Emotional Recognition, Executive Function and Pragmatic Communication in Children with a Diagnosis of Autistic Spectrum Disorder.

Jennifer Wright

Doctorate in Clinical Psychology

The University of Edinburgh

2005

EX BIBL. UNIV. EDINBURGH

Contents

Table of Figures

Declaration

This thesis has been composed by myself and the work contained herein is my own

Acknowledgements

I would like to thank the following people: -

Dr Karen McKenzie for her supervision, help, advice and patience.

Dr George Murray for his supervision, encouragement and support.

Dr April Quigley and Arthur Still for statistics advice.

Claire Allfrey for her help, advice and proof-reading.

Dr Katie Williams for her advice and loan of the emotional recognition test.

The local ASD team for their support.

All those who participated: the children, parents and their schools.

All of those who have had to put up with me over the past few months: my friends, family, fellow trainees and, finally, my long suffering partner, Steve, for all of his support and doing all of the housework!

Abstract

This study aimed to examine the links between executive function (EF), emotional recognition, and pragmatic communication, in children with a diagnosis of ASD. It also compared the performance of the children with ASD with the performance of typically developing children on each of the tests. It was an experimental study with both a between subjects and a correlational design. Twenty children, aged 6-15 years, with a diagnosis of ASD comprised the experimental group. Twenty-one typically developing children, aged 6-12 years, comprised the control group. The groups were matched on gender, chronological age and IQ. Both groups were tested using the Tower subtest of the NEPSY (Korkman et al. 1998), an emotional recognition test, using Ekman and Friesen's Facial Effect Slides (1976). Parents were asked to complete the Children's Communication Checklist (CCC-2: Bishop, 2003), in order to gain a score for pragmatic communication. The results showed that children with ASD performed more poorly on tests of EF, emotional recognition and pragmatic communication compared to controls, suggesting that children with ASD have relative deficits in these areas. In addition, a significant positive correlation was found between emotional recognition and EF in the ASD group. No other correlations were found, in either of the groups. In conclusion, the results support previous research, that EF could be one of the primary cognitive deficits in individuals with ASD. Future research is suggested, looking into the links between pragmatic communication and cognitive theories of ASD, as well as further investigation into the links between ASD and the specific sub-domains of EF.

1. Introduction

1.1. General Overview

The thesis will initially discuss the concept of autistic spectrum disorder (ASD), providing definitions and contextual information, including a brief overview of its history, prevalence and the main theories. This will be followed by an outline of research into theory of mind, language ability, emotion and some of the main cognitive theories used to explain ASD, as well as the major factors involved in these. These include theory of mind, weak central coherence, and executive function. Finally, the rationale for the current study will be outlined.

Terminology

In this study, the term autistic spectrum disorder is used to refer to children with a diagnosis of autism, Asperger's syndrome or high functioning autism. In the literature reviewed, these are often described separately as different disorders. For the purposes of this literature review, when discussing studies, the terminology used by the authors of the studies will be used.

1.2. Autistic Spectrum Disorder

History

Leo Kanner published the first accepted clinical paper about autism (Kanner, 1943). He wrote this paper about a group of children referred to his clinic, who all had in common an unusual presentation, which he named 'early infantile autism'. He described the features of the condition as: lack of affective emotional contact with others, intense insistence on sameness, bizarre and elaborate repetitive routines, muteness or marked abnormality of speech, fascination with and dexterity in manipulating objects, high levels of visuo-spatial skills or rote memory in contrast to learning difficulties in other areas, and an attractive, alert, intelligent appearance (Wing, 1996).

At around the same time, Hans Asperger published a paper in Germany in 1944 in which he described a pattern of behaviour similar to Kanner's 'early infantile autism'. The features he selected were naïve, inappropriate social approaches to others, intense circumscribed interest in particular subjects such as railway time-tables, good grammar and vocabulary but monotonous speech that was not used for conversations, level of ability in the borderline, average or superior range but often with specific difficulties in one or two subjects. Asperger published his papers in Germany, and it is only in the past twenty years that his work has been available in the UK. Asperger believed that although his condition had similarities to Kanner's, it was a different condition (Wing, 1996). Whether autism and Asperger's syndrome are separate disorders is a topical issue and something that will be returned to later in this chapter.

Prevalence

Early studies gave a prevalence rate of 5-6 per 10,000 for autism (Rutter, 1966). More recent studies have found prevalence rates of 10-12 per 10,000 for autistic spectrum disorder (Gillberg et al. 1991).

The male-to-female ratio for autistic spectrum disorder is approximately 3 or 4:1 (Carr, 1999). There is data to suggest that ASD is increasing in the population, but there is controversy about the reason for this. It is thought that there is an increase in numbers diagnosed due to an increased awareness and understanding of the whole autistic spectrum rather than an actual increase in the incidence of ASD. It has also been suggested, however, that there is a real increase in incidence, due to factors such as pollution, additives in food, and the measles, mumps and rubella (MMR) vaccination, but there is currently not strong enough evidence to allow us to determine the true reason (Wing, 1996).

Diagnosis

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), (American Psychiatric Association, APA, 1994) and ICD-10 (World Health Organisation, WHO, 1992, 1996) contain the classification PDD, which includes a range of disorders (see appendix 7.1), and of these, the most commonly diagnosed are ASD and AS. There are no 'tests' available that can diagnose ASD; instead diagnosis is based on interpretation of a child's observed and reported behaviours, using either the DSM-IV (APA, 1994) or ICD-10 (WHO, 1992, 1996). The full diagnostic

criteria for autism, according to ICD-10 (WHO, 1992, 1996) and DSM-IV (APA, 1994), are given in Appendix 7.1. These offer a description of behaviours and children are required to display a certain number of the behaviours from each category to be given a diagnosis. The main categories refer to impairments in social interaction, communication and imagination, and rigid, repetitive patterns of activities. These categories are often referred to as the triad of impairments, or Wing's triad, which consists of impairments in the following three areas, social development, language and imaginative play (Wing, 1996). Diagnosis of autism, Asperger's syndrome and other pervasive developmental disorders continue to be based on the interpretation of a child's observed and reported behaviours.

As mentioned earlier, Hans Asperger thought that infantile autism and Asperger's syndrome were different conditions, and in the diagnostic criteria they are described as distinct disorders. However, it has been proposed that that they are not distinct from one another and that they both fall at different places on the autistic spectrum. Wing (2000) claims that her purpose, when she published her first paper on Asperger's work (Wing, 1981), was to emphasise the possibility that Asperger's syndrome was not separate but part of the autistic spectrum, and that there are no clear boundaries separating them. Since then, however, autism and Asperger's syndrome have come to be understood as two separate disorders.

The other term that is frequently used in the literature is high functioning autism (HFA). There is a great deal of disagreement as to whether Asperger's syndrome

(AS) and HFA are, indeed, separate entities. Schopler (1996) surveyed fourteen authorities about this, and found that two felt AS and HFA are 'distinct disorders', six felt that the distinction is ambiguous, and six felt that they are not distinct developmental disorders. There still exists debate about the similarities and differences between autism, HFA and AS. There have been various studies to examine whether they can be distinguished from one another (Ozonoff, Rodgers and Pennington, 1991), but currently, the literature suggests that there is no meaningful difference between them.

Theories of Autism

Early explanations of autism described it as an emotional disorder caused by the coldness of the child's parents, (Wing, 1996). This had a huge impact on parents and families and the way the condition was viewed. This view implied that the parents were to blame, resulting in them not only having to cope with their child's behaviour but also the guilt that they were responsible for it.

It was not until the 1960s, when more was known about brain function and development, that alternative theories were suggested. This led to a more biological explanation of the disorder, and a move away from the idea that parents were to blame. In the 1970s and 80s, Kanner's autism started to be viewed much more as part of a wider autistic spectrum.

Theories of ASD currently fall into three broad categories: psychogenetic, biogenetic and cognitive. Psychogenetic theories argue that psychosocial processes are central in the aetiology of autism, whereas biogenetic theories look to biological factors as the basis for the condition. Cognitive theories are concerned with explaining the patterning of symptoms in terms of specific underlying cognitive deficits (Carr, 1999). Many studies have been carried out to examine the deficits associated with ASD.

In order to explain the deficits associated with ASD, a number of theories have been developed, which postulate that various cognitive mechanisms appear to be malfunctioning, giving rise to the symptomatology of ASD (Wahlberg, 2001). The predominant theories, which will be discussed in detail later, are theory of mind (ToM), weak central coherence (WCC) and impaired executive function (EF).

In summary, Leo Kanner (1943) and Hans Asperger (1944) were the first to publish papers describing autism and Asperger's syndrome. Although there is some controversy over whether or not these are different disorders or different presentations of the autistic spectrum, they have in common Wing's triad of impairments (Wing, 1996). The triad includes impairments in social development, language and imaginative play (Wing, 1996). The current prevalence is thought to be around 10-12 per 10,000 for ASD (Gillberg et al., 1991). Diagnosis of ASD can be difficult, but is currently given using the DSM-IV (APA, 1994) and ICD-10 (WHO, 1992, 1996). The theories of ASD fall into three main categories:

psychological, biological and cognitive. This thesis concentrates on the three cognitive theories of theory of mind (ToM), weak central coherence (WCC) and executive function (EF). The following sections will outline these theories, as well as examining emotion and language in relation to ASD.

1.3. Theory of Mind

Theory of Mind (ToM) can best be described as a person's ability to attribute mental states to others. It describes a person's ability to think about another person's mental state, i.e. their thoughts and beliefs. A distinction is often made between first and second order ToM. First-order ToM involves predicting someone else's mental state. Second-order ToM involves predicting one person's mental state about another person's mental state, for example, "Mary thinks that John thinks that...." ToM is often tested using standard false belief tests (Wahlberg, 2001), which are concerned with the desires and beliefs of another person. In these tasks, an individual is asked to predict a character's actions based on their beliefs, which is different from what the individual knows or believes. There are many different stories and variations, but the classic task is the Sally-Anne test. In this test, Sally puts a favourite object in a basket and goes away. While she is away, Anne moves the object from the basket to a box. The task is to work out where Sally will look for her object when she returns, the basket or the box. The individual must be able to reason out that Sally will believe the object is still in the basket, even though he or she themselves knows that it is in the box.

1.3.1. Autism and Theory of Mind

As discussed earlier, one of the key features of ASD is a difficulty in engaging in social communication (Attwood, 2000). Research suggests that one of the causes of social communication deficit in ASD, is a deficit in ToM. ToM has been much studied in relation to ASD, because it is considered to be key to an individual's ability to communicate effectively.

There has been a great deal of research to investigate the extent to which people with ASD possess ToM. Baron-Cohen, Leslie and Firth (1985) conducted a study using the Sally-Anne task and found that children with autism were unable to predict where Sally would look for the object that was moved in her absence, compared to matched controls of typically developing four-year-olds and children with Down syndrome.

An impaired ToM has been used to explain various symptomatologies associated with ASD, in particular the inability to share joint attention (Baron-Cohen, 1994), as well as deficits in imagination, communication and socialisation (Wing, 1996, Happé & Firth, 1996).

Bauminger & Kasari (1999) examined the link between children with ASD and performance on the false belief task. They found that high functioning children with autism did not differ from typically developing children in their performance on the

false belief task. Instead, they found that a high performance on the false belief task was related to high full scale and verbal IQ scores.

It has been suggested that it is important to consider cognitive theories, in addition to ToM, when analysing the performance of children with ASD on ToM tasks (Bauminger & Kasari, 1999). It goes on to propose that children with a diagnosis of ASD do not have a specific impairment in ToM, and that such impairments are not exclusive to ASD.

This was explored further by Kissgen & Schleiffer (2002), who tested the hypothesis that the ToM deficit is exclusive to autism, in a replication of the Sally-Anne Test, and they too found that it is not unique to autism. If the ToM hypothesis is to be accepted, as the primary deficit in ASD, it must be found consistently and be specific to ASD. If the ToM deficit is not specific to ASD, and is present in other populations without ASD, then it cannot fully explain the symptomatology observed in ASD.

Other studies have also shown that ToM deficits are not always apparent in high functioning autism (HFA) and Asperger's syndrome (AS) (Ozonoff, Rodgers & Penington, 1991; Bowler, 1992). However, this contrasts markedly with observed difficulties in everyday social situations.

Kaland et al. (2002) looked at theory of mind in ASD, using an advanced theory of mind test. This test used stories of everyday life to test the hypothesis that, although individuals with ASD can pass standard ToM tasks, this contrasts with their performance in more naturalistic settings. They assessed the ability of 21 children and adolescents with a diagnosis of AS to infer physical states and mental states on an advanced test of ToM, using stories of everyday life. The stories tested the child's ability to make an inference about a physical state (for example, the answer to the question *"How does Adrian's room look?"* would be *"Tidy"*), and ability to infer a mental state (for example, the answer to *"Why does Adrian say this?"* would be because he is being *"sarcastic"*), from the 'naturalistic' story context.

The group of children with a diagnosis of Asperger's syndrome had more problems attributing mental state inferences (e.g. sarcastic), compared to the control group of typically developing children. They performed better on tasks involving physical states (e.g. tidy), but still less well than controls. The overall conclusion was, again, that children with ASD have an impaired ToM and that, although children with AS had been able to pass previous ToM tasks by working the answer out, they found the task more difficult when the it was more naturalistic.

Heavey et al. (2000) also used an advanced ToM task, designed to approximate the demands of real-life ToM in individuals with autism. Short clips of film were presented, showing characters in social situations, with participants required to answer questions on characters' mental states. When compared with control

participants, adults with AS and HFA were the most impaired in their ability to answer questions requiring ToM ability.

In summary, early research has suggested that individuals with a diagnosis of ASD are impaired at passing false-belief tasks and, therefore, have an impaired ToM (Baron-Cohen, Leslie and Firth, 1985). This has been used to explain various symptomatologies associated with ASD, for example, the inability to share joint attention (Baron-Cohen, 1994), imagination, communication, and socialisation deficiencies (Wing, 1996; Happé & Firth, 1996). More recent research has shown that individuals with a diagnosis of HFA and AS can pass standard false belief tasks, suggesting that a ToM deficit is not specific to ASD (Bauminger & Kasari, 1999). This, however, does not fit with performance in naturalistic social settings. Other researchers have explored this by using advanced ToM tests, finding that individuals with a diagnosis of HFA and AS are impaired, compared to controls, at passing advanced ToM tasks (Heavey et al., 2000). The following section begins to look at the links between ASD, ToM and language ability.

1.4. Language Ability and Theory of Mind

Research has looked at the relationship between ASD, ToM and language ability. Some researchers have hypothesised that children with ASD perform badly on ToM tests, not because they have a specific impairment in ToM, but because they have impaired language abilities (Senju, 2002). A number of pieces of research have suggested that an ASD-diagnosed child's grammar and vocabulary are closely linked

to their performance on ToM tasks (Tager-Flusberg, 2000). Longitudinal studies have shown similar results, with respect to typically developing children, which would indicate that language is related to the development of ToM, irrespective of an ASD diagnosis (Astington & Jenkins, 1999).

Some researchers have argued that tests used to assess ToM are too verbally demanding, and that links found between ToM and ASD, might be a result of flaws in design of the tasks (Senju, 2002). This would suggest that the poor performance of children with ASD, in previous research, has been due to the verbal demands of the tasks.

An early study by Perner et al. (1989) examined the ToM abilities of children with ASD and children with a Specific Language Impairment (SLI). They found that 80% of children with an SLI were able to pass the ToM task, compared to 20% of children with a diagnosis of ASD. These results suggest that ToM ability is unrelated to language ability.

The link between language abilities and ToM has also been examined in deaf children (Peterson et al. 2000). This research found that deaf children from hearing families were likely to be delayed in acquiring ToM, while deaf children from signing families were not. This suggests that those children exposed to sign language from an early age developed ToM, but that those not exposed to language, because they were from a non-signing family, had a deficit in ToM. These results

support the hypothesis that ToM is linked to language ability, but suggest that this may be due to early language exposure, rather than current language ability.

Watson, Painter & Bornstein (2001) suggested that early language ability is predictive of later ToM ability. In their study, they tested children's language competence at 24 months of age and then carried out tests of their ToM abilities at 48 months. Children's language skills at aged 24 months, predicted their performance on a ToM task at 48 months. These findings suggest a relationship between early language and later acquisition of complex concepts such as ToM. This indicates that impairment in ToM may be explained by a lack of, or delayed development of, early language or by a lack of exposure to early language, rather than current speech and language difficulties. This could explain the results found in the Perner et al. (1989) study. However, this would contradict the ICD-10 (WHO, 1992, 1996) and DSM-IV (APA, 1994) criteria for AS, which say that there should be no clinically significant delay in language development for the diagnosis. Jackson (2001) went on to examine the relationship between ToM performance and receptive language in deaf and hearing children. He found that language ability correlated positively and significantly with ToM ability, again suggesting that early exposure to, or experience of, language is predictive of subsequent ToM performance.

There is a lack of research interest in the developmental change in ToM abilities of children with ASD. Two longitudinal studies have looked at the development of ToM abilities in children with a diagnosis of ASD. Holroyd & Baron-Cohen (1993)

examined ToM ability in children with a diagnosis of ASD in 1983 and again in 1990-1991: a seven-year follow-up. They found no difference in the number of children who passed ToM tasks over the seven years, suggesting that there was no developmental change in their ToM abilities. Likewise, Ozonoff & McEvoy (1994) researched changes in ToM abilities, in seventeen children with a diagnosis of AS, over a three-year period, and again observed very little improvement in ToM abilities.

Steele, Joseph & Tager-Flusberg (2003) re-examined development of ToM abilities in children with ages ranging from 18 months to early adolescents. Their IQ, language ability and ToM ability were tested and then re-tested at a one-year follow-up. They found that in 21% the ToM score decreased; in 9% it stayed the same and in 70 % the score increased. They correlated the ToM scores at time 1 and time 2, with age, IQ and language ability, in order to investigate which variables predicted the child's ToM score. The results showed that developmental improvement in ToM ability was related to an increase in language abilities, as measured by the Peabody Picture Vocabulary Test, Third Edition (PPVT-III) (Dunn & Dunn, 1997) and the Expressive Vocabulary Test (EVT) (Williams, 1997).

Some studies suggest that children with ASD have a specific impairment in acquiring terms that refer to mental states (Hobson & Lee, 1989; Tager-Flusberg, 1992). These findings would fit with the view that ToM deficits underlie the language difficulties associated with ASD. The particular aspects of language, found to be impaired in

ASD, are those that require an understanding of the mental state of the listener, particularly their knowledge or belief states.

The speech and language characteristics associated with ASD suggest a pattern in which some abilities are spared and others impaired, and this appears to relate to ToM. ToM is necessary in order to be able to interpret and describe the beliefs and intentions of characters in storytelling (Ashington, 1990; Bruner, 1986). The language and communication of individuals with a diagnosis of ASD could be explained by their having a core difficulty in ToM.

In summary, a link between language development and ToM has been determined (Tager-Flusberg, 2000). Research has shown that children with language impairment perform significantly better than children with a diagnosis of ASD on ToM tasks, suggesting that ToM ability is not related specifically to language ability (Perner et al. 1989). Research has gone on to suggest that early exposure to language is predictive of later ToM ability (Peterson et al. 2000; Watson et al. 2001; Peterson & Siegal, 1995; Jackson, 2001). Finally, there is conflicting research about whether ToM improves developmentally. Steele et al. (2003) found developmental improvement of ToM, which was related to developmental improvements in speech and language ability. Other studies have found no developmental improvement in ToM (Holroyd & Baron-Cohen, 1993; Ozonoff & McEvoy, 1994). The following

section will focus on the role that impairments in language abilities have on the social interactions of children with ASD.

1.5. Language abilities and social interactions

As noted earlier, one of the key diagnostic features of autism includes 'qualitative impairments in communication' (DSM-IV, APA, 1994). The social interactions of children with ASD are affected by the social deficits at the core of ASD (Tager-Flusberg, 2001). Children with ASD have well-documented problems with verbal and non-verbal communication, one aspect of which is pragmatic communication (Mundy, Sigman & Kasari, 1990, 1993).

1.5.1. Pragmatic Communication

Pragmatics refers to the social use of language. It is defined as 'the selection of the appropriate message or interpretation, in relation to the communicative context' (Bishop, 1997). Roth & Spekman (1984) described pragmatic communication as being at 'the interface of social, cognitive and linguistic knowledge'. Crystal (1987), described pragmatic communication as 'the assumptions that people make when they communicate, the intentions underlying what they say, the way context influences the amount they say or the way they say it, the turn-taking which makes a conversation run smoothly, and the appropriateness of the subject matter to the situation'. Children with specific pragmatic disorders show significant difficulty

with these aspects of communication, compared to other aspects of the language profile, for example, phonology, grammar, word knowledge or word finding abilities.

Three main areas of communication appear in the definitions of pragmatics:

- interactive process of communication
- selection and organisation of information/ideas within the communicative context.
- comprehension of meaning open to interpretation.

(Rinaldi, 2000)

Pragmatics represents the aspects of language that are, in essence, related to communication and are, therefore, social. Individuals with ASD have been shown to have core social deficits (Wing, 1988), and it is thought that the social difficulties originate from this core deficit in pragmatic communication (Rinaldi, 2000). Wetherby (1986) suggested that the language impairments observed in children with ASD are all related to the social, rather than regulatory, uses of language. For example, in comparison with children with Down syndrome, children with autism rarely communicate about an object that is the focus of their mother's attention (Rollins, 1994). Also, children with ASD use fewer affirming or agreement utterances than children with a specific language impairment (Loveland, 1988).

Tager-Flusberg & Anderson (1991) looked at the deficits in the conversational ability of children with autism. They compared children with ASD and children with Down syndrome on their ability to maintain a conversational topic. When the children's mothers introduced a topic, the children with ASD often did not respond to their mother about the relevant topic and would instead introduce irrelevant comments. On the occasions that the children with a diagnosis of ASD did respond to the topic appropriately, they did not expand on the information already given by their mother.

There has also been research looking at more advanced language skills, in particular narrative skills. Loveland et al. (1990) asked individuals with autism and Down syndrome, matched on chronological and verbal mental age, to retell a story they were shown in the form of a puppet show. Compared to children with Down syndrome, children with autism showed more problems with pragmatic communication, in non-verbal communication, an increase in bizarre or inappropriate utterances, and poorer ability to take into account the listeners' needs

Tager-Flusberg (1995) set children the task of narrating a story from a book of pictures. She compared the narration of ten children with a diagnosis of ASD, with that of ten children with a learning disability and ten typically developing children. These three groups were matched for verbal mental age. She found that the children with ASD tended to tell shorter stories, with less detail. Some of the children with

ASD did not even interpret the pictures as a story and simply described each picture, independently of the others.

Loveland et al. (1989) found that individuals with ASD perform significantly poorer than controls on tasks in which they have to communicate something that only they know to a listener. Paul & Cohen (1984) found that children with a diagnosis of ASD also find it difficult to respond to a request for further information, for example, about a story.

All of the above research indicates that people with a diagnosis of ASD have deficits in conversational discourse and narrative, which appears to be related to the social deficits observed in children diagnosed with ASD. In summary, Tager-Flusberg (2001) suggests that, although children with a diagnosis of ASD have language difficulties, their structural language, i.e. phonological, lexical-semantic and grammatical aspects of language, are less affected than the social aspects of language, such as pragmatic communication.

1.5.2. Pragmatic communication, Theory of Mind and ASD

This section will begin by looking at the links between pragmatic communication, ASD and ToM. There is only a limited amount of literature on pragmatic communication and ASD. Pragmatic aspects of language development have been

shown to be closely tied to development in children's ToM (Locke, 1994; Tager-Flusberg, 1993). Since children with ASD have deficits in ToM, it is not surprising that researchers have identified pragmatics as the most impaired aspect of language in autism (Tager-Flusberg, 2001). It has been suggested that children with a diagnosis of ASD are deficient in pragmatic communication, due to their inability to understand the mental states of others, i.e. ToM (Baron-Cohen, 1988; Tager-Flusberg, 1993).

Shyu et al. (2001) investigated the processes underlying the language profile seen in autism, which, as we have already seen, is described as having weak functional and social language (semantic, discourse, and pragmatic processing deficits), compared to structural language (phonology, vocabulary and syntax). They found that the ASD group showed a deficit in pragmatic communication skills, and that their performance on pragmatic communication skills tasks was best predicted by their performance on ToM tasks. This suggests that a deficit in ToM was predictive of a deficit in pragmatic communication skills, indicating a link between ToM and pragmatic communication (Shyu et al. 2001).

Research suggests that individuals with ASD have a deficit in pragmatic communication, and that this explains the social deficits observed in ASD (Rinaldi, 2000). Further research has examined this by comparing individuals with semantic-pragmatic disorder (SPD) to individuals with ASD (Rinaldi, 2000). SPD is a disorder that is characterised by unusual word choices and pragmatic deficits rather

than phonology and syntax, which is similar to the language profile observed in children with a diagnosis of ASD (Szatmari, 1998). Researchers have investigated the overlap between SPD and ASD. Early research suggested that those children with a diagnosis of SPD have similar social deficits to those observed in ASD (Bishop & Rosenblum, 1987). It was suggested that SPD was, in fact, another label for ASD. However, Bishop (1989) later concluded that children with SPD did not meet the diagnostic criteria for ASD. Pragmatic impairments have been observed in children with ASD, but they have also been observed in children who do not have social deficits. This suggests that the pragmatic impairments observed in children with ASD are not the cause of their social deficits.

It was Rapin & Allen (1987) who classified semantic-pragmatic syndrome, which later became semantic-pragmatic disorder (SPD: Bishop, 1989). Currently, however, semantics is considered separately to pragmatics when looking at a child's language profile, as it is felt that the two areas, semantics and pragmatics, cannot be linked in this way (McTear & Conti-Ramsden, 1992). Some children described as having semantic-pragmatic disorder have been described as having 'sophisticated vocabularies' (Rapin & Allen, 1987), suggesting that semantics is a relative strength. This, therefore, calls into question the value of the term SPD. Rinaldi (2000) supports this view, saying that the term SPD 'obscures the nature of the difficulty it represents'. The semantic difficulties, noted in the original description of SPD (Rapin & Allen, 1987), are related to the pragmatic use and understanding of vocabulary in context, rather than difficulties with word-retrieval or word learning,

i.e. there are children whom present with specific pragmatic language impairment (PLI), but not SPD.

In summary, the above research demonstrates that individuals with ASD have specific deficits in language and communication, in particular the more social aspects of communication, for example, pragmatic communication (Mundy, Sigman & Kasari, 1990, 1993). Tager-Flusberg (2001) suggests that in children with a diagnosis of ASD communicative and pragmatic language are relatively more impaired than their phonological, lexical-semantic and grammatical language skills. Pragmatics is the part of language that represents its social and communicative aspects. It has been suggested that the social difficulties observed in children with ASD stem from a deficit in pragmatic communication (Rinaldi, 2000). Pragmatic aspects of language development have been shown to be related to developments in children's ToM (Locke, 1994; Tager-Flusberg, 1993). It has also been suggested that impairment in pragmatic communication is linked to impairment in ToM (Baron-Cohen, 1988; Tager-Flusberg, 1993). Shyu (2001) also found that individuals with a diagnosis of ASD showed a deficit in pragmatic communication and that their performance on pragmatic communication skills tasks was best predicted by their performance on ToM tasks. This suggests a link between ToM and pragmatic communication (Shyu, 2001).

Further research has explored the suggestion that the social deficits observed in ASD originate from pragmatic communication impairments. This has been investigated

by comparing individuals with ASD to individuals with SPD (Bishop, 1989). Individuals with SPD do not always have the social deficits observed in ASD. Therefore, impairment in pragmatic communication alone is not sufficient to explain the social deficits in ASD.

More recent research has gone on to suggest that SPD is not a useful term. Rinaldi (2000) is in agreement, stating that the term SPD, 'obscures the nature of the difficulty it represents.' In order to examine the social deficits observed in individuals with ASD the following section will focus on ASD and emotion.

1.6. ASD and Emotion

An inability to identify both one's own and others' emotions can be very damaging to social relationships (Eisenberg, 2000; Keltner & Buswell, 1997). For example, we use emotions such as embarrassment and shame to recognise whether or not we have offended somebody. Without the ability to appreciate our own or other people's emotions, it is inevitably difficult to function socially in society (Keltner & Kring, 1998).

Children with ASD have been shown to have deficits in emotional recognition - the ability to recognise emotion in others. Emotional recognition involves the ability to understand the various expressions of emotions in facial, gesture, and verbal display

and to be able to do so in context (Hobson, 1986; Ozonoff, Pennington & Rodgers, 1990).

Tasks designed to measure emotion recognition abilities have been used in many studies to compare the performance of individuals with ASD with that of controls. There have been several main conclusions from these studies. The first is that, although people with ASD have been shown to have a deficit in ToM and emotional recognition, this deficiency is not exclusive to this group. Other groups have also been shown to be deficient in emotional recognition, for example, individuals with ADHD (Buitelaar et al. 1999), a learning disability (Yirmiya & Shulman, 1996) and those who are deaf (Peterson & Siegal, 1995).

Originally it was thought that ToM and emotional recognition were mutually exclusive (Baron-Cohen, 1988), however, recent studies have reported significant positive correlations between ToM and emotional recognition in children with ASD (Buitelaar & Van der Wees, 1997; Ozonoff, Pennington & Rodgers, 1991).

More recent studies have also supported the link between ToM and emotional recognition. Heerey, Keltner & Capps (2003) aimed to link ToM with the recognition of one's own emotions - self-conscious emotional recognition. They found that children with autism performed more poorly than controls when required to identify their own emotions; however, they did not differ from controls in their ability to recognise other people's emotions. Heerey et al. (2003) claimed that these

findings suggest that deficits in the recognition of one's own emotions are linked to ToM ability. A significant relationship was found between self-conscious emotion recognition and ToM (Heerey et al. 2003).

Heerey et al. (2003) used responses to photographs of facial expressions to assess emotional recognition; a limitation of this study is that they only used one photo of each facial expression. These findings need to be reassessed to see if the children with ASD still have difficulty judging emotional displays when using other photograph sets, with more than one photograph of each facial expression.

Studies that have examined the correlates of emotional recognition performance among children with ASD provide confusing results. In one study, Verbal IQ, Performance IQ, EF, verbal memory and chronological age were not found to predict success on emotional recognition tasks (Ozonoff et al. 1991). By contrast, another study found that the quality of empathic understanding and emotional perspective taking in children with a diagnosis of HFA showed significant positive correlations with Verbal IQ and Full-scale IQ (Yirmiya, Sigman, Kasari & Mundy, 1992).

Children with ASD have been shown to have deficits in understanding and recognition of emotions (Hobson, 1986; Ozonoff, Pennington & Rodgers, 1990). In individuals with Asperger's syndrome (AS) and HFA, emotion-related deficits are not general and appear to be specific. For example, some research has found that

children with a diagnosis of HFA and AS have the ability to recognise simple emotions when prompted, e.g. happy, sad, afraid (Capps et al. 1992; Ozonoff et al. 1990). However, they do still tend to ignore the emotions in social situations (Hobson, 1986).

Dissanayake & Macintosh (2003) investigated the link between ToM and social functioning in children with autism. They used the parent version of the Vineland Adaptive Behaviour Scale (VABS; Sparrow, Balla and Cicchetti, 1984) and naturalistic observations to assess children's spontaneous social interactions with their peers in the school yard. Children's social skills were rated both by their parents and teachers using Gresham and Elliot's (1990) Social Skills Rating System (SSRS). They found similar performances in children with high functioning autism and children with Asperger's syndrome on the social functioning measures, both were impaired in their social functioning compared to the typically developing children. They also found no relationship between ToM and the social functioning in any of the participants.

Averill (2000) examined the relationship between emotion perception and ToM in children with autism. Children diagnosed with ASD were individually matched to non-autistic control participants on the basis of chronological age and nonverbal mental age or verbal mental age. Averill used a test battery, which included the Facial Discrimination Task - Matching (FDT-M) and four standard first-order theory of mind tasks. The results indicated that, compared to both control groups, autistic

children did not demonstrate a specific impairment in emotion perception, but more global deficits across the facial discrimination task (FDT). This suggests that children with a diagnosis of ASD have a deficit in face processing rather than emotional recognition per se.

Other studies support the suggestion that children with a diagnosis of ASD may have difficulty understanding emotions, particularly complex emotions such as surprise, (Baron-Cohen, Spitz & Cross, 1993). In summary, the difficulty of children with a diagnosis of ASD to identify their own and others' emotions has broad consequences, disrupting their relationships and social interactions. Research has shown that children with ASD have deficits in emotional recognition tasks, compared to controls, and this has been linked to ToM (Buitelaar et al. 1997; Ozonoff et al. 1991; Heerey, 2003). Recent studies have found significant positive correlations between ToM and emotional recognition in children with ASD (Buitelaar & Van der Wees, 1997; Ozonoff, 1991). Studies examining the other correlates of emotional recognition produce confusing results. In some, non-verbal and verbal IQ correlate with performance (Yirmiya et al. 1992), whilst, in others, no correlations were found (Ozonoff et al. 1991). Some researchers have found verbal memory to predict performance on emotional recognition tasks (Buitelaar et al. 1999), while others have found no such link (Ozonoff et al. 1991). Although there is some disagreement about the correlates of emotional recognition, studies have consistently found a correlation between emotional recognition and ToM in children with ASD.

The ToM hypothesis is especially persuasive, because it appears to be able to explain the social and communicative deficits in children with a diagnosis of ASD. It does not, however, currently offer an explanation for other behaviours observed in individuals with a diagnosis of ASD. For example, there is limited research linking ToM with repetitive stereotype behaviour and need for rigid routines, observed in children with ASD (DSM-IV, APA, 1994). Repetitive behaviour is an area that has received little attention, even though it appears in the diagnostic criteria for autism and Asperger's syndrome (DSM-IV, APA, 1994). This lack of interest could be due to a belief that this behaviour is not specific to ASD, and that it is related to a developmental delay, however, there is some research to demonstrate that children with high functioning autism still display some repetitive behaviours (Bartak & Rutter, 1976). This suggests that the repetitive behaviour is not linked to a general developmental delay. Other work has suggested that the repetitive behaviours observed in ASD are qualitatively different from those observed in other disorders (Turner, 1999).

Baron-Cohen (1989) does suggest that deficits in ToM make the social world of the child so unpredictable that the child develops non-functional routines as a way of making the unpredictable predictable. Baron-Cohen (1989) and Carruthers (1996) suggest that individuals with a diagnosis of ASD find social situations unpredictable because of their limited awareness of other people's mental states, due to ToM deficits and, therefore, engage in repetitive behaviours as a way of imposing control.

A clear prediction here is that these behaviours should increase with increased social demands. However, repetitive behaviours have been found to appear less frequently during periods of social interaction, than in periods when the individual is alone (Clark & Rutter, 1981; Dadds et al. 1988). If repetitive behaviour is a method of imposing control, then you would expect to see it increase in social situations.

The ToM deficit is not specific to ASD, and in some cases this ability has been found to be intact in children with a diagnosis of AS (Bauminger & Kasari 1999). There are, however, other cognitive theories that have been postulated to explain the strengths and deficits found in children with a diagnosis of ASD. The following sections go on to discuss two of these, namely, weak central coherence and executive dysfunction.

1.7. Weak Central Coherence

There has been a great deal of interest in the cognitive style of individuals with autistic spectrum disorder, to try and explain the strengths and deficits that characterise the disorder. These cognitive theories are, ToM, which we have already looked at, weak central coherence and executive dysfunction. This section will concentrate on weak central coherence (WCC).

Weak Central Coherence (WCC) is a theory that has been postulated to explain various symptomatologies associated with ASD (Happé, 1997). This theory

proposes that individuals with autism have a weak drive for central coherence. Central coherence is a processing style that allows us to attend to incoming information and its context as a whole, rather than in its parts, which is essential to general information processing. Firth (1989) states that the underlying cognitive deficits associated with ASD are caused by a failure to process information for meaning, i.e. a failure to use the context.

Hermelin & O'Connor's (1967) work is thought to support the WCC hypothesis. They found that those individuals with a diagnosis of autism were no better at recalling sentences than word lists, whereas controls were more able to recall sentences than word lists. This suggests that the individuals with autism did not gain the usual benefit from the meaning of the whole and concentrated on the parts.

Shah & Firth (1993) further demonstrate WCC, using the Wechsler Intelligence Scales for Children, block design subtest. They showed that individuals with a diagnosis of ASD were better at this subtest than controls. They suggested that this could be explained by WCC, because individuals with a diagnosis of ASD see the design in its constituent parts, rather than as a whole. When the figures were presented so that the individual blocks needed to make the pattern were highlighted, rather than the participants having to work out which blocks were needed, the controls then performed as well as the ASD individuals. The performance of the individuals with a diagnosis of ASD was not altered by this change, suggesting that

they were able to do the task without the need for highlighting, adding further support to the WCC hypothesis (Shah & Firth, 1993).

Happé & Firth (1996) found further evidence for WCC in their more recent study. They gave individuals with a diagnosis of ASD and control group participants paragraphs to read that were either meaningful or not meaningful. They then asked participants to recall either the text or the meaning from the text. Happé & Firth (1996) found that those individuals with a diagnosis of ASD could recall the text verbatim, but could not give the meaning. While the control participants could not recall the text verbatim, but they could remember the gist. Interestingly, the recall of the individuals with a diagnosis of ASD for meaningful and meaningless texts was equal. Control participants without a diagnosis of ASD were, however, better at recalling the meaningful texts than the meaningless texts. Happé and Firth (1996) suggested that the reason the individuals with ASD could recall the text verbatim was because the individuals with ASD were able to attend to the parts, i.e. the words, rather than being distracted by the meaning, i.e. the whole. This meant, however, that they were unable to give the gist of the story. Also, because they did not attend to the whole, the gist of the passage, their performance was not influenced by whether the passages were meaningful or meaningless, unlike the control participants.

Happé (1996) asked individuals with ASD to make judgements about visual illusions. She hypothesised that, if children have weak central coherence, then they

would focus on the part to be judged, rather than on the picture as a whole, and would, therefore, not be fooled by the illusion. She found that individuals with a diagnosis of ASD were more able than controls to make accurate judgements about the illusions (Happé, 1996).

It is possible that the difficulty individuals with ASD have in comprehending certain aspects of language may not stem from ToM difficulties, but from this inability to use context to derive meaning. Firth (1989) described central coherence as a system that integrates incoming information into a whole. If an individual has a WCC, they attend to small parts of the information, instead of processing it collectively. It is argued that this affects the way that language is processed, because it is processed in fragmented pieces. Language relies on context in order to be clearly understood (Prutting, 1982) and, therefore, language should be one of the first things to suffer if an individual has a WCC.

WCC is, hence, a basic processing style that seems to affect a range of tasks, such as visual illusions and pragmatic understanding. Although the WCC theory may appear to offer an account of some of the ToM and pragmatic deficits found in ASD, there are studies that criticise this theory. Replication of some studies has been unsuccessful. Repor & Mitchell (1999, 2001) attempted to replicate Happé's (1996) findings on visual illusions, but were unsuccessful and, in fact, findings suggested that individuals with ASD are susceptible to visual illusions (Ropar & Mitchell, 1999, 2001). Mottron et al. (1999) tested the WCC theory and found that individuals

with ASD could process information in a holistic way, which contradicts the prediction of WCC.

Martin & McDonald (2004) examined two hypotheses relating to WCC and ToM, to account for pragmatic difficulties in individuals with ASD. As already discussed, individuals with Asperger's syndrome are often noted to have intact structural language ability, yet fail to use this language effectively in a social setting. This difficulty using language in a social context has been referred to as a deficit in pragmatic language. The aim of Martin & McDonald's (2004) study was to investigate the causes of pragmatic deficits in individuals with AS. They found evidence that was consistent with both the WCC and ToM hypotheses. For example, they found that individuals with AS processed puzzles in a local manner and failed to use the context or meaning in putting together the puzzles; they have suggested that this demonstrates a deficit in central coherence. They also found that individuals with AS have difficultly in making inferences about the mental states of others, supporting the ToM hypothesis. Martin & McDonald (2004) aimed to examine the link between WCC, ToM and pragmatic communication. Their results suggested that WCC was not related to pragmatic communication or, indeed, ToM.

In summary, the WCC hypothesis is understood as a basic processing style that affects how individuals process incoming information. If an individual has a WCC, they tend to focus upon details, whilst neglecting the context, and they, therefore, do

not attend to all of the information collectively. This is thought to affect pragmatic communication. Studies using visual illusions, stories and puzzles have been used to give a convincing demonstration of WCC in individuals with a diagnosis of ASD (Happé et al. 1996; Shah & Firth, 1993; Happé & Firth, 1996). Although the WCC theory may appear to give a good explanation of the ToM and pragmatic deficits found in ASD, some studies have been unsuccessful in finding the same results. When researchers attempted to replicate Happé's (1996) findings on visual illusions, they were unsuccessful (Ropar & Mitchell, 1999, 2001; Mottron & Burack, 1999). Finally, the aim of Martin & McDonald's (2004) study was to investigate the correlates of pragmatic communication in individuals with AS. They found evidence to support both the WCC and ToM hypotheses, but their results suggested that WCC was not linked to pragmatic ability or ToM. As a cognitive theory of ASD, research into WCC has yielded conflicting findings and there still remains controversy regarding the existence of WCC and which strengths and weaknesses it might explain. The following section looks at one of the other cognitive theories used to explain some of the strengths and deficits found in children with a diagnosis of ASD, executive function (EF).

1.8. Executive Function

Executive function (EF) encompasses a range of behaviour, from very broad to very specific. It is an abstract term and it is therefore difficult to find specific EF tests (Archibald & Kerns, 1999). EF has become an umbrella term that encompasses a number of sub-domains, which include: set shifting, hypothesis generation, problem

solving, concept formation, abstract reasoning, planning, organisation, goal setting, fluency, working memory, inhibition, self monitoring, initiative, self control, mental flexibility, attentional control, anticipation, estimation, behavioural regulation, common sense, and creativity. Most executive processes are goal-directed and future-orientated (Welsh & Pennington, 1988). A number of proposed definitions of EF overlap, whilst remaining distinct. For example, Luria (1993) suggests that EF involves 'maintaining an appropriate set', which allows future goals to be achieved. Welsh et al. (1991) argue that EF is not only a tool for impulse control, strategic planning and organised search, but also allows for flexibility of cognition and behaviour. Gioia et al. (2000) also emphasise the role of emotion regulation, as well as the involvement of processes to manage thoughts and actions in active, novel and problem-solving situations. EF is not one unitary system, but is rather a collection of tools for aiding 'goal-directed activity'.

Originally, EF was used to explain deficits found in patients with frontal lobe damage and has since developed into a broadly defined concept (Ozonoff & McMahon-Griffith, 2000). Damage to the frontal lobes results in behaviour similar to that observed in individuals with a diagnosis of ASD. These include repetitive movements and speech, lack of insight, social isolation, lack of appreciation of social rules (Damasio & Van Hoesen, 1983; Stuss & Benson, 1986), impairment in communication, such as an inability to initiate conversation or a tendency to engage in lengthy monologues (Duncan, 1986). However, there is no evidence to suggest that these common behaviours originate from the same neurological deficit, as a

number of different areas of the brain are involved in EF (Ozonoff, 1998). The following section examines some of the research that has been prompted by the similarities between behaviours observed in children with a diagnosis of ASD and those with EF deficits.

1.8.1. ASD and Executive Function

Recent investigations in cognitive neuropsychology have identified a pattern of cognitive impairments in ASD that appear to reflect deficits in EF. For example, children with a diagnosis of ASD often display rigid and inflexible behaviours and often focus on one narrow interest or repetitively engage in stereotyped behaviours. In addition, they do not appear to be future orientated, and have difficulty anticipating consequences of behaviour. As a result, they often experience difficulty self-reflecting and self-monitoring. Children with ASD can also be uninhibited and are frequently impulsive in their actions (Ozonoff, 1991).

Rumsey (1985) used the Wisconsin Card Sorting Task (WCST, Grant & Berg, 1948), which is widely used to measure EF, to compare the performance of men of normal intelligence with a childhood diagnosis of autism to a control group, which was matched for gender, age and IQ. The research showed the autistic group to be more perseverative in attempting the WCST, than the control group. Prior and Hoffman (1990) used a variety of EF tests, including the WCST, to compare children with a diagnosis of ASD to matched controls and, again, found that children with ASD performed more poorly than the controls.

Liss et al. (2001) examined children with high functioning autism and developmental language disorder. These children were tested using a variety of EF tests. A significant difference was found between the two groups on the perseverative errors on the WCST (Grant & Berg, 1948), but not on any of the other tests of EF. The significant difference between the groups on the perseverative errors was not significant when verbal IQ was partialled out. They found a relationship between EF, adaptive functioning, measured using the Vineland Scales of Adaptive Functioning (Sparrow et al. 1984), and autistic symptomatology, measured using Wing Diagnostic Symptom Checklist, in those children with high functioning autism. They also found, however, that these relationships were no longer significant once the variance, due to verbal IQ, was accounted for. This suggests that EF deficits could be merely due to verbal IQ, rather than EF deficits per se.

As has already been observed in previous sections, children with a diagnosis of ASD often have language difficulties. It has been suggested that patients with damage to the prefrontal cortex, an area of the brain that is crucial to EF, have a lack of spontaneous speech, (Alexander, Benson, & Stuss, 1989) as is often observed in children with a diagnosis of ASD.

Some researchers have hypothesised that difficulty with cognitive shifting may be behind the problems that individuals with ASD experience when shifting from initial literal interpretations of language, to the less apparent, but more appropriate, non-

literal interpretation (Teunisse et al., 2001). For example, figures of speech, such as "It's raining cats and dogs" and "You're pulling my leg" are most confusing if taken literally. It is suggested that individuals with ASD find such language problematic because they find it difficult to make frequent shifts, from the literal interpretation of language to the non-literal interpretation, within a conversation.

Links have also been made between EF and the imitation deficits in ASD, with the suggestion that poor imitation reflects impaired executive control of action (Smith & Bryson, 1994). Findings also suggest that impaired imaginative activity might reflect a lack of executive control, because research has shown that imaginative play in children with a diagnosis of ASD improves significantly when the demands for spontaneity and flexibility are reduced (Lewis & Boucher, 1988), however, it could be argued that such play could not be truly imaginative.

Both the ToM and WCC hypotheses both fail to adequately explain repetitive behaviour in ASD. There is some research that supports the possibility that a deficit in executive function can explain repetitive behaviour. A primary impairment in executive function could explain why such behaviours are so prevalent, pervasive and persistent in ASD. Turner's studies (1997, 1999) confirm that a deficit in executive function is associated with everyday problems of repetitive behaviour. There are good grounds for the view that executive function could play a direct and important role in the repetitive behaviour.

Ozonoff, Pennington & Rogers (1991) investigated the relationship between EF, emotional perception and theory of mind. Concurrently, research was suggesting a link between such deficits and the core impairments in autism. To measure emotional perception they used photographs of faces and to examine EF they used the Tower of Hanoi and the WCST, and control tasks. Results showed that the children with a diagnosis of ASD performed significantly worse than the control group in EF, ToM, and emotional perception, as well as in the verbal memory domain, which was not predicted. The ASD group performed equally as well as controls on control tasks, indicating that the autistic group had selective impairments in these domains. Although 56% of the ASD group failed the ToM tasks, 15% of the control group also failed, supporting previous research findings that such deficits are not specific to ASD. However, in the EF tests, nearly two standard deviations separated the lowest scoring ASD participant from the lowest scoring control. In summary, this study found that individuals with a diagnosis of ASD have selective deficits in EF, ToM, emotional perception and verbal memory. However, the universality of the EF deficits, found in this study, suggested that executive dysfunction may be a primary deficit of ASD, as opposed to ToM.

The relationship between these two deficits is currently unknown and further research is needed to examine the links between them. However, the work of Ozonoff et al. (1991) would suggest that the EF deficit is primary to the ToM deficit. If executive dysfunction theory is to provide a convincing alternative to the theory of mind view of ASD, it needs to demonstrate similar associations between executive

deficits and social and communicative functioning that are so centrally defining of the disorder, as well as the other associations already discussed.

The absence of joint attention is a primary feature of ASD, and has been referred to as 'the cornerstone of social development and communication' (Baron-Cohen, 1994). For example, often infants with ASD do not make eye contact, do not point for shared attention and do not bring things to caregivers to show them. Recent findings suggest that difficulties in rapid shifting of attentional focus may contribute to the problems of joint attention (Burack, 1994). On a test of cognitive flexibility, joint attention was correlated to performance in children with ASD (McEvoy et al. 1993). As previously mentioned, EF is thought to be associated with the prefrontal cortex. Research has shown that in children with lesions in this area, joint attention impairments are associated with the extent of damage to the prefrontal cortex (Caplan et al. 1993). However, it is unclear as to what extent executive dysfunction contributes to impairments in joint attention in individuals with a diagnosis of ASD.

Increased structure in the environment of children with a diagnosis of ASD has been shown to result in less stereotypic and more social behaviours (Clark & Rutter, 1981; Schopler & Olley, 1982: Dadds, Schwartz, Adam & Rose, 1988). It is suggested that, by increasing the structure, the EF demands placed on the children are reduced, therefore, reducing the behaviours associated with executive dysfunction.

Two longitudinal studies of high functioning adolescents with autism demonstrate that performance on a standard executive test (WCST, Grant & Berg, 1948) is a highly effective predictor of the emergence of social understanding (Berger, van Spaendonck, & Horstinck, 1993), and social functioning in adulthood (Szatmari, Bartolucci, & Bremner, 1989). These studies indicate that executive functions may contribute to social ability across the entire developmental span in individuals with ASD. The influence of EF on social skills may, not only enable individuals to engage directly in social interactions, but may also indirectly aid the development of more advanced social skills. Alternatively, the relationship between EF and social and communicative skills may be mediated by underlying associations with ToM development.

Work with young typically developing children provides considerable evidence that ToM and EF performance are closely associated (Hughes, 1998a, 1998b; Moore 1996; Russell et al. 1991). This association is also significant for high functioning individuals with autism (Ozonoff et al. 1991). The association has been interpreted in a number of different ways. Two of these views assume a functional link between ToM and EF, with Pacherie (1997) and Russell (1996), arguing that EF is necessary for the development of mental-state concepts. Alternatively, ToM has been proposed as a prerequisite for the development of EF (Carruthers, 1996; Perner, 1991, 1999).

Research suggests a relationship between EF and a range of social and communicative skills. However, although the research suggests a relationship, it

does not say anything about causal direction, so it is worth considering whether social impairment might lead to poor EF. The consequences of executive dysfunction may match with many of the real life problems experienced by people with ASD, for example, difficulties in coping with change to routines, repetitive behaviour, and lack of flexibility of thought. However, there are very few direct investigations of associations between EF and real-life problems experienced by individuals with a diagnosis of ASD.

In summary, although the studies that have been carried out to date have shown an EF deficit in ASD, there have been relatively few studies. EF has been postulated as a primary neurological deficit, able to explain ToM dysfunction as a secondary deficit (Ozonoff et al. 1991), but this needs to be explored further in relation to ASD.

1.9. Conclusion

ASD is a condition that has a significant impact on the lives of individuals and their families. Individuals with ASD have been shown to have impairments in social development, language and imaginative play (Wing, 1996). More specifically, research has demonstrated that individuals with a diagnosis of ASD have impairments in emotional recognition and pragmatic communication. Studies have attempted to find the cause or causes of these deficits, and this introduction has outlined some of the main cognitive theories, namely, ToM, WCC and executive dysfunction.

ToM is currently the most studied cognitive theory of ASD. Research has suggested that children with a diagnosis of ASD have an impaired ToM (Baron-Cohen, Leslie and Firth, 1985; Happé 1994). Various aspects of ASD have been explained by this theory specifically, deficits in joint attention and difficulty in sharing others' perspectives (Happé & Firth, 1996), and imagination, communication and socialisation deficiencies (Wing, 1996). More recent research has shown that individuals with a diagnosis of high-functioning autism and AS can pass classic ToM tasks (Bauminger et al. 1999), but that this does not fit with their performance in naturalistic social settings. Researchers have explored this by using advanced ToM tests, developed to mimic the demands of real-life ToM in individuals with ASD, using parts of films with the characters in social situations. Such studies have found that individuals with a diagnosis of high-functioning autism and Asperger's syndrome are impaired in ToM, when an advanced ToM task is used (Heavey et al., 2000). The ToM hypothesis has been used to explain other deficits found in individuals with ASD, for example, speech and language difficulties and emotional recognition. Research has suggested that there is a link between speech and language abilities and ToM (Dahlgren & Trillingsgaard, 1996; Happé, 1995; Sparrevohn & Howie, 1995; Tager-Flusberg, 2000; Tager-Flusberg & Sullivan, 1994). Research has also demonstrated a link between ToM and emotional recognition (Buitelaar et al. 1997; Ozonoff et al. 1991 & Heerey, 2003).

Although the ToM hypothesis is persuasive, research has shown that it is not specific to ASD (Kissgen & Schleiffer, 2002). Ozonoff et al. (1991) found evidence to suggest that ToM is not a primary deficit. Shyu (2001) found a link between pragmatic communication and ToM, but other studies have found no such link (Martin & McDonald, 2004). The ToM hypothesis accounts for problems with social and communicative behaviour; however, currently, it does not fully account for restricted, repetitive and stereotyped patterns of behaviour, interests and activities (DSM-IV, APA, 1994).

In an attempt to find a primary cognitive defect, studies have incorporated various other cognitive theories, explicitly, WCC and EF. Studies using visual illusions, stories and puzzles have supported a presence of WCC in individuals with a diagnosis of ASD (Happé et al. 1996; Shah & Firth, 1993 & Happé & Firth, 1996). Although WCC appears to offer an account of ToM and pragmatic deficits in ASD, it remains a controversial viewpoint. Replication of these studies has often been unsuccessful, with findings, at times, being contradictory to those of the original study, (Ropar & Mitchell, 1999, 2001; Mottron et al. 1999). Martin & McDonald (2004) investigated the causes of pragmatic deficits in individuals with AS. Results suggested that WCC was not related to either pragmatic ability or ToM. As such, controversy remains regarding the existence of WCC and which deficits it might explain.

EX BIBL. UNIV. EDINBURGH

Recently, research has begun to look at EF and ASD. Ozonoff et al. (1991) examined EF, emotional perception and ToM in children with a diagnosis of ASD. They found that the children with ASD performed more poorly than controls on tests of EF, ToM and emotional perception. They suggested that EF rather than ToM might be a primary deficit of ASD. They went on to suggest that it is, therefore, important to carry out research further research, examining EF and its relationship to ToM and emotional recognition. EF deficits can also be linked to the pragmatic communication deficits observed in children with ASD, for example, deficits in EF such as planning, shifting sets, working memory, and inhibition of responses could give rise to deficits in many aspects of pragmatic functioning.

Relatively few studies have examined EF in relation to ASD. Previous studies have shown that individuals with a diagnosis of ASD have a deficit in EF (Ozonoff et al. 1991). Executive dysfunction has been postulated as a primary neurological deficit in ASD (Ozonoff et al. 1991). An executive dysfunction could account for the ToM deficit, emotional recognition impairment and pragmatic impairment, observed in ASD.

If executive dysfunction is a primary deficit, one would expect EF, emotional recognition and pragmatic communication to be linked. This has not been examined in previous literature. This study, therefore, aims to examine the links between executive function and some of the deficits that have been observed in children with a diagnosis of ASD, specifically, emotional recognition and pragmatic

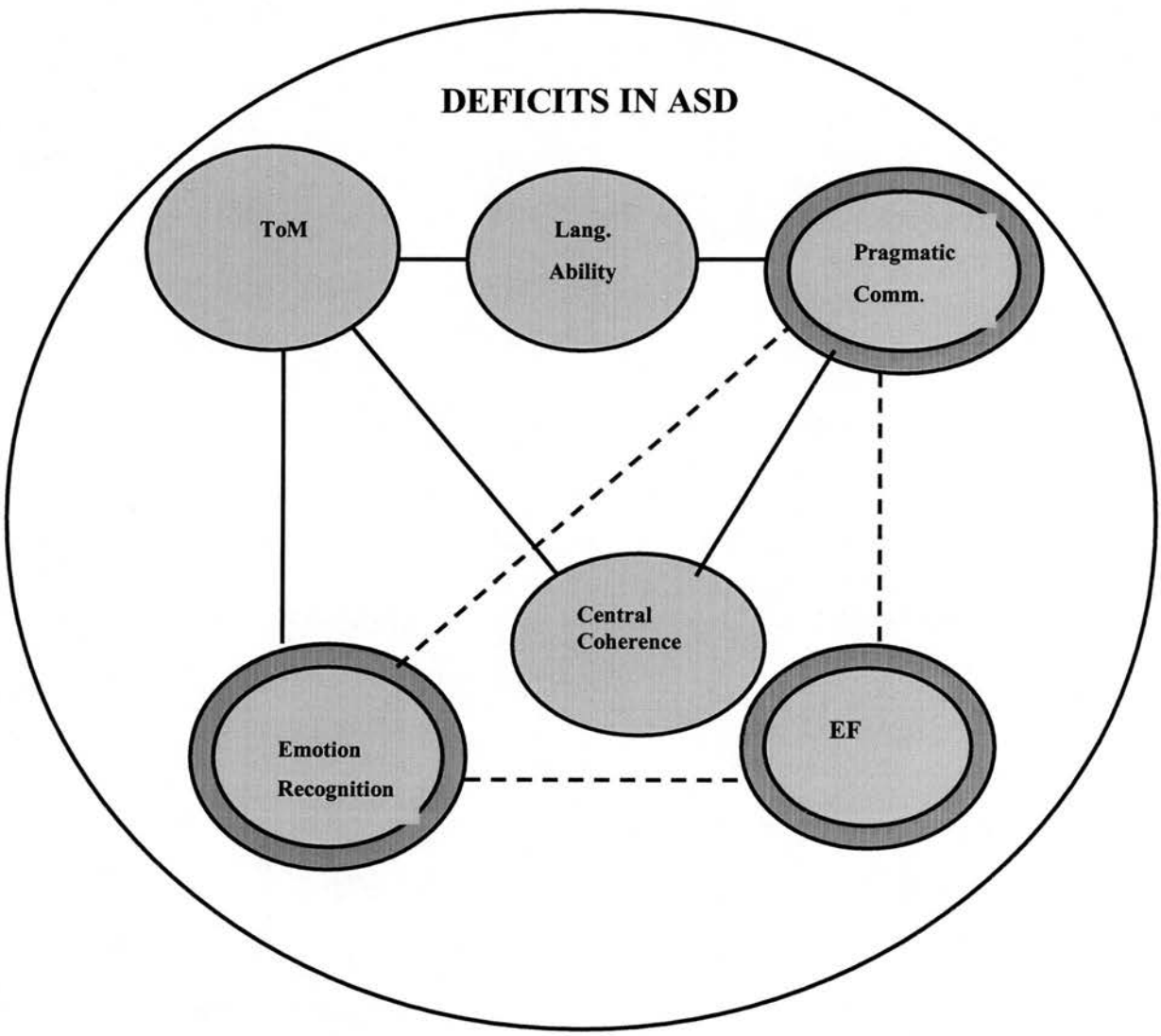
communication. Although pragmatic communication has been shown to be a deficit in children with a diagnosis of ASD, studies so far have shown that other cognitive theories, WCC and ToM, are not related to pragmatic communication (Martin & McDonald, 2004).

This study also aims to see if these variables are linked in a control group of typically developing children, matched for age, IQ and gender. Finally, the study also aims to compare the ASD group with the control group of typically developing children to look for evidence to support previous studies that suggest that children with a diagnosis of ASD have deficits in executive function, pragmatic communication and emotional recognition.

It is important to identify the primary neurological deficits, in terms of furthering our knowledge and understanding of this disorder, as well as guiding the development of interventions to help children, families and the education system.

Figure I (below) attempts to further explain the purpose of this study. It shows the deficits observed in children with a diagnosis of ASD and the links between them.

Figure I: Showing the links that have been studied, denoted by a line, and the links not yet studied, denoted by a dashed line to show what this study is examining.



1.10. Hypotheses

Hypothesis 1: There will be a statistically significant positive correlation between executive function and pragmatic language/communication in children and young people with a diagnosis of ASD.

Hypothesis 2: There will be a statistically significant positive correlation between pragmatic language/communication and emotional recognition in children with a diagnosis of ASD

Hypothesis 3: There will be a statistically significant positive correlation between executive function and emotional recognition in children with a diagnosis of ASD.

Hypothesis 4: The experimental group will perform statistically significantly poorer on all three variables than the children without a diagnosis of ASD.

Hypothesis 5: There will be a statistically significant positive correlation between all three variables in the control group.

2. Method

2.1. Design

This was an experimental study using both a between subjects and correlational design.

2.2. Participants

Two groups participated in this study, a group of individuals with autistic spectrum disorder (ASD) and a control group of non-ASD individuals, matched for age, gender and IQ.

The inclusion criteria, for both the experimental and control group, stated that all participants needed to be able to speak in full sentences, have no other diagnoses, e.g. ADHD, and be aged between 5 and 16 years. In the experimental group, participants needed to have already have been given the diagnosis of ASD by a multi-disciplinary team before being included in the study.

Overall, 198 participants were invited to take part in this study, 98 in the experimental group and 100 in the control group. 26 consented to participate in the experimental group, a response rate of 25.5 %. Of those 26, 4 were unable to speak in full sentences and, therefore, did not meet the inclusion criteria, one participant

withdrew from the study and one family moved away. This left an experimental group of 20.

Thirty-one consented to take part in the control group, a response rate of 31%. All 31 were tested, however, only 21 of the parents returned the questionnaires.

The ASD participants' ages ranged from 6 to 15 years (mean CA = 10.75, SD = 2.95). Participants were matched for non-verbal intelligence, which was assessed using the Raven's Coloured Matrices (Raven et al. 1995) or the Standard Progressive Matrices (Raven et al. 2000), depending on the age of the child. The participants with ASD were recruited from an NHS clinical database.

The control group comprised of 21 individuals without ASD who were aged between 6 and 12 years (mean CA = 10.00, SD = 1.89). Participants were recruited from local schools. The control participants were matched with the participants with ASD for non-verbal IQ, age and gender.

The two groups were statistically compared on age, non-verbal IQ, gender and their scores on the emotional recognition control task. Age was compared using an independent t-test and the non-verbal IQ and control task scores were compared using a Mann-Whitney test. No statistically significant differences were found between the two groups on age, IQ grade or gender. There was a significant

difference between the groups on the control task. Table 1 (below) summarises the results of the tests of difference, for the experimental and control groups.

Table 1: Descriptive characteristics of the sample

	ASD Group (n = 20) X (SD) Range	Control Group (n = 21) X (SD) Range	Test of difference	P
CA Chronological age	10.75 (2.95) 6-15	10.00 (1.89) 6-12	t = 0.972	0.337
Raven's Progressive Matrices Non-verbal IQ	2.80 (1.15) 1-5	2.67 (0.85) 2-5	Z = -0.198	0.843
ERC Emotional recognition control task	16.40 (2.66) 7-18	17.67 (0.65) 16-18	Z = 2.236	0.025*
Gender M:F	15:5	18:3		

*A significant difference was found.

There was a significant difference between the experimental group of children with ASD and the control group of typically developing children on their performance on the control task. This was due to outliers in the experimental group.

The two outliers in the experimental group were removed. The descriptive characteristic of the sample with the two outliers removed is shown in Table 2 (below).

Table 2: Descriptive characteristics of the sample with the outliers removed

	ASD Group (n = 18) X (SD) Range	Control Group (n = 21) X (SD) Range	Test of difference	P
CA Chronological age	10.72 (2.80) 6-15	10.00 (1.89) 6-12	t = 0.954	0.346
Raven's Progressive Matrices Non-verbal IQ	2.67 (1.08) 1-5	2.67 (0.85) 2-5	Z = -0.216	0.829
ERC Emotional recognition control task	17.17 (0.98) 15-18	17.67 (0.65) 16-18	Z = -1.783	0.075
Gender M:F	13:5	18:3		

A significant difference was not found between the emotional recognition scores in the control task. However, a significant difference was found in the emotional recognition experimental task when using a Mann-Whitney. An ANOVA was

carried out to examine further if there was a significant difference between the two groups scores on the emotional recognition experimental and control task.

Table 3: Results of an ANOVA on the emotional recognition control and experimental task

		Sum of Squares	df	Mean Square	F	Sig.
Emotional Recognition Task – Control	Between groups	16.436	1	16.436	4.468	0.041
	Within groups	143.467	39	3.679		
	Total	159.902	40			
Emotional Recognition Task – Experimental	Between groups	30.693	1	30.693	9.852	0.003
	Within groups	121.502	39	3.115		
	Total	152.195	40			

In the emotional recognition control task there were significant differences among the mean scores on the emotional recognition control task for the two groups ($F = 4.468$, $p = < 0.05$).

In the emotional recognition experimental task there were significant differences among the mean scores on the emotional recognition experimental task for the two groups ($F=9.852$, $p=< 0.05$).

2.3. Measures

Materials used to measure each variable are described below.

The Raven's Progressive Matrices (RPM) are a widely used assessment and come in a variety of formats to cover different needs. This study used the Progressive Coloured Matrices (PCM; Raven et al. 1995) for participants aged 5-12 years and the Standard Progressive Matrices (SPM; Raven et al. 2000) for those participants aged 12-16 years. These are tests that can quickly assess general cognitive ability or intelligence. The Standard Progressive Matrices is divided into five sets of twelve problems (Sets A, B, C, D and E). The Coloured Progressive Matrices consists of parts A and B of the SPM but has an additional Set Ab. The CPM is designed for use with children, individuals with a learning disability and older adults. In both the CPM and the SPM, each set starts with a problem that is self-evident and develops a theme in the course of which the problems build on the argument of what has gone before and, thus, become progressively more difficult. The problems consist of a picture of a pattern with a part missing. The participant must identify the correct missing part from a choice of five below. In the SPM, these are all black and white.

In the CPM, the problems are set on colourful backgrounds to attract attention, make the test interesting and avoid the need for as much verbal instruction. The scores on the sets are used to assess the individual's percentile grade of either:

Grade I:	'Intellectually superior'
Grade II:	'Definitely above the average in intellectual capacity'
Grade III:	'Intellectually average'
Grade IV:	'Definitely below average in intellectual capacity'
Grade V:	'Intellectually impaired'

Each participant was given a grade of I, II, III, IV or V. This gives an estimate of each child's non-verbal IQ. All of the tasks were selected on the basis that they did not make demands on verbal ability. As a result, participants were not matched for verbal ability. It was more important, due to the nature of the tasks, that they were matched on performance rather than verbal IQ.

2.3.1. Emotional Recognition

The photographs, used for both tasks, were from Ekman and Friesen's Facial Affect Slides (1976), a series of black and white photographs of both men and women. The photographs are of facial expressions of six different emotions: happiness, sadness, anger, surprise, fear and disgust. There is also a set of 'neutral' expression photographs. They have been shown to have good inter-rater reliability (Ekman & Friesen, 1976).

All of the photographs used were stuck onto cardboard, with one photo at the top and three at the bottom. Pink card was used for the control identity task and blue card was used for the experimental emotion task.

The specific photographs used were selected on the basis of their high reliability rating. Ekman & Friesen (1976) tested the mean agreement across all photographs, the photographs selected for this study had 95% or above agreement in validity data.

2.3.2. Executive function

Executive function was assessed using the Tower subtest of the NEPSY (Korkman et al. 1998), which is based on the Tower of Hanoi (Shallice, 1982). It is a nonverbal task that involves moving three coloured balls on three pegs into different patterns of increasing difficulty. There are rules and each pattern must be achieved in a certain number of moves in a set amount of time. The task assesses the following executive functions: planning, strategising, monitoring, self-regulating and problem solving within a set of rules (Kemp, Kirk & Korkman, 2001). In studies looking at the validity of the NEPSY, children with HFA performed poorly on the Tower subtest compared with controls (Kemp, Kirk & Korkman, 2001). Each participant (both control and ASD) completed the Tower subtest to give an executive function score.

2.3.3. Pragmatic language

The Children's Communication Checklist (CCC-2: Bishop, 2003) was used to assess each participant's communication. Parents of all participants in the ASD and control groups were asked to complete the CCC-2. This is a questionnaire that rates various aspects of language and communication.

It states in the CCC-2 manual (Bishop, 2003), that to get realistic impression of a child's pragmatic abilities, one needs information from someone who has had the opportunity to observe the child frequently, over a long period of time. The CCC-2 is designed to be completed by an adult who has known the child for a long time. In this study, a parent of each participant completed the questionnaire.

The CCC-2 consists of 70 multi-choice items and takes approximately 10-15 minutes to complete. Items are divided into 10 scales: A: speech, B: syntax, C: semantics, D: coherence, E: inappropriate initiation, F: stereotype language, G: use of context, H: non-verbal communication, I: social relatedness, and J: interests. The test gives a score for each scale and an overall score. Scales E, F, G and H have been identified as examining the pragmatic aspects of communication. The scores for these scales were added together to give an overall pragmatic communication score for each participant. A copy of the questionnaire appears in appendix 7.2.

2.3.4. Procedure

Ethical approval was sought and obtained from the local ethics committee (see appendix 7.3).

Participants were identified using the local autism team database. This contained all of the open cases of children with ASD in the local area. Once identified, each participant was sent an invitation pack through the post. The invitation pack comprised of a letter of invitation, a parent information sheet, a child information sheet, a parent consent form and a child consent form, all of which appear in appendix 7.4. The researcher also visited the local ASD support group, to raise awareness of the study in the local area and met with the head teacher of local mainstream schools to ask if they would be happy to identify children who would be willing to participate as part of the control group.

Once the participants in the ASD group were identified, the matching requirements of the control group were known and the control group could be approached. The control group was identified by asking two local schools to give out invitation packs to selected age groups. The children were asked to take these packs home to their parents. The control invitation pack was the same as the ASD invitation pack apart from the invitation letter, which appears in appendix 7.5.

The invitation pack asked those who wished to take part to sign the consent forms and return them in the envelope provided. For both groups, each of the parents and children who consented were contacted by telephone by the researcher to arrange a convenient time to assess the child. Parents and children were given a choice; their child could be seen at the local CAMHS department, at school, or at home. Individual appointment times were then arranged with each participant.

All participants were tested on a one-to-one basis, in a separate room. The researcher tested all of the participants so that testing was consistent with all participants. All participants in the ASD group had been given a diagnosis of autistic spectrum disorder or Asperger's syndrome by a multi-disciplinary assessment team, prior to being identified to participate in the study.

Measures of the experiment were then presented in one of two preset orders. The full testing battery took approximately 45 minutes to 1 hour. If the attention span and co-operation of the participants was sufficient, the testing was conducted in one session. All participants were informed that they could discontinue at any time. The test battery included the emotional recognition experimental task, the emotional recognition control (identity) task and the Tower subtest of the NEPSY (Korkman et al. 1998). Depending on age, either the Raven's Coloured Progressive Matrices or Standard Progressive Matrices (Raven et al. 1995, 2000) was administered to all participants in the ASD and the control group.

Emotional recognition task

The emotional recognition task required participants to match photos of faces of unfamiliar adults on the basis of emotion. A control task required participants to match the same photos on the basis of identity, which acted as a control for general face processing ability.

The control task

The participants in both the ASD and control groups were shown a card with a photograph at the top - the target photograph, and three photographs at the bottom - the choice photographs. When presented to the participant, the choice photographs were covered and only the target photograph was showing. The participants were told, "This is [name]" (target photograph). They were then shown the three choice photographs at the bottom of the card (the correct photograph and two distracter photographs) and asked, "Can you find another picture of [name]?"

The emotion expressed in the correct choice photograph was different from that expressed in the initial (target) photograph, but the emotion in all of the choice photographs was kept constant; so if the target photograph was happy, then the correct photograph and both distracter photographs were sad. Also, in the identity task, only happy and sad emotions were used as target photographs, as these are easily distinguishable. This was to minimise emotion-processing demands. There were 18 trials (9 each of male and female faces) presented in a fixed order. An example of the card layout appears in appendix 7.6.

The Emotion Task

As in the control task, the participants in both the ASD and control groups were shown a card with a photograph at the top (the target photograph), and three photographs at the bottom (the choice photographs). When presented to the participant, the choice photographs were covered and only the target photograph was showing. The participants were told, "This man looks (e.g.) happy." The three choice photographs were then uncovered and the participant was asked, "Can you find another picture of a man that looks happy?" The three choice photographs each displayed a different emotion, the correct emotion and two distracter emotions. There were 18 trials (9 female and 9 male faces). The target emotions, happiness, sadness, anger, surprise, fear and disgust, were presented three times each. In all three trials for each emotion, the remaining five emotions and one neutral pose were used once each as a distracter. In the case of anger, fear and disgust, participants were also given a second label, such as cross, scared and "yuck" respectively, to ensure that a term that was familiar to the participant was used.

Emotion trials were presented in a fixed order, with facial identity kept the same in all the choice photographs, but differing from the target photograph.

To avoid expressive language and memory difficulties, participants were only required to point to the correct photograph and all four photographs remained on display to ensure that emotion recognition or identity recognition, rather than

recognition memory, was being tested. Children were reminded throughout to take their time and look at all the pictures. The identity and emotion tasks were carried out over one session. A copy of the scoring sheet appears in appendix 7.7.

Children's Communication Checklists (CCC-2: Bishop, 2003) were posted to all of the parents of both the experimental and control group. Parents were asked to complete the CCC-2 and return it in the envelope provided. All of the tests and questionnaires were scored and added to an SPSS database.

Ethical Considerations

The British Psychological Society (BPS) Good Practice Guidelines for the Conduct of Psychological Research within the NHS was adhered to. The appropriate steps were taken to ensure that this study was ethical and that no harm was caused by the study. During the design of the study, the tasks were carefully selected and attention was given to the task difficulty and length. Great consideration was given to the information sheet for both parents and children by the researcher and the local ethics committee, in order to ensure that it was easy to understand, while giving all of the necessary information. It included the following: the reasons their child had been chosen, the purpose of the study, what the study involved, and the potential disadvantages of the study. Consideration was given, before testing, to what the researcher would do if the participant became distressed during testing. It was clearly stated in the information sheet that if any of the participants became distressed during testing, the session would be immediately terminated, and the child

would be helped with relaxation techniques if necessary (see information sheet in appendix 7.4). An information sheet was also compiled for each child. This gave less information but briefly explained the experiment. All of the children who participated were considered able to give informed consent; those unable to do so were not tested.

The researcher did not assume informed consent on the receipt of the consent form, and each participant and parent who consented were contacted by telephone to confirm they had given consent and to allow them to ask any questions. They were given a choice of venue - either at the local child and family department, at the child's school or at their home - and parents were given the option to be present during testing, if they wished. Each participant was given the same information at the beginning of testing, including a reminder that if he decided that he wanted to stop doing the puzzles, then that was perfectly acceptable, and that he did not have to give a reason. The researcher explained that she would not be upset or angry in such circumstances. Both parents and children were aware that they could withdraw from the study at any time. Each participant was asked how he felt about taking part in the study at the beginning of testing, to check if any of the participants felt worried or anxious. It was explained to each participant exactly what would happen and how long it would take. Each participant was told before testing that some of the questions were hard and some of them easy, but that they were supposed to get difficult, because the tests were designed for people older than them, and not to

worry if some of the tests were too difficult. The tasks were discontinued if the participants appeared distressed in any way.

One participant gave consent, but at the time of testing appeared anxious. When the researcher checked how the participant felt about testing, he reported that he felt anxious. The researcher then reminded the participant he could withdraw and the participant was withdrawn from the study.

After testing, each participant was thanked and asked if he had any questions. Participants were told that they would receive a summary of the findings, once the study was completed.

Risk to the researcher was considered regarding entering peoples homes, however, since all the participants in the experimental group were recruited from the local autism team's clinical database, all of the families were well known by the team and any risk was, therefore, considered minimal. The participants were aware that the data would be made anonymous to protect confidentiality.

2.3.5. Statistical analyses

Power calculation

Using Cohen's (1992) formula for calculating effect size (for correlations and tests of difference) a large effect size was selected based on previous research in this area (Ozonoff et al. 1991; Tager-Flusberg, 2001; Baron-Cohen, 1991 & Hobson, 1986). Based on Cohen's (1992) estimate of sample size (setting power at 0.8 and alpha at 0.05), correlations would require that N = 28, and tests of difference would require N= 26.

The data was compiled into a data set and statistically analysed using SPSS (Statistical Package for the Social Sciences) for Windows, Version 11.

3. Results

Preparation of data for analysis

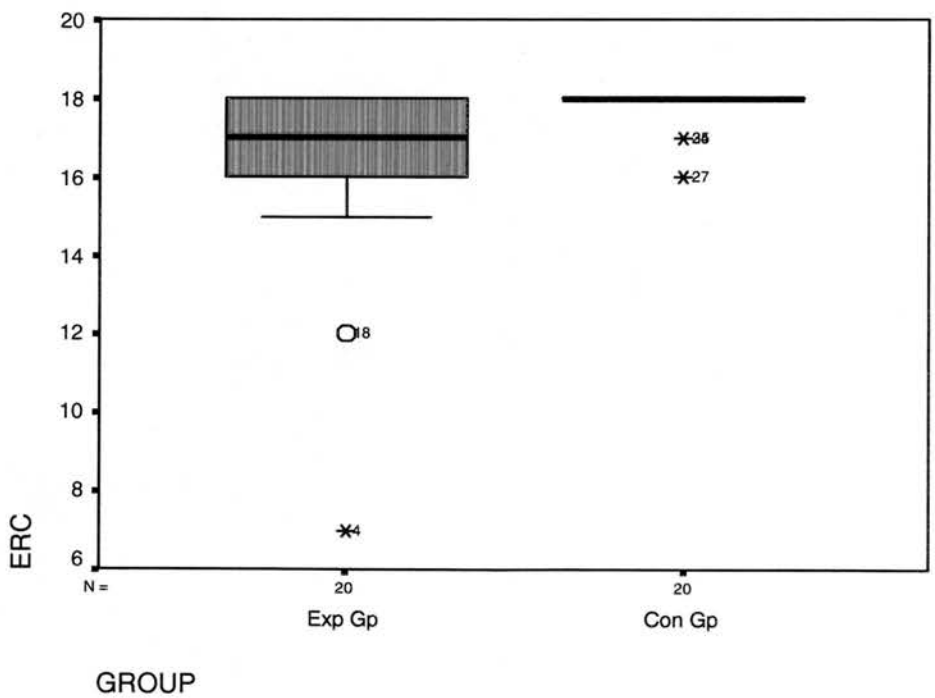
The distribution of the variables was investigated by examining the histograms, skewness and kurtosis scores for each variable. A table to show the skewness and kurtosis for each variable appears in appendix 7.9. The age and IQ variables were normally distributed. The other variables, emotional recognition, executive function and pragmatic communication, were examined for each group. The data for these variables was not normally distributed in either of the groups. In the experimental group, the emotional recognition data and the Tower data were negatively skewed, therefore, the scores for these variables clustered to the right, at the high values. The pragmatic communication data for the experimental group was positively skewed and, therefore, scores cluster to the left, at the low values. In the control group, the emotional recognition data, the Tower data and the pragmatic communication data were all negatively skewed, therefore, the scores in the control group all clustered to the right, at the high values.

The data was, therefore, analysed using non-parametric tests. The data was analysed using SPSS (Statistical Package for the Social Sciences) Version 11. The significance level of test results, unless otherwise stated, was set at p=0.05 (two-tailed).

3.1. Exploratory Data Analysis

As mentioned in the method section, two participants were removed due to outlier scores on the emotional recognition control task. These scores caused a statistically significant difference between the control group and the experimental group on the emotional recognition task and therefore need to be removed in order for the groups to be matched on the emotional recognition control task. Figure II (below) illustrates a box-plot of the emotional recognition control task scores for the experimental group.

Figure II: A box-plot to show the scores on the emotional recognition control task for the experimental and control group.

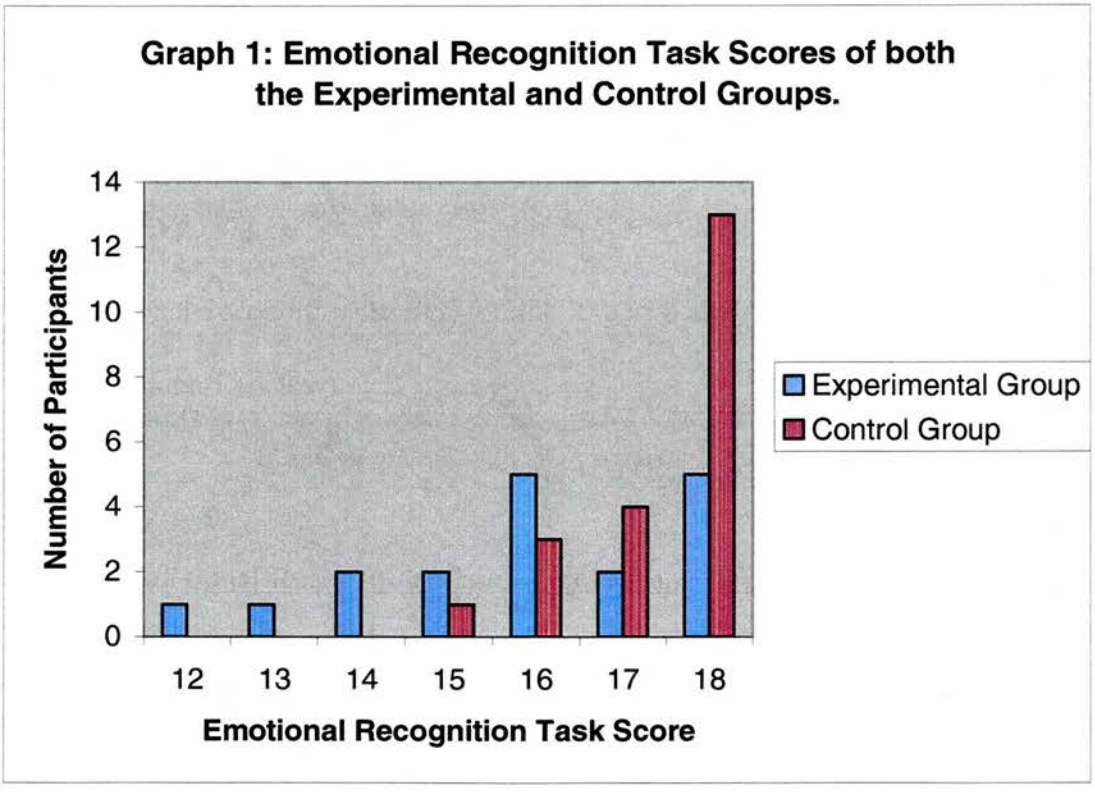


3.2. Descriptive Statistics

For a description of the groups please refer to Table 2 in the method section.

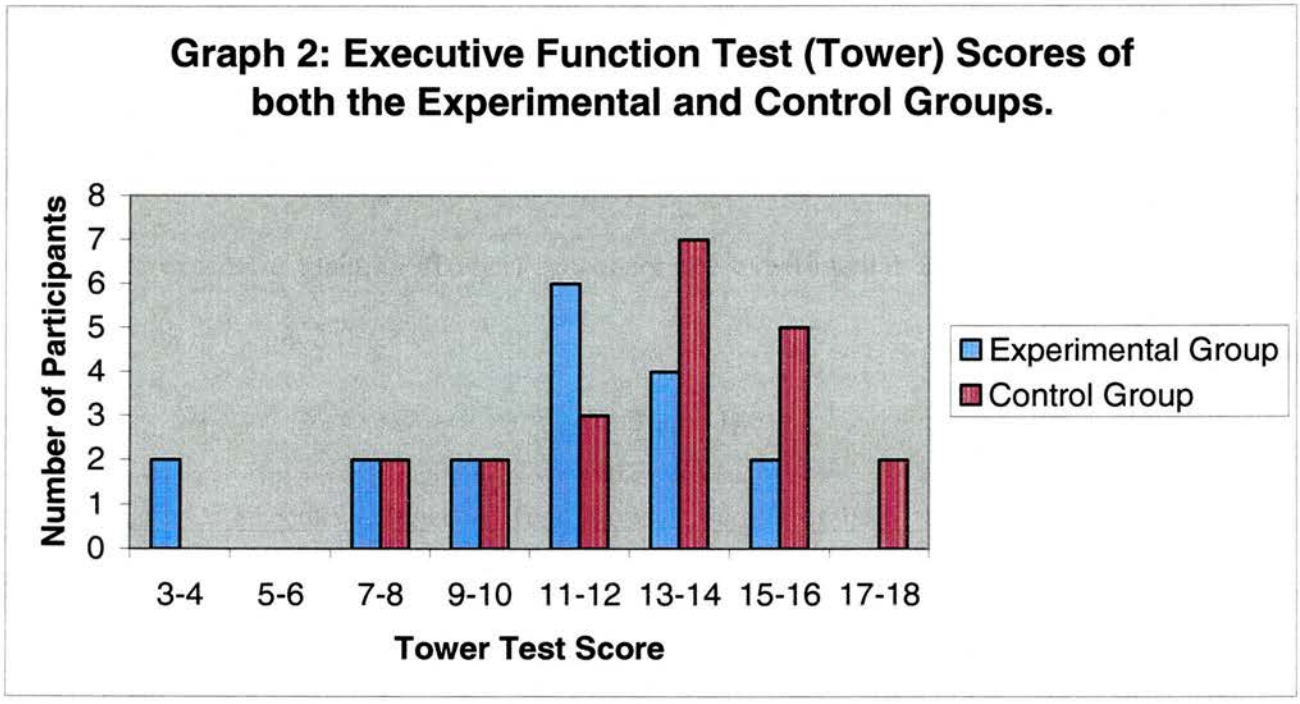
The emotional recognition scores for the experimental and the control group are shown in Graph 1 (below).

Graph 1: Emotional Recognition Task Scores of both the Experimental and Control Groups.



The executive function (Tower) scores for the experimental and control group are shown in Graph 2 (below).

Graph 2: Executive Function Test (Tower) Scores of both the Experimental and Control Groups.



Pragmatic communication scores for the experimental and control group are shown in Graph 3 (below).

Graph 3: Pragmatic Communication Questionnaire Scores for both the Experimental and Control Groups.

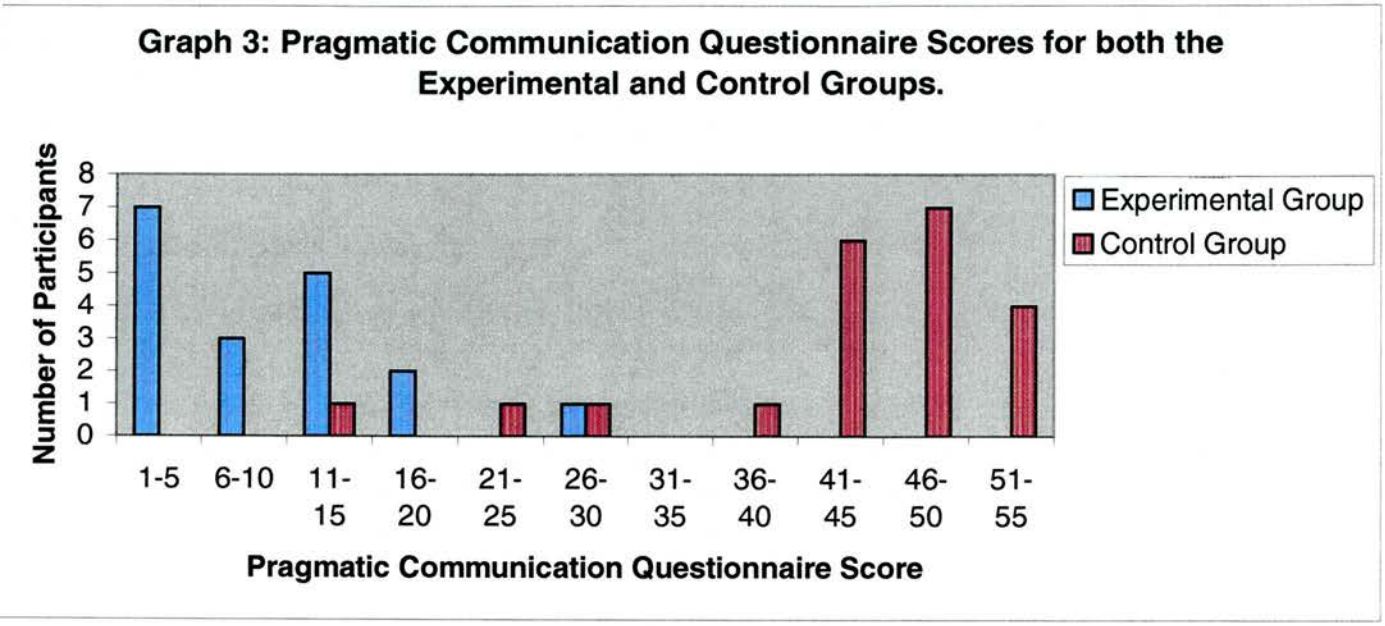


Table 3 (below) illustrates the scores on the Tower, the CCC-2 and the emotional recognition task for the experimental and control groups.

Table 4: Mean scores, range and SD on the Tower, the CCC-2 and the emotional recognition task for the experimental and control groups

	Experimental Group				Control Group			
Variable	N	Range	Mean	SD	N	Range	Mean	SD
Executive function (Tower)	18	3-16	10.83	.833	21	7-17	13.00	0.625
Pragmatic Communication (CCCPS)	18	1-26	10.00	6.57	21	13-55	43.38	10.33
Emotional recognition (ERE)	18	12-18	15.94	1.83	21	15-18	17.38	0.921

3.3. Inferential Statistics

Each hypothesis was tested using inferential statistics. Spearman's correlations were used to investigate hypotheses 1, 2, 3 and 5. A Mann-Whitney test was used to investigate hypothesis 4. The results are reported below for each hypothesis.

Hypothesis 1

There will be a statistically significant positive correlation between EF and pragmatic communication in children and young people with a diagnosis of ASD.

A Spearman's correlation found no relationship between EF and pragmatic communication in children with a diagnosis of ASD (rho= -.016, p= 0.949, N= 18).

Hypothesis 2

There will be a statistically significant positive correlation between pragmatic language/communication and emotional recognition in children with a diagnosis of ASD.

Similarly, a Spearman's correlation found no relationship between pragmatic communication and emotional recognition in children with a diagnosis of ASD (rho=0.145, p=0.567, N=18).

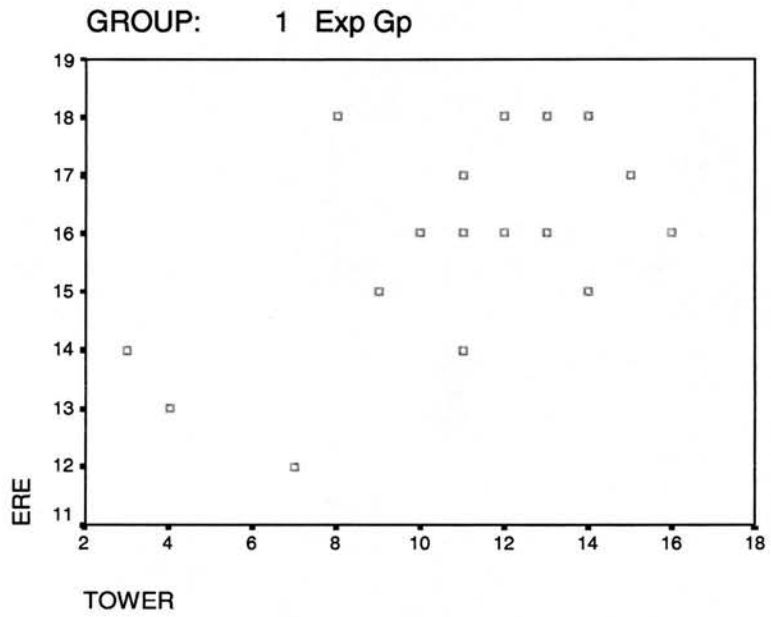
Hypothesis 3

There will be a statistically significant positive correlation between EF and emotional recognition in children with a diagnosis of ASD.

Spearman's correlation found a statistically significant positive correlation between EF and emotional recognition, (rho = 0.483, p=<0.05, N= 18). This illustrates that high scores in the EF task are associated with high scores on the emotional recognition task in children with a diagnosis of ASD. Figure III (below) illustrates a

scatter plot of the emotional recognition scores and Tower scores of the experimental group.

Figure III: Scatter plot of emotional recognition scores and Tower scores of the experimental group.



Hypothesis 5

There will be a statistically significant positive correlation between all three variables in the control group.

A Spearman's correlation found no statistically significant relationships between, EF and emotional recognition (rho= 0.339, p= 0.132, N= 21), EF and pragmatic communication (rho= 0.069, p=0.765, N= 21) or emotional recognition and pragmatic communication in the control group (rho= 0.252, p= 0.271, N= 21).

The correlation matrix appears in appendix 7.10.

3.4. Testing for differences

Hypothesis 4

The experimental group will perform statistically significantly worse on all three variables than the control group.

A Mann-Whitney test was used to investigate whether there was a statistically significant difference between the experimental group and the control group scores on pragmatic communication, EF and emotional recognition.

Table 5: Results of the Mann-Whitney test for emotional recognition, executive function and pragmatic communication

	Emotional Recognition - Experimental	**Executive function - Tower**	**Pragmatic communication – CCC2**
Mann-Whitney	98.000	119.000	6.500
Wilcoxon W	269.000	290.000	177.500
Z	-2.718	-1.983	-5.151
Asymp. Sig. (2-tailed)	0.007	0.047	0.0001

The experimental group scored statistically significantly poorer than the control group on all of the variables, EF ($Z= -1.983$, $p< 0.05$), the emotional recognition task ($Z= -2.718$, $p< 0.01$), and pragmatic communication ($Z= -5.151$, $p< 0.0001$).

4. Discussion

This study examined the relationship between EF, pragmatic communication and emotional recognition in children with a diagnosis of ASD and matched controls. It also looked at differences in performance between the children with a diagnosis of ASD (the experimental group) and typically developing children (the control group) matched on age, gender and IQ.

4.1. Interpretation of the results

Hypothesis 1 stated that there would be a statistically significant positive correlation between EF and pragmatic communication in children and young people with a diagnosis of ASD. After statistical analysis, a significant correlation was not found between EF and pragmatic communication in the experimental group. This suggests that in children with a diagnosis of ASD, pragmatic communication deficits and EF deficits are not related. Hypothesis 1 was, therefore, rejected.

Hypothesis 2 stated that there would be a statistically significant positive correlation between pragmatic communication and emotional recognition in children with a diagnosis of ASD. After statistical analysis, a significant correlation was not found between pragmatic communication and emotional recognition in the experimental group. This suggests that deficits in emotional recognition and pragmatic

communication are not related in children with a diagnosis of ASD. Hypothesis 2 was, therefore, rejected.

Hypothesis 3 stated that there would be a statistically significant positive correlation between EF and emotional recognition in children with a diagnosis of ASD. After statistical analysis, a significant positive relationship was found between EF and emotional recognition. Hypothesis 3 was, therefore, accepted. This suggests that, as performance on emotional recognition improves, so does performance on EF tasks in children with a diagnosis of ASD.

Hypothesis 4 stated that the experimental group would perform significantly poorer on all three variables than the control group. After statistical analysis a significant difference was found between the control group's and the experimental group's performances on all three variables. The experimental group performed statistically significantly poorer than the control group on the emotional recognition task, the EF task and pragmatic communication. Hypothesis 4 was, therefore, accepted.

Hypothesis 5 stated that there would be a statistically significant positive correlation between all three variables in the control group. After statistical analysis, no significant correlations were found between pragmatic communication, EF and

emotional recognition in the control group. The results suggest that in children without a diagnosis of ASD, EF, pragmatic communication and emotional recognition are not related. Hypothesis 5 was, therefore, rejected.

4.2. Discussion of the results

In this study, a statistically significant difference was found between the control group of typically developing children and the experimental group of children with a diagnosis of ASD, on all three variables. Each variable is discussed below.

Executive function

The experimental group performed significantly poorer than the control group on the EF task, suggesting that children with a diagnosis of ASD have a deficit in EF. This finding supports research discussed previously, which found that individuals with a diagnosis of ASD performed more poorly on the Wisconsin Card Sorting Task (WCST, Grant & Berg, 1948) than controls (Rumsey, 1985; Prior & Hoffman, 1990).

The results of the current study are also consistent with the research by Ozonoff et al. (1991) cited earlier. They showed significant differences between the children with a diagnosis of ASD and the controls on their scores on two EF measures, the Tower of Hanoi (Shallice, 1982) and the WCST (Grant & Berg, 1948).

As noted in the introduction, EF has been associated with the deficits found in individuals with frontal lobe damage (Ozonoff et al., 2000). Previous research has suggested that some of the behaviours observed in children with a diagnosis of ASD are similar to the behaviours observed in individuals with frontal lobe damage (Ozonoff et al. 1991), therefore, linking ASD and EF. This is demonstrated by the fact that the following behaviours are observed in individuals with ASD and individuals with EF deficits caused by frontal lobe damage; rigid inflexible behaviour, tendency to focus on one narrow interest, difficulty self-reflecting and self-monitoring (Ozonoff et al. 1991), lack of spontaneous speech (Alexander et al. 1989), difficulty with cognitive shifting, when shifting from literal to metaphorical interpretation of language (Teunisse et al. 2001), and imitation deficits related to impaired executive control of action (Smith et al. 1994). Finally, the problems with joint attention in children with a diagnosis of ASD may be partly explained by difficulties in rapid shifting of attentional focus (Burack, 1994).

Pragmatic communication

The experimental group performed significantly poorer than the control group on the pragmatic communication section of the CCC-2 (Bishop, 2003), suggesting that the children with a diagnosis of ASD have a deficit in pragmatic communication. This supports previous literature discussed in the introduction (Rinaldi, 2000). There is a limited amount of research examining ASD and pragmatic communication. As discussed earlier, Tager-Flusberg (2001) found that pragmatic communication is

impaired in children with a diagnosis of ASD, compared to children without a diagnosis.

Emotional Recognition

The experimental group performed significantly poorer than the control group on the emotional recognition task, suggesting that children with a diagnosis of ASD have impairment in emotional recognition. This supports the previous literature on ASD and emotional recognition. Children with a diagnosis of ASD have been shown to be impaired in their ability to identify their own and other people's emotions (Hobson, 1986; Ozonoff et al. 1990).

In summary, this study supports previous research in finding that EF, pragmatic communication and emotional recognition are all deficits that exist in individuals with ASD, when compared to a control group of typically developing children. The causes of the emotional recognition, pragmatic communication and EF deficits found in this and earlier studies still remains unclear, as do the links between these variables. It is still not known whether these deficits exist at the very onset of ASD or whether these impairments emerge later in development and so may be consequences, rather than causes or contributory factors, of ASD. This is an area that requires further research and will be discussed later.

The following section discusses the links between the variables EF, emotional recognition and pragmatic communication.

Pragmatic communication and executive function

This study aimed to link pragmatic communication with EF; however, no such relationship was found. Other research has suggested that deficits in pragmatic communication are linked to deficits in ToM (Baron-Cohen, 1988; Tager-Flusberg, 1993). Shyu et al. (2001) contributed to the idea that there is an association between pragmatic communication and ToM. They found that individuals with ASD were deficient in pragmatic communication skills and that pragmatic communication ability was best predicted by ToM performance. It was predicted that if pragmatic communication is linked to ToM, and ToM is linked to EF, that pragmatic communication would be linked to EF. It is possible that no link was found because EF and ToM are not linked. Similarly, it is possible that these two cognitive constructs are linked, but that only ToM relates to pragmatic communication. ToM has been linked with pragmatic communication in the past, and it is suggested that a deficit in pragmatic communication is indicative of a fundamental impairment in an individual's capability to process information relating to the mental states of others - ToM (Baron-Cohen, 1988; Tager-Flusberg, 1993).

It is possible that pragmatic communication is not linked to ToM and there is some research to suggest that this is the case. As discussed earlier, Martin and McDonald (2004) looked at the pragmatic impairments found in individuals with a diagnosis of ASD, and they found that ToM was not related to pragmatic ability as had been

previously found. They also investigated whether pragmatic communication was related to WCC, but did not find evidence to support this.

Finally, a relationship may exist between EF and pragmatic communication, but was not identified in this study. This could have been due to methodological limitations, such as the small sample size and/or the measures used. Limitations of the study will be discussed in detail later.

Pragmatic communication and emotional recognition

This study aimed to link pragmatic communication and emotional recognition; however, no such link was found. Rinaldi (2000) suggested that the social difficulties observed in children with a diagnosis of ASD are related to the deficits that they have in pragmatic communication. If this is the case, it is unusual that, in this study, pragmatic communication was not found to be related to emotional recognition. Again, however, although a relationship was not found in this study, this could be due to methodological limitations, rather than a lack of a true relationship.

Executive function and emotional recognition

In this study, EF and emotional recognition were significantly positively correlated in children with a diagnosis of ASD, suggesting an association between EF and emotional recognition in children with a diagnosis of ASD. These results suggest

that as EF improves, so does emotional recognition ability. As mentioned earlier, this association was only found in those children with a diagnosis of ASD. In the control group of typically developing children, no such association was found. It would appear from this study that any association between these two variables is specific to ASD.

Earlier research, examining the variables that are linked to emotional recognition, has provided conflicting results. As observed in the introduction, studies have identified a link between emotional recognition and ToM (Buitelaar et al. 1997; Heerey et al. 2003; Capps et al. 1992). Ozonoff et al. (1991) examined the correlates of emotional recognition, verbal IQ, non-verbal IQ, EF, verbal memory and chronological age, and found that none of them predicted success on an emotional recognition task (Ozonoff et al. 1991). Others have found that the quality of empathic and emotional perspective understanding in individuals with a diagnosis of HFA correlated positively with verbal and full-scale IQ (Yirmiya et al. 1992), suggesting that there are links between emotional recognition and IQ. There has been some research to support the association between EF and emotional recognition. As discussed earlier, performance on the WCST (Grant & Berg, 1948) has been shown to be predictive of social understanding, in longitudinal studies of children with a diagnosis of HFA (Berger et al. 1993). Executive function has also been found to be predictive of social functioning in adulthood (Szatmari et al. 1989).

In summary, the EF deficit found in children with a diagnosis of ASD has been used to explain many of the behaviours observed in individuals with ASD. As was highlighted in the introduction, if the EF deficit is to be accepted as one of the main cognitive deficits in children with ASD, the question must be asked as to whether it is able to explain the social deficits observed in ASD, as well as the other behaviours. This study demonstrates a link between emotional recognition and EF, therefore, offering some support for the EF deficit being a primary cognitive deficit in ASD.

As well as mainly examining EF, this study also considered other cognitive theories, specifically, ToM and WCC. The following section discusses WCC in relation to the results obtained in this study.

Weak Central Coherence

The WCC theory suggests that some of the deficits observed in children with a diagnosis of ASD are related to a weak drive for central coherence, suggesting that children with ASD concentrate on details, rather than using context (Firth, 1989). WCC has been postulated as a processing style in individuals with a diagnosis of ASD that affects perception of visual illusions (Happé, 1996) and pragmatic understanding (Happé & Firth, 1996). This theory is not without controversy, due to unsuccessful replication of many studies (Ropar et al. 1999, 2001; Mottron et al. 1999).

It is possible that the emotional recognition deficit found in this study could be explained by WCC. This theory would suggest that the ASD participants would match on the basis of specific facial features and that they would try and match emotions on the same basis. WCC would postulate that the reason the children with a diagnosis of ASD performed more poorly on the emotional recognition task was because they concentrated on one feature of the face, making processing the emotions more difficult, compared to the children without ASD, who processed the face as a whole. It would be interesting to test participants with only the mouth or eyes showing to see if this affected the performance in the two groups. If it is assumed, according to WCC, that this is how individuals with a diagnosis of ASD are matching, then there should not be a difference in performance, with either the faces partially covered or shown whole. However, we should see a decrease in the control group's scores, as their performance should be impaired, since they will no longer be able use the whole face.

Studies using photographs of faces partially covered have suggested that people with ASD classified the expressive faces, using 'non-emotional perceptual strategies', (Hobson, Ouston and Lee, 1988). Studies have shown that children with a diagnosis of ASD encounter less difficulty than controls in face recognition tasks, if the faces are inverted (Hobson et al. 1988). Inverting the faces, it has been suggested, affects configural processing, i.e. by the arrangement of the face, instead relying upon featural processing, i.e. the facial features (Bartlett & Searcy, 1993). Some emotions are recognised configurally, rather than through the features themselves (McKelvie, 1995). The ability of children with ASD to recognise emotion in the

inverted faces is, therefore, improved, since they have been shown to process faces featurally, rather than by arrangement. This makes it difficult for children with a diagnosis of ASD to recognise emotions that are identified through facial configuration.

It is possible that the participants, in the present study, with a diagnosis of ASD demonstrated an information-processing deficit in the emotional recognition task, rather than an emotional recognition deficit. Although the control task was designed to control for this, significant differences were found between the groups on the control task, as noted in Table 1 in the Method section. The two outliers were removed before further statistical analysis was carried out; however, it is possible that this test highlighted a deficit in face processing, rather than emotional recognition, as expected. This is an area that warrants further investigation.

Pelphrey et al. (2002) used visual scanpaths (the pattern of eye movements that occur when an individual processes stimulus, Noton & Stark, 1971), to examine face processing in individuals with a diagnosis of ASD. They found differences in the way individuals with ASD process faces, compared to controls, when asked to identify the emotion portrayed in a picture of a face. The scanpaths showed that the ASD group seemed 'erratic, undirected and disorganised' (Pelphrey et al. 2002). They often concentrated on less important features, for example, ears or chin, compared to controls whose scanpaths generally showed them tracing the eye, nose and mouth in a 'strategic and controlled' way. This research is consistent with the

findings of Hobson et al., discussed above, that ASD individuals rely more on specific features of a face rather than the configuration of those features (Hobson et al. 1988). It also supports the, previously discussed, WCC hypothesis, as the ASD group focused on specific areas of the face rather than processing the face in an organised, holistic fashion (Firth, 1989; Happé, 1996). Pelphrey et al. carried out a study that was limited by a small sample size and a lack of sufficient matching, however, the findings are consistent with other research in this area (Pelphrey et al. 2002).

The central issue is whether it is possible to account for performance deficits in emotional recognition in individuals with a diagnosis of ASD with reference to information processing or whether such performance deficits are a consequence of underlying impairments in emotional recognition competence.

A further hypothesis to explain the deficits observed in the facial processing and emotional recognition of individuals with autistic spectrum disorder comes from the suggestion of abnormal amygdala function. It has been proposed that the amygdala is linked to recognising emotions from facial expressions in normal individuals (Breiter et al.1996), and that individuals with damage to the amygdala display similar features to individuals with a diagnosis of ASD, (Broks et al. 1998). Adolphs et al. (2001) attempted to explore this further and also found that similar processes were impaired in both individuals with bilateral amygdala damage and those with a diagnosis of ASD, further supporting the proposed link.

Summary

The present study was undertaken to attempt to investigate the deficits and links between pragmatic communication, emotional recognition and EF in children with a diagnosis of ASD and a control group of typically developing children. It also attempted to integrate the findings into the three main cognitive theories of ASD, specifically, ToM, EF and WCC. These theories predict various deficits in the functioning of children with a diagnosis of ASD. This study concentrated on three specific deficits: pragmatic communication, emotion recognition and EF. Although deficits have been found in these areas in the past, no research had been undertaken to see if a relationship existed between each of these factors.

While the present study found, as predicted, that children with ASD performed significantly poorer on all three measures than children without ASD, only one correlation was found in the study. This showed a positive correlation between emotional recognition and EF for children with ASD. This suggests a relationship between EF and emotional recognition in this group.

Although a correlation was found between EF and emotional recognition, the lack of correlations between the other factors, for both groups, may indicate two things. The first possibility is that the lack of significant results is due to the fact that research has tended to concentrate on looking at EF, ToM and WCC as separate cognitive

concepts; however, it is possible that they are not mutually exclusive. It is possible that individuals with a diagnosis of ASD have multiple cognitive deficits. ASD is a complex disorder, and it would be unrealistic to expect to identify just one cognitive deficit to explain all of the symtomatologies associated with the disorder.

Instead, as Ozonoff et al. (1991) suggest, it may be more productive to consider autism as a disorder of multiple primary deficits. They propose that ASD does not need to have one primary deficit, that it can have several, and that these do not need to be specific to ASD, but that the combination of these could be specific to ASD (Ozonoff et al. 1991). This suggests, therefore, that ASD is underpinned by a broad pattern of deficits, rather than by any single impairment.

The second possibility is that the lack of predicted results was due to methodological limitations of the study. These will be discussed in detail below.

4.3. Methodological considerations

This study had a number of methodological constraints and limitations; these are discussed below. The personal pronoun 'he' is used for all participants for convenience, and this does not reflect any gender bias in the methodology.

Statistical limitations

The data for each of the variables was not normally distributed, so parametric tests could not be used to analyse the data. Transforming the data, to allow parametric tests to be used, was considered. When the data was analysed using parametric tests, however, the results did not change. The correlation between emotional recognition and EF in the experimental group became stronger, but no other correlations were identified, therefore, the data was not transformed.

Limitations of Measures

Executive Function Tests

The Tower subtest from the NEPSY (Korkman et al. 1998) was used to assess EF. However, in order to assess EF more thoroughly, further EF tasks could have been used, for example the Wisconsin Card Sorting Task (WCST: Grant & Berg, 1948), which is a task widely used to measure EF. Using this task was considered, however, due to the sessions already taking up to 45 minutes, it was felt that adding further tests would be too much for the participants to manage during one session. If this study were repeated, it would be improved by using both the Tower subtest and the WCST (Grant & Berg, 1948).

The BRIEF (Behaviour Rating Inventory of Executive Function: Gioia et al. 2000) could also have been used to assess EF. This is a questionnaire that can be

completed by parents and teachers, and would give further information about the child's EF, and it was considered as an alternative to the Tower subtest. However, it was felt that the Tower subtest would give a more accurate measure of the participant's EF, rather than relying on parental and teachers' reports.

Emotional Recognition task

The participants all scored highly in the emotional recognition task. The scores were negatively skewed, with scores clustering in the high values. To improve this study, this task should be made more difficult in order to gain a more normal distribution and to avoid ceiling effects. For example, it might have been better to have used more naturalistic tests of emotional recognition, for example, using stories or cartoon clips and asking the participants questions based on these. However, these tests would not have been validated and there are very few validated tests of emotional recognition for children.

Also, in the emotional recognition task, each emotion was presented three times, and therefore, an unequal number of male and female faces were shown for each emotion. To control for this, a male face could have been substituted for a female face in half the sample.

Although Ekman's (1976) pictures of facial effect were carefully developed, and he found that 90% of the pictures were identified correctly by more than 80% of the

people rating them, this tool is not rigorously standardised. The Penn Facial Discrimination Task (PFDT; Erwin et al. 1992) was standardised, and distracting cues such as hair and clothes were subdued. This would have been an advantage, given, as we have already discussed, that children with a diagnosis of ASD have a tendency to focus on details rather than process the face as a whole (Firth, 1989; Happé, 1996; Happé & Firth, 1996).

Limitations of sample size

The ASD database contained 106 names and, of those, 98 were invited to participate in the study. In order to achieve statistical power for the correlations, 28 participants were required, and this would have been a response rate of approximately 28%. In order to achieve statistical power for tests of difference, 26 participants were required, a response rate of approximately 26%. This was almost achieved with a response rate of 25.4%. However, six participants could not participate, and two participants had to be removed for matching purposes, bringing the total number of participants to 18. This was insufficient to reach statistical power. At the outset of the study, it was not felt that it was unrealistic or ambitious to expect 28 participants, since this would have only been a response rate of 30%. However, unfortunately, this was not achieved, and there were a number of potential factors that contributed to this, which are discussed below.

Time Constraints

The numbers achieved in this study could have been affected by the considerable time constraints on the data collection phase of this study. Ethical approval was sought with the submission of the COREC form, in November 2004, to the local ethics committee. The ethical committee requested several changes to the invitation and information sheets included in the invitation pack, which was to be sent out to potential participants' parents and guardians. Unfortunately, this process took four months and final ethical approval was not gained until March 2005. This delayed data collection considerably. If there had been more time for data collection, data could have been collected from other areas, such as, Lothian.

Although the time constraints potentially limited the number of participants, there was still a low response rate from the 98 participants invited. It is possible that people may have been put off by the need for direct testing. People may have been intimidated by the prospect of having to complete a questionnaire, due to the time and effort, or due to limited literacy ability (McColl , 1993). They may have been worried about how their child would cope with testing and whether they could give informed consent. It is also possible that they were put off by the lengthy information sheet and unfamiliar terminology. Finally, the low response in the group of participants with ASD could be linked to higher stress levels in parents with a child with a diagnosis of ASD (Weiss et al. 2003; Longenecker, 2003). However, the control group also demonstrated a relatively low response rate, and they could also have been affected by similar factors to those mentioned above.

There are many factors that could potentially have influenced the response rate for both groups. The researcher approaching parents in person, giving them the information verbally, as well as in written form, and allowing them to ask questions could have improved the low response rate. This was not possible in this case but, in future research, participants could be invited to take part during a follow-up appointment after their child has received a diagnosis of ASD from the local multi-disciplinary team.

A number of questionnaires were not returned by participants' parents. Many factors impact on whether people return questionnaires, for example, Gaskell et al. (1993) have shown that the wording in questionnaires can affect responses. Also, some parents may have had difficulty in completing the questionnaire due to reading difficulties and not returned their questionnaire for this reason (McColl, 1993). In future, testing could take place in people's homes, in order to allow the researcher to guide people through the questionnaires, rather than posting them out. This method also prompts parents to complete the questionnaire while the researcher is present, which allows the researcher to take the questionnaire away, rather than relying on potentially busy parents to find time to complete it and send it back

Design Limitations

The Raven's Progressive Matrices (RPM: Raven et al. 1995, 2000) was used to assess non-verbal IQ, and verbal IQ was not tested. Several studies have failed to

document emotional recognition deficits when children are matched on verbal mental age (Ozonoff et al. 1990; Prior et al. 1990). As discussed earlier, Liss et al. (2001) found that, although EF deficits were identified in children with high functioning autism, compared to controls with developmental language disorder, these differences stopped being significant once the variance caused by verbal IQ was accounted for. This suggests that EF deficits found in this study could merely be an artefact of verbal IQ. This could have been explored if participants had been matched on verbal IQ, as well as non-verbal IQ, in this study. A short form of the Wechsler Intelligence Scale for Children, Third Edition (WISC-III), could have been used to gain a better estimate of both performance and verbal IQ. The short forms of the WISC-III consist of two subtests from the performance scale and two from the verbal scale. Research has shown that they can be used to give a valid estimate of the full-scale tests score for IQ (Sattler, 1992). This would, however, have added time to the testing session. It was felt that adding extra time to the session would have made it necessary for the tests to be spread over two sessions. Due to time constraints, this was not felt to be practical on this occasion, but any further research would need to control more carefully for IQ.

Non-verbal IQ, rather than verbal IQ, was selected in this study, because the tests used were performance-related. The verbal demands of the tasks were kept to a minimum. All tasks could be completed without the participant having to give a verbal response, but the tasks required the participants to respond to verbal instructions. Participants also needed to be able to speak in full sentences, in order for their parents to complete the CCC-2 (Bishop, 2003).

Another reason for using a short form of the WISC-III, rather than the RPM (Raven et al. 1995, 2000), to match participants is the WCC theory. As discussed earlier, children with a diagnosis of ASD may have a different processing style to that of typically developing children. The RPM may have brought out different processing styles in each group, affecting the ASD group's performance on the RPM (Raven et al. 1995, 2000). Early research has found that children with a diagnosis of ASD were generally more able on the RPM (Raven et al. 1995, 2000) than they were on tests of 'verbal ability' (Bartak, Rutter and Cox, 1975). Although there were reasons to justify matching on non-verbal IQ, in that to recognise emotions in faces may involve strategies more related to non-verbal than verbal functioning, the possibility remains that non-specific factors related to verbal ability might have affected the performance of children with a diagnosis of ASD.

As participants were only matched according to non-verbal IQ, it is difficult to exclude the possibility that they might achieve low scores because of low verbal IQ. In this study, the emotional recognition deficits found could be a function of a more generalised deficit in verbal IQ, and a poor performance could be a reflection of a deficit in verbal IQ, rather than a result of impairment in emotional recognition.

Despite these limitations, the present study also attempted to address potential methodological flaws in a number of ways. The control participants were also

matched on chronological age. It is important to match for both IQ and age. To match only for IQ would make the control group inadequate, by overlooking the possibility that the findings reflect developmental delay of participants with a diagnosis of ASD, in terms of chronological age.

In addition, in this study a specially designed control task was used, to make it possible to screen participants for their ability to meet the task demands, such that using the RPM (Raven et al. 1995, 2000), a non-verbal IQ matching measure, becomes an appropriate methodological approach.

Most participants fell within the normal range of intelligence and all participants attended mainstream education. This was important because emotional recognition deficits have been found in children with a learning disability (Rojahn et al. 1995; Yirmiya & Shulman, 1996) and so any deficits found could have been explained by the child's learning disability, rather than the ASD diagnosis.

Moore (2001) looks at the information-processing demands made by different types of emotional recognition tasks. His article allows an assessment to be made of the relationship between task performance, emotional recognition capacities and IQ. He provides a table, showing different emotion recognition tasks and the information-processing abilities required for successful completion of each. This was used to

select an appropriate emotional recognition task and control measures for this study (Moore 2001).

Diagnostic limitations

There are inherent problems in drawing conclusions from any research carried out with individuals with a diagnosis of ASD. ASD is not a definitive diagnosis, and is made based on behavioural and cognitive observations. It is, therefore, more difficult to relate findings directly to ASD, unlike Fragile X syndrome or Down syndrome for example, which have specific tests, each leading to a definitive diagnosis. When working with participants with a diagnosis of ASD, one cannot be certain that the participants definitely have ASD. In this study, all participants had been diagnosed by a multi-disciplinary team, prior to being invited to take part in the study. It was assumed for this study that children diagnosed by the multi-disciplinary team were given as accurate a diagnosis as is possible with ASD.

In summary, if this study were repeated, the following changes would be made. The participants would be recruited from the clinic, on a face-to-face basis, rather than via a letter of invitation, in order to try to increase the response rate. The testing would all be carried out in the home environment, in order to ensure completion of the CCC-2 questionnaire (Bishop, 2003). The following measures would be used: a short form of the Wechsler Intelligence Scales for Children, Third Edition (WISC-III), to measure both performance and verbal IQ. The emotional recognition task

would be made more difficult, and possibly involve a more naturalistic measure of emotional recognition, to avoid ceiling effects and gain a more normal distribution. The WCST (Grant & Berg (1948) would be used, as well as the Tower subtest, to give a greater measure of EF.

This study clearly has a number of methodological limitations and if it were repeated, changes would be required to make it more robust. Although these limitations do not allow us to be definitive about the conclusions, it has pointed to necessary future research, which is discussed in the following section.

4.4. Future research

Despite the methodological constraints of the current study, it has highlighted a number of areas that require further research. For example, there is no clear conclusion to explain the pragmatic communication deficits found in children with a diagnosis of ASD. Future research is required in order to examine why this deficit exists, and to which other factors it is related. So far, research has not identified a consistent link between pragmatic communication and ToM, WCC or EF.

As well as carrying out research to identify the deficits observed in children with a diagnosis of ASD, research is required to examine these in more detail. This study found EF deficits in children with ASD, which is consistent with previous literature.

However, the more specific areas of EF need to be examined in relation to ASD. As discussed in the introduction, EF has become a term that encompasses a number of sub domains. These include: set shifting, hypothesis generation, problem solving, concept formation, abstract reasoning, planning, organisation, goal setting, fluency, working memory, inhibition, self-monitoring, initiative, self-control, mental flexibility, attentional control, anticipation, estimation, behavioural regulation, common sense, and creativity. Standard clinical measures to assess specific EFs have not yet been developed. The concept of EF remains abstract and is, therefore, open to interpretation. This explains, to some extent, the difficulty in developing sensitive and specific EF tests (Archibald & Kerns, 1999).

Some studies have investigated whether people with a diagnosis of ASD have a deficit in working memory (WM), which is part of EF. Bennetto, Pennington & Rogers (1996) found individuals with high functioning autism to be significantly impaired in WM when compared to controls without a diagnosis of ASD. Russell, Jarrold and Henry (1996) also found that children with a diagnosis of ASD performed poorly on tests of WM, compared to controls without autism. Their performance was, however, similar to that of individuals with a learning disability. Further work would be required in order to establish a consistent link between WM and ASD, as well as the other specific elements of EF.

Bishop & Norbury (2005) investigated response inhibition as a specific sub domain of EF. They compared four groups: children with a diagnosis of high functioning

autism, children with pragmatic language impairment, children with specific language impairment and typically developing children as a control. They found children with high functioning autism, as well as those with pragmatic language impairment and those with specific language impairment, all performed equally poorly on the response inhibition tasks. They did not find that children with high functioning autism were specifically impaired in response inhibition. Bishop & Norbury (2005) suggested that their results could be a consequence of the participants in each of the groups, except the control group, having impairments in 'inner speech'. Inner speech can be described as verbalising things to aid understanding in one's head, not out loud. Young children have been shown to talk out loud when solving problems (Sokolov, 1972). It is thought that, as they get older, this become internal. It is likely to be important in tests of executive function, as they often involve solving problems and adhering to rules. Bishop & Norbury (2005) suggested that children with a diagnosis of ASD perform badly, compared to controls, on some tests of EF, not due to specific EF impairment but instead due to language impairments affecting their 'inner speech'. As Bishop & Norbury (2005) point out, if they had carried out the same study with children with high functioning autism and a control of typically developing children, but not other language impairment, their conclusions would have been that children with high functioning autism have a specific deficit in response inhibition. This acts as a cautionary reminder to any future research in this area.

Bishop & Norbury (2005) also suggested that generally inattention and hyperactivity are not controlled for, in studies of children with ASD, however, they found

clinically significant levels of inattention and hyperactivity in the high functioning autism group. They go on to suggest that executive function deficits, found in previous studies of children with a diagnosis of ASD, could be due, not to ASD symptomatology, but co-morbid attentional deficits, as children with ADHD have been shown to have deficits in executive function (Lawrence, 2004).

As well as research to find links between the components of EF and ASD, the link between EF and ToM warrants further investigation. There is some research to suggest that these two cognitive concepts are linked in typically developing children (Hughes, 1998a, 1998b; Moore 1996; Russell et al. 1991), as well as in children with a diagnosis of AS (Ozonoff et al. 1991). As previously mentioned, Ozonoff et al. (1991) postulated that EF is a primary deficit in ASD, and ToM is a secondary deficit.

Ozonoff et al. (1991) took a closer look at the link between ToM and EF, and suggested that it is possible that EF is related to ToM in a number of ways: -

- One deficit is primary and causes the other (for example EF deficit causes ToM deficit).
- One is primary but does not cause the other.
- There is a correlated deficit caused by brain damage (frontal lobe).
- A third deficit is primary and causes both EF and ToM deficit.
- EF and ToM are both independent primary deficits.

- Widespread prefrontal impairment.

(Ozonoff, et al. 1991)

Further research would give a clearer picture about these links.

The links between all of the main cognitive theories need to be investigated to try and establish which of them offer explanations for specific behaviours. Such research could also determine if any of the cognitive deficits are primary deficits or if, as was suggested earlier, there is a mix of cognitive deficits. It is also possible that the cognitive deficits observed are the result of an unknown factor.

As discussed earlier, ASD is a complicated disorder, made more confusing by various factors. Relatively little is known about ASD, even though it is a well-researched area. It is difficult to research, partly due to problems with reliable diagnosis, but also due to factors such as strict matching of all variables and, particularly in this study, concepts such as EF being an ill-defined construct without clear assessment tools. All of these factors make carrying out research, and gaining a clear understanding of ASD, difficult. That is not to say, however, that research should not continue to pursue a fuller understanding of the disorder. In recent times, this area has gained a great deal from research and stands to gain a great deal more.

It is important for future research to identify the primary neurological deficits in children with a diagnosis of ASD, in terms of furthering knowledge and understanding of this disorder, as well as guiding the development of interventions to help children, families and the education system with this diagnosis.

Children with a diagnosis of ASD often have difficulties in the real world, for example, in making friends, communicating with others, and coping in unfamiliar environments. This study focuses broadly on the social and communicative difficulties observed in children with a diagnosis of ASD. These are possibly the most disabling elements of this disorder, as they impact on quality of life, in terms of social development from childhood through to adulthood, resulting in difficulties forming and maintaining relationships. These difficulties not only affect the individual with the diagnosis but also their parents and their siblings (Wing, 1996). They affect families practically as well as emotionally. Parents can find it difficult to take their child out, or to find baby-sitters, but they can also find the communication difficulties and aloofness of their child emotionally challenging. Siblings can feel that they do not receive as much attention, or that they cannot bring friends to the house. It must be noted that there is controversy surrounding the literature about how having a sibling with ASD affects a child, with both positive and negative outcomes reported (Wing, 1996). Finally, ASD also poses a challenge to professionals and the education system, raising questions about how best to help individuals and families affected by ASD.

This study attempted to contribute to the literature working to identify the primary cognitive deficits in children with ASD, as a means of gaining a better understanding of this disorder, which is important in terms of earlier and more accurate diagnosis. It may also allow more specific interventions to be developed in order to help children with ASD cope in the real world. If the core problems are identified, interventions and strategies can be targeted more accurately to help children, families and professionals to help children with ASD to enjoy their lives and function more fully in the everyday world.

5. Conclusion

The present thesis attempted to examine three of the main deficits observed in ASD, specifically, emotional recognition, pragmatic communication and executive function, and the links between them. Despite a number of methodological limitations, outlined above, the thesis did find evidence of relative deficits in children with ASD in emotional recognition, pragmatic communication and executive function, compared to children without ASD. In addition, a link was found between emotional recognition and executive function in the experimental group, but not the control group. These findings are consistent with much of the previous research, which suggests that children with a diagnosis of ASD are deficient in emotional recognition (Hobson, 1986; Ozonoff et al. 1990), pragmatic communication (Rinaldi, 2000) and executive function (Ozonoff et al. 1991). The link found, in this study, between emotional recognition and executive function supports previous reports that executive function could be one of the primary cognitive deficits in children with ASD (Ozonoff et al. 1991). The thesis also identified a number of areas for future research, including identifying the links between the pragmatic communication deficits and cognitive theories and exploring the specific sub domains of executive function and their relationship with ASD. Children and adults with ASD face a number of difficulties in their daily lives. It is hoped that the discovery of one or more underlying causes of these difficulties will offer practical ways of alleviating, reducing or overcoming some of these difficulties.

6. References

Adolphs, R., Sears, L., & Piven, J. (2001). Abnormal Processing of Social Information from Faces in Autism. Journal of Cognitive Neuroscience, 13, (2), 232-240.

Alexander, M. P., Benson, D. F. & Stuss, D. T. (1989). Frontal lobes & Language. Brain & Language, 37, 659-691.

American Psychiatric Association. (1994). Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), Fourth Edition. Washington, DC: APA.

Archibald, S., & Kerns, K. A. (1999). Identification and Description of new tests of executive functioning in children. Child Neuropsychology, 5, (2), 115-129.

Ashington, J. (1990). Narrative and the child's theory of mind. In Britton & A. Pellegrini (Eds.) Narrative thought and narrative language. Hillsdale, NJ: Erlbaum.

Astington, J., & Jenkins, J. (1999). A longitudinal study of the relationship between language and theory of mind development. Developmental Psychology, 35, 1311-1320.

Attwood, T. (2000). Strategies for improving the social integrations of children with Asperger Syndrome. Autism, 4, (1), 85-100.

Averill, C. (2000). The relationship between emotional perception and ToM in children with autism. Dissertation abstracts International: Section B: the Sciences and Engineering, 60, (11-B), 5761.

Baron-Cohen, S. (1988). Social and Pragmatic deficits in autism: Cognitive or affective? Journal of Autism and Developmental Disorders, 18, 379-402.

Baron-Cohen, S. (1989). Do autistic children have obsessions and compulsions? British Journal of Clinical Psychology, 28 (3), 193-200.

Baron-Cohen, S. (1991). Do people with autism understand what causes emotion? Child Development, 62, (2), 385-395.

Baron-Cohen, S. (1993). From attention-goal psychology to belief-desire psychology: The development of a theory of mind and its dysfunction. In S. Baron-Cohen, H. Tager-Flusberg & D. J. Cohen (Eds.), Understanding other minds: Perspectives from autism (pp59-82). Oxford: Oxford University Press.

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

Baron-Cohen, S., Spitz, A., & Cross, P. (1993). Do children with autism recognise surprise? A research note. Cognition and Emotion, 7, 507-516.

Baron-Cohen. S, (1994). From attention-goal psychology to belief-desire psychology: The development of theory of mind, and it's dysfunction. In S. Baron-Cohen, H. Tager-Flusberg & D. Cohen (Eds.) Understanding Others Minds: Perspectives from Autism (pp 59-82) Oxford, UK: Oxford University Press.

Bartak, L., & Rutter, M. (1976). Differences between mentally retarded and normally intelligent autistic children. Journal of Autism and Childhood Schizophrenia, 6, 109-120.

Bartak, L., Rutter, M. & Cox, A. (1975). A Comparative study of infantile autism and specific developmental receptive language disorder: I. The Children. British Journal of Psychiatry, 126, 127-145.

Bartlett, J. C. & Searcy, J. (1993). Inversion and configuration of faces. Cognitive Psychology, 25, (3), 281-316.

Bauminger, N. & Kasari, C. (1999). Brief Report: ToM in high functioning children with autism. Journal of Autism and Developmental Disorders, 29, (1), 81-86.

Bennetto, L., Pennington, B. & Rogers, S. (1996). Intact and impaired memory functions in autism. Child Development, 67, 1816-1835.

Berger, H. J. C., van Spaendonck, K. P. M. & Horstinck, M. W. I. M. (1993). Cognitve shifting as a predictor of progress in social understanding in high functioning adolescents with autism: A prospective study. Journal of Autism & Developmental Disorders, 23, 341-359.

Bishop, D. (1997). Uncommon understanding: Development and disorders of language comprehension in children. England: Psychology Press.

Bishop, D. V. M. & Norbury, C. F. (2005). Executive functions in children with communication impairments, in relation to autistic symptomatology. Autism, 9, (1), 29-43.

Bishop, D. V. M. & Rosenbloom, L. (1987). Classification of childhood language disorders. In W. Yule and M. Rutter (Eds.), Language Development and Disorders (pp. 16-41). London: Mac Keith Press.

Bishop, D. V. M. (1989). Autism, Asperger's syndrome and semantic-pragmatic disorder: Where are the boundaries? British Journal of Disorders of Communication, 24, 107-121.

Bishop, D. V. M. (2003). The Children's Communication Checklist. Second Edition. The Psychological Corporation.

Bowler, D. & Strom E. (1992). Elicitation of first-order 'theory of mind' in children with autism. Autism, 2, (1), 33-44.

Breiter, H. C., Etcoff, N. L., Whalen, P. J., Kennedy, W. A., Rauch, S. L., Buckner, R. L., Strauss, M. M., Hyman, S. E., & Rosen, B. R. (1996). Response and habituation of the human amygdala during visual processing of facial expressions. Neuron, 17, 875-887.

Broks, P., Young, A. W., Maratos, E. J., Coffey, P. J., Calder, A. J., Isaac, C., Mayes, A. R., Hodges, J. R., Montaldi, D., Cezayirli, E., Roberts, N., & Hadley, D. (1998). Face processing impairments after encephalitis: Amygdala damage and recognition of fear. Neuropsychologia, 36, 59-70.

Bruner, J. (1986). Actual Minds, Possible Words. Cambridge: Harvard University Press.

Buitelaar, J. K. & van der Wees, M. (1997). Are deficits in the decoding of affective cues and in mentalising abilities independent? Journal of Autism and Developmental Disorders, 27, 539-556.

Buitelaar, J., van der Wees, M., Swaab-Barneveld, H., Jan van der Gaag, R. (1999). Verbal Memory and performance IQ predict ToM and emotional recognition ability in children with autistic spectrum disorders and in psychiatric control children. Journal of Child Psychology and Psychiatry and Allied Disciplines, 40, (6), 869-881.

Burack, J. A. (1994). Selective attention deficits in persons with autism: Preliminary evidence of an inefficient attentional lens. Journal of Abnormal Psychology, 103, 535-543.

Caplan, R., Chugani, H. T., Messa, C., Guthrie, D., Sigman, M., de Traversy, J. & Mundy, P. (1993). Hemispherectomy for intractable seizures, pre-surgical cerebral glucose metabolism and post-surgical nonverbal communication. Developmental Medicine Child Neurology, 35, 582-592.

Capps, L., Yirmiya, N., & Sigman, M. (1992). Understanding of simple and complex emotions in non-retarded children with autism. Journal of Child Psychology and Psychiatry and Allied Disciplines, 33, 1169-1182.

Carr, A. (1999). The Handbook of Child and Adolescent Clinical Psychology: A contextual approach. Brunner and Routledge.

Carruthers, P. (1996). Autism as mind blindness: An elaboration and partial defence. In P. Carruthers & P. K. Smith (Eds.), Theories of Theories of Mind (pp.257-273). Cambridge, UK: Cambridge University Press.

Clark, P., & Rutter, M. (1981). Autistic children's responses to structure and to interpersonal demands. Journal of Autism & Developmental Disorders, 11, 201-217.

Crystal, D. (1987). Concept of language development: A realistic perspective. In R. Rule & M. Rutter (eds.) Language Development and Language Disorders. London: MacKeith Press.

Dadds, M. R., Schwartz, S., Adams, T. & Rose, S. (1988). The effects of social context and verbal skill on the stereotypic and task-involved behaviour of autistic children. Journal of Child Psychology and Psychiatry, 29, 669-676.

Dahlgren, S., O. & Trillingsgaard, A. (1996). Theory of mind in non-retarded children with autism and Asperger's syndrome: A research Note. Journal of Child Psychology & Psychiatry & Allied Disciplines, 37, (6), 759-763.

Damasio, A. R., & Van Hoesen, G. W. (1983). Emotional disturbances associated with focal lesions of the limbic frontal lobe. In K. M. Heilman & P. Satz (Eds.). The Neuropsychology of Human Emotion (pp. 85-110) New York: Guilford Press.

Dissanayake, C. & Macintosh, K. (2003). Mind reading and social functioning in children with autistic disorder and Asperger's disorder. In B. Repacholi & V. Slaughter (eds). Individual differences in theory of mind: Implications for typical and a typical development. (pp213-239) New York: Psychology Press.

Duncan, J., (1986). Disorganisation of behaviour after frontal lobe damage. Cognitive Neuropsychology, 3, 271-290.

Dunn, L. M. & Dunn, L. M. (1997). Peabody Picture Vocabulary Test – Third Edition. Circle Press, MN: American Guidance Service.

Eisenberg, N. (2000). Emotion, regulation, and moral development. Annual Review of Psychology, 51, 665-697.

Erwin, R. J., Gur, R. C., Gur, R. E., Skolnick, B., Mawhinney-Hee, M. & Smailis, J. (1992). Facial emotion discrimination: I. Task construction and behavioural findings in normal subjects. Psychiatry Research, 42, 231-240.

Firth, U. (1989). Autism: Explaining the enigma. Oxford: Basil Blackwell.

Gaskell, G., Wright, D. & O'Muircheartaigh, C. (1993). Reliability of surveys. The Psychologist, 500-503.

Gillberg, C., Steffenburg, S. and Schaumann, H. (1991). Autism: Epidemiology: Is autism more common now than 10 years ago? British Journal of Psychiatry, 158, 403-409.

Gioia, G. A., Isquith, P. K., Guys, S. C. & Kenworthy, L. (2000). Behaviour Rating Inventory of Executive Function. Odessa, FL: Psychological Assessment Resources, Inc.

Gioia, G. A., Isquith, P. K., Guys, S. C., & Kenworthy, L. (2000). Behaviour Rating Inventory of Executive Function. Odessa, FL: Psychological Assessment Resources, Inc.

Gioia, G. A., Isquith, P. K., Guys, S. C., & Kenworthy, L. (2000). Behaviour Rating Inventory of Executive Function. Odessa, FL: Psychological Assessment Resources, Inc.

Grant, D. A. & Berg, E. A. (1948). A behavioural analysis of degree of reinforcement and ease of shifting to new responses in a weigl-type card sorting problem. Journal of Experimental Psychology, 38, 404-411.

Gresham, F. M., & Elliot, S. N. (1990). Social Skills Rating System. Circle Pines, MN: American Guidance Service.

Happé, F. (1994). Autism: An introduction to psychological theory. London, UK: University College London Press.

Happé, F. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. Child Development, 66, 843-855.

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

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

Happé, F. G. (1996). Studying weak central coherence at low levels: Children with autism do not succumb to visual illusions: A research note. Journal of Child Psychology and Psychiatry & Allied Disciplines, 37, (7), 873-877.

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

Heavey, L., Phillips, W., Baron-Cohen, S., Rutter, M., (2000). The Awkward Moments Test: A Naturalistic Measure of Social Understanding in Autism. Journal of Autism and Developmental Disorders, 30, (3), 225 – 236.

Heerey, E. A., Keltner, D. & Capps, L. M. (2003). Making Sense of self-Conscious Emotion: Linking Theory of Mind and Emotion in Children with Autism. Emotion. 3, (4), 394-400.

Hermelin, B., & O'Connor, N. (1967). Remembering of words by psychotic and subnormal children. British Journal of Psychology, 58 (3-4), 213-218.

Hobson, P. R. (1986). The autistic child's appraisal of expressions of emotions: A further study. Journal of Child Psychology and Psychiatry and Allied Disciplines, 27, 671-680.

Hobson, R. P. & Lee, A. (1989). Emotion related and abstract concepts in autistic people: Evidence from the British Picture Vocabulary Scale. Journal of Autism and Developmental Disorders, 19, 601-623.

Hobson, R. P., Ouston, J., Lee, A. (1988). What's in a face: The case of autism. British Journal of Psychology, 79, 441-453.

Holroyd, S. & Baron-Cohen, S. (1993). Brief Report: How far can people with autism go in developing a theory of mind? Journal of Autism and Developmental Disorders, 23 (2), 379-385.

Hughes, C. (1998a). Executive function in preschoolers: Links with theory of mind and verbal ability. British Journal of Developmental Psychology, 16, 233-253.

Hughes, C. (1998b). Finding your Marbles: Does preschoolers strategic behaviour predict later understanding of mind? Developmental Psychology, 34, (6), 1326-1339.

Jackson, A. (2001). Language facility and theory of mind development in deaf children. Journal of Deaf Studies and Education, 6, (3), 161–176

Kaland, N., Moller-Nielsen, A., Callesen, K., Mortensen, E. L., Gottlieb, D. & Smith, L. (2002). A new advanced test of theory of mind: Evidence from children

and adolescents with Asperger's syndrome. Journal of Child Psychology & Psychiatry & Allied Disciplines, 43, (4), 517-528.

Kanner, L. (1943). Autistic disturbances of affective contact. Nervous Child, 2, 217-250.

Keltner, D. & Buswell, B. N. (1997). Embarrassment: Its distinct form and appeasement functions. Psychological Bulletin, 122, 250-270.

Keltner, D. & Kring, A. M. (1998). Emotion, social function and psychopathology. Review of general Psychology, 2, 320-342.

Kemp, S. L., Kirk, U., Korkman, M. (2001). Essentials of NEPSY Assessment. (Ed.) A. S. Kaufman & N. Kaufman, USA: Wiley.

Kissgen, R. & Schleiffer, R. (2002). About the specificity of a theory of mind deficit in autism. German title, 30 (1) 29-40.

Korkman, M., Kirk, U. & Kemp, S. L. (1998). NEPSY: A Developmental neuropsychological assessment. San Antonio, TX: Psychological Corp.

Lawrence, V., Houghton, S., Douglas, G., Durkin, K., Whiting, K., Tannock, R. (2004). Executive function and ADHD: A comparison of children's performance during neuropsychological testing and real-world activities. Journal of Attention Disorders, 7, (3), 137-149.

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

Locke, J. (1994). A child's path to spoken language. Cambridge, MA: Harvard University Press.

Longenecker, H., Q. (2003). Parent stress related to having a child with autism: Impact of educational programming. Dissertation Abstracts International: Section B: The Sciences & Engineering, 64, (1-B), 424.

Loveland, K. T., McEvoy, R. E., Tunali, B. & Kelley, M. L. (1990). Narrative story telling in autism and Down's syndrome. British Journal of Developmental Psychology, 8, 9-23.

Loveland, K., Landry, S., Huges, S. Hall, S. & McEvoy, R. (1988). Speech acts and the pragmatic deficits of autism. Journal of Speech and Hearing Research, 31, 593-604.

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

Luria, A. (1993). The working brain: An introduction to neuropsychology. Harmondsworth, UK: Penguin.

Martin, I & McDonald, S (2004). An exploration of cause of non-literal language problems in individual with Asperger's syndrome. Journal of Autism & Developmental Disorders, 34, (3), 311-238.

McColl, E. (1993). Questionnaire design and construction. Nurse Researcher, 1,(2), 16-25.

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

McKelvie, S. J. (1995). Emotional expression in upside-down faces: Evidence for configurational and componential processing. British Journal of Social Psychology, 34, (3), 325-334.

McTear, M. & Conti-Ramsden, G. (1992). Pragmatic Disability in Children. Whurr Publishers Led: London.

Moore, C. (1996). Evolution and the modularity of mind reading. Cognitive Development, 11, 605-621.

Moore, D. G. (2001). Reassessing Emotional Recognition Performance in People with Mental Retardation: A Review. American Journal on Mental Retardation, 106, 6, 481-502.

Mottron, L., Burack, J. A., Stauder, J. A. S. & Robaey, P. (1999). Perceptual processingamong high functioning persons with autism. Journal of Child Psychology & Psychiatry & Allied Disciplines, 40, (2), 203-211.

Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. Journal of autism and Developmental Disorders, 20, 115-123.

Mundy, P., Sigman, M., & Kasari, C. (1993). The theory of mind and joint attention deficits in autism. In S. Baron-Cohen, H. Tager-Flusberg & D. J. Cohen (Eds.) Understanding other minds: Perspectives from autism (pp181-203). Oxford: Oxford University Press.

Noton, D., & Stark, L. (1971). Eye movements and visual perception. Scientific American, 224, 6, 35-43.

Ozonoff, S. & McMahon-Griffith, E. (2000). Neuropsychological Function and the External Validity of Asperger Syndrome. In A. Klin, F. R. Volkmar & S. S. Sparrow, (Eds.), Asperger Syndrome. The Guilford Press: New York.

Ozonoff, S. (1998). Assessment and Remediation of Executive Dysfunction in Autism and Asperger's syndrome. In E. Schopler, G. B. Mesibov, L. J. Kunce, (Eds.), Asperger Syndrome or High-functioning Autism? (pp263-293). Plenum Press: New York.

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

Ozonoff, S., Pennington, B. F. & Rogers, S. J. (1991). Executive Function Deficits in High-Functioning Autistic Individuals: Relationship to Theory of Mind. Journal of Child Psychology and Psychiatry, 32, (7), 1081-1105.

Ozonoff, S., Pennington, B. F., Rogers, S. J. (1990). Are There Emotion Perception Deficits in Young Autistic Children? Journal of Child Psychology and Psychiatry, 31, (3), 343-361.

Pacherie, E. (1997). Motor-images, self-consciousness and autism. In J. Russell (ed) Autism as an Executive Disorder (pp 215-355). New York: Oxford University Press.

Paul, R. & Cohen, D. J. (1984). Responses to contingent queries in adults with mental retardation and pervasive developmental disorders. Applied Psychlinguistics, 5, 349-357.

Pelphrey, K. A., Sasson, N. J., Reznick, S., Paul, G., Goldman, B. D. & Piven, J. (2002). Visual Scanning of Faces in Autism. Journal of Autism and Developmental Disorders, 32, (4), 249-261.

Perner, J. & Lang, B. (1999). Theory of mind and executive function: Is there a developmental relationship? In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen

(Eds.) Understanding other Minds: Perspectives from Autism and Developmental Cognitive Neuroscience (2nd ed.) Oxford: Oxford University Press.

Perner, J. (1991). Understanding the Representational Mind. Cambridge, MA: MIT Press.

Perner, J., Firth, U., Leslie, A., & Leekman, S. (1989). Exploration of the autistic child's theory of mind: Knowledge, belief, and communication. Child Development, 60, 689-700.

Peterson, C. & Siegal, M. (2000). Insights into theory of mind from deafness and autism. Mind and Language,15, (1), 123-145.

Peterson, C. C. & Siegal, M. (1995). Deafness, conversation and theory of mind. Journal of Child Psychology and Psychiatry, 31, 587-601.

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

Prior, M., Dahlstrom, B., & Squires, T. L. (1990). Autistic children's knowledge of thinking and feeling states in other people. Journal of Child Psychology and Psychiatry. 31, 587-601.

Prutting, C. A. (1982). Pragmatics as social competence. Journal of Speech and Hearing Disorders, 47, (2), 123-134.

Rapin, I., & Allen, D. A. (1987). Developmental language disorders: nosologic considerations. In U. Kirk (ed.), Neuropsychology of Language, Reading and Spelling. Academic Press: New York.

Raven, J. C., Court, J. H. & Raven, J. (1995). Coloured Progressive Matrices. Oxford Psychology Press.

Raven, J., Raven, J. C. & Court, J. H. (2000). Standard Progressive Matrices. Oxford Psychology Press.

Rinaldi, W. (2000). A pragmatic disorder in the contexts of autism and developmental language disorder. In Rinaldi, W. (ed.) Language Difficulties in an Educational Context. Whurr Publishers: London.

Rojahn, J., Lederer, M., & Tasse, M. J. (1995). Facial Emotion Recognition by Persons with Mental Retardation: A Review of the Experimental Literature. Research in Developmental Disabilities, 16, (5), 393-414.

Rojahn, J., Rabold, D. E., & Schneider, F. (1995). Emotion specify in mental retardation. American Journal on Mental Retardation, 99, 477-486.

Rollins, P. (1994). A case study of the development of communicative skills for six autistic children. Dissertation Abstracts International: Section B: The Sciences & Engineering, 55, (7-B), 3038.

Ropar, D. & Mitchell, P. (1999). Are individuals with autism and Asperger's syndrome susceptible to visual illusions? Journal of Child Psychology, Psychiatry and Allied Disciplines, 40, (8), 1238-1293.

Ropar, D. & Mitchell, P. (2001). Susceptibility to illusions and performance on visuospatial tasks in individuals with autism. Journal of Child Psychology, Psychiatry and Allied Disciplines, 42, (4), 539-549.

Roth, F. & Spekman, N. (1984). Assessing the pragmatic abilities of children. Part 1. Organizational framework and assessment parameters. Journal of Speech and Hearing Disorders, 49, 2-11.

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

Russell, J. (1996). Agency: Its role in mental development. Hove, UK: Lawrence Erlbaum Associate Ltd./Taylor and Francis.

Russell, J., Jarrold, C. & Henry, L. (1996). Working memory in children with autism and with moderate learning difficulties. Journal of Child Psychology & Psychiatry, 37, 673-686.

Russell, J., Mauthner, N., Sharpe, S. & Tidswell, T. (1991). The " windows task" as a measure of strategic deception in preschoolers and autistic subjects. British Journal of Developmental Psychology, 9, 331-349.

Russell, J., Saltmarsh, R., & Hill, E. (1999). What do executive factors contribute to the failure on false belief tasks by children with autism? Journal of Child Psychology & Psychiatry, 40, (6), 859-868.

Rutter, M. (1966). Behavioural and cognitive characteristics of a series of psychotic children. In J. K. Wing (ed), Early Childhood Autism, 51-81.

Rutter, M. (1991). Autism as a Genetic Disorder. In P. McGuffin & R. Murray (Eds), The New Genetics of Mental Illness (pp.225-244): Butterworth-Heinemann: The Mental Health Foundation.

Sallice, T. (1982). Specific impairments in planning. Philosophical Transactions. The Royal Society of London B, 298, 199-209.

Sattler, J. M. (1992). Assessment of Children: WISC and WPPSI-R Supplement. San Diego: Jerome M. Sattler Publisher Inc.

Schopler, E. & Olley, J. (1982). Comprehensive educational services for autistic children: The TEACCH model. In C. R. Reynolds & T. B. Gutkin (Eds.), Handbook of School Psychology. New York: Wiley.

Schopler, E. (1996). Are autism and Asperger's syndrome different labels or different disabilities? Journal of Autism and Developmental Disorders, 26, 109-110.

Senju, A. (2002). Reading mind from pictures of eyes: Theory of mind, language ability, general intellectual ability, and autism. The Japanese Journal of Psychology. 73 (1), 64-70.

Shah, A. & Firth, U. (1993). Why do individuals show superior performance on the block design task? Journal of Child Psychiatry, 34, (8), 1352-1364.

Shallice, T. (1982). Specific impairments of planning. Phil. Trans. Royal Society of London, 199, 199-209.

Shyu, V. (2001). The respective roles of general processing limitations and ToM impairments in determining the language profile seen in autism. Dissertation abstracts International: Section B: The Sciences and Engineering, 6,1, (12-B), 6732.

Smith, I. & Bryson, S. (1994). Imitation and action in autism: A critical review. Psychological Bulletin, 2, 259-273.

Sokolov, E. M. (1972). Inner speech and thought. G. T. Onischenko. New York: Plenum.

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

Sparrow, S., Balla, D., & Cicchetti, D. (1984). Vineland Adaptive Behaviour Scales (Survey Form). Circle Pines, MN: American Guidance Service.

Steele, S., Joseph, R., Tager-Flusberg, H. (2003). Brief Report: Developmental Change in Theory of Mind Abilities in Children with Autism. Journal of Autism & Developmental Disorders, 33, (4), 461-467.

Stuss, D. T., & Benson, D. F. (1986). The frontal lobes. New York: Ravens Press.

Szatmari, P. (1998). Differential Diagnosis of Asperger Disorder. In E. Schopler, G. Mesibov & L. Kunce (eds.). Asperger Syndrome or High Functioning Autism? 61-76. Plenum Press: New York

Szatmari, P., Bartolucci, G., & Bremner, R. (1989). Asperger's syndrome and autism: Comparison of early history and outcome. Developmental Medicine and Child Neurology, 31, 709-720.

Tager-Flusberg, H. (1992). Autistic children talk about psychological states: Deficits in early acquisition of a theory of mind. Child Development, 63, 161-172.

Tager-Flusberg, H. (1993). What language reveals about the understanding of minds in children with autism. In S. Baron-Cohen , H., Tager-Flusberg, & D. J. Cohen (Eds.) Understanding other minds: Perspectives from autism (pp181-203). Oxford: Oxford University Press.

Tager-Flusberg, H. (1995). "Once upon a ribbit": Stories narrated by autistic children. British Journal of Developmental Psychology, 13, 45-59.

Tager-Flusberg, H. (2000). Language and understanding minds: Connections in autism. In S. Baron-Cohen, H. Tager-Flusberg & D. J. Cohen (Eds.). Understanding other minds: Perspectives from developmental cognitive neuroscience (pp, 124-149). Second Edition. Oxford: Oxford University Press.

Tager-Flusberg, H. (2001). Understanding the language and communication impairments in autism. In Glidden, Laraine Masters (ed) International review of research in mental retardation: Autism (vol 23) (pp 185-205) San Diego, CA, US Academic Press 312 pp

Tager-Flusberg, H., & Anderson, M. (1991). The development of contingent discourse ability in autistic children. Journal of Child Psychology and Psychiatry, 32, 1123-1134.

Teunisse, J. P., Cools, A. R., van Spaendonck, K. P. M., Aerts, F. H. T. M. & Berger, H. J. C. (2001). Cognitive styles in high-functioning adolescents with autistic disorder. Journal of Autism and Developmental disorders, 31 (1), 55-66.

Turner, M. (1997). Towards an executive dysfunction account of repetitive behaviour in autism. In J. Russel, (Ed.) Autism as an executive disorder (pp.57-100). New York: Oxford University Press.

Turner, M. (1999). Repetitive behaviour in autism: Repetitive behaviour in autism. Journal of Child Psychology & Psychiatry, 40, (6), 837-850.

Wahlberg, T. (2001). Cognitive theories and symptomatology of autism. In T. Wahlberg, F. Obiakor, S. Burkhardt, A. F. Rotatori, (eds). Autistic Spectrum Disorders: Educational and Clinical Interventions. Advances in Special Education. Vol 14. Oxford, England, Elsevier Science Ltd.

Watson, A. C., Painter, K. M. & Bornstein, M. H. (2001). Longitudinal relations between 2-year-olds' language and 4-year-olds' theory of mind. Journal of Cognition and Development, 2, (4), 449-457.

Wechsler, D. (1997). Wechsler Intelligence Scale for Children – Third Edition (WISC-III). Dan Antonio, TX: Psychological Corp.

Weiss, J. A., Sullivan, A. & Diamond, T. (2003). Parent stress and adaptive functioning of individuals with developmental disabilities. Journal of Developmental Disabilities, 10, (1), 129-135.

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

Wetherby, A. (1986). Ontogeny of communication functions in autism. Journal of Autism and Developmental Disorders, 16, 295-316.

Williams, K. T. (1997). Expressive Vocabulary Test. Circle Pines, MN: American Guidance Service.

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

Wing, L. (1988). The continuum of autistic characteristics. In E. Schopler, G. B. Mesibov (eds.) Diagnosis and Assessment in Autism. New York: Plenum.

Wing, L. (1996). The Autistic Spectrum. Robinson: London.

Wing, L. (2000). Past and Future of Research on Asperger Syndrome. In A. Klin, F. R. Volkmar & S. S. Sparrow, (eds). Asperger Syndrome. The Guilford Press: New York.

World Health Organisation, (1992). The ICD-10 Classification of Mental and Behavioural Disorders. Geneva: World Health Organisation.

World Health Organisation, (1996). Multi-Axial Classification of Child and Adolescent Psychiatric Disorders: ICD-10 Classification of Mental and Behavioural Disorders in Children and Adolescents. Cambridge: Cambridge University Press.

Yirmiya, N. & Shulman, C. (1996). Seriation, conservation, and theory of mind abilities in individuals with autism, individuals with mental retardation and normally developing children. Child Development, 67, 2045-2059.

Yirmiya, N., Sigman, M. D., Kasari, C. & Mundy, P. (1992). Empathy and cognition in high functioning children with autism. Child Development, 63, 150-160.

7. Appendices

7.1. Appendix: Diagnostic Criteria

Diagnostic criteria: The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), (American Psychiatric Association, APA, 1994) and ICD-10 (World Health Organisation, WHO, 1992, 1996)

Diagnostic Criteria for 299.00 Autistic Disorder (DSM-IV)

A. A total of six (or more) items from (1), (2) and (3), with at least two from (1), and one each from (2) and (3)

(1) qualitative impairment in social interaction, as manifested by at least two of the following:

(a) 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

(b) failure to develop peer relationships appropriate to developmental level

(c) 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)

(d) lack of social or emotional reciprocity.

(2) qualitative impairments in communication as manifested by at least one of the following:

(a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gestures or mime)

(b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others

(c) stereotyped and repetitive use of language or idiosyncratic language

(d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

(3) restricted repetitive and stereotyped patterns of behaviour, interests, and activities, as manifested by at least one of the following:

(a) encompassing preoccupation with one or more stereotyped patterns of interest that is abnormal either in intensity or focus

(b) apparently inflexible adherence to specific, nonfunctional routines or rituals

(c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)

(d) persistent preoccupation with parts of objects.

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

Diagnostic Criteria for 299.80 Asperger's Disorder (DSM-IV)

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 repetitive and stereotyped 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, non-functional 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 behavior (other than in social interaction), and curiosity about the environment in childhood.

F. Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

299.80 Pervasive Developmental Disorder Not Otherwise Specified (Including Atypical Autism)

(1) qualitative impairments in communication as manifested by at least one of the following:

(a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gestures or mime)

(b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others

(c) stereotyped and repetitive use of language or idiosyncratic language

(d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level .

(2) restricted repetitive and stereotyped patterns of behaviour, interests, and activities, as manifested by at least one of the following:

(a) encompassing preoccupation with one or more stereotyped patterns of interest that is abnormal either in intensity or focus

(b) apparently inflexible adherence to specific, non-functional routines or rituals

(c) stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)

(d) persistent preoccupation with parts of objects.

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific Pervasive Developmental Disorder, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder. For example, this category includes "atypical autism" - presentations that do not meet the criteria for Autistic Disorder because of late age of onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

Diagnostic Criteria for Autism (ICD 10)

A. Qualitative impairment in reciprocal social interaction, 3 from the following 5 areas:

1. Failure to use eye gaze, body posture, facial expression and gesture to regulate interaction adequately.

2. A failure to develop (in a manner appropriate to mental age, and despite ample opportunity) peer relationships that involve a mutual sharing of interests, activities and emotions.

3. Rarely seeking and using other people for comfort and affection at times of stress or distress and/or offering comfort and affection to others when they are showing distress or unhappiness.

4. A lack of shared enjoyment in terms of vicarious pleasures in other people's happiness and/or a spontaneous seeking to share their own enjoyment through joint involvement with others

5. A lack of socio-emotional reciprocity, as shown by an impaired or deviant response to communicative behaviours.

B. Qualitative impairment in communication, 2 from the following 5 areas:

1. A delay in, or total lack of, spoken language that is not accompanied by an attempt to compensate through the use of gesture or mime as alternative modes of communication.

2. A relative failure to initiate or sustain conversational interchange (at whatever level of language skills is present) in which there is a reciprocal to and fro responsiveness to the communication of the other person.

3. Stereotyped and repetitive use of language and/or idiosyncratic use of words or phrases.

4. Abnormalities in pitch, stress, rate, rhythm and intonation of speech.

5. A lack of varied spontaneous make-believe play, or, when young, social imitative play.

C. Restricted, repetitive, and stereotyped patterns of behaviour, interests and activities, 2 from the following 6 areas:

1. An encompassing preoccupation with stereotyped and restricted patterns of interest.
2. Specific attachments to unusual objects.

3. Apparently compulsive adherence to specific, non-functional routines or rituals.
4. Stereotyped and repetitive motor mannerisms that involve either hand / finger flapping or twisting or complex whole body movements.
5. Preoccupation with part-objects or non-functional elements of play materials (such as odour, the feel of their surface, or the noise/vibration they generate).

6. Distress over changes in small, non-functional details of their environment.

D. Developmental abnormalities must be present in the first 3 years for the diagnosis to be made.

E. Clinical picture is not attributable to other varieties of pervasive developmental disorder; specific developmental disorder of receptive language with secondary socio-emotional problems; reactive attachment disorder or disinhibited attachment disorder; mental retardation with some associated emotional/behavioural disorder; schizophrenia of unusually early onset; and Rett syndrome.

This category should be used when there is a severe and pervasive impairment in the development of reciprocal social interaction or verbal and nonverbal communication skills, or when stereotyped behavior, interests, and activities are present, but the criteria are not met for a specific Pervasive Developmental Disorder, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder. For example, this category includes "atypical autism" - presentations that do not meet the criteria for Autistic Disorder because of late age of onset, atypical symptomatology, or subthreshold symptomatology, or all of these.

7.2. Appendix: The Children's Communication Checklist

The Children's Communication Checklist
Second Edition

CCC-2

By D.V.M. Bishop

INSTRUCTIONS

The CCC-2 was developed to help us understand more about communication strengths and difficulties in children. Although we can get an idea of how a child communicates by using language tests, it is helpful to also find out how the child behaves in an everyday setting. You can help us do this by completing the items on the next three pages.

This checklist contains a series of statements describing how children communicate. For each statement, you are asked to give information about the child whose name (or code number) appears below. You are asked to judge whether you have observed that behaviour:

0. less than once a week (or never)
1. at least once a week, but not every day
2. once or twice a day
3. several times (more than twice) a day (or always)

Please write the number in the box for each item, choosing the response that, in your judgement, best describes the child. If you find it hard to make up your mind, think over the last week, and try to remember how often you have observed the child behaving this way.

Please read each item carefully. Do not leave any items blank. If you are really unable to make a judgement, please put an X against that item, and add a comment if you wish.

Name or code number of child: _____ Gender: _____

Date of birth: _____ Today's date: _____ Age: _____

Your name (person completing the checklist): _____

Your relation to the child (i.e. parent, speech therapist, etc.): _____

(For respondents other than parents) How long have you known this child? _____

Has s/he ever had a permanent hearing loss diagnosed? YES ☐ NO ☐
If YES, please give further details below.

Has s/he any permanent physical handicap or chronic illness? YES ☐ NO ☐
If YES, please give further details below.

Is English the main language spoken at home? YES ☐ NO ☐
If NO, please give further details below.

Is s/he able to string words together in sentences? YES ☐ NO ☐
The CCC-2 is intended to be used with children who can talk in simple sentences, so if you have ticked NO, please do not complete any further questions

Additional details:

Please enter a number in the ☐ box in the right hand column, as follows:
0 = less than once a week (or never); 1 = at least once a week, but not every day
2 = once or twice a day; 3 = several times (more than twice) a day (or always)

1 Gets mixed up between he and she so might say "he" when talking about a girl, or "she" when talking about a boy	
2 Simplifies words by leaving out some sounds, e.g. "crocodile" pronounced as "cockodile", or "stranger" as "staynger"	
3 Appears anxious in the company of other children	
4 Makes false starts, and appears to grope for the right words; e.g., might say "can I – can I – can – can I have an – have an ice-cream"	
5 Talks repetitively about things that no-one is interested in	
6 Forgets words s/he knows – e.g. instead of "rhinoceros" may say "you know, the animal with the horn on its nose..."	
7 With familiar adults, seems inattentive, distant or preoccupied	
8 Looks blank in a situation where most children would show a clear facial expression – e.g. when angry, fearful or happy	
9 When given the opportunity to do what s/he likes, chooses the same favourite activity (e.g. playing a specific computer game)	
10 Uses terms like "he" or "it" without making it clear what s/he is talking about. For instance, when talking about a film, might say "he was really great" without explaining who "he" is	
11 Says things that s/he does not seem to fully understand (may appear to be repeating something s/he's heard an adult say). So, for instance, a 5-year-old may be heard to say of a teacher "she's got a very good reputation"	
12 Mixes up words of similar meaning. e.g., might say "dog" for "fox", or "screwdriver" for "hammer"	
13 Is babied, teased, or bullied by other children	
14 Does not look at the person s/he is talking to	
15 Misses the point of jokes and puns (though may be amused by nonverbal humour such as slapstick)	
16 Is left out of joint activities by other children	
17 Gets mixed up between he/him or she/her, so might say "him is working" rather than "he is working", or "her have a cake" rather than "she has a cake"	
18 Uses favourite phrases, sentences or longer sequences in rather inappropriate contexts. E.g., might say "all of a sudden" rather than "then", as in "we went to the park and all of a sudden we had a picnic". Or might habitually start utterances with "by the way"	
19 Gets confused when a word is used with a different meaning from usual: e.g. might fail to understand if an unfriendly person was described as "cold" (and would assume they were shivering!)	
20 Stands too close to other people when talking to them	
21 Talks to people too readily: e.g. without any encouragement, starts up a conversation with a stranger	
22 Talks about lists of things s/he has memorised e.g., the names of the capitals of the world, or the names of varieties of dinosaurs	
23 Pronounces words in an over-precise manner: accent may sound affected or "put-on", as if child is mimicking a TV personality rather than talking like those around him/her	
24 Pronounces words in a babyish way, such as "chimbley" for "chimney" or "bokkle" for "bottle"	
25 Can be hard to tell if s/he is talking about something real or make-believe	
26 Moves the conversation to a favourite topic, even if others don't seem interested in it	

Please enter a number in the ☐ box in the right hand column, as follows:
0 = less than once a week (or never); 1 = at least once a week, but not every day
2 = once or twice a day; 3 = several times (more than twice) a day (or always)

27 Produces utterances that sound babyish because they are just 2 or 3 words long, such as "me got ball" instead of "I've got a ball" or "give dolly" instead of "give me the dolly"	
28 Ability to communicate varies from situation to situation – e.g. may cope well when talking one-to-one with a familiar adult, but have difficulty expressing him/herself in a group of children	
29 Leaves off beginnings or ends of words, e.g. says "roe" instead of "road" or "nana" instead of "banana"	
30 Repeats back what others have just said. For instance, if you ask, "what did you eat?" might say, "what did I eat?"	
31 Ignores conversational overtures from others (e.g. if asked, "what are you making?" does not look up and just continues working)	
32 Mixes up words that sound similar. e.g. might say "telephone" for "television" or "magician" for "musician"	
33 Hurts or upsets other children without meaning to	
34 Takes in just 1-2 words in a sentence, and so misinterprets what has been said. E.g. if someone says "I want to go skating next week", s/he may think they've been skating, or want to go now	
35 It's difficult to stop him/her from talking	
36 Leaves off past tense – ed endings on words, so might say "John kick the ball" instead of "John kicked the ball", or "Sally play over there" instead of "Sally played over there"	
37 Tells people things they know already	
38 Makes mistakes in pronouncing long words; e.g. says "vegebable" rather than "vegetable" or "trellistope" rather than "telescope"	
39 Fails to recognise when other people are upset or angry	
40 Gets the sequence of events muddled up when trying to tell a story or describe a recent event. E.g. if describing a film, might talk about the end before the beginning	
41 Is over-literal, sometimes with (unintentionally) humorous results. E.g., a child who was asked "Do you find it hard to get up in the morning" replied "No. You just put one leg out of the bed and then the other and stand up." Another child who was told "watch your hands" when using scissors, proceeded to stare at his fingers.	
42 Includes over-precise information (e.g. exact date or time) in his/her talk, e.g. when asked "when did you go on holiday" may say "13th July 1995" rather than "in the summer"	
43 Leaves out "is", and so says "Daddy going to work" rather than "Daddy's going to work" or "Daddy is going to work". Or might say "The boy big" rather than "The boy is big"	
44 Mispronounces "th" for "s" or "w" for "r". E.g. says "thoap" instead of "soap" or "wabbit" instead of "rabbit"	
45 Asks a question, even though s/he has been given the answer	
46 Is vague in choice of words, making it unclear what s/he is talking about, e.g. saying "that thing" rather than "kettle"	
47 Shows interest in things or activities that most people would find unusual, such as traffic lights, washing machines, lamp-posts	
48 Doesn't explain what s/he is talking about to someone who doesn't share his/her experiences; for instance, might talk about "Johnny" without explaining who he is	
49 Surprises people by his/her knowledge of unusual words – uses terms you'd expect to hear from an adult rather than child	
50 It is hard to make sense of what s/he is saying (even though the words are clearly spoken)	

Please enter a number in the ☐ box in the right hand column, as follows:
0 = less than once a week (or never); 1 = at least once a week, but not every day
2 = once or twice a day; 3 = several times (more than twice) a day (or always)

The questions so far have asked about difficulties children may have that affect communication. The remaining questions ask about communicative strengths.

Please respond 0 to 3, as before, but remember that now a 0 response would mean that a child lacks this strength, and a 3 would indicate good communicative skill.

51 Speaks clearly so that the words can easily be understood by someone who doesn't know him/her very well	
52 Reacts positively when a new and unfamiliar activity is suggested	
53 Talks clearly about what s/he plans to do in the future (e.g. what s/he will do tomorrow, or plans for going on holiday)	
54 Appreciates the humour expressed by irony. Would be amused rather than confused if someone said "isn't it a lovely day!" when it is pouring with rain	
55 Produces long and complicated sentences such as: "When we went to the park I had a go on the swings"; "I saw this man standing on the corner"	
56 Makes good use of gestures to get his/her meaning across	
57 Shows concern when other people are upset	
58 Speaks fluently and clearly, producing all speech sounds accurately and without any hesitation	
59 Keeps quiet in situations where someone else is trying to talk or concentrate (e.g. when someone else is watching TV, or during formal occasions such as school assembly or a religious ceremony)	
60 Realises the need to be polite – would pretend to be pleased if given a present s/he did not really like, and would avoid making personal comments about strangers	
61 When answering a question, provides enough information without being over-precise	
62 You can have an enjoyable, interesting conversation with him/her	
63 Shows flexibility in adapting to unexpected situations: e.g. does not get upset if s/he planned to play on the computer, but has to do something else because it isn't working	
64 Uses abstract words that refer to general concepts rather than something you can see – e.g. "knowledge", "politics", "courage"	
65 Smiles appropriately when talking to people	
66 Uses words that refer to whole classes of objects, rather than a specific item. E.g. refers to a table, chair and drawers as "furniture", or to apples, bananas and pears as "fruit"	
67 Talks about his/her friends; shows interest in what they do and say	
68 Explains a past event (e.g. what s/he did at school, or what happened at a football game) clearly	
69 Produces sentences containing "because" such as "John had a cake because it was his birthday"	
70 Talks to others about their interests, rather than his/her own	

The Psychological Corporation®
Meeting Your Assessment Needs

CCC-2

Published by The Psychological Corporation Limited, 32 Jamestown Road, London NW1 7BY

Copyright © The Psychological Corporation 2003.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage or retrieval system, without permission in writing from the publisher.

Printed in the United Kingdom

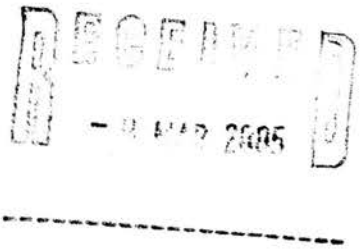
ISBN 0 7491 2601 9

7.3. Appendix: Ethical Approval Letter

NHS
Borders

Borders Research Ethics Committee
NHS Borders
Newstead
Melrose
Roxburghshire
TD6 9DB

07 March 2005



Ms Jenny Wright
Trainee Clinical Psychologist
Andrew Lang Unit, Dept. of Child and Family Psychiatry
Viewfield, Viewfield Avenue
Selkirk
TD7 4LJ

Dear Ms Wright

Full title of study: ***Emotional Recognition in Autistic Spectrum Disorder (ASD): The effects of pragmatic communication and executive function.***
REC reference number: ***04/S0301/21***
Protocol number:

Thank you for your letter of 25 January 2005, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information was considered at the meeting of the Sub-Committee of the REC held on 08 February 2005. A list of the members who were present at the meeting is attached.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Conditions of approval

The favourable opinion is given provided that you comply with the conditions set out in the attached document. You are advised to study the conditions carefully.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type:	Version:	Dated:	Date Received:
Application		11/11/2004	22/11/2004
Investigator CV		11/11/2004	22/11/2004
Letters of Invitation to Participants		23/01/2005	25/01/2005

Participant Information Sheet		23/01/2005	25/01/2005
Participant Consent Form		11/11/2004	22/11/2004
Response to Request for Further Information		23/01/2005	25/01/2005
Control Group Information Sheet		23/01/2005	25/01/2005

Membership of the Committee

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

04/S0301/21	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project,

Yours sincerely,

Chair

E-mail: deborah.adams@borders.scot.nhs.uk

Enclosures *List of names and professions of members who were present at the meeting and those who submitted written comments*

Standard approval conditions

7.4. Appendix: Invitation Pack, including: -

- Cover letter
- Parent Information Sheet
- Parent Consent Form
- Child Information Sheet
- Child Consent Form

Cover Letter

Jenny Wright
Trainee Clinical Psychologist
CAMHS
The Andrew Lang Unit
Viewfield Lane
Selkirk
TD7 4LJ

Work Telephone: (01750) 23715
Home Telephone: (01896) 750604
Email: jennywright84@hotmail.com

Dear Parent/Guardian

We are conducting a research project looking at emotional recognition in children with Autistic Spectrum Disorder (ASD).

I would like to invite your child to participate in the project.

I have enclosed some information to help you decide whether or not you would like your child to take part. I have also enclosed some information for your child. If they have any problems reading it, please read it aloud to him/her.

If you decide to participate, please sign the enclosed consent forms and return them in the enclosed SAE. My contact details are also enclosed; please do not hesitate to contact me with any questions or queries. You are not in any way obliged to take part in this project and can withdraw at any time without giving a reason.

I look forward to hearing from you.

Yours faithfully

Jenny Wright
(Trainee Clinical Psychologist)

Parent Information Sheet

I am conducting a study, as part of my qualification in clinical psychology, working with children with and without a diagnosis of Autistic Spectrum Disorder (ASD), to look more closely at their social and communication abilities.

The title of the project is *Emotional Recognition in Autistic Spectrum Disorder (ASD): The affect of pragmatic communication and executive function.*

What is executive function?

Executive function is an umbrella term that refers to different skills and abilities such as problem solving, planning, organization, and goal setting.

What is pragmatic communication?

Pragmatic communication can very basically be described as the non-verbal parts of communication.

Many children with ASD struggle to recognise emotions in others. This study aims to look at how children's executive function and pragmatic communication are linked to this.

Your child is being invited to take part in this research study. Before you decide whether or not you would like them to take part, it is important for you to understand why the research is being carried out and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish. Please contact me if there is anything that is not clear or if you would like further information. Thank you for reading this.

Why has my child been chosen?

I am inviting children with a diagnosis of ASD and children without a diagnosis. I am inviting children without a diagnosis, as a control group, so I can compare the two groups and see if there are any differences.

What is the purpose of the study?

The aim of the study is to look at the relationship between children's emotional recognition, pragmatic communication and executive function. I would like to compare children who have ASD and children who do not. Currently, research in this area has produced unclear results.

What does the study involve?

Your child will be asked to complete a brief test of intelligence (this basically involves looking at pictures with a part missing, where your child must choose from a choice of pieces which one fits best), an emotional recognition task (this basically involves matching pictures of faces to emotions) and an executive function test (which is a selection of short puzzles). These will take approximately 45-60 minutes. These will be carried out wherever is most convenient for you: in school, at home, or at the Andrew Lang Unit in Selkirk.

You will be asked to complete a questionnaire about your child's pragmatic communication, which will take approximately 10-15 minutes. This can be completed while the tasks are completed with your child or via post.

Will I find out how it went?

If you wish to hear about the results of the study, you can request a written or verbal summary of the results.

Do I have to take part?

You do not have to take part. Even if you sign the consent form, you can withdraw at any time without giving a reason. Your child will be told at the start of testing, and reminded throughout testing, that they can leave at any time without giving a reason. A decision to withdraw, or a decision not to take part, will not affect the standard of care you or your child receive.

Will there be any disadvantages?

It is possible that your child could become anxious or distressed during the study. This will be closely monitored throughout the study; at any sign of anxiety or distress, the testing will be stopped immediately. Your child will be asked throughout the study if they are happy to continue and they will be reminded that they can leave at any time without giving a reason.

What about confidentiality?

All of the information in the study is confidential. The study is designed to promote knowledge about ASD, but may be of no direct benefit to you and your child.

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

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

What should I do if I want my child to take part?

If you decide that you would like your child to take part, then please sign the consent form and send it back in the envelope provided. I will then be in touch via mail or telephone to arrange the details of where you would like me to see your child, either at home, at school, or at the Andrew Lang Unit in Selkirk. I will also arrange to send you the questionnaire and answer any questions you might have. After signing the consent form, you can still decide to withdraw your child from the study at any time without giving a reason.

Thank you for taking the time to consider taking part in this study. If you have any questions or wish to discuss any aspects of the study, please do not hesitate to contact me. My contact details are given at the top of this letter.

Yours faithfully

Jenny Wright

(Trainee Clinical Psychologist)

Parent Consent Form

CONSENT FORM

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

Title: -
Emotional Recognition in Autistic Spectrum Disorder (ASD): The effect of pragmatic communication and executive function.

Researcher: -
Jenny Wright, Trainee Clinical Psychologist.

Name of child:.....

Name of Parent/Guardian:.....

Address:.....

Contact telephone number:.....

I confirm that I have read and understood the information sheet for the above study and have had the opportunity to contact Jenny Wright, Trainee Clinical Psychologist, to ask questions.

I have agreed to my child taking part in the study as it has been outlined to me.

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

I understand that my child's participation is voluntary and that I am free to withdraw my child at any time, without giving a reason, without my child's medical care being affected.

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

Signature of Parent/Guardian:.....Date:.....

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

At school ☐

At home ☐

At the Andrew Lang Unit ☐

Child Information Sheet

Information Sheet for Children

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

I would like to meet with you to do some puzzle's. These will take about 45 minutes.

All the information gathered will be private.

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

If you would like to take part, but then change your mind later, that's okay. No one will mind.

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

Jenny Wright
Trainee Clinical Psychologist

Child Consent Form

CONSENT FORM FOR CHILDREN

(Please circle your answer)

Have you read the project information sheet or had someone read it to you?

Yes No

Have you been able to ask questions about the project?

Yes No

Do you understand that you don't have to take part in the project if you don't want to?

Yes No

Do you understand that even if you say yes now, you can change your mind at any time and you don't have to give a reason?

Yes No

Do you want to take part in this project?

Yes No

Your signature.....

Your name.....

Date.....

7.5. Appendix: Control Group Invitation Letter

Jenny Wright
Trainee Clinical Psychologist
CAMHS
The Andrew Lang Unit
Viewfield Lane
Selkirk
TD7 4LJ

Work Telephone: (01750) 23715
Home Telephone: (01896) 750604
Email: jennywright84@hotmail.com

Dear Parent/Guardian

I am conducting a research project looking at emotional recognition in children with and without Autistic Spectrum Disorder (ASD).

I need a control group, i.e. a group of children without Autistic Spectrum Disorder, to compare the ASD children with. The control group needs to have children of the same age and gender as the ASD group.

I would like to invite your child to participate in the project.

I have enclosed some information to help you decide whether or not you would like your child to take part. I have also enclosed some information for your child. If they have any problems reading it, please read it aloud to him/her.

If you decide to participate, please sign the enclosed consent forms and return them in the enclosed SAE. My contact details are also enclosed; please do not hesitate to contact me with any questions or queries. You are not in any way obliged to take part in this project and can withdraw at any time without giving a reason.

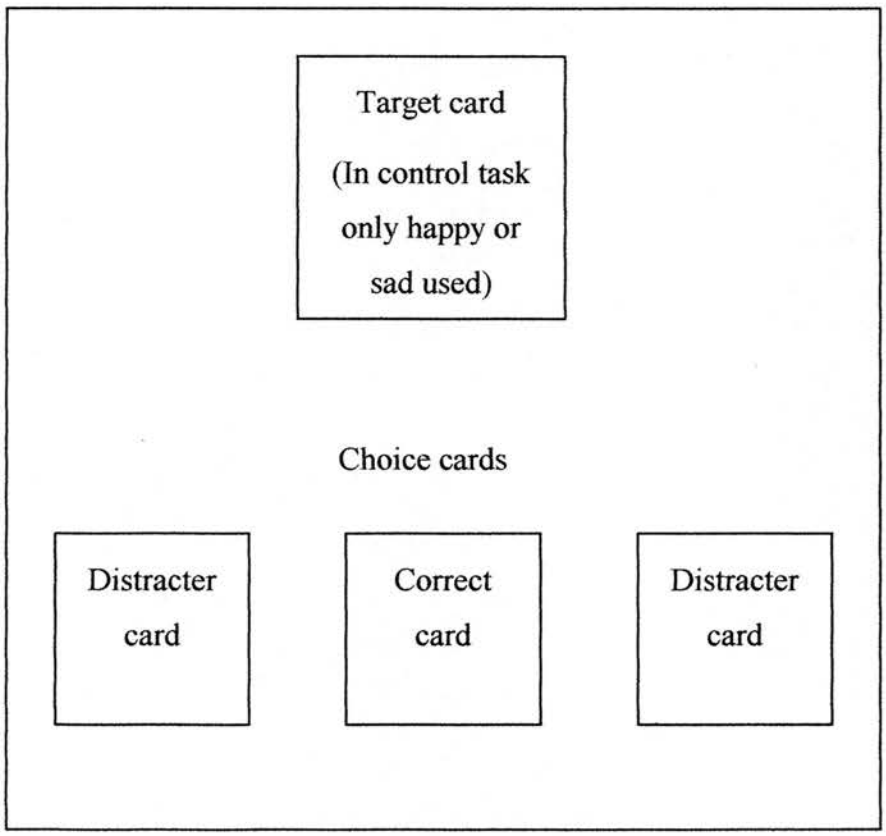
I look forward to hearing from you.

Yours faithfully

Jenny Wright
(Trainee Clinical Psychologist)

7.6. Appendix: Card Layout for Emotional Recognition Task

Layout of cards used in emotional recognition experimental and control tasks.



7.7. Appendix: The Emotional Recognition Experimental Task Scoring Sheet

FACIAL EMOTIONAL RECOGNITION TASK

Child's name……
DoB……...
Date……...
Order AB or BA

This man/women looks (emotion). Can you find another picture of a man/women who looks (emotion)?

Trial A	Gender	Emotion	Answer	Child's answer	Score
EA1	M	frightened	A		
EA2	F	angry	A		
EA3	M	happy	C		
EA4	F	frightened	B		
EA5	M	disgusted	C		
EA6	F	happy	A		
EA7	F	sad	B		
EA8	F	angry	B		
EA9	M	surprised	C		

Total score……

Trial B	Gender	Emotion	Answer	Child's answer	Score
EB1	F	disgusted	A		
EB2	M	frightened	C		
EB3	M	sad	A		
EB4	F	disgusted	B		
EB5	F	surprised	B		
EB6	M	Surprised	A		
EB7	M	Sad	C		
EB8	M	Angry	C		
EB9	F	Happy	B		

Total score……

Total emotional recognition score……..

7.8. Appendix: The Identity Task: The Emotional Recognition Control Task Score Sheet.

FACIAL EMOTIONAL RECOGNITION IDENTITY (CONTROL) TASK

Child's name……
DoB……
Date……
Order AB or BA

This is (name). Can you find another picture of (name)?

Trial A	Name	Answer	Child's answer	Score
IA1	Mary	C		
IA2	Nicola	A		
IA3	Jamie	C		
IA4	Carol	C		
IA5	Peter	A		
IA6	Jamie	A		
IA7	Nicola	C		
IA8	Billy	C		
IA9	Maggie	B		

Total score……

Trial B	Name	Answer	Child's answer	Score
IB1	Sue	B		
IB2	Maggie	A		
IB3	George	B		
IB4	Peter	B		
IB5	Carol	A		
IB6	Eric	B		
IB7	Mary	B		
IB8	George	C		
IB9	Eric	A		

Total score……

Total identity/control score……

7.9. Appendix: Table to Show the Skewness and Kurtosis of the Data

Table to show skewness and kurtosis of all the variables in the experimental and control group.

Descriptive Statistics

GROUP		N	Minimum	Maximum	Mean	Std.	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Exp Gp	ERE	18	12	18	15.94	1.830	-.621	.536	-.332	1.038
	ERC	18	15	18	17.17	.985	-.784	.536	-.606	1.038
	TOWER	18	3	16	10.83	3.536	-.878	.536	.412	1.038
	CCCPS	18	1	26	10.00	6.571	.796	.536	.546	1.038
	IQGRADE	18	1	5	2.67	1.085	1.072	.536	.748	1.038
	AGE	18	6	15	10.72	2.803	-.112	.536	-.899	1.038
	Valid N (listwise)	18								
Con Gp	ERE	21	15	18	17.38	.921	-1.313	.501	.726	.972
	ERC	21	16	18	17.67	.658	-1.851	.501	2.326	.972
	TOWER	21	7	17	13.00	2.864	-.692	.501	.019	.972
	CCCPS	21	13	55	43.38	10.337	-1.638	.501	2.846	.972
	IQGRADE	21	2	5	2.67	.856	1.271	.501	1.292	.972
	AGE	21	6	12	10.00	1.897	-.583	.501	-.882	.972
	Valid N (listwise)	21								

7.10. Appendix: Table to Show the Correlation Matrices of the Spearman's Rho.

Table to show the correlation found between executive function (TOWER), emotional recognition (ERE) and pragmatic communication (CCCPS) in the experimental and control task using Spearman's Rho.

Correlations

GROUP				TOWER	ERE	CCCPS
Exp Gp	Spearman's rho	TOWER	Correlation Coefficient	1.000	.483*	-.016
			Sig. (2-tailed)	.	.042	.949
			N	18	18	18
		ERE	Correlation Coefficient	.483*	1.000	.145
			Sig. (2-tailed)	.042	.	.567
			N	18	18	18
		CCCPS	Correlation Coefficient	-.016	.145	1.000
			Sig. (2-tailed)	.949	.567	.
			N	18	18	18
Con Gp	Spearman's rho	TOWER	Correlation Coefficient	1.000	.339	.069
			Sig. (2-tailed)	.	.132	.765
			N	21	21	21
		ERE	Correlation Coefficient	.339	1.000	.252
			Sig. (2-tailed)	.132	.	.271
			N	21	21	21
		CCCPS	Correlation Coefficient	.069	.252	1.000
			Sig. (2-tailed)	.765	.271	.
			N	21	21	21

*. Correlation is significant at the .05 level (2-tailed).

7.11. Appendix: Answer Sheet for the Coloured Progressive Matrices

Answer Sheet for

THE COLOURED PROGRESSIVE MATRICES

– Classic Version

Sets A, A_B and B

Please complete the information asked for next to any headings written in RED, and read and carry out all other instructions given in RED.

Name:		Date:
Age:	Date of Birth:	Place of Testing:

Place a single line across the number of the answer you think is correct. If you make a mistake, put a cross (X) through your incorrect answer and a single line across the correct one. If you skip a question because you don't know the answe make sure you miss out the question on this answer sheet. Please mark your choices firmly with pencil. Work downward through each column.

DO NOT START UNTIL YOU ARE ASKED TO DO SO

SET A		SET A_B		SET B	
A1	1 2 3 / 4 5 6	Ab1	1 2 3 / 4 5 6	B1	1 2 3 / 4 5 6
A2	1 2 3 / 4 5 6	Ab2	1 2 3 / 4 5 6	B2	1 2 3 / 4 5 6
A3	1 2 3 / 4 5 6	Ab3	1 2 3 / 4 5 6	B3	1 2 3 / 4 5 6
A4	1 2 3 / 4 5 6	Ab4	1 2 3 / 4 5 6	B4	1 2 3 / 4 5 6
A5	1 2 3 / 4 5 6	Ab5	1 2 3 / 4 5 6	B5	1 2 3 / 4 5 6
A6	1 2 3 / 4 5 6	Ab6	1 2 3 / 4 5 6	B6	1 2 3 / 4 5 6
A7	1 2 3 / 4 5 6	Ab7	1 2 3 / 4 5 6	B7	1 2 3 / 4 5 6
A8	1 2 3 / 4 5 6	Ab8	1 2 3 / 4 5 6	B8	1 2 3 / 4 5 6
A9	1 2 3 / 4 5 6	Ab9	1 2 3 / 4 5 6	B9	1 2 3 / 4 5 6
A10	1 2 3 / 4 5 6	Ab10	1 2 3 / 4 5 6	B10	1 2 3 / 4 5 6
A11	1 2 3 / 4 5 6	Ab11	1 2 3 / 4 5 6	B11	1 2 3 / 4 5 6
A12	1 2 3 / 4 5 6	Ab12	1 2 3 / 4 5 6	B12	1 2 3 / 4 5 6

© J C Raven Ltd. 1998 All rights reserved
Published by OPP® Limited, Elsfield Hall, 15-17 Elsfield Way, Oxford OX2 8EP UK
® OPP is a registered trade mark of OPP Limited
Product Code RA0101
10 9 8 7 6 5 4 3 2 1

7.12. Appendix: Answer Sheet for the Standard Progressive Matrices

Answer Sheet for

THE STANDARD PROGRESSIVE MATRICES

– Classic Version

Sets A, B, C, D and E

Please complete the information asked for next to any headings written in BROWN, and read and carry out all other instructions given in BROWN.

Name:		Date:
Age:	Date of Birth:	Place of Testing:

Place a single line across the number of the answer you think is correct. If you make a mistake, put a cross (X) through your incorrect answer and a single line across the correct one. If you skip a question because you don't know the answer, make sure you miss out the question on this answer sheet. Please mark your choices firmly with pencil. Work downwards through each column.

DO NOT START UNTIL YOU ARE ASKED TO DO SO

Time Started: Time Finished:

SET A	SET B	SET C	SET D	SET E
A1 1 2 3 / 4 5 6	B1 1 2 3 / 4 5 6	C1 1 2 3 4 / 5 6 7 8	D1 1 2 3 4 / 5 6 7 8	E1 1 2 3 4 / 5 6 7 8
A2 1 2 3 / 4 5 6	B2 1 2 3 / 4 5 6	C2 1 2 3 4 / 5 6 7 8	D2 1 2 3 4 / 5 6 7 8	E2 1 2 3 4 / 5 6 7 8
A3 1 2 3 / 4 5 6	B3 1 2 3 / 4 5 6	C3 1 2 3 4 / 5 6 7 8	D3 1 2 3 4 / 5 6 7 8	E3 1 2 3 4 / 5 6 7 8
A4 1 2 3 / 4 5 6	B4 1 2 3 / 4 5 6	C4 1 2 3 4 / 5 6 7 8	D4 1 2 3 4 / 5 6 7 8	E4 1 2 3 4 / 5 6 7 8
A5 1 2 3 / 4 5 6	B5 1 2 3 / 4 5 6	C5 1 2 3 4 / 5 6 7 8	D5 1 2 3 4 / 5 6 7 8	E5 1 2 3 4 / 5 6 7 8
A6 1 2 3 / 4 5 6	B6 1 2 3 / 4 5 6	C6 1 2 3 4 / 5 6 7 8	D6 1 2 3 4 / 5 6 7 8	E6 1 2 3 4 / 5 6 7 8
A7 1 2 3 / 4 5 6	B7 1 2 3 / 4 5 6	C7 1 2 3 4 / 5 6 7 8	D7 1 2 3 4 / 5 6 7 8	E7 1 2 3 4 / 5 6 7 8
A8 1 2 3 / 4 5 6	B8 1 2 3 / 4 5 6	C8 1 2 3 4 / 5 6 7 8	D8 1 2 3 4 / 5 6 7 8	E8 1 2 3 4 / 5 6 7 8
A9 1 2 3 / 4 5 6	B9 1 2 3 / 4 5 6	C9 1 2 3 4 / 5 6 7 8	D9 1 2 3 4 / 5 6 7 8	E9 1 2 3 4 / 5 6 7 8
A10 1 2 3 / 4 5 6	B10 1 2 3 / 4 5 6	C10 1 2 3 4 / 5 6 7 8	D10 1 2 3 4 / 5 6 7 8	E10 1 2 3 4 / 5 6 7 8
A11 1 2 3 / 4 5 6	B11 1 2 3 / 4 5 6	C11 1 2 3 4 / 5 6 7 8	D11 1 2 3 4 / 5 6 7 8	E11 1 2 3 4 / 5 6 7 8
A12 1 2 3 / 4 5 6	B12 1 2 3 / 4 5 6	C12 1 2 3 4 / 5 6 7 8	D12 1 2 3 4 / 5 6 7 8	E12 1 2 3 4 / 5 6 7 8

© J C Raven Ltd, 1998. All rights reserved.
Published by OPP Limited, Elsfield Hall, 15–17 Elsfield Way, Oxford, OX2 8EP.
® OPP is a registered trade mark of OPP Limited.
Product Code: RA0051
10 9 8 7 6 5 4 3