

EXECUTIVE FUNCTION, THEORY OF MIND AND SOCIAL PROBLEM
SOLVING IN ASPERGER'S SYNDROME.

JANE HEAP

JULY 1999
D. CLIN. PSY
UNIVERSITY COLLEGE LONDON

ProQuest Number: 10608918

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



ProQuest 10608918

Published by ProQuest LLC (2017). Copyright of the Dissertation is held by the Author.

All rights reserved.

This work is protected against unauthorized copying under Title 17, United States Code
Microform Edition © ProQuest LLC.

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 – 1346

CONTENTS

VOLUME 1 : RESEARCH THESIS

ACKNOWLEDGEMENTS

ABSTRACT

1.INTRODUCTION

1.1.1 OVERVIEW	1
1.1.2 DEFINITION OF ASPERGER'S	4
1.1.3 AETIOLOGY	7
1.1.4 POSSIBLE BRAIN MECAHANISMS	8
1.15 DEFICITS IN AUTISM AND ASPERGER'S SYNDROME	9
1.2.1COGNITIVE THEORY	13
1.2.2 CENTRAL COHERENCE	14
1.2.3 INTERPERSONAL RELATEDNESS	15
1.2.4.THEORY OF MIND	15
1.2.5 EXECUTIVE FUNCTION	20
1.3.HOW WELL DO THE THEORIES EXPLAIN THE PATTERN OF IMPAIRMENT	26
1.4 SUMMARY OF RESEARCH	35
1.5 AIMS OF THE PRESENT STUDY	38
1.6 HYPOTHESIS'	39
2 METHOD	
2.1.1PARTICIPANTS	40
2.1.2 PROCEEDURE	41
2.1.3DESIGN	41
2.2.MEASURES	41

2.2.1 RAVENS STANDARD PROGRESSIVE MATRICES	42
2.2.2 CLINICAL EVALUATION OF LANGUAGE FUNDAMENTALS-REVISED	43
2.3. EXECUTIVE FUNCTION MEASURES	45
2.3.1 BEHAVIOURAL DYSEXECUTIVE SYNDROME	45
2.3.2 POISONED FOODS	47
2.3.3 TRAIL-MAKING	47
2.4. THEORY OF MIND AND SOCIAL COGNITION MEASURES	48
2.4.1 HAPPE' STRANGE STORIES	48
2.4.2 EYES TASK	51
2.4.3 DEWEY STORIES	51
2.5 SOCIAL PROBLEM SOLVING MEASURES	53
2.5.1 PREDICAMENTS	53
2.5.2 EXAMPLE OF PREDICAMENTS	56
2.6. DEX QUESTIONNAIRE	59
3. RESULTS	
3.1. DESCRIPTION OF ANALYSIS OF DATA	60
3.1.1 DYSEXECUTIVE QUESTIONNAIRE	61
3.1.2 EXECUTIVE FUNCTION MEASURES	62
3.1.3 THEORY OF MIND AND SOCIAL COGNITION MEASURES	64
3.1.4 PREDICAMENTS	66
3.1.5 CORRELATIONS BETWEEN PREDICAMENTS MEASURES	74
3.1.6 CORRELATIONS BETWEEN PREDICAMENTS AND EXECUTIVE FUNCTION MEASURES	78
3.1.7 CORRELATIONS BETWEEN PREDICAMENTS AND THEORY OF MIND AND SOCIAL COGNITION ASSESSMENTS	81
3.1.8 CORRELATIONS BETWEEN THEORY OF MIND AND EXECUTIVE FUNCTION MEASURES	82

3.1.9 LANGUAGE	83
4.DISCUSION	
4.1 MAIN FINDINGS	86
4.1.1PREDICAMENTS	86
4.1.2 EXECUTIVE FUNCTION MEASURES	87
4.1.3THEORY OF MIND MEASURES	88
4.1.4 RELATIONSHIP BETWEEN EXECUTIVE FUNCTION AND THEORY OF MIND MEASURES	90
4.1.5 THEORY OF MIND AND EXECUTIVE FUNCTION: EVIDENCE FROM PREDICAMENTS	91
4.1.6 SUMMARY OF MAIN FINDINGS	93
4.2.FURTHER EXPLORATION OF THE FINDINGS	93
4.2.1OTHER EXPLANATIONS OF THE FINDINGS	93
4.2.2 FURTHER EXPLORATION OF PREDICAMENTS	94
4.2.3 FURTHER EXPLOARTION OF EXECUTIVE FUNCTION MEASURES	99
4.2.4 FURTHER EXPLORATION OF THE THEORY OF MIND MEASURES	101
4.3 SUMMARY	104
4..4.LIMITATIONS	107
4.5 CLINICAL IMPLICATIONS	111
4.6 FUTURE RESEARCH	112
5 REFERENCES	114
6 APPENDICES	128
1.Ethical Approval	
2. Letter to participants	
3. Consent form	

LIST OF TABLES

1 SAMPLE CHARACTERISTICS	40
2 T-TESTS TO LOOK AT THE DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON THE DEX QUESTIONNAIRE.	62
3 T-TESTS TO LOOK AT DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON THE EXECUTIVE BATTERY.	63
4 T-TESTS TO LOOK AT DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON THE THEORY OF MIND AND SOCIAL COGNITION BATTERY	65
5 T-TESTS TO LOOK AT DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON NUMBER OF PROMPTS USED IN RECOUNTING THE PREDICAMENTS.	67
6 T-TESTS TO LOOK AT DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON THE SOLUTIONS GENERATED IN SOCIAL PREDICAMENTS AND NON SOCIAL PREDICAMENTS	68
7 MEANS, STANDARDS DEVIATIONS AND SIGNIFICANCE LEVELS FOR THE EFFECT OF GROUP AND PERSPECTIVE ON OPTIMAL AND PERSONAL SOLUTIONS.	70
8 T-TESTS TO LOOK AT DIFFERENCES BETWEEN ASPERGER'S AND CONTROLS ON RATING ALTERNATIVE SOLUTIONS	72
9 T-TESTS TO LOOK AT RATINGS OF AWKWARDNESS OF PREDICAMENTS AND SATISFACTION WITH SOLUTIONS	73
10 CORRELATIONS BETWEEN AVERAGE SOLUTION QUALITY AND OTHER PREDICAMENTS MEASURES FOR ASPERGER'S AND CONTROLS	75

11 CORRELATIONS BETWEEN TOTAL SOLUTION QUALITY AND OTHER PREDICAMENTS MEASURES FOR ASPERGER'S AND CONTROLS	76
12 CORRELATIONS BETWEEN NUMBER OF SOLUTIONS GENERATED AND NONSOCIAL PREDICAMENTS	77
13 CORRELATIONS BETWEEN PREDICAMENTS AND EXECUTIVE FUNCTION MEASURES FOR ASPERGER'S AND CONTROLS	79
14 CORRELATIONS BETWEEN WITH THEORY OF MIND/SOCIAL COGNITION ASSESSMENTS AND PREDICAMENTS FOR ASPERGER'S AND CONTROLS.	81
15 CORRELATIONS BETWEEN THEORY OF MIND AND EXECUTIVE FUNCTION MEASURES	82
16 CORRELATIONS BETWEEN LANGUAGE AND EXECUTIVE FUNCTION MEASURES	83
17 CORRELATIONS BETWEEN LANGUAGE AND THEORY OF MIND MEASURES	84
18 CORRELATIONS BETWEEN LANGUAGE AND PREDICAMENTS MEASURES	85

ACKNOWLEDGEMENTS

I am very grateful to Dr. Shelly Channon and Dr. Tony Charman for their help in all aspects of the research. I am also grateful to the clinical and administrative team at Harper House Child Development Service who were most supportive in relation to the practical and theoretical aspects of the study. I would like to thank Patricia Rios, Clinical Psychologist at Harper House for her invaluable contribution. The young people themselves were unfailingly patient throughout a very demanding assessment procedure, and I would like to especially thank them and their families for taking part. I would also like to acknowledge the assistance of the University of London Central research Fund and the Tregaskis Bequest.

ABSTRACT

A group of 15 adolescents with a diagnosis of Asperger's syndrome were compared with a group matched for language ability, IQ and age on measures of theory of mind, executive function and a measure of social problem solving. The social problem solving measure has been developed as a measure of real life type problem solving ability. The Asperger's group were significantly impaired compared to the control group on some measures of executive function, namely those involving planning and set shifting. They were also impaired on some measures of theory of mind, namely story comprehension. Within the social problem solving measure, the Asperger's group were significantly impaired on number of solutions they generated and the quality of those solutions. The quality of the solutions was significantly impaired in relation to the social appropriateness measure. The results were considered in the context of theory of mind deficit and executive dysfunction accounts of autism and Asperger's. Partial support was found for both accounts, but an executive deficit account was considered the more parsimonious explanation of the findings.

1. Introduction

1.1 Overview

In the introduction the history and development of Asperger's syndrome will be considered, and its relationship to autism discussed. The deficits common to this spectrum of disorders will then be explained. The cognitive theories which aid to explain the behaviours will be considered with particular reference to executive function and theory of mind accounts. The strengths and weaknesses of each theory will then be explored through considering how well, each theory accounts, for the observed behaviours and the experimental findings. Finally the aims and hypothesis of the current study will be set out.

Historical background of autism

The first formal description of autistic psychopathology was Kanner's 1943 account of 11 children with a similar set of symptoms. In his paper entitled "Autistic disturbances of affective contact" he described the characteristic features as; "extreme autistic aloneness", "anxiously obsessive desire for the preservation of sameness", "excellent rote memory", "delayed echolalia", "oversensitivity to stimuli", "limitation in the variety of spontaneous activity", "good cognitive potentialities" and "highly intelligent families".

Historical background of Asperger's syndrome

Shortly after this in 1944 Asperger wrote a dissertation describing “autistic psychopathy”, this was translated by Frith (1991). In this he described seven areas in which children demonstrated their autistic psychopathy. Asperger thought the most obvious characteristic was an impairment in two-way social interaction. He suggested the problem arose due to a lack of ability to understand and use the rules governing social behaviour. Asperger claimed speech developed at around the same age as in normal child development, but was characterised by difficulties in using pronouns correctly, abnormal content and a tendency to be pedantic. He also noted that there was a tendency for lengthy reports of favorite subject areas. In non verbal communication he noted little facial expression and poor comprehension of the gestures and expressions of others. He also described repetitive activities and resistance to change. He observed motor coordination to be clumsy and poorly coordinated and described these children as having an odd gait and posture. Asperger claimed that those with the syndrome in its most typical form had certain skills. He described excellent rote memories and an interest in one or two subjects, such as, prehistoric monsters, astronomy, steam trains, genealogy of royalty and bus time tables.

Overlap in the early descriptions of Kanner & Asperger

Whilst the two authors had not seen each other's work their descriptions were similar in certain ways. The most apparent similarity being the use of the term autistic to describe the syndrome. They both noted poor eye contact, resistance to change and isolated special interests. More generally Kanner and Asperger differentiated this syndrome from

schizophrenia. They felt that there was an improvement rather than a deterioration with time, with the children appearing to demonstrate the syndrome from the earliest years and the absence of hallucinations.

Their accounts diverged in three main areas, language, motor co-ordination and learning. Firstly as regards language abilities, Kanner described his group of children as not using speech to communicate, even when vocabulary was good. Asperger described his group as using language well. Asperger's group was characterised by deficits in both gross and fine motor co-ordination whilst Kanner described some of his group as having poor gross motor skill with fine motor skills intact. The final discrepancy was in how the child best learned. Kanner believed rote learning produced the best results in his group and Asperger believed that his group performed best when allowed to produce spontaneously. Overall whilst it is difficult to say with certainty it is likely, that Asperger and Kanner were describing a different group of children.

The autistic continuum

The discussions of differences between these two groups gained momentum with Wing & Gould's (1979) introduction of the concept of an autistic continuum and subsequently Wing's (1981) introduction of the term 'Asperger's syndrome' to describe more able autistic people who were not socially aloof. Wing & Gould (1979) conducted an epidemiological survey of all children known to social, educational or health services living in the Camberwell area. They then screened the 914 identified. Children were then selected from this group if they had severe learning difficulties, and or, a social impairment, a language impairment or repetitive activities. Wing & Gould then assessed the

remaining 132 children. They discovered that the children with social impairments also had repetitive behaviour and abnormalities of language. These three deficits they described as problems of socialisation, imagination and communication, they have become known as the triad of impairments. This triad constitutes the syndrome of autism and is generally considered the common denominator for the spectrum of autistic disorders.

Since Wing (1981) other researchers have tended to consider Asperger's syndrome at the end of this autistic continuum. Tantam (1988) studied a group of adults in touch with psychiatric services and concluded that autism and Asperger's lay on a continuum of severity. Similarly Gilberg & Gilberg (1989) who examined all non-retarded six-year-old children in Gothenburg suggested a continuum of disorders. This continuum ranged from severe to mild autism, Asperger's and included a more mildly handicapped group and the very end of the continuum with deficits in attention, motor control and perception. Wing (1991) p111 describes the continuum as ranging, "from the most profoundly physically and mentally retarded person, who has a social impairment as one item among a multitude of problems, to the most able, highly intelligent person with social impairment in its subtlest form as his only disability. It overlaps with learning disabilities and shades into eccentric normality." For the purposes of the present research, and review, evidence from the research in autism and Asperger's shall be considered on the assumption that they do indeed lie on a continuum.

1.1.2 Definition of Asperger's Syndrome

The specific category of Asperger's syndrome was recently introduced into the formal diagnostic manuals DSM-IV (American Psychiatric Association, 1994) and ICD-10 (World Health Organisation, 1993). The DSM-IV criteria are reproduced below.

The diagnostic criteria for 299.80 Asperger's disorder

A. Qualitative impairment in social interaction, as manifested by at least two of the following:

- (1) marked impairment in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction
- (2) failure to develop peer relationships appropriate to developmental level
- (3) a lack of spontaneous seeking to share enjoyment, interests or achievements with other people (e.g., by a lack of showing, bringing or pointing out objects of interest to other people)
- (4) lack of social or emotional reciprocity

B. Restricted patterns of behaviour, interests, and activities, as manifested by at least one of the following:

- (1) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus
- (2) apparently inflexible adherence to specific, nonfunctional routines or rituals
- (3) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)
- 4) persistent preoccupation with parts of objects

C. The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.

D. There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).

E. There is no clinically significant delay in cognitive development or in the development of age appropriate self-help skills, adaptive behaviour (other than in social interaction), and curiosity about the environment in childhood.

F. Criteria are not met for another Pervasive developmental disorder or Schizophrenia.

The diagnosis of Asperger's is essentially different from that of autism in terms of language and cognitive abilities, shown in criteria D and E. Indeed it may be misleading to consider Asperger's at the end of a spectrum as it implies all of the difficulties are less severe. However the same criteria for social impairment has to be met for Asperger's as autism, despite their largely intact cognitive and language skills.

Currently the syndrome is described in terms of behavioral descriptions of symptom clusters, meaning the diagnosis entails subjective judgments of whether behaviours are normal or clinically abnormal. There is continuing disagreement between professionals as to whether or not Asperger's syndrome is synonymous with high functioning autism. It is not clear what the differences are, if any, between high functioning autism and Asperger's. Gilberg (1998) notes that there are at present no explicit diagnostic guidelines for high functioning autism. He maintains that it is open to speculation as to whether high functioning autism and Asperger's are identical or essentially different. Whilst this study does not directly address this issue it is important nevertheless, as the literature reviewed will include studies which used participants diagnosed with high functioning autism and Asperger's syndrome.

However the core impairment in both Asperger's syndrome and autism is social. Current debate focuses on whether the differences in the two groups reflect differences in severity or whether they are sufficiently different to be considered as related but distinct. Van Krevelen (1971) suggests that the "child with autism lives in a world of his own and acts as if others do not exist, whereas the child with Asperger's syndrome lives in our world in his own way and evades other people of whom he is aware".

1.1.3 Aetiology

Early theories focused on environmental explanations of autism (e.g. Bettelheim, 1967) who described autism as a maladaptive response to an unloving environment. However in the last twenty years, research has increasingly focused on genetic factors in the aetiology. In 1977, Folstein & Rutter reported that the concordance rate in twins with autism was higher in monozygous twins than dizygous twins, the conclusion being that genetic factors must then be responsible for this. Subsequent research has confirmed this, Szatmari, Jones Zwaigenbaum & Maclean (1998) reviewed all the published family studies, and found that combining the results gave a risk of 2.2% for the incidence of autism in siblings. Happé and Frith (1996) note that estimates between 2-3% may be low in absolute terms but are high in comparison to the general population as they represent a 20-50 times greater risk. When the studies are widened to include any type of pervasive developmental disorder (PDD) risk may be increased to 5%. They found that Asperger's, autism and atypical autism demonstrated significant familial aggregation. The reviewers note that in the few studies which look at second and third degree relatives give a greatly risk estimate is reduced to 0.18%, suggesting multiple interacting genes in aetiology.

There have been no twin studies of Asperger disorder and four twin studies of autism. The original Folstein and Rutter (1977) report found a 82% incidence of the disorder in autistic MZ twins and 10 % in DZ twins. This has been replicated by Ritvo, Freemam, Mason-Brothers & Ritvo (1985) who found rates to be 91% and 30% respectively, and Bailey et al (1995) who found the rates to be 87% and 9% respectively. There have been no adoption studies in autism research. The twin studies are used to give an estimate of heritability. Szatamari et al (1998) estimate that the heritability of autism is over 90%.

They conclude their review by saying autism and PDD are genetic disorders and share common genetic mechanisms.

1.1.4 Possible Brain Mechanisms

Damasio & Maurer (1978) implicated the mesolimbic system and associated frontal lobe structures in their proposal of the neurobiological basis of autism. Recent research in brain imaging has supported this contention. Happé et al (1996) assessed a group of five young men with a diagnosis of Asperger's syndrome. The group was asked to read stories which required mentalising, physical control stories and strings of unconnected sentences. PET scans were taken in each of the different conditions. They found significant differences in the activation of a specific brain area in the prefrontal cortex responding to the theory of mind stories. The researchers suggest that the abnormal activation in this region may be due to the Asperger's subjects using a different mechanism in order to understand mental states. Further Bauman & Kemper (1994) looked at sections of autistic brains and found increased cell packing, reduced cell size and reduced connections in parts of the limbic system. They suggested that this type of pattern resembled earlier stages of brain maturation, and as such, may signify a curtailment of development in the effected areas.

There are a number of signs of neurological damage in studies of autism including significant associations with learning disabilities, Pennington et al (1997) notes that 75% of individuals with autism also have a learning disability. Happé & Frith (1996) conclude that individuals with autism are at a significantly increased risk of being affected by epilepsy and infantile spasms.

Damasio & Maurer (1978) originally proposed a general dopaminergic deficit in autism,

but Happé & Frith (1996) conclude there has been no robust evidence to implicate the dopaminergic system and pharmacological treatment has not been effective. Hobson (1993 p11), concludes, “that it has yet to be established that any given pattern of inheritance, or any given distribution of neuroanatomical or neurological dysfunction, is applicable to all autistic people”.

1.1.5 Deficits in autism and Asperger’s

We have discussed how the deficits found in the autistic continuum can be considered to fall into the three domains of communication, socialisation and imagination. There is considerable overlap between these domains so that difficulties in socialisation will be related to difficulties in both communication and imagination, indeed ‘social communication’ is a term often used in the literature to explain some of the deficits common to autism. The evidence will be reviewed in each of these three domains, with the proviso that some of the evidence will be relevant to more than one domain.

Communication

Happé & Frith (1996) note that lack of communication, rather than language, seems to characterises autism. They suggest language delay may be secondary to the failure of communicative understanding. So that the communicative process necessary for language acquisition such as communicative gestures, eye gaze and joint attention may be responsible for the delay, as they are invariably impaired in autism. Gilberg and Gilberg’s (1989) diagnostic criteria of Asperger’s syndrome give emphasis to language use. They

suggest that at least three of the following are characteristic of speech; a) delayed development, b) superficially perfect expressive language, c) formal pedantic language, d) odd prosody, e) peculiar voice characteristics and f) impairments in comprehension, including misinterpretations of literal implied meanings.

Attwood (1998) points out that as the person with Asperger's matures they show impairment in the "art of conversation". He suggests a number of areas where the person with Asperger's may have difficulties: in initiating a conversation appropriately, repairing a conversation, coping with uncertainty or mistakes, overcoming the tendency to make irrelevant comments and knowing when not to interrupt.

Imagination

Pretend play is one of the earliest examples of imaginative ability. Leslie (1987) described three types of pretend acts: object substitution, attribution of false properties, and attribution of presence to imaginary objects. Children with autism have been consistently shown to engage in less pretend play than matched controls. Wing et al (1977) found that while some children with autism played, they did so in a stereotyped way and did not engage in symbolic play. These deficits in imagination are also evident as children mature. Pennington & Ozonoff (1996) note that the interests of the higher functioning autistic individuals tend to be idiosyncratic, revolving around unusual themes such as, vacuum cleaners, automobile hubcap emblems and venomous snakes.

Socialisation

Happé & Frith (1996) state that the three core areas of very early social interaction which are impaired in autism and presumed to be the foundation for later social development are, joint attention, imitation and interpersonal relatedness. Peer relationships are also considered as an aspect of socialisation in older autistic individuals.

Joint attention

Social difficulties are present early in development. Joint attention is one of the earliest social behaviours and usually emerges in infant behaviour between 9-12 months being well developed by 24 months. Joint attention behaviours are those which “involve directing another person’s attention (or being directed by another) to a visual spectacle or object,” McEvoy, Rogers & Pennington (1993, p565). It is well replicated that autistic children are impaired in their joint attention skills (e.g. Loveland & Landry, 1986)

Imitation

Meltzoff & Gopnik (1993) have suggested that for the normal child, imitation is a tool for social understanding. They suggest that it may underlie emotional contagion, by sharing the same expression, the infant may come to share the same emotion as another. This ability is present from birth. Happé & Frith (1996) note that there is no evidence to suggest that children with autism lack neonatal imitation. However, Rogers, Bennetto, McEvoy & Pennington (1996) review the literature on imitation in autism and report

consistent findings of imitation deficits with older subjects with autism.

Interpersonal relatedness

Hobson (1993, p15) maintains that lack of engagement is the essential and universal feature of autism and it is the “autistic child’s limited experience of intersubjective engagement per se..... that severely constrains their ability to develop an understanding of the nature of persons and thereby evolve a range of supervenient cognitive, linguistic and social capacities. In this sense, abnormalities in the intersubjective domain would constitute an irreducible bedrock in the explanation of autism.”

Peer relationships

The quality of relationships will vary across individuals, with the difficulties in peer relationships becoming more apparent as children mature. Pennington & Ozonoff (1996) suggest that the core difficulty in autistic people, of all levels of functioning, appears to be reciprocity. Even those mildly affected, who are interested in others, have difficulty with social reciprocity. This means relationships tend to be one-sided and do not involve “the same level of mutuality, shared interests, and intimacy observed in non autistic peers”(p70). The DSM-IV criteria (see above) uses four criteria in the domain of social interaction, two of which need to be present for the diagnosis.

1.2.1 Cognitive Theory

The general consensus at present is that autism and Asperger's syndrome are biologically caused. However the diagnosis, is currently based on its behavioural features as seen by the DSM-IV criteria. Cognitive theory has the potential to aid the explanation of behaviour and improve understanding the deficits and strengths found in autistic psychopathology. As Pennington, et al (1997) report it is assumed that the effects of biology on observable behaviour (symptoms) is typically mediated by underlying cognitive processes. Happé & Frith (1996) suggest that cognitive theories can give explanatory and predictive accounts of the complex pattern of behaviour we see in developmental disorders such as autism.

One of the aims of cognitive theory in autism and Asperger's has been to uncover the primary deficit that accounts for the whole spectrum of behaviour found in this continuum. The theories which have generated most recent research interest are "theory of mind" accounts (Baron-Cohen, Leslie & Frith, 1985), deficits in executive function (Ozonoff, Pennington & Rogers, 1991), central coherence (Frith, 1989) and interpersonal relatedness, (Hobson, 1989).

Frith & Happé (1994) note that any causal account of autism needs to be able to account for the highly specific pattern of deficits and skills. They note that IQ scores alone are indicative of what they describe as a "spiky" profile. Some subtests such as block design are typically performed well by autistic subjects and others such as picture arrangement are typically performed poorly. A theory is important as it enables one to make predictions and explain the specific pattern of deficits found in autistic spectrum disorders in terms which relate to normal development. Cognitive theory also implicates areas for possible

intervention. The two theories considered here are theory of mind and executive function, however central coherence and interpersonal relatedness will be briefly discussed.

1.2.2 Central Coherence

Frith (1989) suggested that the pattern of symptoms found in autistic psychopathology reflect an imbalance of integration of information at different levels. Normal information processing is considered to be a procedure which enables one to draw together information from diverse sources, to construct its higher level meaning within the context. The central coherence theory proposes that autistic individuals may not be able to utilise contextual information well. Thus the theory predicts that autistic subjects would be good at tasks where attention to local information is necessary, but would perform less well on tasks which require recognition of global meaning. The first evidence for this theory came from Shah & Frith (1983) who found autistic subjects performed more quickly and accurately on the embedded figures task where subjects are required to spot a hidden figure within a drawing of an object. In this task the autistic subjects were not as effected and therefore distracted by the context as controls.

The reason the theory it is not explored further in the present report is well justified as Happé (1997) writes, “the notion of central coherence has not yet been systematically developed and at present is only loosely defined and conceptualised. In particular, it is as yet unclear what is the appropriate level for pinpointing the inability to use context in autism.” p2.

1.2.3 Interpersonal relatedness

The interpersonal relatedness theory suggested by Hobson (1989) sees the deficits in interpersonal relatedness as responsible for the whole pattern of deficits seen in autism. However Hobson does not entirely exclude the utility of establishing 'lower order psychological deficits' but suggests that the difficulty may be that there could well be a range of diverse deficits which could act either alone or in combination to effect a disruption at this intersubjective level. Indeed Hobson (1993) regards his theory as a different level of explanation rather than one which is in competition with other accounts such as theory of mind and executive function describing his account as "a re-description of the phenomenon under consideration"p17. Happé (1994b) notes that Hobson's theory has been hard to either prove or disprove because the of the unclear causal pathway.

1.2.4 Theory of Mind

Definition

Premack & Woodruff (1978) first used this definition in their work with chimpanzees. They maintain that to have a theory of mind, "is to be able to attribute independent mental states to self and others in order to explain and predict behaviour." They considered theory of mind to be a cognitive mechanism allowing the representation of mental states, rather than a conscious mechanism

Historical background

In (1983) Wimmer & Perner published an article on the understanding of false beliefs by normally developing pre-school children. This was then followed by an article by Baron-Cohen, Leslie & Frith (1985) who questioned whether indeed the autistic child had a “theory of mind.” This possibility was initially inspired by the observation that autistic children did not engage in pretend play. The understanding of, and ability to use pretense in play typically develops at around 18 months (e.g., Fein, 1981). Leslie (1987) suggested that in order for the child to separate pretense from real world knowledge he must possess two types of representations. Primary representations which are concerned with the way things really are in the world and metarepresentations which allow pretense to be incorporated but kept separate. These metarepresentations are required for representing independent mental states to ones self and others. This became a testable theory which could make predications about performance on certain types of task.

Assessing theory of mind

False belief tasks were developed as a robust test of theory of mind. The tests require that the correct response is not based on either the observed situation or the subjects own belief. The first test of this hypothesis was carried out by Baron-Cohen, Leslie and Frith (1985) using a test referred to as the, Sally-Ann task. Two toy dolls Sally and Ann act out the following sequence of events: Sally has a basket, Ann has a box, Sally also has a marble. Sally puts the marble into her basket, covers it and leaves the room. While Sally has gone Ann takes the marble out of the basket and puts it in her box. Sally then comes

back into the room and wants her marble. The participants are then asked “where will Sally look for her marble? Approximately 80% of autistic children with a verbal mental age of 4 and a non-verbal mental age of 9 could not answer this correctly. They said that Sally would look in the box. However approximately 80% of normal children aged 4 and children with Down’s syndrome and a lower mental age than the autistic group answered the question correctly.

Theory of mind and autism

The type of false belief described above is considered a first order false belief task, whereby one is able to understand that somebody may think something is true which is really false. Second order false belief tasks are described by Baron-Cohen et al (1997) as those “tests which involve reasoning about what one person thinks of another person’s thoughts.” These second order theory of mind tests are typically passed by normally developing six year olds (Perner & Wimmer 1985). In a later study Baron-Cohen (1989b) found that a group of older autistic subjects, who passed a first order theory of mind test, did not pass a second order theory of mind test. In this study, the autistic subjects could not predict a protagonist’s behaviour on the basis of his or her false belief, about another person’s true belief, about a state of affairs.

Evidence has also shown that autistic subjects find deception difficult, which would implicate a deficit in theory of mind. Russell, Mauthner, Sharpe & Tidswell (1991), used a procedure called the windows task to determine whether autistic children could engage in deception. In this task two opaque boxes are placed between the subject and an opponent, the experimenter sits beside the subject. Both players close their eyes as the experimenter

puts a chocolate inside one of the boxes. The subject's task is to tell the opponent which box to open in order to find the chocolate. The subject does not know which box the chocolate is in at this stage. If the opponent opens the empty box the subject retains the chocolate, but if the opponent opens the baited box they get to keep the chocolate. Thus the subject learns that it is in their interest that the opponent look in the empty box. After 15 of these trials the boxes were changed to boxes with windows which faced the subjects. Normal 4 year old children and non autistic mentally handicapped controls tended to point to the empty box and get the chocolate on the first and remaining trials, whereas 3 year old normal children and autistic children failed to deceive their opponent. They found that success on this windows task correlated well with success on a false belief task, and was consistent with metarepresentational deficit theory.

Problems for theory of mind

In studies which look at mentalising using the false belief tasks some children with autism pass. In a study by Prior et al (1990) 60% of the autistic subjects passed. Frith (1996) suggests that this does not necessarily mean that these subjects do have in tact theory of mind they simply have a strategy which allows them to "hack out" solutions in these artificial test conditions, but does not serve as a theory of mind in real life situations. A delay hypothesis would take into account these difficulties, thus, it would be the delay in acquiring the skill, rather than it's total absence which would explain the difficulties found in autistic spectrum disorders.

A number of researchers Baron-Cohen et al (1997), Happé (1994) have begun to address this issue by developing more developmentally appropriate tasks, for older and more

cognitively able young people and adults with autism and Aspergers. Happé (1994) uses 'Strange Stories' to determine how well autistic children who could pass the second order theory of mind tasks could perform on more naturalistic and complex stories. The Happé stories covered a range of vignettes involving mental state thinking, these included joking, lying, persuasion, double bluff, sarcasm and misunderstanding, and found that the autistic group were impaired, relative to controls. Baron-Cohen, et al (1995) found older autistic subjects, with a verbal mental age of 4.9, and a non verbal mental age of 7.2 were impaired in their use the direction of eye gaze to infer mental states. In this instance cartoon faces were used and questions like "which sweet is he going to take" were asked of children, the correct response could be inferred, from which sweet the face was looking at. Baron-Cohen (1997) developed an advanced assessment of this ability to infer mental states from faces, using photographs of a persons eyes. He found that subjects with high functioning autism and Asperger's syndrome were impaired, compared to matched controls. These types of task help understand how delayed acquisition of theory of mind may express itself in terms of mentalising abilities in older children and adults.

Frith (1996) notes that, so far, no child with autism or Asperger syndrome has been found who can pass false belief tasks by the normal age for passing of 5 years. Frith (1996) notes that while people with Asperger syndrome do perform well on some theory of mind tests that it is also highly unlikely that a single behavioural measure would automatically denote the presence of a critical underlying capacity that the test was supposed to tap. She goes on to say that any task can be performed in a number of different ways, it would be more likely then that this group would perform unreliably and would fail on at least some of a battery of mentalising tasks.

Frith & Happé (1994) argue that while the theory of mind account has helped us

understand the nature of the autistic child's impairment in play, social interaction and in verbal and non verbal communication, it does not explain the non-triad features. They include in these features, restricted repertoire of interests, obsessive desire for sameness, islets of ability, idiot savant abilities, excellent rote memory and preoccupation with parts of objects. Further the theory can not account for the early deficits in behaviours such as joint attention, which are apparent before theory of mind is thought to develop.

Finally there is also recent evidence to suggest theory of mind deficits may not be specific to autistic spectrum disorders, deficits in theory of mind tasks have been demonstrated in deaf children, (Peterson & Siegal, 1995), in non speaking children with cerebral palsy, (Dahlgren, & Trllingsuaard 1996) and in children with ADHD, (Buitelaar, et al, 1999).

1.2.5 Executive Function

Definition

Executive functions are the cognitive operations thought to be driven by the prefrontal cortex. Burgess (1997) states that current consensus regards the executive system as a set of processes whose primary purpose is to facilitate adaptation to novel situations. He goes on to say that evidence suggests that it does this through regulation and control of more routine cognitive skills. Real life situations typically require some adaptation of these skills as no two situations are exactly alike. Dennis (1991) states that all executive function behaviours share the need to disengage from the immediate environment, or external context, and guide action instead by mental models or internal representations.

Welsh & Pennington (1988, p201) have defined executive function "as the ability to

maintain an appropriate problem solving set for attainment of a future goal”. This set can involve one or more of the following: (a) an intention to inhibit a response or defer it to a later more appropriate time, (b) a strategic plan of action sequences, and (c) a mental representation of the task, including the relevant stimulus information encoded into memory and the desired future goal state. In cognitive psychology, the concept of executive function is closely related to the notion of a limited capacity central processing system.

Pennington & Ozonoff (1996, p55) note that typical lists of executive functions include set shifting and set maintenance, interference control, inhibition, integration across space and time, planning and working memory. They go on to describe two central ideas in the concept of executive function; a) “context specific action selection, especially in the face of strongly competing, but context-inappropriate responses and b) “maximal constraint satisfaction in action selection, which requires the integration of constraints from a variety of other domains, such as perception, memory affect and motivation.”

History of executive function

Burgess (1997) describes “executive functions” as relatively new term to neuropsychology. The executive processes have always been linked to the frontal lobes and damage to them has resulted in a range of symptoms previously known as frontal lobe syndrome.

Executive function has been proposed as a potential underlying deficit in autism as Damasio & Maurer, (1978) found patients with prefrontal cortical dysfunction demonstrated behaviours that resemble autism. They made specific reference to motor

disturbances, repetitive stereotyped movements and verbal communication impairments.

Ozonoff, Pennington & Rogers (1991) described a number of features of autism which were similar to that of patients with frontal lobe damage. They made reference to; the rigid and inflexible appearance and sensitivity to small changes in the environment, impassivity the inability to delay or inhibit responses, preservation, the tendency to focus on one narrow interest or repetitively engage in one stereotyped behaviour and difficulties in self-reflecting and self monitoring. They suggest that overall the autistic persons cognition seems to lack executive functions, in that it is not future orientated and the long-term consequences of behaviour do not appear to be anticipated.

Assessing executive function

One of the difficulties in measurement of executive dysfunction, known as dysexecutive syndrome is that there is no prototypical screening measure. A further difficulty arises from the assumption that executive functions are potentially fractionable, making the manifestation of executive damage different across patients. Burgess (1997) describes the study of executive functions as differing from other areas of neuropsychology in that there is task impurity, individual response styles and causal dependence on complex behavioural sequences. This means it is often difficult to detect, the often subtle effect, of executive control on behaviour.

Pennington & Ozonoff (1996) note performance on most executive tasks can be disrupted in different ways, meaning that it is hard to be specific about exactly what executive deficits may be influencing performance on a particular task. Pennington & Ozonoff conclude that despite limitations, measurement of executive function does demonstrate

convergent and divergent validity and the construct of executive functions does have utility. The Wisconsin Card Sorting Task (WCST) is probably the most often used measure of executive function and will be described here to give an indication of how executive function may be measured. The WCST is a sorting test which requires subjects to match cards according to three categories, colour, shape and number. The examiner feeds back to the subject whether they have sorted the cards correctly or incorrectly, and after 10 correct responses the examiner changes the sorting strategy. There is no comment from the examiner except to feedback whether the sorting strategy is correct or incorrect. A measure of perseveration is obtained by collating the number of times the subject will continue to sort using a previously correct principle whilst getting the negative feedback from the examiner.

Executive function and autism

The first formally reported study of executive function deficits in an individual with autism was reported by Steel, Gorman & Flexman (1984). They described a man with intact visuo-spatial and nonverbal analytic abilities. Alongside these intact cognitive functions, this man demonstrated a mild memory impairment, and impairment on measures of executive function, such as the WCST and Porteous Maze test. They described perseverative errors and rigid, inflexible problem solving strategies. The first group studies of executive function deficits in autistic psychopathology were carried out by Rumsey (1985). Rumsey found that autistic, non-retarded verbal men were significantly more perseverative on the WCST, described above, than controls.

Pennington & Ozonoff (1996) report that at present there are several distinct frontal

syndromes recognized which correspond to separate lesion sites in the prefrontal cortex. The syndromes are described as akinetic mutism, apathetic or pseudodepressed syndrome and euphoric or pseudopsychopathic syndrome. The syndrome of akinetic mutism is produced by medial lesions and is characterised by a profound deficit in initiation of speech and other spontaneous behaviour. The pseudopsychopathic syndrome is characterised by sporadic hypomania, childish humor or facetiousness, disinhibition of sexual and eating behaviour, lack of concern for others, and disregard for ethical principles. The apathetic syndrome is the syndrome, which they believe, shares some similarities with autistic psychopathology. It is characterised by reduced awareness, lack of initiative, unconcern and blunting of emotional responses. In this paper they review the evidence of executive dysfunction and the developmental pathologies including conduct disorder, ADHD, Tourettes syndrome and autism. They review 14 papers which have studied executive function in autistic populations and compared these with a control group. They conclude that the WCST, has in the majority of studies, been a highly sensitive indicator of executive dysfunction in individuals with autism. However due to the variety of operations involved in successful performance on the WSCT it does not indicate which cognitive operations may be impaired. One study carried out by Minshew et al (1992) found no significant differences in WSCT performance between high functioning adolescents and adults with autism and controls. However they did find evidence of executive dysfunction in another measure, the Goldstein-Scheerer object sorting test, in which autistic subjects were found to be less able to shift set.

In summary, their review found that 13 out of 14 studies found significant differences between autistic subjects and controls on at least one measure, with the average effect size across all EF tasks being 0.98. The most successful discriminator was the Tower of Hanoi

whose mean effect size was 2.07, and the WCST which was the most widely used measure had an effect size of 1.06. They concluded that these large effects are not only statistically significant but clinically meaningful. Overall, research in young people and adults with autism and Asperger's has been consistent in reporting deficits in executive function.

Problems for executive function theory

Executive function deficits are not specific or unique to the disorder, for example executive problems have been found in ADHD (Pennington & Ozonoff, 1996), and early treated PKU (Welsh, Pennington, Ozonoff, Rouse & McCabe, 1990). However Pennington et al (1997) report that the profiles and severity of the executive deficits differ in autism, so that the exact type of executive deficit found in autism has not been found in any other disorder. Difficulties specifying executive deficits arise from the lack of specificity in current methodology. However manipulations using more pure versions of the presently available tasks, (Ozonoff, 1995) and clearer profiles of executive deficits using multiple measures can potentially resolve this problem.

Happé & Frith (1996) note that no cases of pure autism have been acquired late in life after a brain injury. Gilberg (1991) suggested that marked social impairment following herpes simplex encephalitis may provide a useful model for thinking about childhood autism. Eslinger & Damasio (1985) reported on patient EVR who acquired frontal lobe damage. He performed well on a range of assessments and could engage in discussions about complex issues. However in everyday life he was unable to make appropriate social judgments. Eslinger & Damasio describe his everyday difficulties clearly, with an account

of his decision making process when choosing a restaurant. The process could apparently take hours and entailed analysing seating plans, menus, atmosphere, management, even driving to different restaurants to see how busy they were, and still being undecided. However brain damage acquired in adulthood is unlikely to effect the same structures, in the same way, as damage from birth, and is thus likely to produce a very different picture. Brain damage in childhood, at early stages of development, tend to generally be nonspecific as there is considerable plasticity in the brain at this age. However Pennington & Bennetto (1993) reviewed reported early acquired frontal damage, which led to conduct type disorders characterised by difficulties in peer relationships.

A final difficulty for the theory concerns primacy, a study by Wehner & Rogers (1994) cited in Pennington et al (1997) found no executive deficits in a very young group of children with autism, using some of the same measures as used in other studies which looked at slightly older preschoolers.

1.3. How Well do the Theories Explain the Pattern of Impairment

In summary then deficits have been found on both executive function and theory of mind measures. So the task for the theories is to be able to explain the impairments in other domains. What follows is an exploration of how well each theory can account for the deficits in communication, imagination and socialisation. Most of the research has focused on how well the theories explain the social difficulties so their relationship to the deficits in communication and imagination shall be discussed only briefly.

Communication

Language impairment has been historically considered the cardinal feature of autism (Rutter et al, 1971). Happé & Frith (1996) maintain that the communication deficits in autism show a particular pattern of strengths and weaknesses. Their review suggests that coded communication is possible without mentalising ability. However ostensive-inferential communication (where the function is to communicate information) is not possible without mentalising ability, as one needs to know who knows what. Loveland, Tunali, Kelly & McEvoy (1989) found that when autistic subjects were asked to explain the rules of a board game to a naive listener they did so less efficiently than Downs syndrome controls. They were typically less informative, and included more irrelevant information, yet could reply correctly when asked the specific questions to elicit the missing information.

Happé & Frith (1996) go on to suggest that a mentalising deficit may also account for delays in language acquisition, due to failure in learning words through ostention and by reference to the speakers intention.

Happé (1997) found that autistic subjects made more errors in reading and were less likely to correct themselves when reading sentences using homographs (in her eye there was a tear, in her dress there was a tear) than matched controls. Even participants who performed well on second order of theory of mind tasks still failed to use the context appropriately in the homograph task. This suggests that a deficit in theory of mind is not sufficient to explain this peculiarity of language.

Hobson (1993) reviews the literature on language development in autistic individuals capturing the sense that more able autistic children and adults have normal abilities in a

number of different language domains. Abnormalities tend to occur in prosodic features, so that information is not conveyed about attitudes or meaning using intonation, stress and rhythm, for example. These features may be more difficult for a mentalising theory to explain.

Imagination

As discussed earlier, children with autism engage in less spontaneous pretend play than their peers. This lack of pretense has been considered a very striking example of a deficit in mentalising ability, and indeed, was one of the observations which inspired a mentalising theory. Baron-Cohen (1987) explored functional and pretend play in children with autism and found that production of functional play where toys were used for their designed purpose was unimpaired. In contrast production of pretend play was impaired compared to controls. However, Lewis & Boucher (1988) found that pretend play is intact in autistic children. They found that when autistic children were prompted and/or conditions were structured autistic children engaged in as much play as matched controls. Charman & Baron-Cohen (1997) found that school aged children and adolescents did not differ from controls in functional play acts and situationally appropriate object substitution, yet they produced fewer novel play acts and unprompted object substitutions. Jarrold, Boucher & Smith (1994) explored a specific executive function deficit account of deficits in pretend play. They experimentally tested the Harris (1993) executive hypothesis that, in pretend play the child has to set aside familiar schemas that are evoked by external objects and guide action with reference to an internal plan. This is termed a shift in locus of executive control. Jarrold et al predicted from this hypothesis that children with autism would be

unable to impose their personal pretend schema's on objects with a salient function. Thus the prediction in this experiment would be that if children with autism were given a selection of props where perceptual similarity was controlled they would be more reluctant to use a prop with an alternative function. Jarrold et al found that this was not the case. They concluded that failure to inhibit a salient reference did not seem to be a factor in explaining the problems autistic children have with pretense.

Hughes & Russell (1993) suggest that an executive function deficit explains a number symptoms which could be considered in the domain of imagination. These include stereotypies, excessive desire for sameness, and repetitive narrow interests. They propose these are all easy to regard as manifestations of a deep volitional disorder, and all in some ways involve perseveration.

It seems then that both theories may have some explanatory use in the domain of imagination, although neither seems to be able to give an account which fits all the evidence so far.

Socialisation

Happé & Frith (1996) state that two important early expressions of social abilities crucial for later social development are joint attention and imitation. Deception is also considered here as it is an area which has generated some hypothesis driven research. Finally peer relationships are considered as a later developing socialisation deficit.

Joint attention

Social difficulties are usually present early in development. Joint attention is one of the earliest social behaviours and usually emerges in infant behaviour by about 9-12 months and is well developed by 24 months. Joint attention behaviours are those which “involve directing another person’s attention (or being directed by another) to a visual spectacle or object,” McEvoy, Rogers & Pennington (1993, p565). It is well replicated that autistic children are impaired in their joint attention skills (e.g. Loveland & Landry, 1986). Baron-Cohen (1989) demonstrated that children with autism are not impaired in their production and comprehension of pointing when the behaviour has an instrumental function, but are impaired in both aspects when the behaviour is to share an interest or awareness of an object.

McEvoy et al (1993) found a significant relationship between social behaviours and executive function in autistic preschoolers. They found an inverse relationship between skill in joint attention and increased perseverative responses on the spatial reversal task. In the spatial reversal task a reward is hidden, once the child is successful in discovering it the reward is hidden in a different place. What is measured is how the child can change response set once the response set has been unsuccessful. The authors suggest that the ability to shift cognitive set may be important for the development of joint attention. They propose that joint attention requires the individual to shift set, from the object, to another individual in order to draw their attention towards it. The deficits in this domain are described by McEvoy et al as failure to alternate gaze between an object of interest and the caregiver, failure to use pragmatic eye contact, and failure to comprehend words and gestures aimed at directing attention. The autistic subjects were described as more likely to

use primitive gestures such as moving another persons hand towards desired object. However Pennington (1997), found that there were no executive function deficits in an even younger group, mean age 43 months, of autistic children on this task. Pennington et al (1997) compared the results from two studies and found that perseverative behaviour increases as autistic children get older, a pattern which is opposite to that of normal development.

Dawson et al (1998) found that autistic preschoolers, mean age 15 months, failed to orient their attention to naturally occurring social stimuli. They compared non-social stimuli, the sound of a rattle and a musical toy with social stimuli, their names being called or the sound of hands clapping. Autistic children showed only slightly fewer errors when compared to Down's syndrome controls in orienting towards the non social stimuli. However they often failed to orient to the social stimuli, when they did they were more likely to show a delayed response. They also found a correlation between the attending to social stimuli and shared attention performance, a relationship was not found when attending to non social stimuli was considered. The authors conclude that while children with autism have general impairments in orienting and shifting attention, the impairments are more evident for social stimuli. They suggest that this may be because social stimuli, such as facial expressions and gestures are more complex and autistic children may have difficulty processing these stimuli so therefore their attention is not naturally drawn to social stimuli. They go on to propose that this failure to, selectively attend to, social stimuli could be the precursor to deficits in shared attention. This then effects further development by limiting the opportunities for engaging in critical early social experiences. Similarly Osterling & Dawson (1994) looked retrospectively at videotapes of first birthday parties of toddlers who had been diagnosed with autism. They found that in addition to

impairments in shared attention, the children at age 1, attended less to people and failed to orient when their names were called.

Finally Klin, Volkmar & Sparrow (1992) used the Vineland Adaptive Behaviour scales to assess the range of early social deficits in autism. They found that social dysfunction affects very early emerging social behaviours such as reaching out to caregivers in anticipation of being picked up and showing affection for, and interest in, others. The absence of these behaviours discriminated this group from developmentally delayed controls matched for mental age. The mental age of this group was around 2 years or below. Developmentally equivalent but nonsocial behaviours did not discriminate the groups.

Happé & Frith (1996) note that deficits in very basic social abilities which appear early on in life pose problems for a mentalising theory, a skill which is thought to develop later and as such can not account for deficits which emerge prior to its development. Executive theories have had some success in putting forward explanations for these early occurring deficits. Although the study which measured executive function in the youngest group of autistic children, Pennington et al, (1997), found no deficits in executive function. In this sense the executive account improves on the theory of mind account in terms of primacy of the deficits, but it may not be the primary deficit either.

Deception

The autistic child's failure in tasks requiring deception has usually been seen as supporting a mentalising impairment. However an alternative account was suggested by Hughes and Russell (1993). They looked at the windows task, described earlier, to see if the autistic child's difficulty with deception was really due to a difficulty in implanting a false belief

into the mind of another, or whether they were unable to perform the behavioural strategy necessary for deception. They felt this strategy may involve disengaging from a focal object (a desired object in this instance) and a behavioural reference (pointing in this instance) to a place where there is no object. They suggested it may be that disengagement is difficult for the autistic child. They proposed that if the deceptive element was taken out, in this instance the opponent, then a metalising hypothesis would predict that autistic subjects would perform more successfully. A disengagement theory would predict that the autistic subjects would find the task equally difficult. In this, deception removed, 'windows' task subjects had to learn that to obtain the chocolate they had to point to an empty box. Hughes and Russell found that the removal of the opponent did not make the task easier for autistic subjects, they felt this supported a mental disengagement hypothesis, as a mentrepresentational account could not explain the continued difficulty with this task. They also used a second condition in which there was no experimenter present and the task was for the subject to retrieve a marble from a box. If they went for the most direct method of obtaining the marble they broke a beam and the marble disappeared thorough a trap door. The subject has to use alternative methods. Again Hughes and Russell found that autistic subjects continued to have difficulties. They considered a disengagement hypothesis alone may be too simple to explain the whole pattern of results, and suggested it was only one of other executive operations, which might be implicated in explaining difficulties in this task. However autistic subjects are able to succeed in a task which would require disengagement, the false photograph test, Leekham & Perner (1991). Here the subject has to infer where something will be in an outdated photograph of reality when the subject knows that reality has changed. Pennington et al (1997) argues that the false photograph is not 'false' at all as it is not the

nature of a camera to refer to current reality. Hughes and Russell argue that in this task there is not competition between a mental state and knowledge about an object, rather there is competition between two physical objects for salience and the differences in the demands of this task may explain the different outcomes.

Imitation

Meltzoff & Gopnik (1993) have suggested that for the normal child imitation is a tool for social understanding. They suggest that it may underlie emotional contagion, so that by sharing the same expression the infant may come to share the same emotion as another. This ability is thought to be present from birth. Happé & Frith (1996) note that there is no evidence to suggest that children with autism lack neonatal imitation. However Rogers, Bennetto, McEvoy & Pennington (1996) review the literature on imitation in autism and note that there have been consistent findings of imitation deficits in older subjects with autism. They set up an experimental design which could test an executive hypothesis and a theory of mind hypothesis in relation to the autistic persons deficits in imitation and pantomime. They found no evidence to suggest that subjects with autism had a specific difficulty in imitating movements with symbolic content, as opposed to non-symbolic content. The deficits they found in non meaningful imitation are difficult for theory of mind accounts to explain, as their results demonstrated that meaning aided rather than hindered the performance of the autistic group. However there was also only partial support for the executive hypothesis as the autistic group were deficient on only one of the two sequential tasks.

Peer relationships

The quality of relationships may vary across individuals. Pennington & Ozonoff (1996) suggest that the core difficulty in autistic people of all functioning levels appears to be reciprocity. Even those mildly affected who are interested in others have difficulty with social reciprocity. This means relationships tend to be one-sided and do not involve “the same level of mutuality, shared interests, and intimacy observed in non autistic peers”(p70). As autistic children develop, the difficulties in social interaction with others becomes more apparent, diagnostic criteria, such as DSM-IV and ICD 10 emphasise peculiarities in social interactions. Attwood (1998) notes that at present much of our knowledge about later social behaviour is based on clinical observation rather than scientific study. In view of the fact that there has been little research into the quality of peer relationships and the points at which it breaks down, it is possible that an executive deficit hypothesis and a theory of mind hypothesis could potentially account for the difficulties in this area.

1.4.1 Summary of the Research

It is clear that the two different hypothesis have generated a great deal of research giving some useful insights into cognition in autistic spectrum disorders. Detailed research looking at early development has suggested a number of areas of impairment in very early normal developmental processes. Both the theory of mind and executive accounts have had some success in explaining these. The search for a core deficit, however, remains inconclusive. Sigman (1994) suggests that there are three criteria for a core deficit

specificity, universality and primacy.

Specificity has been a problem for both theories, especially the executive theories. However there is the possibility that different executive syndromes may explain different disorders, (Pennington & Ozonoff, 1996), or different disorders may simply have different executive profiles,(Pennington, 1997).

Universality, could again be considered a problem for both theories as there is always a group of people who pass both executive function and theory of mind tests, measurement issues could be considered partly responsible for this. However, recent research, Baron-Cohen (1997), Happé (1994), concerned with devising developmentally appropriate tasks is taking up this issue. Frith (1996) noted that we would not expect a single measure to highlight the difficulties, rather we would expect to see deficits in a battery of mentalising measures. Indeed the same reasoning is relevant for executive function, especially in light of its potential to fractionate.

Primacy, poses clear problems for a theory of mind account as deficits such as deficits in shared attention and orienting to social stimuli are apparent before mentalising ability is thought to develop. Whereas executive deficits have been reported at an early age,(McEvoy et al, 1993), although not consistently (Pennington, et al , 1997).

In addition to these criteria, parsimony is also an important criteria for any comprehensive account. When we consider the range of behaviours each theory can explain, executive function accounts may be more successful than the theory of mind accounts in terms of parsimony.

Reconciling the findings: the relationship between executive function and theory of mind.

Baron-Cohen & Swettenham (1997) suggest that one of the confounds in autism research is that many tests of theory of mind involve some attention shifting, and many tests of executive function involve taking into account one's own mental states such as plans and thoughts. A further difficulty arises from the number of different possible predications from executive function accounts, however, recently a more coherent account of executive dysfunction is emerging, (Pennington,1997). Operations such as working memory, (Benneto, Pennington & Rogers, 1996) cognitive set shifting, (McEvoy et al 1993) disengagement, (Hughes & Russell, 1993) and planning, (Pennington & Ozonoff,1996) are consistently demonstrated to be impaired in this group.

Baron- Cohen & Swettenham (1997) suggest that the theory-of-mind deficits in autism are not reducible to executive function. They suggest that executive function deficits in autism may co-occur with theory-of-mind deficits, because of their shared frontal origin in the brain. They review the research and propose that the executive function, central coherence and theory of mind are relatively independent of each other.

The finding from both areas of research are not irreconcilable, indeed there is a general agreement, that theory of mind skills and executive functions are both located in the prefrontal cortex, Happé et al (1996). There are a number of possible relationships between these two deficits; a) the deficit in executive function is primary to or responsible for the secondary deficit in theory of mind, b) the deficit in theory of mind is primary and responsible for the secondary deficits in executive function, c) the deficits co occur together or, d) a third deficit is responsible for the deficits seen in each domain.

1.5.1 Aims of the Present Study

Most research has focused on younger autistic children. Cognitive theories such as theory of mind and executive dysfunction have both had some success in explaining these deficits and predicting behaviour in this group. However, little research has been undertaken which systematically looks at how executive function and theory of mind deficits are related to the cognitive and behavioural symptoms of autism, in older children and adolescents.

Moreover, these older children and adolescents experience severe difficulties in socialisation and these problems often cause the most considerable distress to those with diagnosis of Asperger's. Wing (1991) notes that these social deficits have "a particularly profound effect upon the development of the child as a whole person and upon his or her chances of becoming an independent adult, able to work, marry and raise a family". This group can often do well on, standard assessments and have language and IQ within the normal range, they typically pass second order theory of mind tasks (e.g. Dahlgren & Trilingsgaard, 1996). However, despite their skills they still have profound difficulties socially.

This study explores the deficits in these more able older children and see how well the two theories were able to explain some of their social difficulties. An estimate of social difficulties was gained by using a structured a social problem solving task, aimed to resemble real life situations, 'Predicaments'. Klin et al (1992) who found very early emerging social deficits in autism, suggested that cognitive models should investigate the development of social difficulties in real life situations in order to attune these models. The social problem solving task used here has been shown to discriminate patients with frontal

damage, and resultant executive dysfunction, from controls (Channon & Crawford 1999). The social problem solving task attempts to deconstruct, some of the aspects, of what may constitute responding to a social predicament. It is designed to consider areas such the generation of ideas, and the various components of ideas, for example, social appropriateness and effectiveness. The objective in this instance is to consider how patterns of cognitive impairment on executive function tasks might be related to deficits on theory of mind tasks, and how these are both related to the more behavioural symptoms of autism as demonstrated by the social problem solving task

1.6.1 Hypothesis'

Hypothesis 1: The Asperger's group will be impaired relative to controls on the social problem solving task.

Hypothesis 2 : If the Asperger's group have executive function deficits they will be significantly impaired relative to controls on the executive function tasks. If the Asperger's group have theory of mind deficits they will be significantly impaired relative to controls on the theory of mind tasks.

Hypothesis 3: If there is a relationship between theory of mind and executive function there would be some correlations between these measures.

Hypothesis 4 : We would expect to see both theory of mind and executive function deficits in Predicaments. Theory of mind deficits will be demonstrated by impairment on the aspects of Predicaments which involve mentalising, in this instance social appropriateness. Executive function deficits will be demonstrated by impairment on measures of social appropriateness, in addition to, other aspects of social problem solving such as generation of ideas and effectiveness.

2.Method

2.1.1Participants

Twenty five individuals with Asperger's syndrome were originally identified through a tertiary level child development centre. The potential participants were contacted via post. Eighteen people agreed to be involved in the study. Three people were excluded from the final analysis, one person was unable to complete the battery and a further two were found to have severely impaired language scores. Fifteen people were included in the final analysis. The group were aged between 11-19. The participants had all received a diagnosis of Asperger's from this service. Diagnosis is based on developmental interviews with parents and direct observations of the child's behaviour in the clinic and school settings and based on DSM-IV criteria (see introduction). All participants had no additional psychiatric history. Fifteen control subjects were recruited from local youth agencies, in inner city London. The groups were matched on gender and balanced for IQ, as assessed by the Ravens matrices, and language ability as measured by the Clinical Evaluation of Language Fundamentals - Revised, (CELF).

Table of sample characteristics

	Asperger's	controls
Age : mean (SD)	13.9 (2.1)	14.4 (2.0.)
Gender (male /Female)	13M 2F	13M 2F
Age Equivalent IQscore : mean (SD)	13.6 (2.3)	12.4 (2.37)
Language age equivalent score mean (SD)	11.5 (2.80.)	11.4 (2.0.)

2.1.2 Procedure

The subjects were given the assessment battery in two sessions with a break in between. The time taken for assessment ranged between 3 and 4 hours. Order of presentation was counterbalanced. Parents were asked to complete a consent form and a behaviour questionnaire.

2.1.3 Design

A between group design was used to investigate differences between a group of Asperger's participants and group of matched controls, on measures of theory of mind, executive function and social problem solving.

2.2. Measures

The Ravens matrices (Ravens, Court, & Ravens, 1996) and the CELF (Klein, et al , 1994) were used as matching tools. A range of the most advanced measures of theory of mind tasks, and a broad range of executive function measures were chosen to assess the participants.

Each participant was asked to complete the Raven's Standard Progressive matrices, sets A, B, C, & D and the 4 of the 6 subtests of the CELF. These two assessments enabled us to balance the groups on measures of IQ and language skill.

Each participant was given a range of theory of mind tasks, the Eyes task, Baron-Cohen (unpublished), the Dewey stories, Dewey (1991) and the 1998 version of the Happé stories (unpublished).

Each participant was also given a series of executive function measures, the Rule Shift Cards, Six Elements and Key Search from the BADS battery, Wilson, Burgess, Emslie &

Evans (1996). Poisoned foods based on Arenberg (1968) and Trail-making Reitan (1958). Each participant was also given the Predicaments assessment, Channon (1999). Parents were asked to complete the Dysexecutive syndrome questionnaire (DEX), Wilson, Burgess, Emslie & Evans (1996).

2.2.1 The Raven's Standard Progressive Matrices.

Purpose.

Raven reports the matrices were designed to measure what is termed as the eductive component of cognitive ability. This eductive component is described as the ability to forge new insights, the ability to perceive and the ability to identify relationships. The essential feature of eductive ability is the ability to generate new, largely non verbal, concepts which make it possible to think clearly. Lezac (1996) described the RPM as a series of visual pattern matching and analogy problems pictured in nonrepresentational designs which has correlated consistently well as a measure of general ability with a range of other ability measures.

Items.

The scale consists of five sets, A, B, C, D, E each consisting of twelve problems. In this study set E was not included as this last set is more complex, and as such is the most time consuming part of the matrices.

Description.

In each set the first problem is relatively simple, the problems that follow become progressively harder, building on the same principle as the first. The subject is asked to pick out the missing piece of a pattern out of 6-8 choices.

Scoring.

The response is marked correct or incorrect. Responses are then simply added together to form a total score, this can be compared to normative data to give a non verbal IQ estimate which is scaled for age, up to 15.5 years.

The expected score composition presented in the manual allows one to estimate score for set E to give an estimated total score.

2.2.2 Clinical Evaluation of Language Fundamentals - Revised

Purpose.

This is a test of receptive and expressive language skills, standardised on an American population ranging in age from 5 years 0 months to 16 years 11 months. The test has been modified for use in Britain.

Items

The test comprises six subtests, three focus on expressive language and three focus on receptive language. For the purpose of this assessment we chose two subtests from expressive language, formulated sentences and sentence assembly and two from receptive language oral directions and semantic relationships.

Description

Subtest 1: Formulated Sentences. The aim of this subtest is to assess the ability to formulate compound and complex sentences. The participant is asked to make sentences using one or two words given by the administrator. They are also shown a picture each time which they can use, if they wish, to help formulate the sentence. The sentences are recorded verbatim and scored on a scale of 0-3 according to the syntactic and semantic

correctness.

Subtest 2: Sentence Assembly. The aim of this subtest is to assess the ability to assemble syntactic structures into grammatically and semantically acceptable sentences. The participant is given groups of words to put together to make a sentence. The participant is then required to give a second sentence using the same words. For each group of words there are between 2-6 sentences which can be made. The participant must give two correct sentences to score a correct response.

Subtest 3: Oral Directions. The aim of this subtest is to evaluate the ability to interpret, recall and execute oral commands of increasing length and complexity. The participant here is asked to point to shapes in various positions, using various descriptions of the comparative size and position of the shape, in the order the administrator requests. The participant must complete each direction without any errors to score correct on each item.

Subtest 4: Semantic Relationships. The aim of this subtest is to assess the ability to interpret different semantic relationships in sentences. The participant is asked to choose two correct solutions from four possibilities. The semantic relationships are divided into comparative relationships, spatial relationships, passive relationships and temporal relationships. Again the participant has to give the two correct answers to score correct.

Scoring

The four subtests are scaled according to age and then prorated to give an estimated total score which yields an age equivalent, up to age 16.

2.3 Executive Function Measures

2.3.1 Behavioural Assessment of Dysexecutive Syndrome (BADS)

Purpose

This assessment aims to measure Dysexecutive syndrome previously described as frontal lobe syndrome. It is designed to pick up the characteristic deficits within this syndrome. The battery has six test components and a questionnaire. In this study we have chosen three items from the battery and the questionnaire.

Items

The three items used in this study are Rule Shift Cards Test, Key Search Test and Modified Six Elements. The questionnaire will be discussed later.

Description

The Rule Shift Card Test examines the participant's ability to respond correctly to a rule and to shift from one rule to another. In the first part of this test the participant is asked to look at a set of 21 pictures of playing cards and respond 'Yes' to a red card and 'No' to a black card. Time taken and the number of errors are recorded. In the second part of the assessment the participant is asked to respond to a different rule, participants are asked to respond 'Yes' if the card that has been just turned over is the same colour as the previously turned card and 'No' if it is a different colour. In both conditions the rule is placed in front of the subject in large print. The test is designed to measure the ability to shift from one rule to another and to keep track of the colour of the previous card and the current rule.

The Key Search Test requires the participant to imagine that they have lost their keys in a field which is represented by a square on a piece of paper. They are then asked to draw a

line, starting from a black dot outside the square, to demonstrate where they would search the field to be certain that they would find their keys no matter where they were.

This task is designed to examine the participant's ability to plan an effective and efficient course of action. The tester can also look at the participant's ability to monitor their own performance. The scoring of the strategy used relates to the efficacy of the search.

Modified Six Elements Test This is a simplified version of the original Shallice and Burgess (1991) test. It involves the participant being given instructions to follow. There are three tasks, dictation, arithmetic and picture naming. Each task is divided into parts A and B. Thus there are six separate tasks in total. The participant is required to attempt something from each of the six tasks within 10 minutes. The participant is told that there is a rule, that is that they are not able to do two parts of the same task consecutively. This assessment is described as making demands on an individual's ability to plan, organise and monitor behaviour.

Scoring.

In each task the score is scaled to yield a profile score of between 0-4. In the Rule Shift Cards assessment, the number of errors in task two is measured. In the Key Search assessment the task is broken down into its strategic components and the participant is awarded marks for efficacy each component, for example using a predetermined pattern, where the search finishes, likelihood of finding the keys and attempting to cover all ground. In the Six Elements task the marker records how many of the tasks were attempted and how many times rules were broken. A mark is deducted if the participant spends more than 271 seconds on one task.

2.3.2 Poisoned foods.

Purpose

This is a deductive reasoning task first designed by Arenberg (1968).

Items

In this study we initially gave the participants two sample problems followed by twelve different sets of meals (3-5), each meal containing four foods.

Description

In the original study the task was to decide which of nine foods had been poisoned, this has been replicated in the present study. The participant was given a set of meals that people had eaten and information on whether they had lived or died. If the person lived then poisoned food could not have been included in the meal and if they died one of the foods they had eaten was poisoned.

Scoring

The participants response and response time was recorded.

2.3.3 Trail-making

Purpose

The original test was standardized on 200 subjects with past or present brain damage and 80 controls. It is designed to measure how well the participant can switch from one set to another.

Items

In this assessment the participant is asked to first follow a trail of numbers (0-25) with a pencil and secondly follow a trail of numbers and letters, alternating between each so, 1, A, 2, B continuing up to 13.

Description.

The two tasks are preceded by a short practice trail with 8 items. The participants are instructed to complete the task as quickly and as accurately as they can. Errors are pointed out to the participant who must then correct them and continue. The two conditions are matched on number of items, but in the second task the participant has to alternate between letters and numbers.

Scoring

Completion time is recorded for each task. The Time taken on task A can be divided by taken on task B to estimate how efficiently the participant can alternate from letters to numbers.

2.4 Theory of Mind and Social Cognition Measures

2.4.1 Happé Strange Stories

Purpose

The Happé stories are seen as a theory of mind measure. Happé (1994) suggests the ability to mentalise is not only useful for predicting how a person will behave or what a person thinks, but also for understanding what a person does. The Happé stories were designed to measure how well autistic people are able to understand the intentions behind the communications people make. The stories are designed to be unambiguous so that only one interpretation would be made by normal and non-autistic learning disabled participants.

Items

In this study we used a more recent unpublished version of the Happé 1994 strange stories. In the new version of the stories there are eight theory of mind stories based on her original 1994 strange stories and eight physical control stories.

Description

In the eight theory of mind stories the participant can only make sense of the story by implicating a motive to the persons behaviour or communication. In the eight physical control stories matched for difficulty, one can only make sense of the story by implicating a practical reason for the behaviour or communication. The participant is asked to read the story and is then asked to explain the why the person said or did something in the story.

Scoring

a) complexity

The response is given two marks for a correct answer, one mark for a reasonable or possible answer, and nil if they fail to understand the general principle involved in the story.

b) mentalising

Each of the theory of mind responses is then also rated according to mentalising criteria. The number of responses which fall into the 5 following categories were noted : no mentalising , inappropriate mentalising , 1st order mental state, 2nd order mental state and 3rd order mental state. A total mentalising score was calculated by awarding the following : 3rd order mental state = 3 , 2nd order mental state = 2, 1st order mental state = 1, none or inappropriate mentalising = 0.

Sensitivity

Using the original stories Happé found that the autistic group in her sample gave as many mental state answers as controls but that they were inappropriate to the story contexts. She found that autistic subjects who had passed second order theory of mind tasks gave between 17 to 21 correct answers and normal controls 22 to 24 out of a maximum of 24.

Example of a theory of mind story

A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn't know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, "Hey, you! Stop!", the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop. Q : Why did the burglar do that ?

Example of a physical control story

A burglar is about to break into a jewellery shop. He skillfully picks the lock on the shop door. Carefully he crawls under the electronic detector beam. If he breaks the beam it will set off the alarm. Quietly he opens the door of the store-room and sees the jewels glittering. As he reaches out, however, he steps on something soft. He hears a screech and something small and furry runs out past him, towards the shop door. Immediately the alarm sounds. Q : Why did the alarm go off ?

2.4.2 Eyes Task

Purpose

The task is designed to be a 'pure' measure of theory mind as it is thought to involve no executive function component and no central coherence component.

Items

There are 28 photographs of male and female eyes.

Description

In this the participant is shown a section of a face, so that just the eyes are visible. They are then read four words (which are also written next to the eyes), and asked to pick the word which best describes what the person is thinking or feeling.

Scoring

The response is awarded 1 if correct and 0 if incorrect.

Sensitivity

Baron-Cohen (1997) used a different version of the task with adults with either Asperger's syndrome or high functioning autism. He found that this group was significantly impaired relative to age matched normal controls and a clinical control group with a diagnosis of Tourette's syndrome. In this assessment we used a later version of this task, there are no published data of this test to date.

2.4.3. Dewey stories

Purpose

Dewey (1991). Described the stories she devised as, "an informal test of social know-how and its uses" p184. Ellis et al (1994) describe it as a measure of social judgment.

Description

The task is to read eight brief stories which have parts in italics. The reader has to rate the behavior after the italics on a scale A-D as they think most people would judge it if they witnessed it. A, is fairly normal behaviour in that situation; B, is rather strange behaviour in that situation; C, is very eccentric behaviour in that situation; D, is shocking behaviour in that situation.

Example

The behaviour the participant is asked to rate is shown in italics and the modal response in brackets. Keith, age 25, was a clerk who worked in an office in the city. At noon he took his lunch to a small park and sat on a sunny bench to eat. *Often he tore part of a sandwich into bits, scattering it on the ground for pigeons (A)*. One day when he came to his favorite bench a pram was parked beside it. Keith noticed that a young woman was pushing an older child on a nearby swing. The baby in the pram began to cry but the mother did not hear this because the swing was squeaking. Now, Keith had learnt that when his baby nephew screamed, sometimes this meant that a pin in his nappy had opened. *Rather than bother the mother in the park, Keith quickly checked the baby's clothing to see whether he could feel an open pin (B/C)*.

Items

There are eight stories and the respondent is required to make 23 judgments over the eight stories.

Scoring

The scoring is based on Ellis et al (1994) who used 36 adolescents and young adults to generate a modal response. The scoring system they used will be replicated in this study. They gave an error score of one if the response deviated one category, two if it deviated

two categories, and three if it deviated three categories from the modal response.

Sensitivity

Dewey (1991) described the responses of her original sample of autistic young adults as being influenced by their own experience or by behavioural rules which they had learnt and applied rigidly. She found that their answers differed from person to person but were similar in that they failed to attach the typical significance to social interactions. Ellis et al (1994) found discrepancies in judgment in most of their Asperger's sample with a mean error score of 12.7.

2.5 Social problem solving measures

2.5.1 Predicaments

Purpose

In this battery we included a social and non-social set of predicaments. The social predicaments were shown on video tape and the non-social were read as stories. Each predicament was intended to assess the individuals ability to generate possible solutions and then select solutions which demonstrate appreciation of the pertinent aspects of the problem situations, and then solve them in a socially appropriate and effective manner. As the non social predicaments attempted to remove as far as possible the social element these were not rated for social appropriateness responses were judged for problem appreciation and effectiveness only. The situations included a range of social relationships such as family, friends and strangers in a variety of situations. A large number of situations was initially generated on the basis of interviews with a range of people of varying ages, ethnicity and social backgrounds. These were then developed into scenarios and filmed.

They were piloted on a range of healthy volunteers and a small set of brain injured patients with focal lesions in order to refine the measure and devise the scoring system. The final set consisted of eight videos and five stories. Order of video and story presentation was counterbalanced within groups. Participants were then asked either to watch or read each situation, and then to answer a series of questions (see below).

Items

Factual account of the problem situations

After each problem was presented, participants were asked to describe what happened in the situation. If they did not include all the main facts, they were asked to give further detail. If the answer was still incomplete the video/story was presented again and the question was repeated. Finally, if the answer remained incomplete the experimenter verbally summarised the details which had been omitted. Thus a maximum of three prompts was used to ensure that the participants were aware of the factual details of the predicament.

Solution generation

For each problem solution fluency was assessed by asking participants to generate as many potential solutions as possible within 2 minutes. Participants were not given any prompts for further information or clarification of their responses to ensure that no cues were provided as to the adequacy or otherwise of their solutions.

Selection of Optimal and Personal solutions

After generating possible solutions participants were asked to select the best solution from the perspective of the main character in the predicament (Optimal solution). They were then asked to state what they would do if they found themselves in that situation (Personal solution), in order to examine to whether they chose a different type of action from what they considered to be optimal for the main character.

Judgment of alternative solutions

After participants had completed the set of eight video predicaments they were assessed on their judgment of alternative solutions (there was no equivalent for the non social situations). Participants were given a set of five suggestions for what the main character could do in the predicament and asked to rank them from best to worst. The five alternative solutions for each situation were selected from pilot data collected at the beginning of the study.

Ratings of the predicaments and solutions

For each predicament participants were asked to rate the degree of awkwardness of the situation, both for the main character and for themselves if they were in that situation (0-100). After giving their optimal solution, they were asked to rate their degree of satisfaction with it (0-100%), and to rate how many people out of 100 would be satisfied

with their solution. They were then asked to rate their personal degree of satisfaction with their personal solution (0-100%).

2.5.2 Examples of Predicaments

An example of a Social Predicament, “Dogs”

This is the script to one of the social predicaments presented in video format. “Anne is in her office when Tony comes in. She asks how he is, he says he is all right, but tired. She agrees that he looks tired, and asks what is the matter. He has new neighbours which moved into the flat above his a couple of weeks ago. They are nice people, but they own dogs and keep them in the kitchen at night, which is directly above Tony’s bedroom. All night, and every night since they moved in, the dogs jump around and bark. He finds it impossible to get to sleep. He says he has had a word with the neighbours, and although they were very reasonable, they said they had nowhere else to put the dogs as it is a block of flats.”

An Example of a Non Social Predicament, “Game”

This is an example of a non social predicament presented as a story for participants to read. Michael notices an advertisement for a computer game he wants in a Sunday newspaper. Delivery is guaranteed within three weeks and he sends off the order from with a cheque for £35.99. Michael begins to get concerned as three weeks pass and he has not received the game; however he discovers he has not kept a copy of the order nor the advert. Five weeks after he sent off the order a package arrives from the company which

contains a doll. There is no delivery note or return address attached.

Scoring

The scoring system was developed by two judges who initially pooled all the pilot data collected during the development of the Predicaments test, and sorted into categories reflecting different types of solutions. These categories were then classified according to three criteria (see below) as to whether they were thought to show adequate appreciation of the problem (1 or 0), whether they were socially appropriate (1 or 0), and whether they provided effective practical means of resolving the problem (1 or 0). Detailed guidelines which described each category were then produced with examples of answers under each category. The responses in this study were rated by two blind raters. There was a 97.74% agreement on the social predicaments, and a 94.25% agreement on the non social predicaments. Discrepancies were judged by a third blind rater.

Problem Appreciation

This measure assessed whether or not the solution demonstrated adequate recognition of the interpersonal and practical aspects of the problem situation. In the example of “Dogs” (see above), the categories are summarised as follows:

- a) An attempt to negotiate a solution with the neighbours
- b) Make further complaints (e.g. go to landlord/council/police)
- c) Alter your own life (e.g. earplugs, move house)
- d) Extreme ideas (e.g. Kill the dogs)
- e) Irrelevant or incomplete responses (e.g. people shouldn't keep dogs in flats)

In this example categories a, b, and c would score 1 for appreciation and d and e 0 to indicate a poor appreciation of the pertinent issues.

Social appropriateness

These categories were also used to classify solutions as to whether the way of dealing with the predicament was socially appropriate. In the example shown above answers under a scored 1 point, answers under b were split according to the degree of social appropriateness (e.g. aggressive or threatening answers scored 0) and answers under c, d, and e, scored 0.

Effectiveness

The categories were also used to classify solutions according to whether or not the manner of dealing with the situation was likely to provide an effective practical means of resolving it. In the “dogs” example a, b, and c were split according to the degree of effectiveness some scoring 0 and some 1. Answers under d and e scored 0.

Solution quality

A solution quality score was also calculated by adding the three subscores (Problem Appreciation, Social Appropriateness and Effectiveness). The three subscores were not necessarily independent as demonstrated by the above scoring system.

Solution generation

To assess how efficiently people generated solutions, the number of solutions generated for each problem situation was added to create a total score (number of solutions). Each of these solutions was scored for quality using the three measures described above. The solution Quality scores were added and divided by the number of solutions to provide an average solution quality score, independent of the number of solutions generated.

Sensitivity

Channon & Crawford (1999) found significant differences between a group of patients with frontal lesions and controls.

2.6 DEX Questionnaire

Purpose

The DEX focuses on the difficulties that the person may experience in every day life.

Items

This questionnaire is given to an independent rater in this case the parent to complete, there are 20 items each rated 0 (never), 1 (occasionally), 2 (sometimes), 3 (fairly often) and 4 (very often).

Scoring

The DEX yields a total score and 3 factor scores, behaviour, cognition and emotion. The factors are not equally represented, so there are only three questions loading on to the emotion factor yielding a maximum of 12, five questions loading on to the cognition factor yielding a maximum of 20 and eight questions loading on to the behaviour factor yielding a maximum

3. Results

3.1 Description of Analysis of Data

The statistical package SPSS was used to analyse the data. In general, non parametric tests were used only when the data did not satisfy the assumptions underlying parametric tests.

A significance level of 5% was used throughout.

As skewness of distribution and outliers do not comply with the assumptions of normality and linearity underlying parametric tests the data were inspected for these. The degree of skewness was calculated for each variable, and compared against the standard error for skewness using the formula given by Tabachnick and Fidell (1983), to see whether it differed significantly from zero.

The standard error for skewness is

$$S_s = \sqrt{6/N} = S_s = \sqrt{6/15} = 0.632$$

where N is the number of cases. The probability of obtaining a skewness value of this size is

$$z = S - 0 / S_s$$

where S is the value for skewness. At the 1% level, a z value in excess of ± 2.58 would lead to a rejection of normality.

Entering this into the table

$$S = \pm 2.58 \times S_s = \pm 2.58 \times 0.632 = \pm 1.632$$

A criterion of ± 1.63 was therefore used for the present data as a cut off point for normality. Skewness was detected in Trail-making B, in three of the variables of the Predicaments assessment, in two variables of the Six Elements task, and two variables in the Happé stories. Thus non parametric tests were used to look at between group differences on these.

The data were also checked for outliers, using a standard score of ± 3.00 (or 3 standard deviations from the mean) as the cut-off point for continuous variables (Tabachnick & Fidell, 1983). Standardised scores were then calculated for each variable, to identify any which contained values which were outside these limits. None of the variables contained outliers.

Trail-making B was positively skewed and transformed logarithmically. Two of the variables on the predicaments were positively skewed and transformed using a squared transformation. Non parametric tests were applied to the remaining variables.

3.1.1 Dysexecutive Questionnaire

The DEX questionnaire was completed by parents who were asked to fill in a 20 item questionnaire where behaviour was rated 0-4. Two parents did not complete this, one parent in each group. The results are shown in Table 1.

Table 1 T-tests to look at the differences between Asperger's and controls on the DEX questionnaire.

	Asperger's mean	SD	Controls mean	SD	sig (2-tailed)
Total DEX	40.71	10.57	16.64	11.96	0.001*
DEX emotion	6.57	2.06	4.71	6.54	0.32
DEX cognition	8.71	3.17	3.21	2.48	0.001*
DEX behaviour	18.57	5.33	6.92	5.91	0.001*

* $p < 0.5$

Comparison of the groups showed that the Asperger's participants were rated as showing significantly more dysexecutive symptoms than the control group ($t=5.64$, $df=26$, $p=0.001$). When the DEX is divided into its component parts, it yields an emotion, behaviour and cognition score. There were no significant differences in terms of emotion ($t=1.01$, $df=26$, $p=0.32$). There were significant differences in terms of cognition ($t=5.11$, $df=26$, $p=0.000$) and behaviour ($t=5.47$, $df=26$, $p=0.001$). (NB the three factors are not equally represented, in terms of number of items in the questionnaire, see method).

3.1.2 Executive Function Measures

Mean scores, standard deviations and significance tests for the two groups are shown in Table 2. The mean scores are taken from the profile scores on the three subtests from the

BADS battery, some of the raw scores which make up the profile score are also considered independently. So in Rule shift cards the number of errors made was considered alongside the profile score (0-4). In the six elements the profile score (0-4) and the number of tasks attempted are considered. This is a one of the two component scores which make up the six elements profile score. In Key search the profile score only is considered, as in this subtest the raw score directly converts to the profile score. The poisoned foods was reported as number correct (0-12). Trail-making was reported as a proportionate score (B/A), time B measured in seconds, divided by time A measured in seconds to yield a single score

Table 2: T-tests to look at differences between Asperger's and controls on the executive battery

Set shifting tasks

	Asperger's mean	SD	Controls mean	SD	sig (2-tailed)
Rule Shift Cards					
Profile score	3.6	0.63	3.73	0.46	0.51
Error score	0.73	1.67	0.33	0.62	0.39
Trail-making	2.4	0.64	1.95	0.47	0.04*

Planning tasks

Six Elements					
Profile Score	2.93	0.96	3.53	0.64	0.054
No of tasks attempted	4.33	1.5	5.6	0.91	0.009*
Key Search					
Profile score	2.47	1.36	3.27	0.88	0.068

Deductive reasoning

Poisoned Foods	10.07	2.4	10.26	1.44	0.78
-----------------------	-------	-----	-------	------	------

* $p < 0.5$

T-tests were initially carried out for each of the neuropsychological tests except for the six elements; number of tasks attempted score where the Mann-Whitney was used as the data were shown to be skewed as discussed earlier (see Table 2). These showed Asperger's participants to be significantly poorer than the control participants on the Trail-making test ($t=2.20$, $df=28$, $p=0.04$), and the number of tasks attempted on the six elements test ($Z=2.60$, $p=0.009$); the profile scores on two of the three BADS subtests approached significance: the key search test ($t=1.92$, $df=24.08$, $p=0.068$) and the Six Elements test ($t=2.01$, $df=28$, $p=0.054$), the groups did not differ on the BADS Rule Shift test ($t=0.661$, $df=28$, $p=.514$) or poisoned foods ($t=0.028$, $df=28$, $p=.784$).

3.1.3 Theory of Mind and Social Cognition Measures

Mean scores, standard deviations and significance tests for the groups are reported in Table 3. There are four scores reported for the Happé stories; a total complexity score (0-

32) which comprises both theory of mind and physical stories. There are eight stories in each set, each story is scored 0-2. The theory of mind stories complexity score (0-16) and the physical control stories complexity score (0-16). Finally the total mentalising score is derived by rating each response on the theory of mind stories (0-3) according to whether they are mental state answers, if so whether of 1st, 2nd or 3rd order. The eyes task has 28 items scored either correct or incorrect and the Dewey stories yields an error score (maximum error score 52).

Table 3: T-tests to look at differences between Asperger's and controls on the theory of mind and social cognition battery

	Asperger's mean	SD	Controls mean	SD	sig (2-tailed)
Strange stories					
Theory of mind stories	10.27	3.01	13.33	1.95	0.003*
Physical control stories	10.87	3.29	12.4	1.99	0.14
Mentalising score	10.13	2.97	12.33	2.06	0.026*
Eyes task	17.8	4.21	19.93	3.41	0.14
Dewey stories	10.13	2.36	9.07	3.84	0.37

* $p < 0.5$

T-tests were carried out for each of the theory of mind tests (see table 3). The Asperger's group were impaired on the theory of mind stories ($t=3.31$, $df=23.99$, $p=0.003$) and the mentalising score on the theory of mind stories ($t=2.35$, $df=28$, $p=0.26$). There were no significant differences between the groups on the physical control stories. There were no

significant differences between the groups on the Eyes task or the Dewey stories.

The components of the mentalising score were explored further using the Mann-Whitney, which was used to look at the differences between the groups in terms on number of responses under each category type. The Asperger's group used significantly more 1st order mental state responses than controls, ($Z=-2.6$, $p=0.04$). The differences approached significance in terms of 2nd order mental state responses, where controls used more than the Asperger's group ($Z=-1.9$, $p=0.53$). There were no significant differences between the groups in terms of using 3rd order mental states and inappropriate mentalising

3.1.4 Predicaments

Factual account of the Social Predicaments

Mean scores, standard deviations and significance tests for the groups are reported in Table 4. Participants were asked to recount the Predicament, if all the relevant information was not given they were asked for more information, if this was not supplied, they were shown the scene again.

Table 4: T-tests to look at differences between Asperger's and controls on number of prompts used in recounting Predicaments.

Social Predicaments

	Asperger's mean	SD	Controls mean	SD	sig .(2-tailed)
Social Predicaments					
No of prompts	1.25	0.64	0.53	0.36	0.001*
No of times final prompt used	0.11	0.17	0.03	0.07	0.13

Non Social Predicaments					
No of prompts	0.4	0.39	0.13	0.18	0.024*
No of times final prompt used	0		0		

* $p < 0.5$

A t-test was initially carried out for total number of prompts needed (0-3) to give an adequate response in recounting the actual details of the situations. In the social Predicaments comparison of the two groups showed that the Asperger's group needed significantly more prompting than controls ($t=3.74$, $df=28$, $p=0.001$). However there were no significant differences between the groups on use of the third prompt. The Mann-Whitney test was used here as the data was skewed, see earlier ($Z=1.52$, $p=0.128$). The fact that there is no significant difference on the third prompt is important as this is where the participant is told the relevant information. Thus they asked for more repetition, but were eventually able to recount the information, without needing it to be explained.

In the non social predicaments there was a significant difference between the groups, the Asperger's group needing significantly more prompts than controls ($t=2.39$, $df=19.63$,

p=0.027). Again there were no differences between the groups on the number of times the third prompt was used as it was not used at all in Non Social Predicaments.

Solution generation

Mean scores, standard deviations and significance tests for the groups are reported in Table 5.

Table 5: T-tests to look at differences between Asperger’s and controls on the solutions generated in Social Predicaments and Non social predicaments

	Asperger’s mean	SD	Controls mean	SD	sig (2-tailed)
Social Predicaments					
Average no of solutions generated	2.84	0.82	3.33	0.74	0.10
Average Problem Appreciation	0.68	0.09	0.75	0.10	0.056
Average Social Appropriateness	0.37	0.06	0.43	0.01	0.03*
Average Effectiveness	0.40	0.13	0.47	0.15	0.18

Non Social Predicaments					
Average no of solutions generated	2.63	0.82	3.48	0.68	0.005*
Average Problem Appreciation	0.66	0.17	0.69	0.12	0.49
Average Effectiveness	0.41	0.12	0.43	0.09	0.54

* p= <0.5

Before selecting their best Optimal and Personal solutions, participants had to generate as many solutions possible to each situation. The Fluency of solution generation was assessed by counting the total number of solutions which were generated across all problem situations, regardless of their quality as participants were not specifically asked for good solutions at this stage. There were no significant differences between the two groups, see Table 5.

The quality of the solutions generated was examined by rating the solutions for Problem Appreciation, Social Appropriateness and Effectiveness. These were added separately for each solution to yield an average score under each of the variables. When we look at the three components of solution quality the groups differ significantly on the Social appropriateness rating ($t=2.28$, $df=22.65$, $p=0.03$) and approached significance on the Problem Appreciation measure, ($t=1.99$, $df=28$, $p=0.56$).

In Non Social Predicaments comparison of the two groups showed that in this condition participants with Asperger's generated significantly fewer solutions ($t=3.071$, $df=28$, $p=0.005$), but there were no significant differences in the solution quality measures, of Problem Appreciation and Effectiveness. The Social Appropriateness rating is not included in the Non Social Predicaments.

Selection of optimal and personal solutions

Mean scores, standard deviations and significance tests for the groups are reported in Table 6. For each predicament, participants were asked to select an optimal solution from the perspective of the main character then to give their personal solution. These solutions

were rated on Problem Appreciation, Social Appropriateness and Effectiveness. These measures were combined to yield Total Solution Quality score.

Table 6 : Means, standards deviations and significance levels for the effect of group and perspective on optimal and personal solutions.

Social predicaments

	Asperger's mean	SD	controls mean	SD	sig (2-tailed) perspective	sig (2-tailed) group
Problem Appreciation						0.21
Optimal solution	5.8	1.15	6.27	1.33		
Personal solution	5.86	1.18	6.4	0.82	0.63	
Social Appropriateness						0.03*
Optimal solution	3.47	1.13	4.73	1.28		
Personal solution	3.4	1.18	4.4	1.12	0.85	
Effectiveness						0.18
Optimal solution	3.86	1.36	4.67	1.50		
Personal solution	3.8	1.37	4.67	1.23	0.57	

Non Social Predicaments

Problem Appreciation						0.93
Optimal solution	4.07	1.03	4.26	1.09		
Personal solution	4.06	1.03	3.93	1.10.	0.085	
Effectiveness						0.38
Optimal solution	3.27	0.70	3.27	1.22		
Personal solution	3.3	0.82	3.00	1.07	0.58	

* p= <0.5

Optimal and Personal Total Solution Quality scores were compared using ANOVA for the two groups. There was a significant effect of group ($F=5.45$, $df=1,28$, $p=0.027$), there was no significant effect of perspective ($F=0.09$, $df=1,28$, $p=0.77$) or group by perspective interaction ($F=0.02$, $df=1,28$, $p=0.088$).

The two groups were then compared on the three submeasures, Problem Appreciation, Social Appropriateness and Effectiveness. As scores of 0 on Problem Appreciation would also then automatically score 0 on both Social Appropriateness and Effectiveness, the latter two measures were analysed in the ANOVA as a proportion of the Problem Appreciation score. This has the advantage of allowing for difficulties in Problem Appreciation, and checking independently the Social Appropriateness and Effectiveness of solutions when the participant has shown an appreciation of the predicament. The ANOVA had one between group factor (group) and one within groups factor (type of perspective optimal or personal). In social Predicaments the analysis of Problem Appreciation demonstrated no significant effect of group ($F=1.68$, $df=1,28$, $p=0.21$) or perspective ($F=0.41$, $df=1,28$, $p=0.63$) or group by perspective interaction ($F=0.05$, $df=1,28$, $p=0.83$). For Social Appropriateness the ANOVA showed a main effect of group, ($F= 5.78$, $df=1,28$, $p=0.023$) there was no significant effect of perspective ($F=3.19$, $df=1,28$, $p=0.85$) or group by perspective interaction ($F=1.09$, $df=1,28$, $p=0.31$). There were no significant differences between the groups in terms of effectiveness($F=1.93$, $df=1,28$, $p= 0.18$). There was also no significant effect of perspective ($F=0.33,df=1,28$, $p=0.57$) or group by perspective interaction ($F=0.11$, $df=1,28$, $p=0.74$).

In the non social Predicaments, again Optimal and Personal quality scores were compared using ANOVA. There was no significant effect of group, ($F=0.04$, $df=1,28$, $p=0.84$), there was no significant effect of perspective ($F=2.25$, $df=1,28$, $p=0.15$) or of group by

perspective interaction ($F=3.52$, $df=1,28$, $p=0.07$).

As before scores of 0 on Problem Appreciation also then would automatically score 0 on Effectiveness so this was calculated as a proportion of the Problem Appreciation score. Scores on Problem Appreciation were compared using ANOVA and showed no significant effect of group ($F=0.93$, $df=1,28$, $p=0.93$), no significant effect of perspective ($F=3.18$, $df=1,28$, $p=0.085$), and no significant group by perspective interaction ($F=3.18$, $df=1,28$, $p=0.085$). Scores on Effectiveness were then compared on ANOVA and there was no significant effect of group ($F=0.80$, $df=1,28$, $p=0.38$), no significant effect of perspective ($F=0.32$, $df=1,28$, $p=0.58$) and no significant group by perspective interaction ($F=0.16$, $df=1,28$, $p=0.67$).

Judgment of alternative solutions

Mean scores, standard deviations and significance tests for the groups are reported in Table 7. Judgment of alternatives involved ranking five solutions for each of the non social Predicaments. The maximum score for each predicament is 20, there are eight predicaments yielding a maximum score of 160.

Table 7: T-tests to look at differences between Asperger's and controls on rating alternative solutions

	Asperger's mean	SD	Controls mean	SD	sig (2-tailed)
Alternatives	110.67	14.01	120.53	16.12	0.08

In order to examine whether participants showed any difficulties in judging the adequacy of solutions when they were not required to generate them, participants were asked to rank 5 alternative solutions for each problem situation. A T-test comparison of the groups on this measure showed no significant differences between the groups ($t=1.79$, $df=28$, $p=0.84$) see Table 7.

Ratings of predicaments and problem solutions

Mean scores, standard deviations and significance tests for the groups are reported in Table 8. The groups were asked to rate the awkwardness of the predicament for the character and then for themselves. Participants were also asked to rate their satisfaction with the Optimal solution chosen and their Personal solution.

Table 8 :T-tests to look at ratings of awkwardness of predicaments and satisfaction with solutions

	Asperger's mean	SD	Controls mean	SD	sig (2-tailed)
Social Predicaments					
Awkwardness					
<i>For the Character</i>	72.78%	17.05	74.09%	11.27	0.80
<i>For self</i>	73%	19.51	70%	11.40	0.64
Satisfaction with solution					
<i>Optimal</i>	78.51	10.38	79.98	10.74	0.70
<i>Personal</i>	80.67	10.48	82.67	11.68	0.62

Non Social Predicaments					
Awkwardness					
<i>For the character</i>	81.0	14.72	79.07	21.16	0.77
<i>For self</i>	83.2	16.10	79.43	18.97	0.56
Satisfaction					
<i>Optimal</i>	75.6	13.42	82.87	16.96	0.20
<i>Personal</i>	77.85	13.29	81.49	17.83	0.53

The groups were also compared in the percentage ratings given for the situations. T-test comparison of ratings of the degree of awkwardness of the situation showed no significant differences between the groups when rating the awkwardness for the character ($p=0.80$) and when rating the awkwardness for themselves ($p=0.64$).

For each problem situation participants were also asked to rate their own percentage satisfaction with their Optimal and Personal solutions again there were no significant differences between the groups ($p=0.70$) and ($p=0.62$) respectively.

3.1.5 Correlation's Between Predicaments Measures

Pearson product moment correlation's were calculated for those Predicaments measures which significantly differentiated the groups (using a 5% significance level). These variables were Average Solution Quality (see Table 9) and Total Solution Quality (see Table 10). It is noted that when we looked at these composite measures, it was the Social Appropriateness measure which differentiated the groups, there are no significant differences in the data when considered by either measure. As described earlier Average

Solution Quality is the category derived from the item which comes before participants are asked to select their best Optimal and Personal solutions, and had to generate as many solutions possible to each situation. The Total Solution Quality is the combined solution quality score for both Optimal and Personal solutions.

Table 9: Correlations between average solution quality and other predicaments measures for Asperger's and controls

	Asperger's correlation r	sig (2-tailed)	Controls Correlation r	sig (2-tailed)
No of solutions generated	0.05	0.86	-0.35	0.2
Average Appreciation	0.83	0.001*	0.089	0.001*
Average Appropriateness	0.62	0.01*	0.79	0.001*
Average Effectiveness	0.82	0.001*	0.96	0.001*
Quality of Optimal Solution	0.36	0.18	0.65	0.008*
Quality of Personal solution	0.56	0.03*	0.52	0.046*
Total Quality	0.51	0.053	0.64	0.01*
Alternatives Score	0.09	0.76	0.41	0.13

* $p < 0.5$

There was no relationship between the average solution quality and the number of ideas generated for either the Asperger's group ($r=.05$) or the control group ($r=-.35$). However there were significant correlations in both groups between the Average Solution Quality and the Average Problem Appreciation for the Asperger's group ($r=.83$) and controls ($r=0.89$); Average Social Appropriateness for the Asperger's group ($r=.62$) and controls ($r=0.79$); and Average Effectiveness for the Asperger's group ($r=.82$) and controls

($r=.96$). This would be expected as these three subscores make up the Average Solution Quality. There was no significant correlation in the Asperger's group with the Average Solution Quality and the quality of their chosen Optimal Solution ($r=0.36$), whereas in controls there was a correlation ($r=.65$). There was a correlation between Average Solution Quality and the quality of the personal solution in both groups the Asperger's group ($r=.56$) and controls ($r=.52$).

Table 10: Correlations between total solution quality and other predicaments measures for Asperger's and controls

	Asperger's Correlation r	sig (2- tailed)	controls Correlation r	sig (2-tailed)
No of solutions	0.68	0.006*	0.08	0.79
Average solution quality	0.51	0.053	0.64	0.01*
Average problem Appreciation	0.4	0.14	0.50	0.06
Average appropriateness	0.22	0.44	0.66	0.008*
Average effectiveness	0.48	0.71	0.55	0.03*
Total Appreciation	0.86	0.001*	0.94	0.001*
Total Appropriateness	0.66	0.008*	0.88	0.001*
Total effectiveness	0.86	0.001*	0.9	0.001*
Alternatives score	0.36	0.19	0.74	0.001*

* $p < 0.5$

(NB the combined Optimal and Personal Solutions are reported as combined only scores here as there were no differences in significance when they were considered separately.)

Total Solution Quality was correlated with the number of ideas generated for the Asperger's group ($r=.68$) but not for controls ($r=.08$).

In the Asperger's group there were no significant correlations between Total Solution Quality and Average Problem Appreciation ($r=.4$), Average Social Appropriateness ($r=.21$) and Average Effectiveness ($r=.48$). However in controls there were significant correlations between Average Social Appropriateness ($r=.66$) and Average Effectiveness ($r=.55$). There were significant correlations between the combined Optimal and Personal dimensions of Appreciation ($r=.86$), Social Appropriateness ($r=.66$) and Effectiveness ($r=.86$) in the Asperger's group. The same was true of controls on Appreciation ($r=.94$), Social Appropriateness ($r=.88$) and Effectiveness ($r=.9$). There was a significant correlation between the Total Solution Quality and judgment on the Alternatives score for controls ($r=.74$) but not for the Asperger's group ($r=.36$).

Table 11: Correlations between number of solutions generated and other Non Social Predicaments measures in Asperger's and controls

	Asperger's Correlation r	sig (2-tailed)	Controls Correlation r	sig (2-tailed)
Average solution Quality	-0.38	0.16	-0.23	0.4
Total Solution Quality	0.08	0.79	-0.21	0.5

There were no significant correlations with number of solutions generated in either the Asperger's group when looking at the Average Solution Quality ($r=-.38$) and the Combined Solution Quality ($r=.08$) and the control group on Average Solution Quality

($r=-0.23$) and the Combined Solution Quality ($r=-.21$). There were no significant correlations when Appreciation and Effectiveness were looked at separately and when Optimal and Personal Solutions were looked at separately for either the Asperger's group or controls.

Correlations between the Social Predicaments and Non Social predicaments.

There was a correlation between the number of ideas generated in both the non social and social conditions for the Asperger's group ($r=.72$) and controls ($r=.63$). There was no correlation between the Average Solution Quality in the two conditions for the Asperger's group ($r=-.29$) and controls ($r=-.052$). There were also no significant correlations between the combined Optimal and Personal Quality solution score in the two conditions for the Asperger's group ($r=-.09$) and controls ($r=.3$).

3.1.6 Correlations Between Predicaments and Executive Function Measures

Pearson product moment correlations were calculated between the main Predicaments measures and the executive function measures. Correlations between the executive function measures which significantly differentiated the groups (using a 5% significance level), (Six Elements; number of tasks attempted, and Trail-making) and two which approached significance (Key Search profile score and the Six Elements profile score), are shown in Table 12. Pearson product moment correlations were also calculated between the main Non Social Predicaments measures which significantly differentiated the groups and the measures of executive function, above.

Table 12: Correlations between Predicaments and executive function measures for Asperger's and controls

	Six Elements Profile score Asperger r (sig)	controls r (sig)	Six Elements (no of tasks) Asperger's r (sig)	controls r (sig)
Social Predicaments				
Average Appropriateness	0.30(0.27)	0.38(0.16)	0.35(0.20)	0.07(0.80)
Average Quality	0.65 (0.009)*	0.38(0.16)	0.71 (0.003)*	0.28(0.31)
Total Appreciation	0.33(0.26)	0.31(0.27)	0.35(0.21)	0.38 (0.89)
Total Appropriateness	0.18(0.53)	0.15(0.60)	0.18 (0.53)	0.64 (0.82)
Total Effectiveness	0.36(0.19)	0.37(0.17)	0.40(0.14)	0.31(0.25)
Total Quality	0.37(1.74)	0.31(0.26)	0.40(0.15)	0.17(0.56)

Non social Predicaments				
No of solutions generated	0.34(0.21)	0.22(0.43)	0.45(0.09)	0.35(0.20)

Table 12 continued

	Key search profile score Asperger's r (sig)	controls r (sig)	Trails P Asperger's r (sig)	controls r (sig)
Social Predicaments				
Average Appropriateness	-0.01(0.97)	0.57(0.03)*	-0.17(0.54)	-0.18(0.53)
Average Quality	0.25(0.36)	0.58(0.02)*	-0.37(0.18)	0.76(0.79)
Total Appreciation	0.49(0.60)	0.56(0.03)*	-0.35(0.20)	0.53(0.04)
Total Appropriateness	0.05(0.86)	0.46(0.09)	-0.19(0.51)	0.25(0.37)
Total Effectiveness	0.69(0.004)*	0.54(0.04)*	0.27(0.34)	0.23(0.42)
Total Quality	0.55(0.04)*	0.58(0.03)*	-0.34(0.22)	0.36(0.19)
Non social Predicaments				
No of solutions generated	0.17(0.53)	0.20(0.46)	-0.19(0.50)	0.35(0.20)

* $p < 0.5$

There was a significant correlation between Key Search and Predicaments for the Asperger's group on the Effectiveness measure ($r=.69$, $p=0.004$) and on the total Quality measure ($r=.55$, $p=0.035$). In the control group there were also significant correlations between Key Search and Effectiveness ($r=.54$, $p=0.04$) and Total Quality Score ($r=.58$, $p=0.03$). In the control group there were also correlations between key search and Average Solution Quality ($r=.58$, $p=0.02$) and Problem Appreciation ($r=.56$, $p=0.03$). The other correlations in this group was for the Asperger's group between the Six Elements category (number of tasks attempted) and the Average Solution Quality ($r=0.71$, $p=0.003$) and Six Elements profile score and Average Solution Quality ($r=.65$, $p=0.01$).

3.1.7 Correlations with Predicaments and Theory Of Mind /Social Cognition

Assessments.

Pearson product moment correlations were calculated between the main Predicaments measures and the theory of mind and social cognition measures. Correlations between the theory of mind and social cognition measures which significantly differentiated the groups are shown in table13. These were both scores derived from the Happé strange stories and included the score on theory of mind stories and the mentalising score.

Table 13: Correlations between with theory of mind/social cognition assessments and Predicaments for Asperger's and controls.

	TOM stories Asperger's r (sig)	controls r (sig)	Mentalising Asperger's r (sig)	controls r (sig)
Social Predicaments				
Average Appropriateness	0.56(0.03)*	-0.03(0.90)	0.20(0.47)	0.33(0.24)
Average solution quality	0.49(0.07)	0.08(0.77)	0.12(0.66)	0.23(0.42)
Total Appreciation	-0.02(0.95)	0.10(0.72)	-0.06(0.83)	0.28(0.31)
Total Appropriateness	0.18(0.53)	0.12(0.67)	-0.14(0.63)	0.43(0.11)
Total Effectiveness	-0.021(0.46)	0.23(0.42)	-0.24(0.38)	0.55(0.04)*
Total Quality	-0.04(0.89)	0.17(0.55)	-0.19(0.50)	0.47(0.08)

Non social Predicaments				
Average no of solutions	0.26(0.36)	0.01(0.97)	0.10(0.72)	-0.13(0.64)

* p= <0.5

There was one significant relationships between the theory of mind tasks and the Predicaments responses for the Asperger's group, the complexity score on the theory of mind stories correlated significantly with average social appropriateness ($r=0.56$, $p=0.03$). Of the remaining tasks the Dewey stories correlated with Problem Appreciation in the Asperger's group ($r=-.51$, $p=0.05$).

3.1.8 Correlations Between Theory of Mind and Executive Function Measures

Pearson product moment correlations were calculated between the theory of measures which significantly differentiated the groups (5% level) and the neuropsychological measures which significantly differentiated the groups. Two measures which approached significance in the neuropsychological battery are also included, Key Search and Six Elements profile scores, see Table 14.

Table 14: Correlations between theory of mind and executive function measures

	TOM stories Asperger's r (sig)	controls r (sig)	Mentalising Asperger's r (sig)	controls r (sig)
Set shifting				
Trails p	-0.08(0.78)	0.15(0.59)	-0.21(0.42)	-0.09(0.75)
Planning				
Six Elements profile	0.031(0.91)	0.25(0.37)	0.23(0.41)	0.72(0.79)
Six Elements (no of tasks)	0.58(0.84)	0.32(0.24)	0.23(0.41)	0.15(0.59)
Key search profile	-0.09(0.76)	-0.14(0.62)	-0.18(0.53)	0.11(0.71)

3.1.9 Language

Whilst the groups were balanced for language, Pearson product moment correlations were calculated between, executive measures, theory of mind measures and Predicaments and measures of expressive and receptive language (CELF).

Correlations between language and executive function measures

Pearson product moment correlations were calculated between the main Predicaments measures and the executive function measures. Correlations between the executive function measures which significantly differentiated the groups, using a 5% significance level, (Six Elements, number of tasks attempted, and trail making) and two which approached significance (Key Search profile score and the Six Elements profile score), are shown in Table 15.

Table 15: Correlations between language and executive function measures

	Expressive language Asperger's r (sig)	Controls r (sig)	Receptive language Asperger's r (sig)	Controls r (sig)
Six elements (profile)	-0.05 (0.87)	0.66 (0.008)*	0.30. (0.28)	-0.12 (0.67)
Six Elements (no of tasks)	0.03 (0.92)	0.56 (0.03)*	0.34 (0.21)	-0.07 (0.81)
Key search (profile score)	0.72 (0.002)*	0.29 (0.29)	0.73 (0.002)*	0.47 (0.77)
Trails B/A	-0.65(0.009)*	-0.17 ((0.54)	-0.63 (0.01)*	0.15 (0.59)

* p= <0.5

Correlations between language and theory of mind measures

Pearson product moment correlations were calculated between language measures and the theory of mind measures. Correlations between the theory of mind measures which significantly differentiated the groups using 5% significance level are shown in Table 16. These were all scores derived from the Happé strange stories and included the total score the score on theory of mind only and the mentalising score.

Table 16 Correlations between language and theory of mind measures

	Expressive language Asperger's r (sig)	Controls r (sig)	Receptive language Asperger's r (sig)	Controls r (sig)
Strange stories				
Total	0.39 (0.54)	0.02 (0.94)	0.59 (0.02)*	-0.27 (0.33)
TOM stories	-0.06 (0.82)	0.11 (0.69)	0.19 (0.50.)	-0.29 (0.30)
Mentalising score	0.026 (0.92)	0.11 (0.69)	0.09 (0.76)	0.081 (0.77)

* $p < 0.5$

Correlations between language and predicaments measures

Pearson product moment correlations were calculated between language and the main Social and Non Social Predicaments measures which significantly differentiated the groups using 5% level are shown in Table 17. These were average solution quality and total solution quality for the predicaments. It is noted that some of the components of these

composite measures also differentiated the groups. As described earlier Average solution Quality is the category derived from the item which comes before participants are asked to select their best Optimal and Personal solutions, and had to generate as many solutions possible to each situation. The Total Solution Quality is the combined solution quality score for both Optimal and Personal solutions. For the Non Social Predicaments the measure that significantly differentiated the groups using 5% level was the number of solutions generated.

Table 17 Correlations between language and Predicaments measures

	Expressive language Asperger's r (sig)	Controls r (sig)	Receptive language Asperger's r (sig)	Controls r (sig)
Social predicaments				
Average solution Quality	0.036 (0.90)	0.54 (0.03)*	0.28 (0.32)	0.74(0.001)*
Total solution Quality	0.51 (0.052)	0.29 (0.30)	0.71 (0.003)*	0.50 (0.055)

Non social				
No of solutions	0.39 (0.15)	-0.22 (0.44)	0.55 (0.032)	-0.43 (0.10)

4 Discussion

4.1 Main findings

4.1.1 Predicaments

The initial hypothesis was supported, the Asperger's group were significantly impaired compared to controls on some measures of the social problem solving task.

There were no significant differences between the groups on the first measure, where the participant was asked to generate as many solutions to the predicament as they can within a certain time limit. This is not consistent with the results for adults with frontal damage, who were significantly impaired relative to controls on this solution generation, Channon & Crawford (1999). There were, however, significant differences in the quality of the solutions generated, with the Asperger's group generating ideas of poorer quality. The quality measure was made up of problem appreciation, social appropriateness and effectiveness. When the average of these three measures was considered the Asperger's group were significantly impaired relative to controls on the social appropriateness measure. The differences in the groups approached significance on the problem appreciation measure, but there were no significant differences on the measure of effectiveness.

The second part of the Predicaments task was to choose an optimal and personal solution, these are considered as combined measures here. The justification for combining them is that they are both solutions which the participant has selected as good solutions to the predicament. Moreover, the findings were mirrored in both optimal and personal choices.

So there was a significant difference in the overall quality of these solutions again with the Asperger's group selecting poorer quality solutions. This is consistent with the impairments in adult patients with frontal damage (Channon & Crawford, 1999). There were significant differences between the groups, again, on the social appropriateness measure, and no significant differences on problem appreciation or effectiveness. Channon & Crawford (1999) found that frontal patients were impaired on measures of social appropriateness and effectiveness. Finally when participants were required to order solutions from best to worst, on the Judgment of Alternatives task, there were no significant group differences.

The Non Social Predicaments task, found the Asperger's group to be significantly poorer than controls in the generation of solutions. However, there were no significant differences in the quality of the solutions. The solution quality in this task was comprised of problem appreciation and effectiveness only.

4.1.2 Executive Function Measures

The Executive function hypothesis was partially supported by performance on the neuropsychological battery. The Asperger's group were significantly impaired on some of the measures of executive function. This is consistent with previous research, (Pennington & Ozonoff, 1996) where impairments in executive function measures have been found. As regards set shifting, the Asperger's group were significantly impaired relative to controls on the Trail-making test. Minshew et al (1992) assessed 15 high functioning autistic participants, aged between 15 and 40 and did not find any significant differences in performance between the groups on time B in the Trail-making task. There

were no significant differences between the groups on the other measure of set shifting, the Rule Shift Card test. There seemed to be a ceiling effect on this task as very few participants or controls made any errors. As regards planning, the differences approached significance on the Six Elements test. The score for this is comprised of the number of times a rule is broken and the number of tasks attempted. The rule relates to the order in which the tasks must be completed. The total number of tasks is six and the participants are explicitly instructed that they should try to do something from each of the six tasks. So, while there were no significant differences between the groups on the number of times the rules were broken, the Asperger's group attempted significantly fewer tasks than controls. The differences between groups approached significance on the Key Search test. Neither of these tests has been used before with this group.

There were no significant differences between groups on the poisoned food test, a measure of deductive reasoning. Other research has shown that high functioning participants may not necessarily be impaired on all measures of executive function. Minschew (1992) found no significant differences between high functioning adolescents and adults with autism and controls on the WCST, but did find differences in the Goldstein-Scheerer object sorting task.

4.1.3 Theory of Mind Measures

The theory of mind hypothesis was partially supported by performance on the theory of mind and social cognition measures. The Asperger's group were impaired relative to controls on the Strange Stories. This yields two theory of mind measures and a control measure. The Asperger's group were impaired relative to controls on the theory of mind

stories, complexity measure, which is concerned with the quality of the explanation. The Asperger's group scored significantly less than controls on the mentalising component of the theory of mind stories. This measures number and sophistication of the references to mental states in the responses. There were no significant differences between the groups on the physical control stories, as would be predicted by a mentalising hypothesis. These results are consistent with Happé (1994) who compared the performance of 18 autistic subjects to controls. It is important to note here, that the stories used in this study have been recently modified by Happé and there are no published data for these. In her original study Happé used 12 theory of mind stories yielding a maximum score of 24, whereas our study used 8 stories yielding a maximum score of 16. In the Happé (1994) study the autistic participants, mean age 20.6, scored on average 15.7 (range 9-21) whilst controls, mean age 8.6 scored on average 21 (range 11-24) on the theory of mind stories. She found no differences in the physical control stories, but concluded that the stories were not adequate control stories as both groups performed at ceiling. The findings in this study are consistent with the responses on the original Happé (1994) stories. The Asperger's group scoring a mean of 10.27 (range 6-15) and controls scoring a mean of 13.33 (range 11-16) on the theory of mind stories. Similarly in the present data there were no significant differences between the groups on the physical control stories. The Asperger's group scoring a mean of 10.87 (range 6-15) and the controls scoring a mean of 12.4 (range 7-15). Happé also found her autistic group used significantly fewer mental state references than controls. This finding is consistent with the finding in the present study, however the scoring systems are slightly different so the data is not directly comparable.

There were no significant differences between the two groups on the remaining two tasks the eyes task, and the Dewey stories. The results on the Dewey stories are not necessarily

inconsistent with previous research, although this group did perform somewhat better than the similarly aged Asperger's group of Ellis, Ellis, Fraser & Deb (1994). In their group of eight young people with Asperger's syndrome, aged between 11-20, the mean error score was 12.7. This is marginally over one standard deviation from the results in the present study. In our group of Asperger's participants the mean error score was 10.13. However, when matched to controls where the mean error score was 9.07, there were no significant differences between the groups.

The Eyes task used in the present study is a different version to that used by Baron-Cohen, Jolliffe, Mortimore & Robertson (1997). In this earlier version Baron-Cohen et al used 25 sets of eyes in a forced choice task, using two opposing mental state descriptions. The Eyes task reported here used a 28 item assessment, with a choice of four mental state descriptions. Baron-Cohen et al (1997) found that their group of 16 high functioning autistic and Asperger's participants performed significantly worse (mean 16.3) than age matched normal controls (20.3), and controls with Tourettes syndrome (20.4). In the present study there were no significant differences between the means in the Asperger's group mean 17.8 (range 9-24) and the controls 19.9 (range 13-25).

4.1.4 Relationship Between Executive Function and Theory of Mind Measures

The third hypothesis postulated that if there was a relationship between theory of mind and executive function, there would be correlations between these measures. The notion of a relationship did not seem to be supported by this data. Pearson product moment correlation coefficients did not demonstrate any significant relationships between the executive function measures which significantly differentiated the groups, or any of the

theory of mind measures which significantly differentiated the groups. This is consistent with the review of the literature by Baron-Cohen & Swettenham (1997) who concluded that theory of mind, executive function and central coherence are relatively independent of one another. It is inconsistent with studies which have demonstrated significant correlations between the two types of measures, (Ozonoff, et al 1991). Moreover, there were no significant correlations within the theory of mind battery and within the executive function battery. Thus the two measures which reported to measure theory of mind showed no significant correlations. Baron-Cohen, Jolliffe, Mortimore & Robertson (1997) reported that performance on the Strange Stories mirrored performance on the Eyes task in their group of participants with autism and Asperger's. They suggested that this validated the Eyes task, as a measure of theory of mind. The lack of correlation between these two measures in this study, using the more recent version of both tasks, does not support the view that both tasks are measuring the same construct. Likewise, there were no significant correlations between executive function measures, even those which were described as measuring similar constructs.

4.1.5 Theory of Mind and Executive Function : Evidence from Predicaments

Finally, there was partial support for both the theory of mind deficit account and the executive function deficit account in relation to the performance of the Asperger's group on Predicaments. Partial support for an executive hypothesis was demonstrated by the Asperger's group producing significantly fewer solutions, when responding on the Non

Social Predicaments. The Asperger's group were also impaired relative to controls on measures of the average quality of their solutions. This was true both for the solutions they initially generated and the solutions they chose to be optimal and personal. This quality score is comprised of three scores, problem appreciation, social appropriateness and effectiveness. As one would expect, all these scores were positively correlated with solution quality. However when these scores were looked at separately it was only the social appropriateness score which significantly differentiated the groups. This supports the theory of mind hypothesis, as the social appropriateness measure can be considered to necessarily involve mentalising. The finding is not inconsistent, however, with an executive deficit hypothesis.

Further partial support for the two hypotheses was demonstrated by the relationship between performance on the two batteries and Predicaments, within the Asperger's group. As regards executive function, the number of tasks attempted on the Six Elements tasks correlated positively with average solution quality. The Key Search profile score correlated positively with solution quality for the two chosen solutions, and to the effectiveness component within this quality score. However there were no significant relationships between Trail-making and Six Elements profile score with any of the measures on Predicaments.

As regards the theory of mind hypothesis, there was one significant correlation in the Asperger's group between performance on the theory of mind stories and the average social appropriateness of the solutions generated. However, there was no significant correlation between theory of mind and social appropriateness for the chosen solutions, or any of the other predicaments measures.

4.1.7 Summary of Main Findings

The initial hypothesis was supported, the Asperger's group were significantly impaired compared to controls on some measures of the social problem solving task. There was some support for the second hypothesis, the Asperger's group were impaired on some measures of theory of mind and some measures of executive function. The third hypothesis was not supported, there were no significant correlations between executive function and theory of mind measures. Finally there was partial support for the theory of mind and executive hypotheses described in the fourth hypothesis. In the Social Predicaments the measure that significantly differentiated the groups was the social appropriateness measure, however, there was also a significant difference between the groups on the number of solutions generated in the Non Social Predicaments.

4.2 Further Exploration of the Findings

4.2.1 Other Explanations of the Findings

Before considering the findings further, in relation to our two hypotheses, it is necessary to consider the possible contributions of deficits in other domains of cognition. The significant differences in performance on the current battery is unlikely to be an effect of IQ, as the groups were carefully balanced on this measure using Ravens Matrices. The groups were also carefully balanced on measures of receptive and expressive language using the CELF. This explanation was explored further as language ability has been shown to affect task performance in autistic subjects. Sparrevohn & Howie (1995) found that

verbal ability influenced performance on theory of mind tasks. The correlational data shows few significant relationships between language ability and performance, for either of the groups, on any of the measures. It is unlikely then, that differences in language ability could account for the findings. The groups were also matched on gender. There is a consistently higher ratio of males to females in autism and Asperger's syndrome. In Asperger's syndrome estimates vary from 10-15:1 (Gilberg, 1989) to 4:1 (Ehlers & Gilberg, 1993). It was considered important to match the groups in the present study as gender has been shown to significantly affect performance on theory of mind tasks in control groups (Baron-Cohen et al 1997).

Motivational or attention factors were not systematically measured, but clinical observation would indicate that participants from both groups attended to the material and were well motivated. There was no systematic measurement of memory, although items on the receptive language battery involved memory and there were no significant group differences in this task. There were significant group differences, on Predicaments, in the number of prompts required to describe the details of the predicament. However there were no differences between the groups in terms of the number of times the relevant information had to be given, which suggests that memory would not explain the differences in performance on this task.

4.2.2 Further Exploration of Predicaments

Factual account of Predicaments

Exploration of performance on this measure may give us some indication of the points at which social problem solving becomes difficult. The first point of difference was in the

amount of prompting required to produce an adequate summary of the situation. Often the Asperger's group had retained the information, but had not given it. The difference in prompting may reflect a difference in general between the groups, in the understanding of the task requirements, or beliefs about what was acutely pertinent to the situation. This is consistent with the finding of Loveland, Tunali, Kelly & McEvoy (1989), who asked autistic participants to explain the rules of a board game to a naive listener. They found autistic participants were less efficient than controls. The autistic group being typically less informative, although they could reply correctly when asked specific questions to elicit the missing information.

Solution quality

The Asperger's group both produced and selected solutions of a poorer quality, and this, as has already been discussed, seemed largely due to impairment in the social appropriateness aspect of the solution. Participants in both groups of young people gave responses which were naïve, or simply reflected their age and the types of solutions they could actually complete independently. For example one of the control group said on a number of occasions he'd, "tell his mum", which of course was entirely appropriate for his age and probably quite effective. Other instances like, call a solicitor, or move house, suggested a naiveté about how difficult these things might be. However, it was only the Asperger's group which gave what might be considered bizarre or extreme responses. For example, in the first predicament, a couple are complaining about a neighbour's failure to return their lawn mower despite repeated requests for its return. Two, what might be considered extreme or bizarre responses by the Asperger's group were, "go round and

punch him in the face”, “unweed the plants, sell most of the flowers and put the ones they liked most back in order”. For the predicament of a man with new neighbours who own noisy dogs, described in the method section, a number of bizarre responses were elicited. These examples are from different participants; “swap houses with them, so that he would sleep in their flat”, “sneak into the flat and poison the dogs”, “make them into tonight’s dinner”, “build them a dog house in the back yard, they have big gardens in flats, and “cut off his ears”. Another predicament involved a man knocking on a door and explaining to the woman inside he had noticed some damage to her roof. He suggests she gives him £50 so he can get the materials to fix it. Two unusual responses here were “try and kick him” and “ignore it and die in the winter”. To the predicament of a couple who had lost their money and therefore could not pay the hotel they were staying in or afford to get home, two responses were “ask people in the street for money, people are usually quite generous”, and “live in alleyways”.

These bizarre responses were not restricted to the Social Predicaments some of the Non Social Predicaments elicited equally extreme responses. One of the Non Social Predicaments involved a woman arriving home from work. She is preparing a meal and looking forward to the evenings television, when there is a power cut. Some suggestions here were “wire the TV to her car through a 12-240 vault transformer”, “use emergency generator” and “get an old bicycle, wire it up to a generator, and peddle”. The predicament of receiving a doll instead of the requested game, as described fully in the method, was responded to by one participant with “ask a detective to figure out where the doll came from”. To the predicament of returning home and finding the place flooded, one solution was “quickly claim it was not his house and go to someone else’s house”. Finally one response to the predicament of getting a letter, threatening court action for an

unpaid bill, which the character in the story has apparently paid, was “stand up and mark your territory, go to court”.

Selection of solutions

When we look at the actual performance, it seems reasonable to assume that, if the Asperger's group were generating solutions of a poorer quality, then the solutions they chose might also be of a poorer quality. However, when we looked at the relationships between these measures, within Predicaments the Asperger's group was characterised by different relationships to those of the control group. As we would expect, in the control group the average quality of solutions generated correlated with the solution quality of optimal and personal solutions, when these were considered both separately and together. Further, the correlation was stronger in controls for the optimal solution. This might be expected if one takes into account that what you might chose to do yourself may not necessarily be the best solution, even if you are aware of better ways to deal with a difficult situation. However, in the Asperger's group the correlation was only significant between average solution quality and the quality of the personal solution. There was no significant correlation between the average solution quality and the quality of the optimal solution. The optimal solution is the choice the participant makes as optimal for the character in the predicament. One reason for the difficulty would be consistent with a mentalising hypothesis, in that the Asperger's participants found it difficult to imagine what the main character should do. However this doesn't entirely explain why the quality of their choice would not be significantly related to the quality of the solutions they had available. One could speculate that the Asperger's group are may be evaluating the quality of their

responses on different criteria. Indeed, whilst the Asperger's group were significantly poorer on measures of the quality of their chosen solutions, there were no significant differences between the groups on their ratings of satisfaction with their solutions.

There was also another difference in the correlations between the groups. Within the control group there was not a significant relationship between the number of ideas generated and the resultant quality of the solutions chosen. There was a significant correlation for the Asperger's group. The explanations for this are not immediately apparent, but are open to speculation. It could simply be, that the more ideas the this group generated reflected a better understanding of the predicament, and thus a better choice of solution. In summary one could speculate that the lack of relationship, between the average solution quality and quality of the solution chosen for the main character might indicate deficit might be operating, in the judgment of appropriate and effective competing options.

Finally there were no significant differences between the groups in terms of the number of solutions generated on the Social Predicaments task, but there were on the Non Social Predicaments task. It is not clear why this would be. When one looks at the means the mean has reduced slightly in the Asperger's group and increased slightly in the control group on the Non Social task. This implies that the controls found it slightly easier to generate solutions to these predicaments. However the quality of solutions did not differentiate the groups in this task, one possibility is, that this is actually a less complex task. The lack of correlations between the measures on the two Predicaments tasks suggest it might at least be a different type of task. The predicaments not may not be equally matched for difficulty, and as such not directly comparable.

4.2.3 Further Exploration of Executive Function Measures

The findings here are consistent with other research which has demonstrated executive function deficits. The performance on Six Elements approached significance. When the two measures which made up the score were analysed, the groups differed significantly on the number of tasks attempted, but not the number of time rules were broken. The measure of number of tasks attempted correlated positively with the average quality of the solutions generated in the predicaments tasks for the Asperger's group. Participants could fail to attempt all six tasks for a number of reasons. It could be that the instructions were not fully understood, or their importance not fully appreciated. This might mean participants might simply attempt the tasks which they prefer. It could also mean that the participants do not develop a strategy which encompasses all the task requirements. Alternatively they could have intended to complete the task, as instructed, but fail due to poor time management or difficulties in perseveration. Wilson et al (1996) describe the task as a measurement of the participants ability to plan, organise and monitor. This deficit in planning, organising and monitoring correlated with average solution quality. One could speculate that, as the solution quality was composed of three different aspects in Predicaments, this type of impairment may make it difficult to plan both what would be effective and what would be appropriate. There could be deficits in monitoring this process by thinking about the consequences and maybe modifying the solutions on the basis of this. A deficit here might, for example, mean that not all aspects of the solution are effectively considered. The Asperger's group may focus on what would work, without being able to stop and check this against appropriateness in a given situation, then adjusting the solution accordingly.

The Key Search score was significantly correlated with the quality of the two chosen solutions, when the components of this were considered separately it correlated positively with the effectiveness. The Key Search assessment is a measure of the participants ability to plan an efficient and effective course of action. Thus, the relationship here has face validity. Indeed again it was only in the Asperger's group that more bizarre responses were made on this task, for example splitting the field into boxes and drawing a flowery pattern in each box, or just drawing an apparently random wavy line covering only part of the field.

In summary the two planning tasks had the strongest correlations with the Predicaments battery. Pennington & Ozonoff (1996) found the deficits in the autistic group on the Tower of Hanoi discriminated 80% of the autistic groups from controls. The Tower of Hanoi, is considered a measure of planning, as success requires the participant to predict the consequences of different moves and hold them in working memory Ozonoff & McEvoy (1994) found that these deficits in the Tower of Hanoi tasks were stable over a 2.5 year period.

As regards set shifting, Trail-making the task which most significantly differentiated the groups, did not show any significant relationship with the social problem solving measures in the Asperger's group. This task was not measured in terms of errors, but clinical observation noted that errors were rarely made in either group. The Asperger's group were able to complete this task, but not as efficiently as controls. Trail-making was measured so that individual differences in motor speed could not account for the differences in the two groups. The Rule Shift Cards measure, did not differentiate the groups, and appeared to produce a ceiling effect as the majority of the Asperger's group made no errors. This task requires the participant to respond to the cards according to one

rule then according to another. However the rule is printed in large type and placed in front of the participant, and both groups were able to do this quite easily. Thus the Trail-making test seems a more sensitive measure of executive dysfunction in this group. However, there were no correlations between this measure and Predicaments. It may be the Predicaments task allows time for thought and reflection as more real life dilemmas may not. When swift action is required as in actual daily life, the efficiency of set shifting may demonstrate its affect.

Finally the poisoned food measure was included as a measure of deductive reasoning, this did not differentiate the group in terms of either correct responses or response time. In this problem solving task all the information to solve the problem is in front of the participant. In these more structured problem solving tasks the Asperger's group were able to perform as well as controls.

In summary it seems that the planning tasks were more significantly related to the overall quality of solutions generated and chosen. This is consistent with other findings which have found deficits in planning and implicates planning in social problem solving.

4.2.4 Further Exploration of the Theory of Mind Measures

There were significant differences between the groups on the Happé, Strange Stories. The Asperger's group performed significantly worse on the theory of mind measures of complexity and mentalising. It might be slightly misleading to consider these as two separate measures, as second order mental state answers are required to score correct on the complexity measure. There were no significant differences between the groups on the physical control stories. It is important to note that the Asperger's group also scored less

than controls on the physical control stories. On the physical stories the mean score for the Asperger's group was approximately two points below the control group, compared to approximately three points below in the theory of mind stories. In fact the Asperger's group performed very similarly as a group on the theory of mind (10.27) and physical control (10.87) stories. This suggests that the Asperger's group are still finding the stories more difficult to understand than controls, even when they reduce requirements to mentalise.

There was only one theory of mind correlation with Predicaments, the theory of mind stories with the average social appropriateness. This supports to the notion that theory of mind deficits are related to social deficit, however a correlation between social appropriateness and chosen solutions would be more robust evidence.

The Asperger's groups performance on the Strange Stories resembled that of the Predicaments, in that as well as scoring fewer correct they were also more likely to give unusual responses. In the Strange Stories these responses were characterised by longer, more idiosyncratic explanations. In one story a woman is telling a girl she will have to drown some kittens if she can not find homes for them. The reader is also told she wouldn't do anything to hurt the kittens. Two of the more unusual responses to this story were "because there would be so many, they would be charging around the house and scratching the sofa's" and "usually people are right, people have to get rid of kittens. It may seem barbaric, but usually life has a purpose. Kittens need a home, what's the point of life without a home". This was also true for the physical stories. For the story where somebody's washing is wetter than it had been when they left home one response was "because all the moisture had fallen down from the clouds". In another story, a man stealing some jewels gets through the detector beam, sees a small furry thing, and then the

alarm goes off one response to this was “the animal tripped the beam, can’t imagine anyone using a guard cat, if it was a rat it would be shorter than his abdominal cage, unless it was half a meter tall, which it wouldn’t be”

The Eyes task did not significantly differentiate the groups and this was quite an unexpected result. Although the Asperger’s group did perform more poorly than controls when one looks at the means, the results suggests that they are able to use, to some degree, the information from the persons eyes and attribute a correct mental state to them. Finally, the Dewey stories assessment, which required participants to rate behaviours described in a story, correlated negatively in the Asperger’s group, (it is the one score which gives an error score), with the problem appreciation measure. This was only true for the chosen solutions in the Predicaments. However, when rating the behaviour the participant could be basing their judgment on a number of dimensions, and this is not directly assessed. A indication that there may be group differences came from hearing one of the Asperger’s sample laughing a great deal over one of the stories. I asked what they had found amusing. The story being read was about a gardener who likes to have a nap at lunch time, one day its raining and he is invited into the house by the woman whose garden he is working on eat his lunch. He eats his lunch then looks for somewhere to sleep in the house, the living room carpet is thick and he decides to have his nap there. The participant thought this behaviour should be rated as shocking, and indeed the modal rating for this is either “very eccentric” or “shocking.” However this participant found it shocking because they felt he should have slept on the sofa! It is this insight as to why something is rated which demonstrates some of the peculiarities of the Asperger’s group. Frith’s (1996) suggestion that individuals are able to “hack out “ out solutions in mentalising tasks is interesting. Frith (1996) uses the metaphor of blindness, and degrees of blindness to

emphasise varying degrees of mentalising deficit. Thus, in the present study, it is interesting to note that the Asperger's group are able to use information in peoples eyes to infer mental states. Moreover, they did not differ from controls in their appreciation of social convention, as indicated by the Dewey stories. It may be that these measures differ in their sensitivity to more subtle deficits in theory of mind. Possibly there are certain types of theory of mind skills which this more able group can develop, or maybe they learn alternative strategies to "hack out" solutions". Even on the task which did differentiate the groups, at least some of the Asperger's group were able to perform well, or within the 'normal' range. Thus this able group do not seem to lack a theory of mind. Rather, there was some evidence of a deficit in certain tasks.

4.3 Summary

The Asperger's group were impaired relative to controls on some executive measures and some theory of mind measures. The Asperger's group were also significantly impaired on some measures of Predicaments. Within the executive battery impairments were demonstrated in planning and set shifting. Within the theory of mind battery impairments were demonstrated on one measure the Strange Stories, but not on the other measure, the Eyes task. Social judgment, as measured by the Dewey stories, was not found to be impaired in the Asperger's group.

There were no significant relationships between the theory of mind and executive function measures. This was somewhat surprising as much research has indicated relationships, Ozonoff and McEvoy (1994, p429) looked at executive function and theory of mind over a 2.5 year time span and concluded they were "inextricably linked and interdependent". Pennington et al (1997) described two possible types of relationship. The first account

postulates that both executive functions and early social cognition rely on frontally mediated, working memory. The other account suggests that theory of mind tasks may actually be executive tasks. The former hypothesis was not addressed by the current data, but the findings in the present study are inconsistent with the latter account. The findings here are however, consistent with other reviewers, Baron-Cohen & Sweetnam (1997) who proposed the abilities in each domain were independent.

Within the Predicaments task, the Asperger's group were impaired relative to controls on some measures. There were no differences between the groups in the number of ideas generated on the Social Predicaments, but the Asperger's group were impaired relative to controls on this measure in the Non Social Predicaments. The Asperger's group showed no significant differences in their appreciation of the predicaments. Appreciation approached significance when the initial solutions were rated, there were no differences in the solutions they selected. Social appropriateness was impaired in the Asperger's group in both the solutions they generated and those they selected as optimal and personal. The Asperger's group were not impaired on ratings of effectiveness on either the solutions they generated or selected. The Asperger's group generated and selected solutions of lower quality than controls. This suggests that while the Asperger's group were typically aware of the predicament and the pertinent aspects of it they were unable to generate or select solutions of the same quality as controls. The social appropriateness measure significantly differentiated the groups, within the measure of quality, on both the solutions generated and selected. A theory of mind deficit can account for the deficits on the social appropriateness measure in Predicaments for which mentalising is required. Yet it does not account for the deficits on generating solutions found in the Non Social Predicaments or the deficits on the executive function measures. However an executive function account

could explain the impairments in social appropriateness. Executive function accounts of deficits would typically emphasise impairment, due to, the selection of the most salient or obvious solution to solve a Predicament. Dennis (1991) stated that all executive function behaviours share the need to disengage from the immediate environment, and guide actions by mental modes or internal representations. Ozonoff & McEvoy (1994) term an inability to do this as a classic executive function error. Problem solving in everyday life was postulated by Channon & Crawford (1999) to involve, “appropriate selection of information as a focus of attention, identifying appropriate goals, looking ahead to potential future consequences of different courses of action, making reasoned comparative judgments about them, and evaluating performance”. It is likely that these types of tasks involve the executive processes. The salience of a particular solution rather than a reasoned assessment of all the aspects may be one explanation of the findings regarding social appropriateness. Alternatively the gauging of social appropriateness of a solution may simply be the most complex aspect of social problem solving.. Studies looking at very early social skills have implicated complexity in failure to observe and respond to social stimuli. Dawson et al (1998) found that autistic preschoolers fail to orient to naturally occurring social stimuli, they suggested that this may be because social stimuli are more complex, variable and unpredictable. Moreover, Pennington et al (1997) argue that these early social interactions provide practice in several executive functions. Additional support for an executive dysfunction hypothesis is found in the performance of patients with frontal lobe damage on Predicaments, Channon & Crawford (1999) found their patients impaired on executive measures and on the social appropriateness measure on predicaments. Channon (personal communication) has found patients with frontal lesions to be impaired on theory of mind type story comprehension tasks and in their use of mental state

responses. Deficits in tasks in this group have been typically accounted for in terms of executive dysfunction.

Further support for the executive hypothesis is demonstrated by the correlations between some of the neuropsychological measures and Predicaments. One submeasure of the Six Elements task correlated with the average solution quality. This task measures the ability to plan and organise and monitor ones actions. Performance on the Key Search, a measure which looks at the ability to plan an effective and efficient course of action task, correlated with the total solution quality and the effectiveness component within this measure. However performance on Strange Stories did correlate with the average appropriateness of solutions. This implicates a theory of mind deficit in the impairment of social appropriateness within Predicaments.

Overall the data support an executive hypothesis over a theory of mind hypothesis as a parsimonious account of the findings. Executive function deficit accounts offer some explanation and method for exploring the points at which deficits might occur in everyday problem solving.

4.4 Limitations

The findings of this study are circumscribed by consideration regarding the validity of the measures used. Campbell & Fiske (1959) describe four criteria which need to be fulfilled in order for a test to be considered valid. One of these is convergent validity, which they describe as a “confirmation by independent measurement procedures.” Firstly considering the theory of mind measures, there were no significant correlations between the Happé

stories, the Eyes task or the Dewey stories. This is especially consequential for the Stories and the Eyes as they are both described as measures of theory of mind. There were no ceiling or floor effects on either task, so even if the tests were of a different complexity, or sensitivity, one would expect a significant relationship. One explanation would be that emotion recognition as assessed by the eyes task, is not necessarily a measure of theory of mind.

There were similar findings for the executive function measures, where there were no significant correlations between measures. The two measures which are described as measuring planning, did not correlate significantly with each other, Six Elements and Key Search. One possible explanation for this could be that the groups may be failing the two tasks for different reasons. Indeed, the instructions on the Six Elements task are long and complex, whilst the instructions for Key Search are relatively simple. Ozonoff (1995) found improved performance on the WCST in autistic participants when verbal and social demands were removed by using a computerised version of the WSCT. She recommends future research needs to implement paradigms which remove any extraneous measurement variance, by removing unintentional task demands.

There were also concerns regarding Predicaments. In this study, the DEX questionnaire which did significantly differentiate the groups, did not correlate significantly with any other measures. The DEX is designed to be a measure of the difficulties experienced in everyday life. The Predicaments is a newly developed assessment and has not been used with adolescents, therefore it is disappointing that it shows no significant relationship with the DEX. One possible explanation for the lack of relationship would be the status of the rater. The

The ratings were all completed by parents who were experiencing differing levels of

concern around their child's behaviours. Their responses may have then reflected the difficulties they were experiencing in managing difficult behaviours, or the difficulties of the developmental tasks at hand in adolescence, for example beginning secondary school. This could mean that the DEX was not a truly objective account of actual everyday behaviour. Partial support for this comes from comparison of the DEX ratings of adults with frontal damage, Channon & Crawford (1999) found that adults with anterior damage scored a mean of 25.08 and adults with posterior damage scored a mean of 18.67 when a relative rated their behaviour. In our group the Asperger's group scored a mean of 40.71, much higher than the patients with frontal damage, and the controls scored 16.64. Thus it would have been useful to get a second rating by another rater such as a teacher. Some support for the ecological validity of Predicaments is found in Channon & Crawford, (1999). They found that the group of patients they assessed with most real life difficulties, (those with anterior lesions), showed the greatest level of impairment on Predicaments.

The Predicaments task had been developed and devised for adults. The predicaments involved were derived at on the basis of interviewing adults. This may reduce their ecological validity. However, whilst the predicaments were not generated specifically by adolescents a wide range of people of varying ages were interviewed in order to develop the situations. Further, there is no evidence to suggest than the participants had any difficulties understanding these predicaments, and most of the predicaments appeared on the face of it, to be relevant to adults and young people alike. However there would be an increased personal relevance to this group, if the actors in the situations had been of a similar age, and the predicaments had taken place in more familiar places such as colleges and schools, for example, rather than the workplace.

It is difficult to estimate how well performance on the predicaments task predicts or

mirrors more real life social problem solving. These experimental tasks can underestimate difficulties. In these experimental tasks there are cues which structure performance, although Predicaments minimised these by using open ended problem situations and restricting prompting to the factual account of the predicament. There was however an inevitable task structure. The participant was asked to think of as many solutions as they could, and then to select one, a structure which is not necessarily in place in real life. There is also the possibility, that there will be discrepancies between how one would actually act, especially in situations which require immediate reaction, and how one describes verbally one's solution. Similarly difficulties could be overestimated if participants have difficulties in imagining themselves in these situations, or are less motivated by a wish to resolve the predicaments successfully.

The attempt to try and compare Social and Non Social Predicaments was not entirely satisfactory. One issue is the different methods of presentation used in each task. However, when Channon & Crawford (1999) looked at the Social Predicaments and presented half as videos and half as stories, they concluded there was little evidence to suggest that method of presentation significantly altered the nature of the results. A further problem with the Non Social Predicaments is that their description as Non Social is not entirely justified. Although the situations were devised to remove the social element, as far as possible, by only having one character and attempting to use practical predicaments, the solutions to these predicaments immediately introduced a social element. Thus the lack of group differences here may have been to factors such as reduced complexity rather than simply the removal of the social element.

4.5 Clinical Implications

The role of research exploring deficits within a particular group is to determine the differences between these groups. Indeed, the groups did differ on measures of executive function, theory of mind and the Predicaments. However, the Asperger's group were able to understand these reasonably complex predicaments and generate solutions to them. One participant with Asperger's suggested a number of solutions for the predicament "dogs" described in the method, "try and get to sleep and forget about it", "go to the council and complain", "suggest some ideas to the people upstairs", "have a chat with them and tell them this can't go on, they have to move them" and "he could move". Further while the Asperger's group were likely to generate more extreme solutions, visual inspection shows that they did not choose these solutions, at least in this task, for optimal or personal solutions. The results here suggest that this group can think of a number of solutions and recognise the pertinent aspects of a predicament. This means that an area for intervention may be in considering how this group evaluate and choose solutions. A particular focus implicated by the present data would be in planning and monitoring possible solutions, especially in terms of their social appropriateness. Social skills groups aimed at teaching specific skills, have had some success. Ozonoff & Miller (1995) ran a 14 session social skills group and reported some improvement post assessment in their group of normal IQ autistic adolescent boys. In this group specific skills were taught including conversational skills, emotional expression recognition, perspective taking and theory of mind skills. The video format of Predicaments enables one to follow through the pertinent aspects of a difficult situation, through someone else's perspective and one's own and could be used effectively in any educational programme. It may also be useful as a pre and post

assessment measure.

Other types of social skills teaching has focused on understanding rather than learning per se. Gray (1998) used short stories and comic strip conversations of social situations to facilitate social interaction. Gray suggests that these types of task can improve social skills through improved social understanding. The video format of Predicaments would not only be a good assessment tool for considering where particular difficulties might lie for the individual, but may also be useful as an educational tool, for parents and professionals. This would allow these young people to consider their choices and their consequences, against alternative options and maybe develop appropriate strategies for planning and monitoring these options. Attwood (1998) acknowledges that although learning social and emotional skills may seem like an arduous task, that young people with Asperger's respond well in general to these programmes. He predicts the more we know about why the errors occur, the more successfully strategies can be developed to overcome them.

4.6 Future Research

Future research with Predicaments is needed to establish this as a validated measure with this group. In this instance Predicaments did not correlate with performance on the DEX. Other measures to establish convergent and divergent validity will need to look at the presence of social skills as well social difficulties. Various ratings by relatives, teachers, and professionals would have to be included. It is likely that Predicaments may require some adjustments to increase efficacy for use with a younger population, but once validated and adjusted accordingly, it could be used in future research. Research looking at different groups, could improve our understanding of what types of executive dysfunction

and theory of mind deficits are related to what aspects of social difficulties. Attention deficit hyperactivity disorder has been associated with executive dysfunction, Pennington & Ozonoff (1996). This is another group which also experience social difficulties, although of a somewhat different nature. Performance on Predicaments, executive function tasks and theory of mind tasks could be used to differentiate social deficits between Asperger's and autism and indeed, other groups. Happé and Frith (1996) suggest that both executive function and theory of mind theories have a role to play in future research alongside central coherence accounts in informing the search for the genetic mechanisms. Predicaments may be useful in this type of search. Tasks which identify more subtle deficits in relatives of probands, have been used in this type of research. Inquiry into autism has been of interest to clinical psychology and neuropsychology and the combination of methods has led to a detailed account of the phenotype of this disorder. Functional brain imaging and attempts to identify biochemical abnormalities offer opportunities to link brain mechanisms with our current knowledge of the cognitive aspects of this syndrome. Much research has been focused on younger children in order to pinpoint primary deficits. Research with this older group may give us more insight into how these delayed or damaged skills present and are compensated for as these children develop.

5. References

American Psychiatric Association (1994). Diagnostic and Statistical Manual of Mental disorders, 4th edn (DSM-IV). Washington, D.C: APA.

Arenberg, D., (1968). Concept problem solving in Young and old adults. Journal of Gerontology, 23, 279-290.

Attwood, T. (1998). Asperger's syndrome. Jessica Kingsley Publishers: London.

Bailey, A., Le Couteur, A., Gottesman, I., Bolton, P., Simonoff, E., Yudza, E., & Rutter, M. (1995). Autism as a strongly genetic disorder: Evidence from a British twin study. Psychological Medicine, 25, 63-77.

Baron-Cohen, S., Leslie, A.M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? Cognition, 21, 37-46.

Baron-Cohen, S. (1987). Autism and symbolic play. British Journal of Developmental Psychology, 5, 139-148.

Baron-Cohen, S. (1989). Perceptual role taking and protodeclarative pointing in autism. British Journal of Developmental Psychology, 7, 113-127.

Baron-Cohen, S., (1989b). The autistic child's theory of mind: a case of specific

developmental delay. British Journal of Developmental Psychology , 30, 285-297.

Baron-Cohen, S., Campbell, R., Karmiloff-Smith, A., Grant, J., & Walker. (1995). Are Children with autism blind to the mentalistic significance of the eyes?. British Journal of Developmental Psychology, 13, 379-398.

Baron-Cohen, S., Jolliffe, Mortimore & Robertson (1997). Another advanced test of theory of mind: Evidence from very high functioning adults with autism or Asperger syndrome. Journal of Child Psychology and Psychiatry, 38, 813-822.

Baron-Cohen & Swettenham (1997). Theory of mind in autism: Its relationship to executive function and central coherence. In Cohen, D. J. & Volkmar, F. R. (Eds) Handbook of Autism and Pervasive Developmental Disorders. John Wiley: Chichester.

Bauman .M, & Kemper., TL. (1994) Neuroanatomic observations of the brain in autism. In M.L. Bauman.& T.L. Kemper (Eds) . The Neurobiology of Autism. John Hopkins University press: Baltimore.

Bettleheim, B. (1967). The empty fortress: infantile autism and the birth of self. The Free Press: New York.

Buitelaar, J.K., Van Der Wees, M., Swaab-Barneveld, H., & Jan Van Der Gaag. (1999). Theory of mind and emotion recognition functioning in autistic spectrum disorders and psychiatric control and normal children. Development and Psychopathology, 11, 39-58.

Burgess, P.W. (1997) Theory and methodology in executive function research. In P. Rabbitt (ED) Methodology of Frontal and Executive Function. Psychology press: England.

Campbell, D.T. & Fiske, D.W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix, Psychological Bulletin, 56,82-105.

Channon, S., & Crawford, S. (1999 in press). Problem solving in real-life type situations: The effects of anterior and posterior lesions on performance, Neuropsychologica.

Charman, T., & Baron-Cohen, S. (1997). Prompted and pretend play in autism. Journal of Autism and Developmental Disorders, 27, 325-332.

Dahlgren, S.O., & Trillingsgaard, A. (1996). Theory of mind in non-retarded children with Asperger's syndrome. A research note. Journal of Child Psychology and Psychiatry, 37,759-763.

Damasio, A.R & Maurer., R.G. (1978). A neurological model for childhood autism. Archives of Nerology, 35, 777-786.

Dawson, G., Meltzoff, A.N., Osterling, J., Rinaldi, J., & Brown, E. (1998). Children with autism fail to orient to naturally occurring social stimuli, Journal of Autism and Developmental Disorders, 28, 479-484.

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

Dewey, M. (1991). Living with Asperger's syndrome. In U. Frith (Ed) Autism and Asperger Syndrome. Cambridge University Press : Cambridge.

Ellis, H.D., Ellis, D.M., Fraser, W., & Deb, S. (1994). A preliminary study of right hemisphere cognitive deficits and impaired social judgements among young people with Asperger syndrome. European Child and Adolescent Psychiatry, 3, 255-266.

Elhers, S., & Gilberg, C.(1993).The epidemiology of Asperger's syndrome. A total population study. Journal of Child Psychology and Psychiatry,34, 1327-1350.

Eslinger, P.J. & Damasio, A.R. (1985). Severe disturbance of higher cognition after bilateral frontal lobe ablation: patient EVR. Neurology, 35,1731-1741.

Fein, G.G. (1981). Pretend play: an integrative review. Cognitive Development, 52, 1095-1118.

Folstein, S., & Rutter, M (1977).Infantile autism: A genetic study of 21 twin pairs. Journal of Child Psychology and Psychiatry, 18, 297-321.

Frith, U. (1989). Autism : Explaining the Enigma. Basil Blackwell : Oxford.

Frith., U. (1991). 'Autistic Psychopathy' in childhood. In U. Frith (ED) Autism and Asperger Syndrome. Cambridge University Press:Cambridge.

Frith, U.(1996). Social communication and its disorder in autism and Asperger syndrome. Journal of Psychopharmacology, 48-53.

Frith ,U., & Happé, F.(1994). Autism: beyond " theory of mind". Cognition, 50, 115-132.

Folstein, s. & Rutter., M (1977). Infantile autism a study of 21 twin pairs. Journal of Child Psychology and Psychiatry, 18,297-321.

Gilberg, C. (1989). Asperger's syndrome in 23 Swedish children. Developmental Medicine and Child Neurology,31, 520-531.

Gilberg, C.L. (1991). Autistic syndrome with onset at age 31 years: herpes encephalitis as a possible model for childhood autism. Developmental Medicine and Child Neurology, 33, 813-842.

Gilberg, C. (1998). Asperger's syndrome or high functioning autism. British Journal of Psychiatry, 172, 200-209.

Gilberg, I.C. & Gilberg, C. (1989). Asperger syndrome - some epidemiological

considerations : a research note, Journal of Child Psychology & Psychiatry,30, 631-638.

Gray, C. (1998). Social stories and comic strip conversations with students with Asperger's syndrome and high functioning autism. In E. Schopler & G. Mesibov (Eds) Asperger syndrome or high functioning autism? Current issues in autism. Plenum press: New York.

Happé, F. (1994). Annotation: Current Psychological theories of autism: The "theory of mind" account and rival theories. British Journal of Child Psychology and Psychiatry, 35, 215-229.

Happé, F. (1994b). Advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. Autism and Developmental Disorders, 24, 129-154).

Happé, F. (1997). Central coherence and theory of mind in autism: Reading homographs in context. British Journal of Developmental Psychology,15, 1-12.

Happé, F. & Frith, U. (1996). The neuropsychology of autism. Brain,119,1377-1400.

Happé, F, Ehlers, S., Fletcher, P., Frith, U., Johansson, M., Gilberg, C., Dolan, R., Frackowiak, R. & Frith, C. (1996). Theory of mind in the brain. Evidence from a PET scan study of Asperger syndrome. Neuroreport, 8,197-201.

Harris, P.L. (1993). Pretending and planning. In S. Baron-Cohen, H, Tager-Flusberg & D. Cohen (Eds). Understanding Others Minds: Perspectives from Autism. Oxford University Press : Oxford.

Hobson, R.P. (1989). Beyond cognition: A theory of autism.. In G. Dawson(Ed) Autism Nature Diagnosis & Treatment. Guildford Press: New York.

Hobson, R.P. (1993). Autism and the Development of Mind. Lawrence Erlbaum Associates :Hove.

Hughes, C., & Russell. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of Autism. Developmental Psychology, 29, 498-510.

Jarold, C., Boucher, J., Smith, P.K., (1994). Executive Function deficits and the pretend play of children with autism: a research note. Journal of Child Psychology and Psychiatry, 35, 1473-1482.

Kanner, L., (1943). Autistic disturbances of affective contact. Nervous Child, 217-250.

Klien, H., Constable, A., Goulandis, N., Stackhouse, J., Tarplee, C., (1994). Clinical evaluation of Language Fundamentals-Revised : UK examiner's manual supplement. The Psychological Corporation Ltd: London.

Klin, A., Volkmar, F.R., Sparrows, S. (1992). Autistic social dysfunction: some limitations of the theory of mind hypothesis, Journal of Child Psychology and Psychiatry, 33, 861-876.

Leekham, S.R., & Perner, J. (1991). Does the autistic child have a metarepresentational deficit? Cognition, 40, 203-218.

Leslie, A.M. (1987). Pretense and representation: The origins of "theory of mind". Psychological Review, 94, 412-426.

Lewis, V., & Boucher, J. (1988). Spontaneous, instructed and elicited play in relatively able autistic children. British Journal of Developmental Psychology, 6, 325-339.

Lezak, M.D., (1996). Neuropsychological Assessment. Oxford University Press: Oxford.

Loveland, K.A. & Landry, S.H. (1986). Joint attention and language in autism and developmental language delay. Journal of Autism and Developmental Disorders, 16, 335-349.

Loveland, K.A., Tunali, B., Kelly, M.L., & McEvoy, R.E. (1989). Referential communication and response adequacy in autism and Down's syndrome. Applied Psycholinguistics, 10, 301-313.

McEvoy, R.E., Roger, S.J., Pennington, B.F. (1993). Executive function and social

communication deficits in young autistic children., Journal of Child Psychology and Psychiatry, 34, 563-578.

Meltzoff, A.N., & Gopnik, A. (1993). The role of imitation in understanding persons and developing a theory of mind. In S. Baron-Cohen, H. Tager-Flusberg & D. Cohen (Eds). Understanding Others Minds: Perspectives from Autism. Oxford University Press : Oxford.

Minschew, N.J., Goldstein, G., Muenz, L.R., & Payton, L.R. (1992). Neuropsychological functioning in nonmentally retarded autistic individuals. Journal of Clinical and Experimental Neuropsychology, 14, 749-761.

Osterling, J., & Dawson G., (1994). Early recognition of children with autism: A study of first birthday home video tapes. Journal of Autism and Developmental Disorders, 24-247-257.

Ozonoff, S., Pennington, S., & Rogers (1991). Executive function deficits in high functioning autistic individuals: Relationship to theory of mind, Journal of Child Psychology and Psychiatry, 32, 1081-1105.

Ozonoff, S., & McEvoy, R. (1994). A longitudinal study of executive function and theory of mind in development in autism, Development and Psychopathology, 6, 415-431.

Ozonoff, S., & Miller, N. J. (1995). Teaching theory of mind: a new approach to social

skills training for individuals with autism. Journal of Autism and Developmental Disorders, 25, 415-433.

Pennington, B.F. & Bennetto, L. (1993). Main effects or transactions in the neuropsychology of conduct disorder? Commentary on the neuropsychology of conduct disorder." Development and Psychopathology, 5, 151-164.

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

Pennington, B.F., Rogers, S.J., Bennetto, Griffith, E.M., Reed, D.T., & Shyu, V. (1997). In J. Russell (ED.) Executive Functioning and Autism. Oxford University Press: New York.

Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that...." Attribution of second order beliefs by 5-10 year old children. Journal of Experimental Child Psychology, 39, 437-471.

Peterson, C.C., & Siegal, M. (1995). Deafness, conversation and theory of mind. Journal of Child Psychology and Psychiatry, 36, 459-474.

Premack, D., & Woodruff, G. (1978). Does the Chimpanzee have a theory of mind? Behavioural and Brain Sciences, 4, 515-526.

Prior, M.R., & Hoffman, W. (1990). Brief report: neuropsychological testing of autistic children through an exploration of frontal lobe tests. Journal of Autism and Developmental Disorders 20,581-590.

Raven, J.C., Court, J. H., & Raven, J. (1996). Standard Progressive Matrices: manual. Oxford Psychologists Press: Oxford.

Reitan, R.M. (1958). Validity of the Trail-making test as an indicator of organic brain damage. Perceptual and Motor Skills, 8, 271-276.

Ritvo, E.R., Freeman, B.J., Mason-Brothers, A., & Ritvo, A.M. (1985). Concordance for the syndrome of autism in forty pairs of affected twins. American Journal of Psychiatry, 142,74-77.

Rogers, S.J., Bennetto, L., McEvoy, R & Pennington (1996). Imitation and pantomime in high functioning adolescents with autistic spectrum disorders. Child Development, 67, 2060-2073.

Rumsey, J.M. (1985). Conceptual problem solving in highly verbal, non-retarded autistic men. Journal of Autism and Developmental Disorders, 15, 23-36.

Russell, J., Mauthner, N., Sharpe, S., & Tidswell, T. (1991). The 'windows task' as a measure of strategic deception in preschoolers and in autistic subjects. British Journal of

Developmental Psychology, 9, 331-349.

Rutter, M. (1978) Diagnosis and definition of childhood autism. Journal of Autism and Childhood Schizophrenia, 8,139-161.

Rutter, M., Bartak, L.,& Newman, S.(1971). Autism-a central disorder of cognition and language? In M. Rutter (Ed). Infantile Autism : Concepts Characteristics and Treatment. Churchill livingstone : London.

Shah.A., & Frith, U. (1983). An islet of ability in autistic children: a research note. Journal of Child Psychology and Psychiatry,34,1351-4.

Sigman, M. (1994) What are the core deficits in autism?. In S.h. Broman & J. Grafman (Eds) Atypical Cognitive Deficits in Developmental Disorders: Implications for Brain Function (pp.139-157). L.E.A: New Jersey.

Sparrevohn, R., & Howie, P.M. (1995). Theory of mind in children with autistic disorder: Evidence of developmental progression and the role of verbal ability, Journal of Child Psychology and Psychiatry,36, 249-263.

Steel, J.G., Gorman, R., & Flexman, J.E. (1984). Neuropsychiatric testing in an autistic mathematical idiot-savant: Evidence for nonverbal abstract capacity. Journal of the American academy of Child psychiatry, 23, 704-707.

Szatmari, P., Jones, M.B., Zwaigenbaum, L., & Mac Lean, J.E. (1998). Genetics of autism: Overview and new directions. Journal of Autism and Developmental Disorders, 28, 351-368.

Tabachnick, B.G. & Fidell C.F. (1983). Using Multivariate Statistics. Harper & Rowan :New York

Tantum, D. (1988). Asperger syndrome or autistic personality disorder. Communication, 22,37-39.

Van Krevelen, D. (1971). Early infantile autism and autistic psychopathology. Journal of Autism and Childhood Schizophrenia, 1, 82-86.

Welsh, M.C. & Pennington, B.F. (1988). Assessing frontal lobe functioning in children: views from developmental psychology. Developmental Neuropsychology,4, 199-230.

Welsh, M.C., Pennington, B.F., Ozonoff, S., Rouse, B., McGabe, E.R.B. (1990). Neuropsychology early-treated phenylketonuria: specific executive function deficits, Child Development, 61, 1697-1713.

Wilson, B.A., Alderman, N., Burgess, P.W., Emslie, H., & Evans, J. (1996). Behavioural Assessment of the Dysexecutive Syndrome : manual. Thames Valley Test Company: Bury st. Edmunds.

Wimmer & Perner (1983). Beliefs about beliefs : Representation and the constraining

function of wrong beliefs in young children's understanding of deception. Cognition, 13, 103-128.

Wing .L. (1981). Asperger's syndrome: a clinical account. Psychological Medicine, 11, 115-129.

Wing, L. (1991). The relationship between Asperger's syndrome and Kanner's autism. In U. Frith (ed) Autism and Asperger syndrome. Cambridge University Press : Cambridge.

Wing., L., Gould., J., Yeates., S.R., & Brierley, L.M. (1977). Symbolic play in severely mentally retarded and autistic children. Journal of Child Psychology and Psychiatry, 18, 167-78.

Wing, L. & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children : epidemiology and classification. Journal of Autism and Developmental Disorders, 9, 11-29.

World Health Organisation (1993). The ICD-10 Classification of Mental and Behavioural Disorders. Geneva : WHO.

Yeung-Couchesne, R., & Courchesne, E., (1997). From impasse to insight in autism research: From behavioural symptoms to biological explanations. Development and Psychopathology, 9, 389-419.

APPENDIX



Sub-Department of Clinical Health Psychology

UNIVERSITY COLLEGE LONDON

GOWER STREET LONDON WC1E 6BT

Direct Line: 0171-380 7897
UCL: 0171-387 7050
Code from overseas: +44 171
Fax: 0171-916 1989

Prof. Hobsley
Chair Joint UCL/UCLH Ethics Committee
c/o Ms. Vanessa Revill
Committee Secretary
UCL Medical School
Administrative Officers
The Rayne Institute
5 University Street
London WC1E 6JJ

re. Appl. No. 2608 Developmental precursors of a theory of mind

12th January 1996

Dear Prof. Hobsley,

I am writing to ask for an extension of the approval for the above project to cover the introduction of some additional basic assessments of cognitive and neuropsychological function. As with the other measures already employed, these assessments involve asking the participants to solve simple problem-solving, memory and intelligence tasks presented on paper, or on videotape. They do not involve any invasive procedures. The consent of parents, and of the child and adolescent subjects themselves will be sought in the same way as at present, and participants will be able to withdraw from the study at any point.

I hope that you will be able to take Chair's action to grant an extension of my existing approval.

Yours sincerely,

Dr. Tony Charman
Lecturer in Psychology

Administration
Gower Street
London
WC1E 6BT

Telephone 0171 387 7050
Direct Line 0171 209 6305
Fax 0171 383 2462

All correspondence to:

Mrs Vanessa Revill
Committee Secretary
Joint UCL/UCLH Committees on the Ethics of
Human Research: Committee Alpha
(External address as above.
Internal address/deliveries by hand - 6th Floor, St.
Martin's House, 140 Tottenham Court Road
(opposite Warren Street Underground Station).



THE QUEEN'S
ANNIVERSARY PRIZES
1994

19 January 1996

Dr Tony Charman
Lecturer in Psychology
Sub-Department of Clinical Health Psychology
UCL

Dear Dr Charman,

Joint UCL/UCLH Committees on the Ethics of Human Research: Committee Alpha

No: 2608 (Please quote in all correspondence)
Title: Developmental precursors of a theory of mind

Thank you for your letter of 12 January 1996. I am writing to let you know that the amendment to the above study is acceptable and you may go ahead with the project as amended.

Please remember that it is important that you notify the Committee of any adverse events or changes (name of investigator etc) relating to this project. You should also notify the Committee on completion of the project, or indeed if it is abandoned. Please remember to quote the above number in any correspondence.

Yours sincerely,

Professor M Hobsley
Chairman

14/07/98

EXTENDED -> 05 99.



University College London School of Medicine
Department of Paediatrics
Sub-Department of Paediatric Disability



Mr and Mrs

All enquiries to:
Harper House Children's Service
Harper House
Harper Lane
Radlett, Herts WD7 7HU
Tel: 0192 385 7315
Fax: 0192 385 9196

Date.....

Dear Mr and Mrs

Re: Research Project on Social Problem Solving

We are writing to ask for your help. We are involved in researching social problem solving in young people with Asperger's Syndrome and Autism, this is a joint project between the University College London and Harper House. The research involves a series of assessments including watching videos of different situations and being asked to comment on them. The aim of the study is to try and discover more about how social problem solving operates in young people with Asperger's Syndrome and Autism and, what kind of factors may influence it. The whole assessment will take approximately 2½ hours. We were hoping that yourselves and..... will consider..... taking part in this study. We can arrange a time which is convenient for you to bringand we will reimburse any travel expenses. We are hoping to start running the project on the 17th of August and it will continue until the end of the year. We will be providing you with feedback once the project has been completed.

Please could you complete the slip to let us know whether you would be interested in taking part and return it in the stamped addressed envelope provided. We will then contact you to arrange a convenient time and provide you with more information.

Your participation in the study is much appreciated. If you have any queries, questions or would like to find out more about the study phone Jane Heap on 01895 279 968 or Patti Rios on 01923 857315.

Looking forward to hearing from you,

with best wishes,

Jane Heap
Clinical Psychologist
in Training, UCL

Patricia Rios
Clinical Psychologist, Harper House



Research Project on Social Problem Solving

Child's name..... (Please complete and return)

Yes, I am interested in taking part in your project

No, I do not wish to be involved



**Subdepartment of Clinical Health Psychology
University College London, Gower Street, London WC1E 6BT**

**Dr. Tony Charman
Dr. Shelley Channon
Directors of Project
0171-391-1786**

Research Assistants: 0171-504-5929

**UCL 0171-387-7050
Overseas code +44-171
Fax 0171-916-1989**

CONSENT FORM

Memory and problem-solving study

Directors of project: Dr. Tony Charman and Dr. Shelley Channon

To be completed by the parent/guardian of

Delete as necessary:

Have you read the information sheet about this study? Yes/No

Have you had an opportunity to ask questions and discuss this study? Yes/No

Have you received satisfactory answers to all your questions? Yes/No

Have you received enough information about this study? Yes/No

Which researcher have you spoken to about this study?

Do you understand that your son/daughter is free to withdraw from this study at any time, without giving a reason for withdrawing, and without affecting his/her future medical care? Yes/No

Do you agree to your son/daughter taking part in this study? Yes/No

Signature of parent/guardian
Name
Date
Address

Signature of researcher
Name
Date