interest him to engage your attention?	☐	☐
29.	When he was 4- to 5- did he ever offer to share things other than food with you?	☐	☐
30.	When he was 4- to 5- did he ever seem to want you to join in his enjoyment of something?	☐	☐
31.	When he was 4- to 5- did he ever try to comfort you if you were ever sad or hurt?	☐	☐
32.	Between the ages of 4- to 5- when he wanted something or wanted help, did he look at you and use gestures with sounds or words to get your attention?	☐	☐

		YES	NO
33.	Between the ages of 4- to 5- did he show a normal range of facial expression?	☐	☐
34.	When he was 4- to 5- did he ever spontaneously join in and try to copy actions in social games- such as the Mulberry Bush or The Farmer in His Den?	☐	☐
35.	When he was 4- to 5- did he play any pretend or make-believe games?	☐	☐
36.	When he was 4- to 5- did he seem interested in other children of approximately the same age whom he did not know?	☐	☐
37.	When he was 4- to 5- did he respond positively when another child approached him?	☐	☐
38.	When he was 4- to 5-, if you came into a room and started talking to him without calling his name, did he usually look up and pay attention to you?	☐	☐
39.	When he was 4- to 5- did he ever play imaginative games with another child in such a way that you could tell they understood what each other were pretending?	☐	☐
40.	When he was 4- to 5- did he play co-operatively in games that need some form of joining in with a group of other children, such as hide and seek or ball games?	☐	☐

Name of Person Completing Form: _____

Name of Child: _____

Date of Completing Form: _____

Appendix X Social Competence with Peers Questionnaire – Parent

FER-NELSON
FORMING YOUR DECISIONS

Social Competence with Peers Questionnaire – PARENT(S)

ate: Young person's name: His/Her sex:

lass: School: His/Her age:

ame of parent completing the form:

ease put a circle around the rating which best describes your son or daughter *over the ast four weeks.*

ircle the number 0 if the item is not true. Circle the number 1 if the item is sometimes ue. Circle the number 2 if the item is mostly true.

ease answer all items.

	Not true	Sometimes true	Mostly true
Has at least one close friend	0	1	2
Has stable friendships with other kids his/her age	0	1	2
Finds it easy to make friends	0	1	2
Other kids invite him/her to their homes	0	1	2
Other kids invite him/her to social events or activities	0	1	2
Has good relationships with classmates	0	1	2
Gets invited to parties	0	1	2
Is popular amongst others his/her age	0	1	2
Sees a friend or friends socially at weekends	0	1	2

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Appendix XI Social Competence with Peers Questionnaire – Pupil

NFER-NELSON
FORMING YOUR DECISIONS

Social Competence with Peers Questionnaire – PUPIL

ate: Name: Sex:

lass: School: Age:

ease put a circle around the rating which best describes *you over the past four weeks.*
ease answer all the questions.

1	I have at least one close friend	**Not true**	**Sometimes true**	**Mostly true**
2	My friendships with other kids last a long time	**Not true**	**Sometimes true**	**Mostly true**
3	I find it easy to make friends	**Not true**	**Sometimes true**	**Mostly true**
4	Other kids choose me to be on their team at school	**Not true**	**Sometimes true**	**Mostly true**
5	Other kids invite me to their homes	**Not true**	**Sometimes true**	**Mostly true**
6	Other kids invite me to their parties or social events	**Not true**	**Sometimes true**	**Mostly true**
7	I get on well with my classmates	**Not true**	**Sometimes true**	**Mostly true**
8	I am popular amongst other kids	**Not true**	**Sometimes true**	**Mostly true**
9	Other kids like to sit next to me in class	**Not true**	**Sometimes true**	**Mostly true**
10	I see my friend or friends at weekends	**Not true**	**Sometimes true**	**Mostly true**

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Appendix XII Social Competence with Peers Questionnaire – Teacher

ER-NELSON
ING YOUR DECISIONS

Social Competence with Peers Questionnaire – TEACHER

e: Pupil's name: His/Her sex:

s: School: His/Her age:

her's name or initials:

se put a circle around the rating which best describes this pupil *over the past four ks.*

le the number 0 if the item is not true. Circle the number 1 if the item is sometimes . Circle the number 2 if the item is mostly true.

se answer all items.

	Not true	Sometimes true	Mostly true
Has at least one close friend	**0**	**1**	**2**
Has stable friendships with peers	**0**	**1**	**2**
Peers like to sit next to him/her in class	**0**	**1**	**2**
Finds it easy to make friends	**0**	**1**	**2**
Is chosen by peers to be on their team	**0**	**1**	**2**
Peers invite him/her to parties or social events	**0**	**1**	**2**
Is popular amongst peers	**0**	**1**	**2**
Is chosen by peers as a partner to work on a project	**0**	**1**	**2**
Has good relationships with classmates	**0**	**1**	**2**

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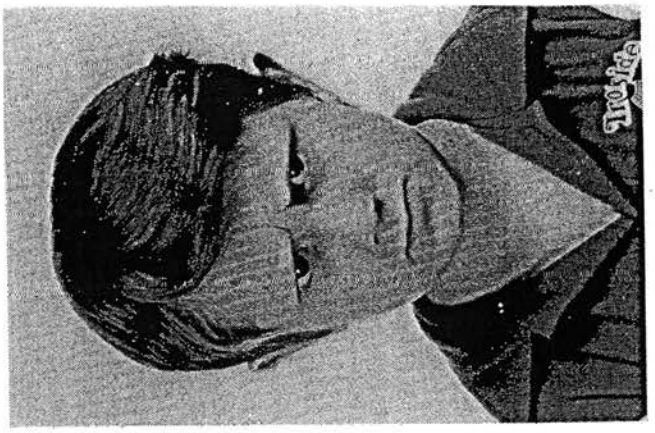
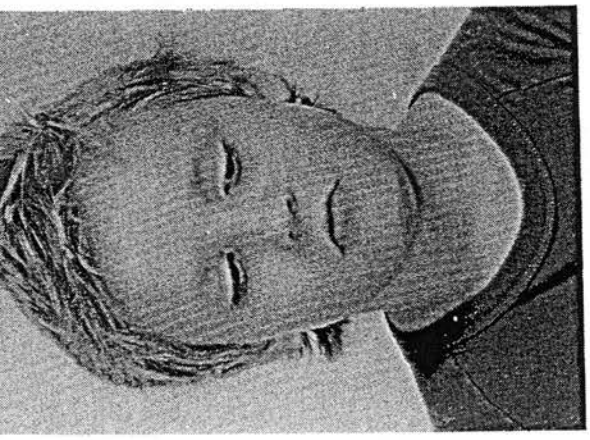
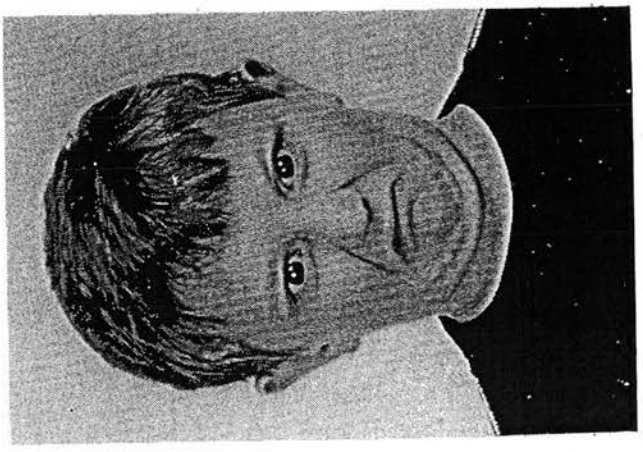
Appendix XIII Assessment of Perception of Emotion (Facial Expression)

Card 1: Facial expressions (male child)







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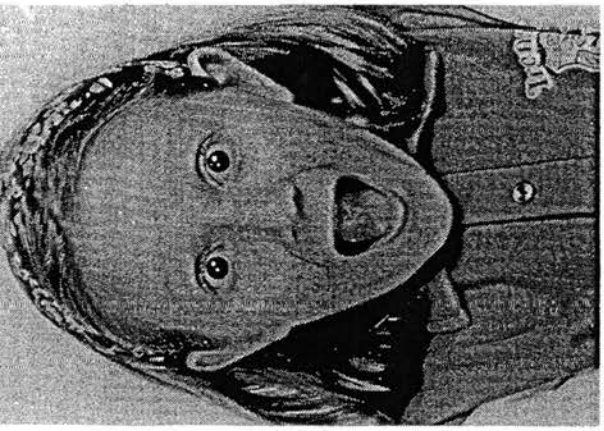
oto Card 2: Facial expressions (female child)



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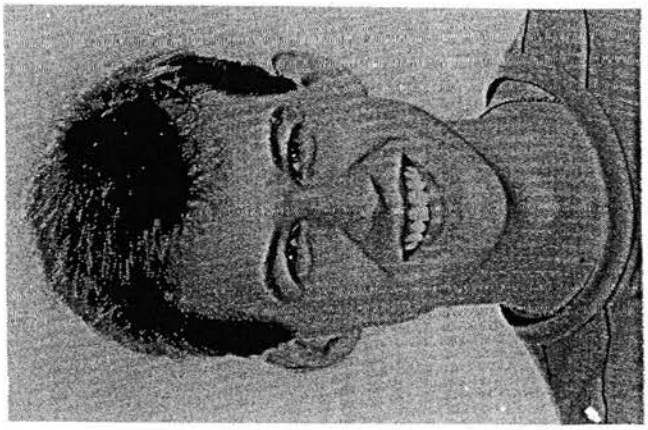
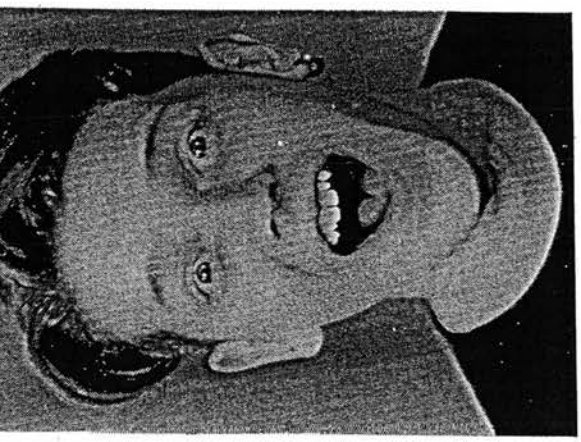
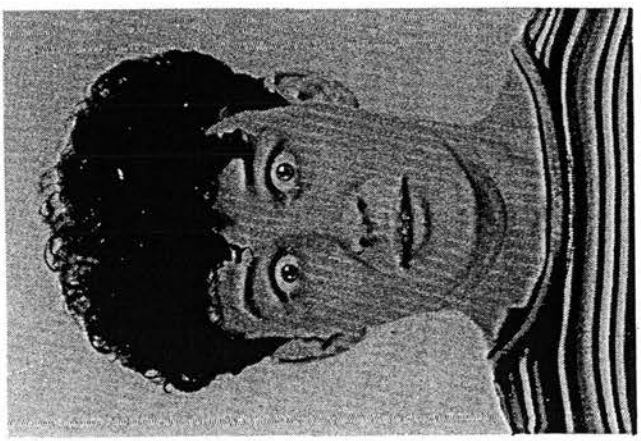
o Card 3: Facial expressions (adult male)







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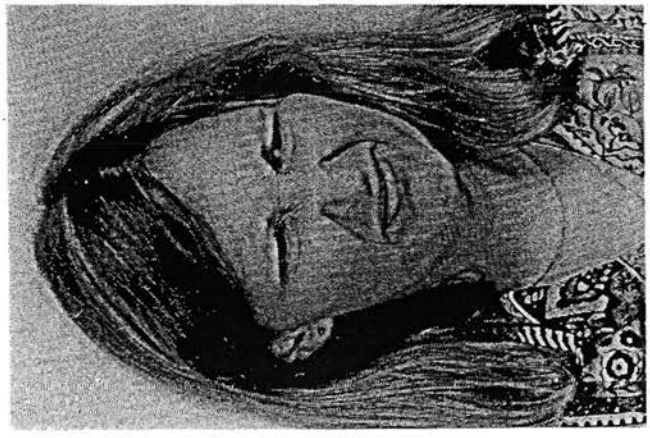
to Card 4: Facial expressions (adult female)



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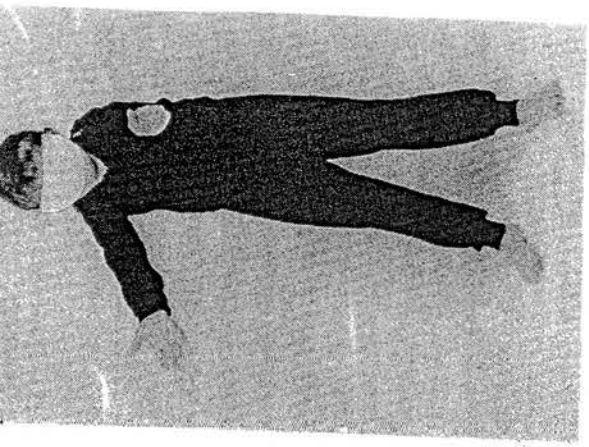
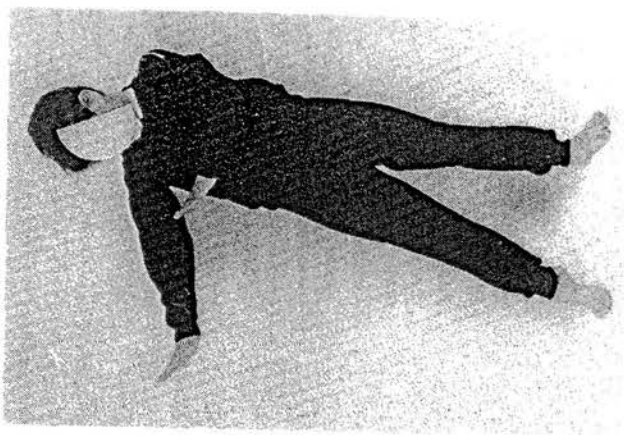
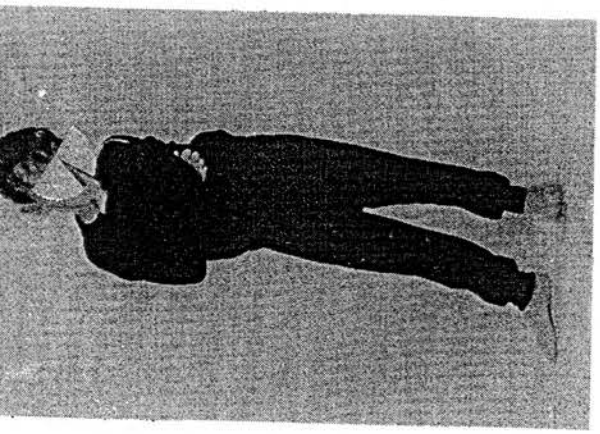
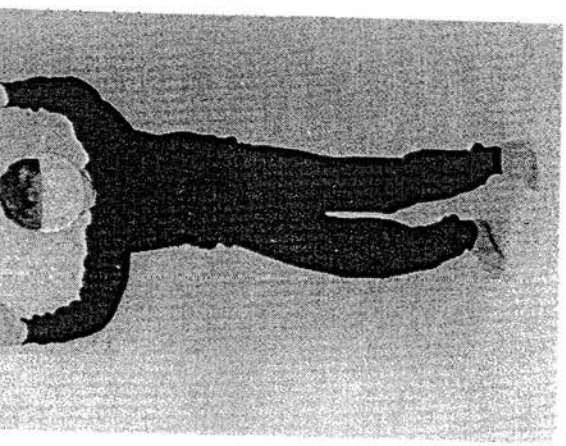
Appendix XIV Assessment of Perception of Emotion (Posture Cues)

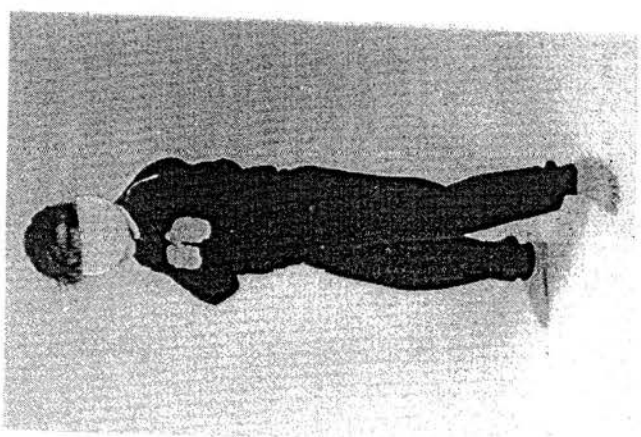
oto Card 5: Posture cues (male child)











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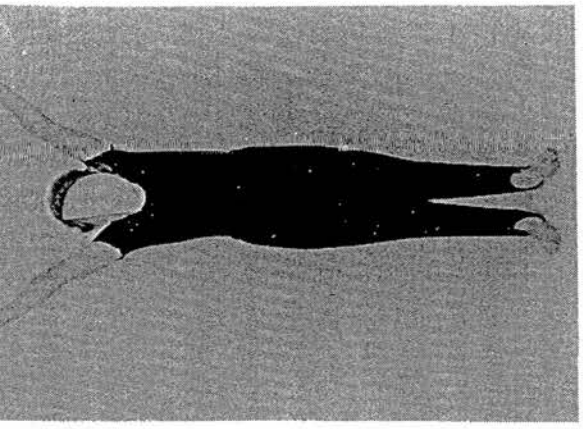
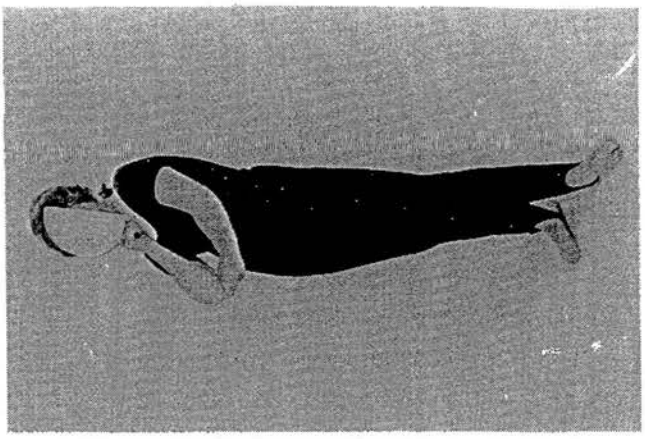
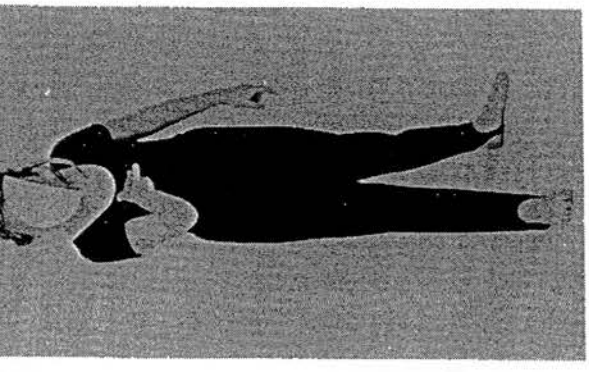
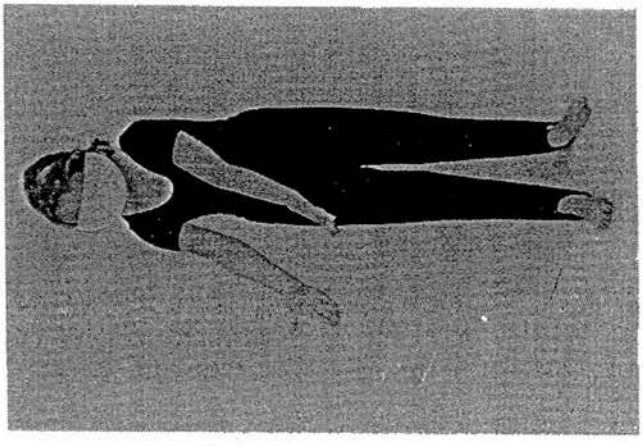
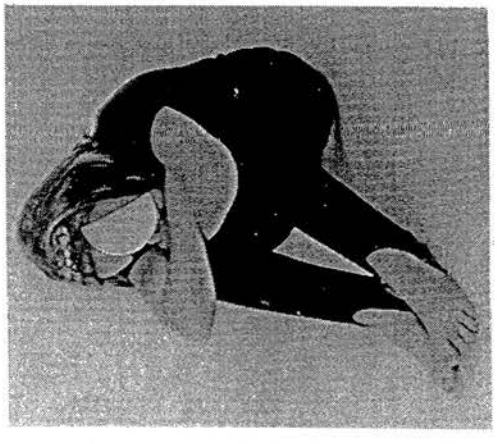
to Card 6: Posture cues (female child)

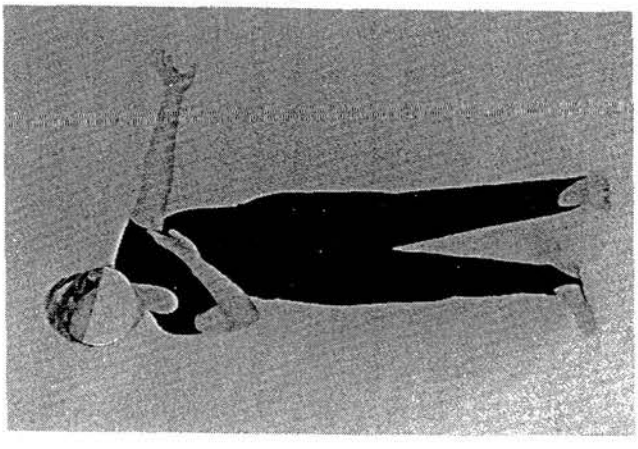












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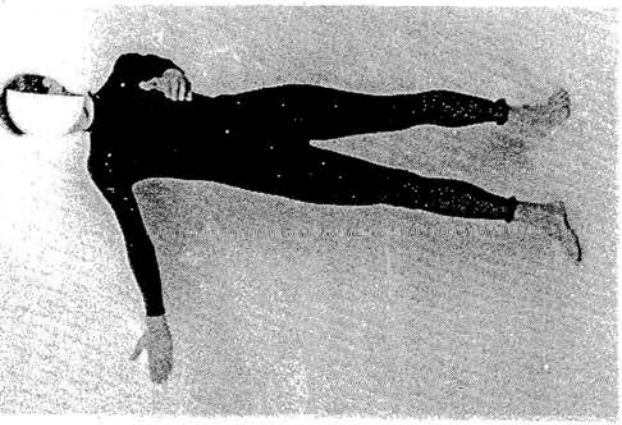
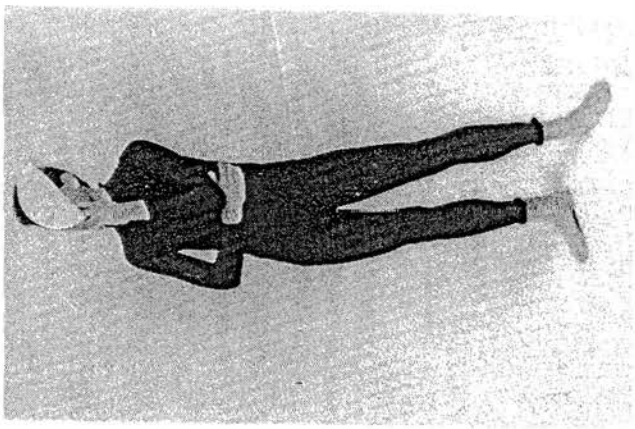
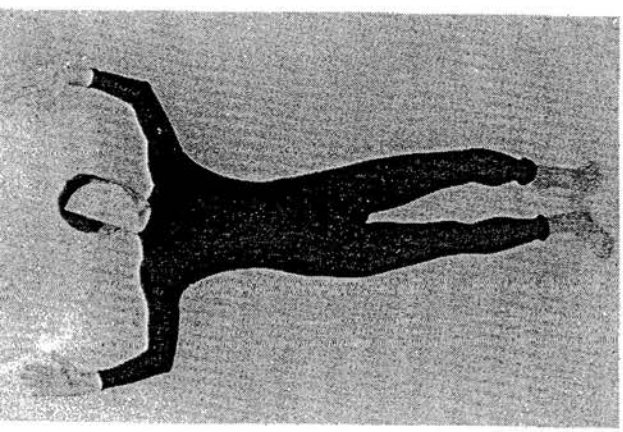
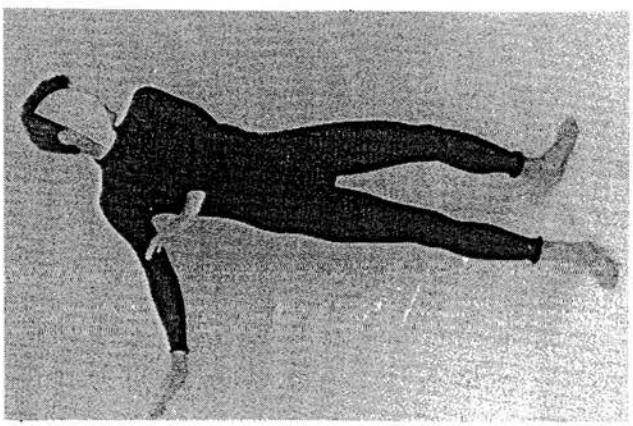
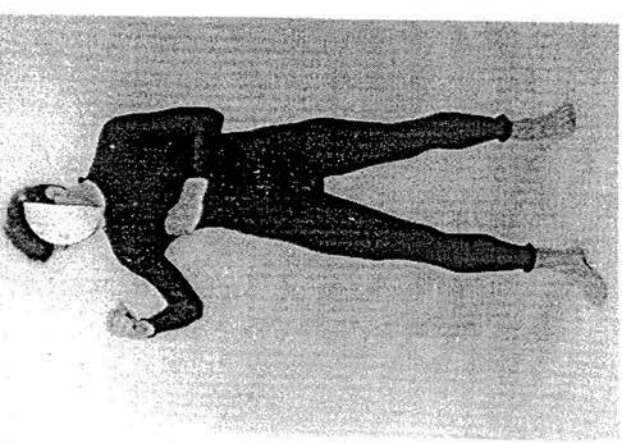
to Card 7: Posture cues (adult male)

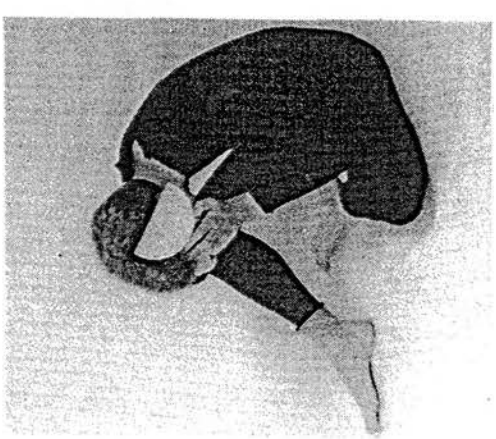












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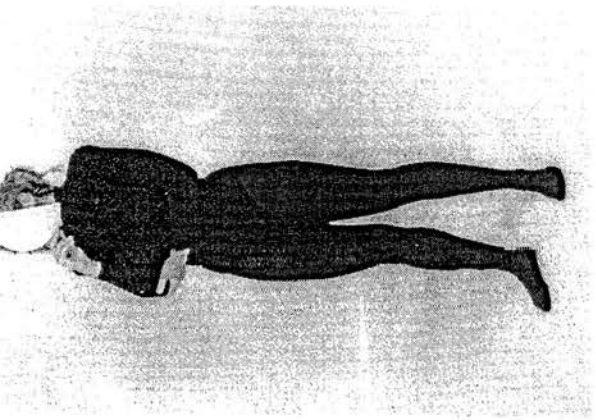
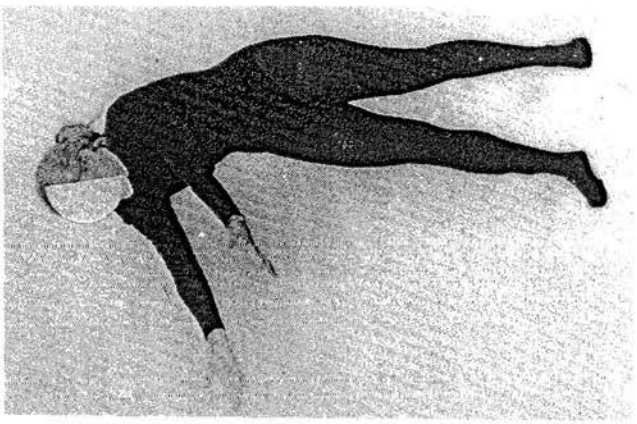
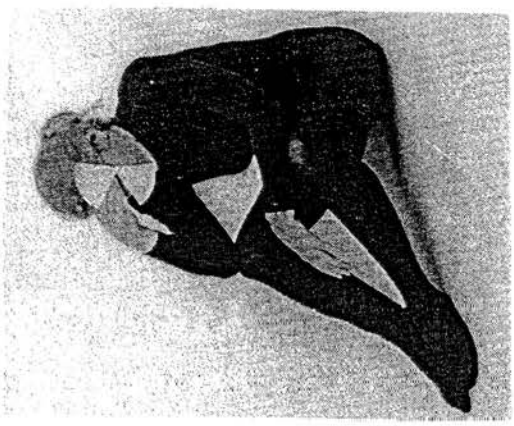
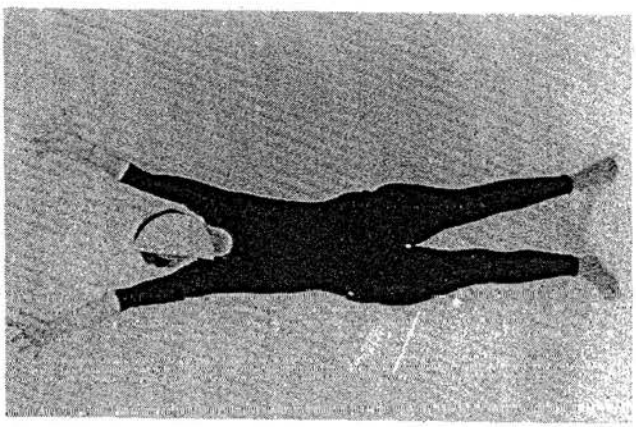
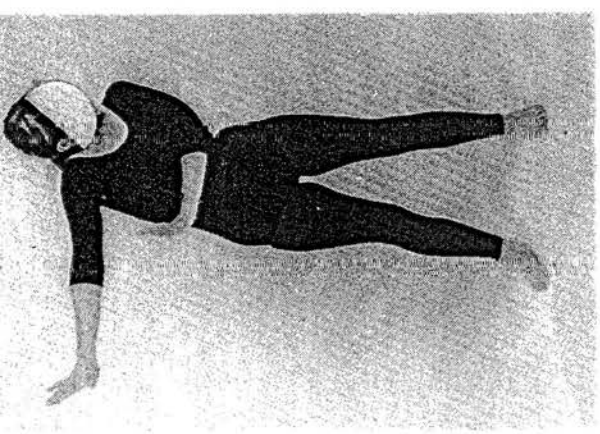
to Card 8: Posture cues (adult female)

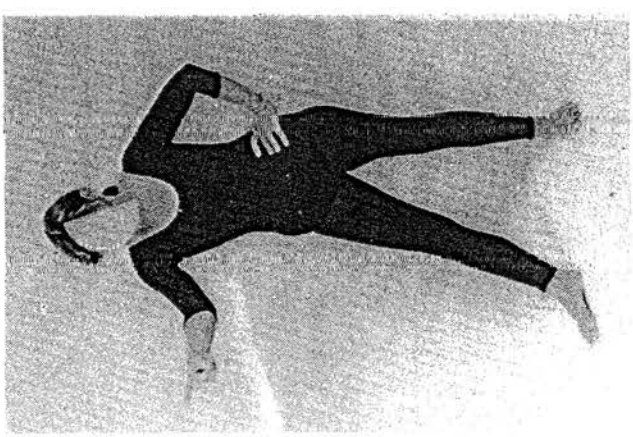












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Appendix XV Correlation between Executive Function Tasks and Social Competence Measures

Spearman correlation analyses between social competence measures (parent) and executive function tasks for the ADHD group.

		Twenty Questions			Color-Word Interference Test		Verbal Fluency	
		Initial Abstraction	Total Questions Asked	Total Weighted Achievement Score	Inhibition	Inhibition/Switching	Letter	Category
SCPQ – Parent	rho	-0.022	0.144	0.057	0.130	-0.078	-0.170	0.238
	Sig (1-tailed)	0.463	0.267	0.404	0.287	0.369	0.230	0.107
	N	21	21	21	21	21	21	21
ABAS - Social	rho	-0.206	0.060	0.060	0.065	-0.099	-0.007	0.067
	Sig (1-tailed)	0.185	0.398	0.398	0.390	0.335	0.488	0.387
	N	21	21	21	21	21	21	21
ABAS - Leisure	rho	-0.023	-0.218	0.028	0.482*	-0.188	0.040	0.103
	Sig (1-tailed)	0.461	0.172	0.453	0.013	0.207	0.432	0.329
	N	21	21	21	21	21	21	21
ABAS - Self-Direction	rho	0.257	-0.246	-0.003	0.223	-0.149	0.061	-0.161
	Sig (1-tailed)	0.131	0.146	0.495	0.166	0.259	0.397	0.244
	N	21	21	21	21	21	21	21
ABAS - Communication	rho	0.184	-0.233	-0.092	0.280	-0.229	0.108	0.279
	Sig (1-tailed)	0.213	0.154	0.346	0.110	0.159	0.321	0.111
	N	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Spearman correlation analyses between social competence measures (teacher) and executive function tasks for the ADHD group.

		Twenty Questions			Color-Word Interference Test		Verbal Fluency	
		Initial Abstraction	Total Questions Asked	Total Weighted Achievement Score	Inhibition	Inhibition/Switching	Letter	Category
SCPQ – Teacher	rho	0.092	-0.292	-0.274	0.338	-0.094	0.054	0.150
	Sig (1-tailed)	0.346	0.100	0.115	0.067	0.343	0.409	0.258
	N	21	21	21	21	21	21	21
ABAS - Social	rho	-0.029	-0.267	-0.162	-0.059	-0.211	-0.081	0.029
	Sig (1-tailed)	0.451	0.121	0.241	0.399	0.179	0.363	0.451
	N	21	21	21	21	21	21	21
ABAS - Leisure	rho	0.230	0.023	0.398*	0.524**	0.097	0.014	0.412*
	Sig (1-tailed)	0.158	0.461	0.037	0.007	0.338	0.476	0.032
	N	21	21	21	21	21	21	21
ABAS - Self-Direction	rho	0.114	-0.362	-0.236	0.060	-0.103	-0.002	-0.149
	Sig (1-tailed)	0.312	0.053	0.151	0.397	0.328	0.497	0.260
	N	21	21	21	21	21	21	21
ABAS - Communication	rho	0.027	-0.141	0.038	0.275	0.079	-0.056	0.038
	Sig (1-tailed)	0.454	0.271	0.435	0.114	0.367	0.404	0.436
	N	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Spearman correlation analyses between social competence measures (parent) and executive function tasks for the control group.

		Twenty Questions			Color-Word Interference Test		Verbal Fluency	
		Initial Abstraction	Total Questions Asked	Total Weighted Achievement Score	Inhibition	Inhibition/Switching	Letter	Category
SCPQ – Parent	rho	-0.011	-0.090	-0.046	-0.132	0.473*	0.004	0.026
	Sig (1-tailed)	0.481	0.349	0.422	0.284	0.015	0.494	0.456
	N	21	21	21	21	21	21	21
ABAS - Social	rho	0.286	0.262	0.442*	0.213	-0.183	0.443*	0.496*
	Sig (1-tailed)	0.105	0.126	0.022	0.176	0.214	0.022	0.011
	N	21	21	21	21	21	21	21
ABAS - Leisure	rho	0.155	0.065	0.208	0.094	-0.113	0.056	0.371*
	Sig (1-tailed)	0.251	0.390	0.183	0.343	0.312	0.405	0.049
	N	21	21	21	21	21	21	21
ABAS - Self-Direction	rho	0.210	0.150	0.270	0.064	-0.045	0.311	0.307
	Sig (1-tailed)	0.181	0.258	0.118	0.392	0.423	0.085	0.088
	N	21	21	21	21	21	21	21
ABAS - Communication	rho	0.368	0.269	0.386*	0.453*	-0.102	0.238	0.552**
	Sig (1-tailed)	0.050	0.119	0.042	0.020	0.331	0.149	0.005
	N	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Spearman correlation analyses between social competence measures (teacher) and executive function tasks for the control group.

		Twenty Questions			Color-Word Interference Test		Verbal Fluency	
		Initial Abstraction	Total Questions Asked	Total Weighted Achievement Score	Inhibition	Inhibition/Switching	Letter	Category
SCPQ – Teacher	rho	0.427*	0.425*	0.655**	0.318	0.090	0.359	0.594**
	Sig (1-tailed)	0.027	0.027	0.001	0.080	0.348	0.055	0.002
	N	21	21	21	21	21	21	21
ABAS - Social	rho	0.304	-0.031	0.411*	0.181	-0.033	0.441*	0.250
	Sig (1-tailed)	0.090	0.446	0.032	0.216	0.444	0.023	0.137
	N	21	21	21	21	21	21	21
ABAS - Leisure	rho	0.281	0.227	0.374*	0.615**	0.269	0.336	0.524**
	Sig (1-tailed)	0.109	0.162	0.047	0.002	0.119	0.068	0.007
	N	21	21	21	21	21	21	21
ABAS - Self-Direction	rho	0.549*	0.333	0.379*	0.456*	0.255	0.291	0.643**
	Sig (1-tailed)	0.005	0.070	0.045	0.019	0.132	0.100	0.001
	N	21	21	21	21	21	21	21
ABAS - Communication	rho	0.606**	0.602**	0.592**	0.494*	-0.099	0.385*	0.631**
	Sig (1-tailed)	0.002	0.002	0.002	0.011	0.335	0.042	0.001
	N	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Appendix XVI Correlations between Assessment of Perception of Emotion and Social Competence Measures

Spearman Correlation Analyses between Assessment of Perception of Emotion and Social Competence Measures (ADHD group).

		Social Competence with Peers Questionnaire			Adaptive Behaviour Assessment System - Parent				Adaptive Behaviour Assessment System - Teacher			
		Teacher	Pupil	Parent	Communication	Leisure	Self-Direction	Social	Communication	Leisure	Self-Direction	Social
Facial Expression	rho	0.387*	0.030	0.540**	0.079	0.198	0.121	0.610**	-0.053	0.415*	0.266	0.031
	Sig	0.041	0.448	0.006	0.366	0.195	0.300	0.002	0.409	0.031	0.122	0.446
	N	21	21	21	21	21	21	21	21	21	21	21
Posture Cues	rho	-0.065	-0.14	0.231	0.144	0.255	0.050	0.328	0.152	0.299	0.035	-0.04
	Sig	0.389	0.270	0.157	0.267	0.133	0.415	0.073	0.256	0.094	0.440	0.435
	N	21	21	21	21	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)

Spearman Correlation Analyses between Assessment of Perception of Emotion and Social Competence Measures (control group).

		Social Competence with Peers Questionnaire			Adaptive Behaviour Assessment System - Parent				Adaptive Behaviour Assessment System - Teacher			
		Teacher	Pupil	Parent	Communication	Leisure	Self-Direction	Social	Communication	Leisure	Self-Direction	Social
Facial Expression	rho	-0.099	0.277	0.002	0.060	0.391*	0.138	0.515**	-0.022	0.002	-0.273	-0.04
	Sig	0.334	0.112	0.496	0.398	0.040	0.275	0.008	0.463	0.496	0.116	0.434
	N	21	21	21	21	21	21	21	21	21	21	21
Posture Cues	rho	0.220	0.161	-0.063	0.020	0.395*	-0.064	0.298	0.200	0.035	-0.041	0.149
	Sig	0.169	0.243	0.394	0.466	0.038	0.391	0.095	0.192	0.439	0.430	0.260
	N	21	21	21	21	21	21	21	21	21	21	21

* correlation significant at the 0.05 level (1-tailed)

** correlation significant at the 0.01 level (1-tailed)