

**An Experimental Investigation of Social Cognitive
Mechanisms in Asperger Syndrome and an
Exploration of Potential Links with Paranoia**

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ABSTRACT

Background: Social cognitive deficits are considered to be central to the interpersonal problems experienced by individuals with a diagnosis of Asperger syndrome, but existing research evidence regarding mentalising ability and emotion recognition ability is difficult to interpret and inconclusive. Higher levels of mental health problems are experienced in Asperger Syndrome than in the general population, including depression, general anxiety and anxiety-related disorders. Clinical accounts have described symptoms of psychosis in individuals with autism spectrum disorders, including Asperger syndrome, and a number of research studies have reported elevated levels of delusional beliefs in this population. Investigations of social cognition in psychosis have highlighted a number of impairments in abilities such as mentalising and emotion recognition, as well as data-gathering and attribution biases that may be related to delusional beliefs. Similarly, a number of factors, including theory of mind difficulties, self-consciousness and anxiety, have been associated with delusional beliefs in individuals with Asperger syndrome, but there is a lack of agreement in the existing research. A preliminary model of delusional beliefs in Asperger syndrome has previously been proposed, which needs to be tested further and potentially refined. The current study aimed to further investigate social cognitive mechanisms in individuals with Asperger syndrome and to explore potential links with the development of paranoia.

Method: Participants with a diagnosis of Asperger syndrome were recruited through a number of voluntary organisations and completed screening measures, the Autism Spectrum Quotient and the Wechsler Abbreviated Scale of Intelligence, to ensure their suitability for the study. Participants in the control group were recruited through the university and local community resources and were matched group-wise with the Asperger syndrome group for age, sex and IQ scores. The study compared the Asperger syndrome group (N=30) with the control group (N= 30) with regard to their performance on four experimental tasks and their responses on a number of self-report questionnaires that were delivered as an online survey. The experimental tasks included two theory of mind measures, one designed to assess mental state decoding ability (The Reading the Mind in the Eyes Test) and one designed to assess mental state reasoning ability (the Hinting Task). The recognition of emotions was evaluated through the Facial Expression Recognition Task. The Beads Task was administered to assess data-gathering style and specifically to test for Jumping to Conclusions biases. The self-report questionnaires were employed to measure levels of depression, general anxiety, social anxiety, self-consciousness and paranoid thoughts.

Results: The Asperger syndrome group performed less well than the control group on tasks measuring mental state decoding ability, mental state reasoning ability and the recognition of emotion in facial expressions. Additionally, those with Asperger syndrome tended to make decisions on the basis of less evidence and half of the group demonstrated a Jumping to Conclusions bias. Higher levels of depression, general anxiety, social anxiety and paranoid thoughts were reported in the AS group and levels of depression and general anxiety were found to be associated with levels of paranoid thoughts.

Discussion: The results are considered in relation to previous research and revisions are proposed for the existing model of delusional beliefs in Asperger syndrome. A critical analysis of the current study is presented, implications for clinical practice are discussed and suggestions are made for future research.

DECLARATION

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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BACKGROUND

OVERVIEW

The purpose of this experimental research study was to investigate social cognitive mechanisms in individuals with a diagnosis of Asperger syndrome (AS)¹. Social cognition refers to the mental processes applied to the recognition, understanding, accurate processing and effective use of social cues (Harvey & Penn, 2010). In particular, the aim was to compare an AS group with a control group on their abilities to decode and reason about the mental states of other people, to recognise emotions in facial expressions and also to assess for reasoning biases in their data-gathering style. An additional aim was to consider whether there are any links between abilities to make accurate judgements about social stimuli and levels of paranoia in AS.

This background consists of three sections, with the first section introducing AS and the autism spectrum, including definitions, diagnosis, prevalence and aetiology.

Psychological theories and experimental studies attempting to account for some of the core features and difficulties of individuals with autism spectrum disorders (ASD) are discussed, in particular, those covering theory of mind (ToM), executive function and central coherence. Research assessing the ability of individuals with ASD to recognise emotion through facial expressions is examined. Finally, mental health problems that commonly arise in ASD are discussed, along with psychological interventions.

The second section introduces schizophrenia, psychosis and paranoia, before psychological theories of social cognitive mechanisms related to the development and maintenance of delusions are considered. This includes theories and experimental studies reported in the psychosis literature about ToM, self-esteem and causal attribution, the role of emotional disturbance in delusional beliefs and reasoning biases. A model is presented of the development of paranoid beliefs in psychosis. Research studies assessing the ability of individuals experiencing psychosis to recognise emotion through facial expressions are discussed. Recently developed psychological interventions that are aimed at targeting delusional beliefs are noted.

The third section describes clinical accounts of psychotic symptoms in individuals with AS, research evidence for delusional beliefs in AS and a model is presented of the development and maintenance of delusional beliefs in AS.

The background ends with a rationale, aims and hypotheses for the current study.

¹ Throughout this thesis, from this point onwards, the term Asperger Syndrome will be abbreviated to AS. It is also known as Asperger's syndrome, Asperger (or Asperger's) Disorder and Asperger's.

1. ASPERGER SYNDROME AND THE AUTISM SPECTRUM

What is Asperger syndrome?

AS is a recent diagnostic entity that has been conceptualised as a pervasive developmental disorder within the autism spectrum since the 1990s. AS primarily affects social interaction and communication and often involves circumscribed interests, ritualistic, and repetitive behaviour. The apparently increasing prevalence of the disorder, uncertainty about its aetiology, and overlap and confusion with other diagnoses are some of the factors influencing interest and debate about AS in academic, clinical and media circles.

The first detailed descriptions of autism emerged in the 1940s (Asperger, 1944; Kanner, 1943). Kanner published a case series of children who displayed a range of similar characteristics, with social aloofness and elaborate repetitive routines thought to be the most pertinent to a diagnosis of what he termed 'early infantile autism'. This model of autism remained mostly unchallenged for three decades with many institutions finding cases that fitted suggested criteria and carrying out research to investigate underlying cognitive processes (Bowler, 2007).

A major epidemiological study was conducted (Wing & Gould, 1979) that challenged the concept of a discrete psychiatric condition as described by Kanner, suggesting that this classic form of autism was part of a wider group of disorders sharing common characteristics (to become known as the autism spectrum). A 'triad of impairments' (social interaction, communication and imagination) was proposed based on the recognition that certain 'symptoms' tended to cluster together, regardless of severity or varying manifestations, and were usually associated with a narrow, repetitive pattern of activities. This model of unifying key deficits in ASD, although initially considered controversial (D. Cohen & Volkmar, 1997), eventually became widely accepted and is central to diagnostic systems today, including the International Classification of Diseases, 10th Edition (ICD10; World Health Organisation, 1993) and the Diagnostic Statistical Manual, 4th Edition (DSM-IV; American Psychiatric Association; APA, 1994). The expansion of the parameters of ASD led Wing and colleagues to search for other disorders displaying the triad of impairments, raising the profile of AS (Bowler, 2007).

Asperger's original paper written in German (Asperger, 1944) was published in English in a book reviewing the prevailing understanding of autism (U. Frith, 1991),

making Asperger's clinical observations much more accessible to researchers and clinicians. It was soon after, that AS was introduced to formal diagnostic manuals, ICD-10 and DSM-IV, as a distinct category (e.g. see Figure 1). Classified as a pervasive developmental disorder alongside autism, it was similarly characterised by social deficits and rigid focused interests, but with no significant delay in language or cognitive development.

Figure 1: DSM-IV criteria for AS

- A. Qualitative impairment in social interaction, as manifested by at least two of the following:**
- Marked impairments in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.
 - Failure to develop peer relationships appropriate to developmental level.
 - 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).
 - 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:**
- Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.
 - Apparently inflexible adherence to specific, non-functional routines or rituals.
 - Stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements).
 - 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 significant delay in language (e.g. single words used by age two years, communicative phrases used by age three years).**
- E. There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behaviour (other than social interaction), and curiosity about the environment in childhood.**
- F. Criteria are not met for another specific pervasive developmental disorder or schizophrenia.**

Although intended to provide a coherent framework for the diagnosis of AS, the inclusion of it as a distinct entity in the diagnostic manuals has not resolved an ongoing debate about its relationship with autism. There is discussion about whether AS is any different from what is known as 'high-functioning autism' (HFA) i.e. autism not accompanied by global intellectual impairment (Gillberg, 1998; Hare & Flood,

2001; Kugler, 1998; Mayes, Calhoun, & Crites, 2001). Studies attempting to differentiate AS and HFA have been criticised for inadequate group matching and a lack of consistency in the use of diagnostic criteria for recruitment and assignment to groups, with many results being inconclusive (Goddard, Howlin, Dritschel, & Patel, 2007; Kugler, 1998; Mayes, et al., 2001). It has been proposed that AS is not a distinct disorder but a variant of autism at the higher-functioning end of the spectrum (U. Frith, 2004; Wing, 1998), which provides a model of 'pure' autism without intellectual disability confounding the clinical picture (U. Frith, 2004).

The formalisation of the diagnostic category of AS has changed rather than resolved conceptual problems (Woodbury-Smith and Volkmar, 2008). The internal validity of the concept of AS has been questioned, with some researchers suggesting that subgroups should be identified according to phenotypes (Ghaziuddin, 2008; Kugler, 1998; Shao et al., 2003) and others stressing the importance of recognising that people with a diagnosis of AS can differ widely in terms of severity of symptoms (Ring, Woodbury-Smith, Watson, Wheelwright, & Baron-Cohen, 2008). Any distinctions that can be made between AS and HFA may reflect such subtypes of autism or variations in severity, rather than demonstrating separate conditions.

There have been calls from some researchers for AS to be dropped from diagnostic manuals, while others have proposed that a revision of criteria is required to take into account variable factors such as the quality of social impairment, differences in communication style and cognitive ability (Ghaziuddin, 2010). In draft revisions of the DSM due to be published in 2013 (APA, 2011), it is proposed that AS be 'subsumed' into Autistic Disorder, which is a replacement term for Autistic Spectrum Disorder. This will be rated based on severity of symptoms in two domains (social communication deficits; restricted interests and repetitive behaviours), taking into account the level of support required by the individual. The rationale offered by the DSM-5 work group for these changes included the observation that distinctions among ASD disorders have been found to be: "inconsistent over time, variable across sites and often associated with severity, language level or intelligence rather than features of the disorder". Despite the controversy surrounding AS as a distinct diagnosis, deleting it from the DSM would have implications for those already diagnosed. Wing (2005) asserted that describing and naming AS has had mainly positive effects, particularly for individuals where receiving a diagnosis of AS has led to a greater understanding of their own difficulties and has allowed them access to specialist services. It is clear that some people identify strongly with the label of AS,

finding that it makes sense of previously confusing differences between themselves and their peers (Nadesan, 2005).

Prevalence of ASD

Lotter (1966) published the first epidemiological study of autism indicating an overall prevalence rate of 4.5 per 10,000. Estimates have increased considerably over the years, but it is unclear whether any true rise in incidence is reflected in the statistics. The increase could be due to a variety of factors including: a broadening of the concept of ASD, formalisation of diagnostic criteria and increased awareness amongst clinicians, researchers and the public. Estimates can differ widely, which could be due to differing research methodologies employed and samples. Based on a literature review of what were considered 'well-conducted' epidemiological studies Rutter (2005) stated that the prevalence of ASD is likely to be between 30 and 60 cases per 10,000. The most recent estimate of prevalence of ASD in adults in the UK reports a rate of 98 per 10,000 (Brugha et al., 2011). Since its inclusion in diagnostic manuals, the recognition of AS has increased dramatically (Ghaziuddin, 2010), but classic autism still appears to be much more common. Woodbury-Smith & Volkmar (2009) calculated the median prevalence estimate of AS from seven studies as 2.6 per 10,000.

ASD appears to be more common in males, with traditional estimates of gender ratio at around 4:1 (Medical Research Council, 2001). A more recent UK-based analysis suggested a wider gender gap, finding a ratio of 7.4:1 in collective cases of ASD, with a subgroup of AS diagnosis showing a 12:1 ratio (Whiteley, Todd, Carr, & Shattock, 2010). This estimate for ASD was consistent with another recent UK study that reported a 6.8:1 male:female ratio (Williams, Thomas, Sidebotham, & Emond, 2008). With no indication of greater disparity in population sex ratios at birth that could account for an increasing over-representation of males with ASD, environmental stressors were pointed to as possibly playing a role (Whiteley, et al., 2010). Environmental factors, along with other influences implicated in the aetiology of ASD, will now be discussed in more detail.

Aetiology of ASD

ASDs have been established as neurodevelopmental disorders due to accruing evidence of a biological basis and a genetic component (Medical Research Council, 2001). However, specific single causal pathways have not been identified and the

consensus view is that a variety of interacting factors are involved in the genesis of ASD. An interaction between genetic susceptibility and environmental factors has been proposed (Happé & Frith, 1996) but evidence for this is, as yet, inconclusive.

Genetics

Twin studies have demonstrated that monozygotic (identical) twins are highly concordant² with regard to autism in contrast to dizygotic (non-identical) twins (Bailey et al., 1995; Folstein & Rutter, 1977; Ritvo, Freeman, Mason-Brothers, Mo, & Ritvo, 1985; Steffenburg et al., 1989). For example, a twin study found that 60 per cent of monozygotic twin pairs were concordant for autism but all dizygotic twins were discordant (Bailey, et al., 1995).

Recent twin studies have broadened the focus to ASD, also indicating clear genetic influences and high heritability for the broader phenotype, with a median concordance of 88 per cent for monozygotic twins, compared with 31 per cent for dizygotic twins (Lichtenstein, Carlstrom, Rastam, Gillberg, & Anckarsater, 2010; Rosenberg et al., 2009; Tani, Nishiyama, Miyachi, Imaeda, & Sumi, 2008). The most recent of these studies, with a very large sample of twins (nearly 11,000), indicated that 80 per cent of the variation in liability for ASD was accounted for by genetics.

It has been proposed that several 'susceptibility genes' acting together, with a complex mode of inheritance, lead to the heterogeneous phenotypes of ASD (Klauck, 2006). There are estimates of three or four key genes being involved (Pickles et al., 1995), through to a much larger number of genes (up to 100) of modest effect (Pritchard, 2001). Although none to date have been conclusively implicated, new candidate genes are being reported at an 'unprecedented rate' (Miles, 2011). Happé and colleagues have argued that largely independent genes may be responsible for different clusters of symptoms associated with ASD, reflecting the triad of impairments (Happé & Ronald, 2008; Happé, Ronald, & Plomin, 2006).

In addition, a number of chromosomal abnormalities (deletions and duplications) in particular regions have been found in high frequency in individuals with ASD (R. Kumar et al., 2008; Ullmann et al., 2007; Weiss et al., 2008). Related to this finding is a hypothesis that there are two genetic classes of autism, one which is heritable and another that is the result of genetic mutations, suggested by the recognition of

² Concordance is a term used in genetics to describe the probability that two individuals will both have a certain characteristic, given that one of the pair has the characteristic.

'de novo copy-number variations' or alterations of the genome DNA (Beaudet, 2007). Although evidence is mixed, increased parental age has been linked with such mutations (Sasanfar et al., 2010).

Environmental factors

Some research has focused on environmental factors in an attempt to uncover the causes of ASD and it has been proposed that genetic susceptibility and environmental stressors may work together (Landrigan, 2010; Miles, 2011). In a review of studies on prenatal and perinatal factors, an increased incidence of problems in pregnancy and in the period soon after birth was reported for children who went on to receive a diagnosis of autism (Nelson, 1991). However, it was noted in the review that these problems were not consistent, specific to autism, useful as predictors and 'may well not be causally related'. Based on evidence from autism twin studies, Bailey, et al. (1995) proposed that pre-existing genetically-influenced abnormal development in a foetus could cause pregnancy complications. This was the reverse of what had previously been suggested by other researchers, who believed that in the manifestation of ASD additional adverse perinatal factors compounded genetic predisposition (Steffenburg, et al., 1989).

There is some evidence that exposure to certain drugs *in utero* may increase the risk of ASD (Dufour-Rainfray et al., 2010). For example, a large long-term study found the incidence of ASD to be seven times higher for children exposed to a commonly-prescribed anticonvulsant, sodium valproate, during gestation (Bromley, Mawer, Clayton-Smith, & Baker, 2008), an association that had been demonstrated before (S. Moore et al., 2000). Increased ASD risk has also been associated with an asthma drug, terbutaline, which can be used to prevent premature labour (Connors et al., 2005) and an ulcer-prevention medication, misoprosotal, which can be used to induce labour (Bandim, Ventura, Miller, Almeida, & Costa, 2003). Childhood vaccinations that are given around the time that ASDs are typically identified³ have been the focus of research, in particular, those that have used a mercury-containing preservative, thiomersal (for examples see McCormick et al., 2004), but so far, no support has been found for a relationship between the two (Miles, 2011; Schechter & Grether, 2008).

³ ASD can often be reliably detected by the age of three years (Filipek, et al., 1999).

Neurobiology

Bowler (2007) reports two consistent themes that have emerged from the large number of neurobiological ASD studies that have been conducted, these being the abnormal structure “primarily reflected in the developmental trajectory of brain size and the organisation of cell assemblies⁴” (p. 207) and problems with synchronised connectivity between different brain regions implicated in the processing of complex stimuli. Altered brain development trajectories are currently regarded as the most reliable biomarker of ASD (Vaccarino & Smith, 2009) and a 5-10 per cent enlargement in brain volume has been seen in those with ASD between 18 months and four years of age, attributed to an increase in both gray and white matter (Vaccarino, Grigorenko, Smith, & Stevens, 2009). Two areas of the brain that appear to be most altered in ASD are the medial prefrontal and temporal cortex (Herbert et al., 2004).

ASD brain research has also focused on the amygdala, with abnormalities in both structure and function being observed, which may be related to social cognitive deficits such as emotion and face processing (Mosconi et al., 2009). Research findings include fewer neurons in the amygdala of ASD than neurotypical controls (Schumann & Amaral, 2006), abnormal volume (Mosconi, et al., 2009; Nacewicz et al., 2006; Sparks et al., 2002) and altered activation, reflecting hyperarousal (Dalton et al., 2005; Hadjikhani, Joseph, Snyder, & Tager-Flusberg, 2007). Under-connectivity in the brains of people with ASD has been demonstrated by many functional magnetic resonance imaging (fMRI) studies, suggesting reduced co-ordination of information across particular areas (Just, Cherkassky, Keller, Kana, & Minshew, 2007). For example, there may be poor connectivity between the amygdala and other cortical areas (Gaigg & Bowler, 2007).

Evidence for brain differences does not preclude an interaction with psychological processes in the development of ASD symptoms. It has been hypothesised (Bowler, 2007) that structural abnormalities result in alternative processing strategies, which compromise normally-developed brain structures by relying on them more and using them in an atypical fashion. This overuse may result in increasingly widespread functional abnormalities that in turn lead to unusual behavioural outcomes. In line with this hypothesis, recent fMRI studies have found evidence for enhanced activation of posterior networks and increased reliance on visuospatial abilities for

⁴ Cell assemblies are collections of neurons with co-ordinated firing activity.

both visual and verbal reasoning in individuals with HFA (Minshew & Keller, 2010). This finding, combined with knowledge of reduced activation and connectivity in the fronto-temporal language areas (Sahyoun, Belliveau, Soulières, Schwartz, & Mody, 2010), suggests problems with the specialisation of cortical networks in ASD.

In summary, it seems likely that multiple genetic factors implicated in ASD, perhaps compounded by environmental risk factors, can disrupt brain development and functioning, which interferes with social processes, as evidenced in the behaviour of those with ASD. A cognitive level of description of ASD is crucial in explaining behaviour and providing clues for links with, and direction for, genetic and brain research (Happé & Frith, 1996). The next section will examine psychological theories that have been proposed to account for social cognitive impairments and other characteristics typical of ASD.

Psychological theories of ASD

Social cognition refers to the mental operations implicit in social interactions, which includes perception, interpretation and the generation of responses to the intentions, dispositions and behaviour of others (M. F. Green et al., 2008). It is argued that social cognition also includes perception of the self, which is intertwined in any processing of the social world (Beer & Ochsner, 2006). Possible deficits in social cognitive mechanisms and related processes underlying the difficulties seen in ASD (including mentalising ability, executive function and central coherence) have been the focus of psychological theories and related experimental investigations, which will now be considered.

Theory of mind in ASD

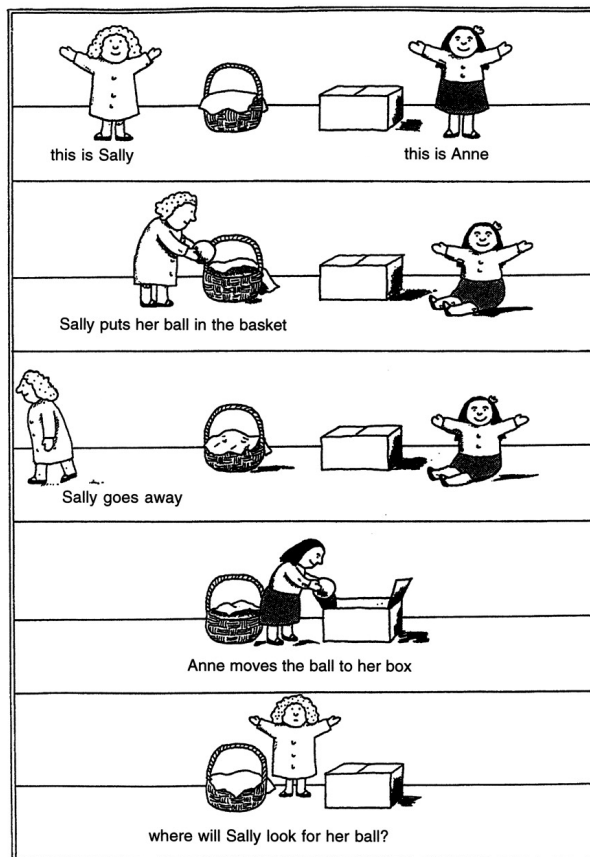
The term 'theory of mind', also known as 'mentalisation', refers to a person's ability to represent and attribute mental states to the self and others, such as beliefs and intentions, and to predict behaviours based on these mental states (Premack & Woodruff, 1978). Research into ToM has built upon the broader philosophical examination of the concept of the 'self' from the 'symbolic interactionist' perspective (e.g. Cooley, 1902; Mead, 1934; Blumer, 1969) and the related 'philosophy of mind' approach (e.g. Dennett, 1989), which advanced the proposition that the understanding of one's own mind and the understanding of other minds is reciprocal and interdependent. The basic premise of the symbolic interactionist perspective is that people act on the basis of ascribed meanings that are derived from social

interaction, which are modified through ongoing interpretation (Blumer, 1969). Mead believed that the individual mind arose out of social interaction and could 'only exist in relation to other minds and shared meanings' (G. Mead, 1982). The idea of the 'looking glass self' was developed by Cooley (1902) who proposed that how we view and understand ourselves is a reflection of how we imagine we appear to others, our imagined judgement of that appearance and the resulting 'self-feeling'. It was considered that an ability to represent others' minds was a necessary precondition for self-consciousness, successful social interaction and moral responsibility (e.g. Dennett, 1978). The idea of the 'intentional stance' was proposed by Dennett (1989), which referred to the understanding that others' actions arise from particular beliefs and desires and hence are goal-directed.

Disruption in ToM ability has been hypothesised to partly account for the social difficulties experienced by those with ASD (Happé & Frith, 1996). Early experimental studies of mentalising ability in ASD demonstrated that children with autism had difficulty understanding that beliefs held by others about a situation can be both false and also different from what they believe themselves (Baron-Cohen, Leslie, & Frith, 1985; Baron-Cohen, Leslie, & Frith, 1986). This impairment was highlighted through a 'first-order' false-belief task (known as this because it only involves inferring one person's mental state) called the Sally-Anne Test, which was adapted from a similar task devised by Wimmer & Perner (1983) to test ToM in typically-developing children. The Sally-Anne Test requires participants to identify and ascribe a mistaken belief to a character represented by a doll in a scenario (illustrated in Figure 2). It was found that children with autism (80 per cent of the sample in Baron-Cohen, et al.'s study, 1985) tended to respond with an answer based on their own perspective of the situation, rather than being able to guess what the character would think and do.

Many subsequent studies similarly showed that children with autism had difficulty shifting perspective to judge what other people might think in a given situation (Leekam & Perner, 1991; Perner, Frith, Leslie, & Leekam, 1989; Reed & Peterson, 1990; Swettenham, 1996; Swettenham, Baron-Cohen, Gomez, & Walsh, 1996). A meta-analysis (Happé, 1995) reported that whereas 50 per cent of typical children passed first order false-belief tasks by the age of four, it was not until children with ASD reach a verbal mental age of 9 years 2 months that 50 per cent passed the same tests. Children with AS also show impairments on ToM false-belief tasks, but to a lesser degree than children with autism (Ziatas, Durkin, & Pratt, 1998).

Figure 2: Illustration of the Sally-Anne Test



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In response to the criticism that a significant number of children with autism can pass first-order ToM tasks, more complex 'second-order' ToM tasks (requiring inferences to be made about two people's mental states) were employed in research (Perner & Wimmer, 1985). In these types of tasks respondents are asked to predict one person's behaviour on the basis of what their thoughts/beliefs might be about another person's mental state (e.g. John thinks that Mary thinks that...), which can be solved by typically-developing children by the age of 7 years. It was demonstrated that adolescents with ASD who had passed first-order tests failed these more complicated ToM tests (Baron-Cohen, 1989). However, despite exhibiting social impairments in real life, adolescents and adults with AS and HFA can pass both first and second-order ToM tasks (Bowler, 1992; Dahlgren & Trillingsgaard, 1996; Ozonoff, Pennington, & Rogers, 1991; Tager-Flusberg & Sullivan, 1994). The high complexity of the real social world is not accurately reflected in controlled experimental tasks, which could explain this discrepancy (Klin, Jones, Schultz, & Volkmar, 2003).

Mentalising ability in AS may not be less impaired than in autism, but rather difficulties may be 'camouflaged' (U. Frith, 2003). Logical inferences may be

employed by individuals with ASD to deal with problems that normally involve affective processes (Hermelin & O' Connor, 1985). Hence, people with AS may use intact cognitive abilities to compensate for a lack of intuitive social knowledge, described as 'hacking out' solutions by Happé (1995), enabling them to pass ToM tasks, but the less spontaneous, alternative routes of processing could make them appear odd in real life social interactions (Bowler, 1992).

Advanced ToM tasks have been developed with the aim of reflecting skills needed in real life, such as a series of vignettes called the Strange Stories Test (Happé, 1994) that examines understanding of non-literal verbal expressions (such as jokes, lies, sarcasm, persuasion, figure of speech). Adults with HFA and AS do not perform well on this task, giving fewer mental state explanations appropriate to the context of the stories than control participants (Jolliffe & Baron-Cohen, 1999). On another task called Stories from Everyday Life (Kaland et al., 2002), subtle signs of impairment were found in an AS group when inferring the mental states of others, such as a need for more external prompts, a tendency to interpret events literally and slow responses, although the method for measuring reaction time was criticised as 'unreliable' (Bowler, 2007). Adults with AS have also shown impaired ToM ability on the Projective Imagination Test (Blackshaw, Kinderman, Hare, & Hatton, 2001; Meraj & Hare, 2004) designed to elicit both open-ended and cued verbal responses to a number of line drawings depicting social situations.

The Reading the Mind in the Eyes Test (Eyes Test; Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997) was developed as an advanced adult ToM task to assess ability to infer complex mental states of others as expressed by the eyes (including emotion, cognition and desire states). A revised version was subsequently developed that was reported to have increased sensitivity (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). It was demonstrated to detect subtle individual differences (inverse correlations were found with scores on an autism screening measure) as well as discriminating adults with AS/HFA from controls, with the former showing significantly impaired performance. These findings have been replicated by subsequent studies (Golan, Baron-Cohen, Hill, & Rutherford, 2007; Kleinman, Marciano, & Ault, 2001). The authors of the Eyes Test acknowledge that it only involves the first stage of ToM, attribution of the type of mental state (e.g. compassion) but does not involve the second stage, inference about context (e.g. compassion for a friend's loss). Some researchers have asserted that the Eyes Test is different from other ToM tasks in that it requires automatic decoding rather than

reasoning about mental states and is therefore measuring a different ability that relies more on social-perceptual systems (Sabbagh, 2004; Tager-Flusberg & Sullivan, 2000). The Eyes Test has previously been used as a measure of subtle emotion discrimination due to its conceptual overlap with typical facial emotion recognition tasks, in that both assess the 'detection of social stimuli in the immediate environment' (Fertuck et al., 2009). In a study investigating mentalising ability in adults with AS/HFA, correlations between scores on the Eyes Test and two other ToM measures (Happé's Strange Stories Test and the Faux Pas Task, devised by Stone, Baron-Cohen, & Knight, 1998) were reported to be very low (Spek, Scholte, & Van Berckelaer-Onnes, 2010).

Moran et al. (2011) claimed to 'tap more sophisticated aspects' of ToM reasoning with a task requiring moral judgement. It was found that HFA participants did not reliably judge accidental harm as less morally wrong than attempted harm. It appeared that they were failing to weigh up intent and were showing an over-reliance on the knowledge of negative outcomes of people's actions, thus demonstrating ToM impairment. Taking a delayed ToM development perspective (e.g. Baron-Cohen, 1989; Frith, Morton & Leslie, 1991), it was hypothesised that skills required in this task may be later-maturing aspects of ToM that never fully develop, even in higher-functioning adults with ASD. An alternative explanation offered was that atypical compensatory processing might not deal well with the subtle demands of moral judgment (e.g. Bowler, 1992).

Bowler (2007) provided a detailed and thorough review of the ToM account of ASD and concluded that mental state understanding is likely to be just one facet of "the co-ordinated functioning of a range of diverse systems" (p. 50). Furthermore, it was described as 'vague shorthand' for a diverse range of abilities and deficits, measured by an equally diverse range of paradigms. Bowler's conclusion was further supported by a recent study that investigated the concurrent validity of a battery of tasks designed to assess ToM ability (Coffait, Hare, & Corcoran, 2008), which found no significant correlational relationships between scores on the measures in an AS group. A number of tasks that differentiated between the AS group and a neurotypical control group were conceptually similar. It was concluded that different types of ToM tasks have different underlying demands.

Researchers investigating ToM in the general population have argued that it is 'highly unlikely' that there is a single psychological faculty for mentalisation and have

proposed that there are two distinct cognitive 'systems' involved in social reasoning, which make different trade-offs between flexibility and cognitive efficiency (Apperly, 2009; Apperly & Butterfill, 2009). A later-developing capacity that is required for sophisticated judgements makes more demands on executive function and memory.

Studies exploring the possible neural bases of ToM in ASD have indicated that there may be at least two functionally and anatomically distinct neural circuits involved in decoding the mental states of others (Sabbagh, 2004), one processing visual cues, such as facial expression, and another involved in reasoning. It has also been proposed, however, that the appraisal of other people's intentions and emotions are closely interrelated and are part of the same process, which then determines one's own emotional and behavioural responses towards others (Ochsner, 2008).

There is evidence for diminished autobiographical memory (which involves episodic and semantic memory) in children and adults with ASD (Bruck, London, Landa, & Goodman, 2007; Crane & Goddard, 2008; Hare, Mellor, & Azmi, 2007), and in particular in AS (Goddard, et al., 2007). Attenuation in the episodic part of the memory system in particular would affect the ability of those with ASD to reflect on their own and others' actions, which would affect the ability to make predictions about the intent and behaviour of others in social situations (Bowler, Gardiner, & Gaigg, 2007). It has been suggested that problems with autobiographical memory may be related to specific, possibly visually-dependent, ToM impairments in AS (Adler, Nadler, Eviatar, & Shamay-Tsoory, 2010). A positive correlation was reported between autobiographical memory abilities and scores on the Eyes Test but not with scores on the Strange Stories Test. However, in an earlier study, mentalising ability as assessed by the Strange Stories Test was associated with a measure of autobiographical memory in AS (Abell & Hare, 2005).

In accord with philosophical discussions about the concept of the self (Cooley, 1902; Mead, 1934), impairments in self-referential cognition and empathy have been shown to be associated in an AS/HFA sample and alexithymia was predictive of poor mentalising ability (Lombardo, Barnes, Wheelwright, & Baron-Cohen, 2007). Alexithymia has also been found to be linked with poor ToM ability at the neural level (Moriguchi et al., 2006). A recent study reported that a group of individuals with AS showed impaired self-understanding and an underdeveloped self-concept compared with a matched control group (Jackson, Skirrow, & Hare, 2011). Specifically, AS participants generated fewer self characteristics, and reported fewer social and

psychological descriptions of themselves in the 'self-as-object' and 'self-as-subject' domains of the Self-understanding Interview (Damon & Hart, 1988). These findings support Hobson's (1995) assertion that individuals with ASD have a reduced capacity for self-awareness and reflection.

Executive function in ASD

A possible link between ToM and executive functions in ASD has also been considered, with causal relationships being hypothesised in both directions. It has been proposed that impairment in executive functions (such as those involved in self-monitoring) can impact upon the acquisition of ToM (J. Russell, 1997) and conversely, that ToM is necessary for the development of executive functioning (Perner, 1998; Perner & Lang, 2000). Some researchers have concluded that there are no distinct brain systems involved in mentalising and that performance on ToM tasks can be explained by the level of executive functioning (e.g. Frye, Zelazo, Brooks, & Samuels, 1996; Frye, Zelazo & Palfai, 1995). Others have pointed to evidence that executive functions can develop independently of ToM, hypothesising that the amygdala plays a role in ToM, which is not simply a function of the executive system (Fine, Lumsden, & Blair, 2001).

Executive dysfunction has been offered as a possible explanation for some of the common features of ASD and associated social cognitive difficulties. Executive functions are brain processes thought to be responsible for volition, planning, purposeful action and effective performance, which form the basis of many cognitive, emotional and social skills (Lezak, Howieson, & D., 2004). These capacities allow distancing from a situation or task so that attention can be moved between different aspects of it, inhibition of inappropriate responses and planning of appropriate strategies (Bowler, 2007). The prefrontal cortex is the primary area of the brain implicated in executive functions, although it is by no means the only area thought to be involved (Fine, et al., 2001). It was evidence that those with ASD do not perform well on tests that require mental flexibility (e.g. Prior & Hoffmann, 1990; Szatmari & Tuff, 1990) such as the Wisconsin Card Sorting Test (Heaton, Chelune, Talley, Kay, & Curtiss, 1993) that led researchers to consider whether executive dysfunction might contribute to common impairments seen in ASD. Lack of mental flexibility is also evident in the perseverative and stereotyped behaviours that are common features in individuals with ASD.

A particular profile of impairment in ASD has emerged based on evidence from executive function tests, which shows deficits in specific skills, including shifting of attention, generating novel responses and planning (see Hill, 2004a, 2004b). With regard to inhibition, evidence is less conclusive. On some measures, such as Stroop tasks that require inference suppression and tests of negative priming, the performance of children and adolescents with ASD is not impaired (Ozonoff, 1997; Ozonoff & Jensen, 1999; Ozonoff & Strayer, 1997; J. Russell, Jarrold, & Hood, 1999). Other studies have found impairments in voluntary response inhibition in ASD (Goldberg et al., 2002; Luna, Doll, Hegedus, Minshew, & Sweeney, 2007; Minshew, Luna, & Sweeney, 1999; Ozonoff, Strayer, McMahon, & Filloux, 1994). A hypothesis offered to explain this discrepancy in findings (Luna, et al., 2007) is that ability to suppress responses to distracters through shifting attention or the use of other strategies may compensate for difficulties with inhibiting prepotent behavioural responses. Russell (2002) argues that individuals with ASD experience more difficulties on executive function tests that appear to have arbitrary rules or a lack of rationale, which may account for variability in findings regarding inhibition from different tests.

In a study of the developmental trajectories of executive functions in ASD, it was shown that although widespread executive dysfunction appears to be present across age groups, voluntary response inhibition, as well as speed of sensorimotor processing, may mature and improve over time (Luna, et al., 2007). This theory of developmental plasticity provides hope of a window of opportunity for interventions that might build on improving capacities. It has been proposed that some executive functioning difficulties could relate to what has been termed 'weak central coherence' in that there is evidence for deficiency in broadening the spread of visual attention, perhaps due to difficulties with executive functions that facilitate disengaging and shifting of attention (Mann & Walker, 2003).

Central coherence in ASD

Central coherence is the ability to integrate information to construct higher-level meaning in context and the so-called 'weak central coherence' account of autism posits that people with ASD have a tendency to focus more on local details at the expense of global processing (U. Frith, 1989). A lack of drive in those with ASD to search for overarching meaning was thus proposed by Frith, which was considered to be due to deficient central control processes that are responsible for integrating components into a whole.

Experimental studies focusing on perceptual processes have utilised visuo-spatial measures, such as embedded figures tests (Witkin, 1971) and block design (e.g. Weschler, 1981) to demonstrate increased focus on local details, while in conceptual processing verbal-semantic tasks have demonstrated less use of context in the comprehension of sentences (U. Frith & Happé, 1994; U. Frith & Snowling, 1983; Jolliffe & Baron-Cohen, 1997, 2000; Shah & Frith, 1983, 1993; Snowling & Frith, 1986). However, it is unclear whether weak central coherence results from enhanced ability to see details to the detriment of seeing the overall configuration, or whether there is difficulty in integrating parts into a whole. Furthermore, some studies have been unable to corroborate the early findings in support of the weak central coherence hypothesis (Mottron, Burack, Stauder, & Robaey, 1999; Ozonoff, et al., 1994). A study that included a verbal homophone task, requiring auditory processing, found a lack of evidence for weak central coherence being a cross-domain phenomena (Hoy, Hatton, & Hare, 2004).

Based on observations from experimental studies, the 'task support hypothesis' states that in any given task, the performance of individuals with ASD will be better if support is provided (Bowler, Gaigg, & Gardiner, 2008; Bowler, Gardiner, & Berthollier, 2004). It is proposed that if information required for the successful resolution of tasks is not physically present at the time of testing but instead needs to be recalled, generated or inferred, then performance will be impaired. In the context of central coherence research it has been noted that people with ASD can more easily process information in a global manner when explicitly required to do so if prompts, priming, cueing or indication of context are given in tasks (Plaisted, Swettenham, & Rees, 1999; Ropar & Mitchell, 2002). This suggests that although global processing does not always occur automatically in those with ASD, they are capable of doing so, but perhaps tend to default to a local detail focused type of processing.

As a result of this attenuation of the weak central coherence hypothesis there has been more focus on superior local processing than global weakness (Happé & Frith, 2006), for example, the 'enhanced perceptual functioning' model (Mottron & Burack, 2001; Mottron, Dawson, Soulieres, Hubert, & Burack, 2006) proposes excessively developed low-level perception occurs due to the over-functioning of the brain regions involved in primary perceptual functions. Moreover, experimental research on weak central coherence has been criticised for utilising paradigms that conflate

global and local processing, often placing them in competition, so it is not possible to extrapolate their separate effects on performance (Happé & Booth, 2008). It has been suggested that the possibility of impaired integration has been neglected and tests directly investigating reduced global processing independent of local processing need to be developed in order to clarify its contribution.

Diminished coherence and superior local processing might help to explain a number of characteristics observed in ASD including fascination with parts of objects, heightened sensitivity to sensory input, narrow interests, obsession with details and good rote memory. Although weak central coherence is not capable of accounting for social cognitive deficits in ASD, it is possible to see how it might impact upon this further when more attention is paid to details than context during social interaction and communication. For example, less use of context in the interpretation of social behaviour and speech could lead to misunderstanding. Similarly, a tendency to focus more on the separate features of faces rather than whole configurations may interfere with the processing of emotion expressions. Faces are considered to be a special class of visual stimulus, with significant evolutionary importance with regard to social functioning, and may have specialised processing circuits that differ from those used to process other visual input (Hole & Bourne, 2010). Therefore, the examination of facial expression recognition in ASD has been the focus of an expanding body of research.

Psychological theories conclusion

No one theory can fully account for all of the characteristics of ASD, but rather each makes its own contribution towards a better comprehension of these complex and multidimensional conditions. Bowler (2007) concluded that this complexity requires a 'more subtle explanation than a simple reduction' to a single theory. It is more plausible to consider the features of ASD as arising from interrelated abnormalities affecting a range of core cognitive processes involved in mentalisation, executive function and central coherence, as well as other systems, such as autobiographical memory and face processing. As there is a lack of specificity to ASD, difficulties in each of these areas can be found in other clinical conditions, such as attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD) and schizophrenia (Hill, 2004b). The key to further understanding is working out how and why the different processes and related impairments specifically fit together in ASD. Advancing work in the areas of genetics and neurobiology, combined with cross-

theory psychological experimental research, could help to elucidate the particular combination of difficulties typically observed in individuals with ASD.

Facial expression recognition in ASD

The ability to produce and decode facial expressions has long been regarded as a critical skill in successful social interactions (Darwin, 1965; Ekman, 1984). Faces are a rich source of emotional information and usually play a significant role in mediating interpersonal communication. Equally, social interaction may be crucial for the normal development of facial emotion recognition (Leppänen & Nelson, 2006). Individuals with ASD have been shown to have impairments in the cognitive processing of their own emotions, including difficulties identifying and describing feelings (Berthoz & Hill, 2005; E. Hill, et al., 2004; Tani et al., 2000). Recognising, understanding and expressing one's own emotions is associated with the ability to recognise emotions in others (Fonagy, Gyorgy, & Jurist, 2004), a finding which relates to the philosophical stance of symbolic interactionists.

Impaired use of non-verbal behaviours, such as facial expression, is included in the diagnostic criteria for AS (APA, 1994), but deficits in facial expression recognition are not. Nevertheless, considering the central role that facial expressions play in human social interaction, and with social difficulties being at the centre of ASD, a search for evidence of deficits in facial emotion recognition has been the focus of a considerable body of research. A review of behavioural and neuroimaging studies from 1986-2010 in both children and adults with ASD concluded that findings in this area have been mixed and inconsistent (Harms, Martin, & Wallace, 2010). The authors proposed that this was due to demographic factors, task demands and the range of dependent variables measured.

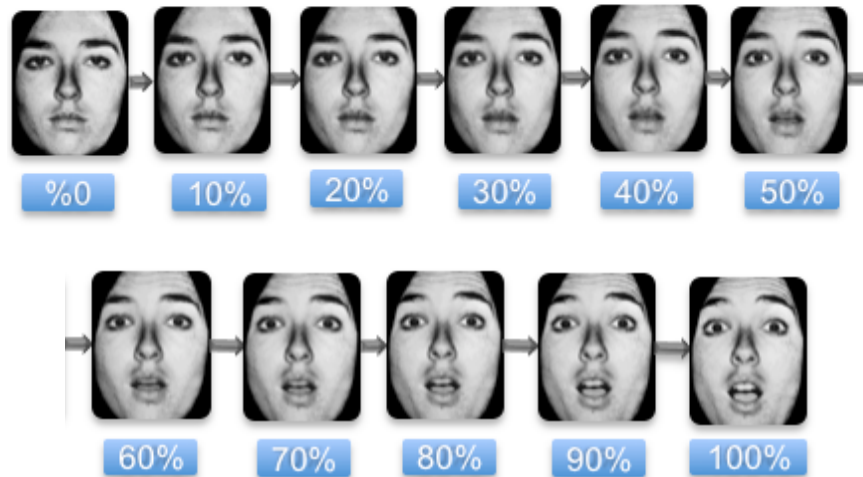
In typically developing children, emotion recognition improves throughout childhood (Vicari, Reilly, Pasqualetti, Vizzotto, & Caltagirone, 2000) and into adolescence (Thomas, De Bellis, Graham, & LaBar, 2007). Research indicates that these abilities may improve with increasing age in ASD, but to a lesser extent (e.g. Gepner, Deruelle, & Grynfeldt, 2001; O'Connor, Hamm, & Kirk, 2005). However, cognitive ability might contribute to emotion recognition, but its conflation with age in research studies makes it difficult to interpret findings (e.g. Buitelaar, Wees, & Swaab-Barneveld, 1999; Loveland et al., 1997; Wright et al., 2008).

In adults with ASD impaired facial emotion recognition has been found (Ashwin, Wheelwright, & Baron-Cohen, 2006; Corden, Chilvers, & Skuse, 2008; Howard et al., 2000; Wallace, Coleman, & Bailey, 2008), but in other work involving participants with HFA/AS, either no significant impairment in performance has been found (Adolphs, Sears, & Piven, 2001; Loveland, et al., 1997; Neumann, Spezio, Piven, & Adolphs, 2006; Ogai et al., 2003; Rutherford & Towns, 2008), or deficits have been subtle (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Teunisse & de Gelder, 2001). Nevertheless, there is evidence of differences in emotion recognition abilities between HFA and control groups (Dalton, et al., 2005; Macdonald et al., 1989).

The wide variation in the experimental tasks used in emotion recognition research might contribute to such inconsistent findings and particular methodologies employed may not be sensitive enough to detect group differences. The choice of tasks seems to be a more important factor in research with HFA/AS populations than with low-functioning ASD (Harms, et al., 2010), given that the complexity and demands can be more varied. For example, in some studies the duration of exposure to the facial stimuli is either untimed or is too long to be ecologically valid (e.g. Wright, et al., 2008; Rutherford & Towns, 2008). On the other hand, in one study, exposure to the stimuli was so brief (e.g. Clark, Winkielman, & McIntosh, 2008) that it represented a specific involuntary class of expression known as 'micro expression' rather than regular facial expression. Emotion recognition studies in ASD vary in many other ways, including: using static versus dynamic stimuli, forced-choice between two or more answers versus open questions, wide variance in the number of stimuli presented, inclusion of contextual information, presentation of isolated features of the face versus the whole face and obvious prototypical emotion versus reduced intensity of expression.

Recent studies have employed morphing techniques to produce representations of emotional expressions at different intensities (e.g. from neutral to fully expressive emotional face stimuli; see Figure 3 for an illustration) and mixed expressions of two emotions blended, in order to reflect the subtleties of real-life facial expressions and produce more sensitive tasks. Some blended emotion studies have demonstrated recognition deficits in both children and adults with ASD (Humphreys, Minshew, Leonard, & Behrmann, 2007; Kuusikko et al., 2009; Teunisse & de Gelder, 2001), but other findings have been contradictory (Castelli, 2005; Homer & Rutherford, 2008). Possible factors contributing to these discrepancies include small sample sizes, poor group matching and duration of stimulus presentation.

Figure 3: Photographs expressing surprise morphed from 0-100% intensity



The photographs are from Ekman and Friesen's (1976) Pictures of Affect Series and were morphed using the procedure described by Young et al. (1997) for use in a facial expression recognition task (Harmer, Bhagwagar, Perrett, Cowen, & Goodwin, 2003).

Outcomes of recent research using morphed intensities of emotion (e.g. subtle 'lower-intensity' facial expressions through to more obvious 'higher-intensity' facial expressions) have been more consistent, with all such studies finding emotion recognition deficits in children and adults with ASD at lower intensities (Greimel et al., 2010; Law Smith, Montagne, Perrett, Gill, & Gallagher, 2010; Philip et al., 2010), with one study also demonstrating an association with level of social impairment (Bal et al., 2010). Early indications are that morphing can provide sensitive and promising paradigms, but due to a scarcity of studies and limitations in some that have been conducted, more research using these techniques is required to confirm their increased discriminative ability. The study by Philip et al. (2010) presented each of the stimuli for five seconds, which was too long to be ecologically valid, whereas the study by Law Smith, et al. (2010) was well controlled and methodologically robust, but only included adolescent participants. Morphing may be particularly useful when combined with fMRI, such as in a study conducted by Greimel, et al. (2010), which provided evidence for abnormal activation in the fusiform gyrus area of the brain during face processing in AS. However, this particular study only included happy and sad stimuli.

Experiments using neuroimaging, eye tracking and electrophysiological techniques have indicated abnormalities in face processing in ASD (Harms, et al., 2010). Findings of atypical brain activation, delayed event-related potentials and unusual

eye gaze patterns in response to face stimuli, have all provided evidence that people with ASD decode faces irregularly, relying upon compensatory processing mechanisms (e.g. cognitive, perceptual, language-based). It has been proposed that high-functioning individuals are more likely to employ these alternative strategies on face emotion processing paradigms if task demands are not pitched correctly (Harms, et al., 2010).

In support of the hypothesis that faces may be processed atypically, some studies have found evidence of predominant feature-based processing of faces in ASD rather than more global, configural-based strategies (Behrmann, Thomas, & Humphreys, 2006; Deruelle, Rondan, Gepner, & Tardif, 2004; Hobson, Ouston, & Lee, 1988), although in some studies findings are mixed (e.g. Teunisse & deGelder, 2001) and there is also contradictory evidence (Gross, 2008; Rouse, Donnelly, Hadwin, & Brown, 2004). Variations in duration of stimulus presentation could account for these differing findings. It has been proposed that the optimum presentation time to avoid piecemeal processing strategies in favour of holistic processing of faces is <750 milliseconds (Celani, Battacchi, & Arcidiacono, 1999; Homer & Rutherford, 2008).

Eye-tracking studies have indicated that individuals with ASD pay less attention to eyes when processing faces and are less effective at decoding mental states from the eye-region alone (Baron-Cohen, Wheelwright, et al., 1997; Corden, et al., 2008; Pelphrey, Morris, McCarthy, & LaBar, 2007) but look more at the mouth area (Neumann, et al., 2006; Spezio, Adolphs, Hurley, & Piven, 2007). Corden, et al (2008) interpreted reduced fixation on the eyes as avoidance of emotionally arousing stimuli, based on the finding that impairments were in the recognition of negative emotions in particular (sadness, fear and, to a lesser extent, anger). The researchers proposed that this avoidance contributes to social-perceptual impairments in ASD, which is consistent with previous suggestions that chronic inattention to socially meaningful signals interferes with the development of social knowledge and skills in ASD (Grelotti, Gauthier, & Schultz, 2002; Schultz, 2005; Schultz, Romanski, & Tsatsanis, 2000).

The processing of all basic emotions from facial expressions has been reported as problematic in ASD at some time, under certain conditions, in various studies, but not in others. Examples include: sadness (Boraston, Blakemore, Chilvers, & Skuse, 2007; Wallace, et al., 2008), disgust (Ashwin, Chapman, Colle, & Baron-Cohen,

2006; Humphreys, et al., 2007; Wallace, et al., 2008), anger, happiness (Wright, et al., 2008) and surprise (Baron-Cohen, Spitz, & Cross, 1993), as well as more complex emotions such as embarrassment, pride (Capps, Yirmiya, & Sigman, 1992; Heerey, Keltner, & Capps, 2003), guilt (Baron-Cohen, Wheelwright, et al., 1997) and jealousy (Bauminger, 2004).

With regard to facial expressions of fear, a recognition deficit has been found in HFA and AS by some previous studies (Howard, et al., 2000; Humphreys, et al., 2007; Pelphrey et al., 2002; Sigman, Kasari, Kwon, & Yirmiya, 1992; Wallace, et al., 2008), but not others (Adolphs, et al., 2001; Castelli, 2005; Grossman, Klin, Carter, & Volkmar, 2000). Conflicting findings may be explained by methodological limitations, such as small sample sizes and poor group matching in some of the research. Also, the participants in the latter two studies were children and in typical development, emotion expression recognition abilities emerge gradually over time, with accuracy improving with age (Herba & Phillips, 2004; Montirosso, Peverelli, Frigerio, Crespi, & Borgatti, 2010). As happiness typically tends to be the earliest of the six basic emotions⁵ to be recognised accurately and consistently and fear is the last (Herba & Phillips, 2004), there might be less chance of finding group differences for fear stimuli between younger children (i.e. pre-schoolers) with and without ASD.

In the Corden, et al (2008) study, which used an adequately powered adult sample with controls matched for age, IQ scores and visual-perceptual ability, the level of fear recognition impairment in the AS group was predicted by the extent of their lack of fixating on the eyes of face stimuli. Additionally, greater levels of social anxiety were associated with less time spent fixating on the eyes and poorer fear recognition. A recent study exploring the neural basis of abnormal emotional face processing in ASD indicated that social anxiety may mediate the response to emotional face expressions, as higher levels of social anxiety were found to be associated with greater amygdala activation (Kleinhans et al., 2010). Anxious individuals with ASD may have increased sensitivity to emotional faces, making them more challenging to process, which may in turn lead to increased avoidance. Anxiety is known to be common in this population (e.g. Tantam, 2000), so potential links between social cognitive deficits such as face processing difficulties and affective states could have important implications for wellbeing. The experience and expression of anxiety in ASD, along with other mental health issues, will now be considered.

⁵ It is widely agreed that the six basic emotions are anger, disgust, fear, happiness, sadness and surprise, as established by Ekman & Friesen (1969).

ASD and mental health problems

Individuals with ASD have an increased risk of developing mental health problems (Deudney & Shah, 2004; Ghaziuddin, Weidmer Mikhail, & Ghaziuddin, 1998; Hare, 1997, 2012; Hare & Paine, 1997; Tantam & Prestwood, 1999; Tsakanikos, Costello, Holt, Sturmey, & Bouras, 2007). A national UK survey of the parents of more than 450 adults with ASD found that 32 per cent had experienced mental health problems, rising to 45 per cent of those who did not receive a diagnosis until their 20s and as high as 50 per cent of those diagnosed post age 30 (Barnard, Harvard, Potter, & Prior, 2001).

It is important to bear in mind when considering the epidemiology of mental disorder in ASD that the use of differing methodological approaches (e.g. diagnostic schedules, interviews with individuals and their families, self-report or clinician-administered measures) may influence the outcomes of prevalence research, so any figures quoted can only be taken as rough estimates.

The relationship between ASD and other overlapping symptoms or conditions can be unclear and the issue of so-called 'comorbidity' is contentious because it is not always obvious what is meant by the term. Gillberg and Billstedt (2000) have pointed out that a number of inferences about coexisting problems are possible, including that they are directly causally related with one leading to another, indirectly related with another underlying condition or impairment contributing to both, or that they are coincidental. In some cases, features of undiagnosed ASD can be misattributed as symptoms of chronic treatment-resistant mental illness leading to 'revolving-door' use of psychiatric services (Ryan, 1992). Equally, the difficulties that people with ASD may have in communicating distress and the misinterpretation of symptoms as being features of ASD (e.g. increased social withdrawal, abnormal speech patterns), can result in mental health problems being missed, particularly if clinicians lack in-depth knowledge of developmental disorders (P. Howlin, 1997; Tantam, 2000). Additionally, the expression of mental health problems may be influenced by the presence of ASD, making changes more difficult to interpret e.g. low mood leading to irritability and aggression (Stewart, Barnard, Pearson, Hasan, & O' Brien, 2006). There is a general lack of appropriate support services for high-functioning individuals with ASD who often 'fall through the gap' between mental health and learning disability services (Barnard, et al., 2001), which may also contribute to mental health problems developing and going unnoticed.

People with AS are more likely to experience adverse life events that can lead to mental health problems (Tantam, 2000). Psychological distress is influenced by the reactions of others towards them and their disabilities, as well as by their own responses to their situation. Victimisation, exploitation and rejection is not uncommon, particularly for higher-functioning individuals who are more likely to mix with neurotypical peers (Shtayermman, 2007; Tantam, 2000). There is also the common experience of difficulties in forming and maintaining social and intimate relationships, compounded in adolescence by delayed adjustments to physical and sexual maturation (Marcus, Kuncze, & Schopler, 1997). Awareness of differences with peers, and of how they might be viewed by others, often increases with age and development (Attwood, 1998; Stoddart, 1999; Tantam, 2000). In addition, many adults with AS fail to secure employment despite their intellectual ability and are less able to live independently (Hofvander et al., 2009; Newson, Dawson, & Everard, 1984), which may leave them without a sense of responsibility or direction. Difficulties are often exacerbated by life transitions and social challenges that the individual may struggle to adapt to (Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Tantam, 2000). Family relationships can also suffer, with tensions arising and, sometimes, breakdown occurring. These challenges can cause the individual with AS to retreat further into their own private world of special interests and routines, resulting in increased social isolation and vulnerability.

Affective disorders are commonly associated with AS and have consistently been observed clinically and in research for many years, as far back as Asperger's case studies from the 1940s (Wing, 1981). High levels of anxiety have consistently been found in people with AS (Abell & Hare, 2005; Balfe & Tantam, 2010; Kim, et al., 2000; Tantam, 1991; Tantam & Girgis, 2009; Tonge, Brereton, Gray, & Einfeld, 1999) and it has been described as an 'almost universal concomitant' (Tantam, 2000). It has been asserted that anxiety is an unsurprising emotional consequence of living with AS (Tantam, 1991, 2000), for example, any social contact or change to routine can generate high levels of anxiety (Attwood, 1998). It has been suggested that people with ASD are more vulnerable to stress because of a limited repertoire of appropriate coping mechanisms, resulting in increased anxiety (Grodén et al., 2001). Real-time data has been gathered in an attempt to understand the specific nature of anxiety in individuals with AS via an experience sampling method (C. Wood, Skirrow, & Hare, 2008). It was found that countless every day events rapidly caused anxiety in AS participants, who had great difficulty in recognising and articulating cognition associated with the feelings, which were often described as 'confusing'. A

large majority of the anxious feelings that were reported (86 per cent) occurred without an anxious thought being identified.

There also appears to be an increased vulnerability to specific anxiety-related disorders with AS, including social phobia, generalised anxiety disorder, panic disorder, specific phobias and OCD (Klin, Pauls, Schultz, & Volkmar, 2005; Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Tantam, 2003; Tantam & Girgis, 2009). Social phobia is probably the most common anxiety-related disorder in those with AS (Tantam & Girgis, 2009) and may be a consequence of accumulating negative social experiences such as victimisation (Ranta, Kaltiala-Heino, Pelkonen, & Marttunen, 2009). Social phobia is most likely to develop during adolescence and young adulthood in AS and typically leads to social withdrawal, resulting in a lack of social practice that compounds core social difficulties and can lead to further affective problems (Tantam & Girgis, 2009).

It is not difficult to see how some features of autism, such as absorbing and narrow interests that are obsessively pursued and ritualistic activities, could lead to confusion with OCD, especially as it has been observed that these behaviours can increase in response to anxiety (Tantam, 2000). That is not to say that obsessions and compulsions cannot exist in tandem with ASD and high levels of both were found in a sample of adults with HFA and AS that were associated with significant levels of distress (A. Russell, Mataix-Cols, Anson, & Murphy, 2005). The key to the diagnosis of OCD in an individual with ASD is determining if their behaviours are egosyntonic, as is often the case with typical rituals and routines of ASD, or egodystonic as is evident in OCD (Fitzgerald & Corvin, 2001; Tantam & Girgis, 2009; Woodbury-Smith & Volkmar, 2009).

Depression is very common in ASD and of those who had mental health problems in the UK survey (Barnard, et al., 2001) 56 per cent experienced depression and 8 per cent reported suicidal ideation or attempts. In a review of studies investigating long-term outcomes of individuals with AS (Patricia Howlin, 2000), depression was by far the most common psychiatric problem, often associated with severe anxiety, representing more than one third of diagnoses reported. High rates of depression have been reported specifically in AS, including 37 per cent in a clinical series (Ghaziuddin, et al., 1998). A recent study found that 70 per cent of a sample of adults with AS had experienced at least one episode of major depression, with 50 per cent having recurrent episodes (Lugnegård, Hallerbäck, & Gillberg, 2011).

An increased risk of bipolar disorder has been reported in ASD, especially for high-functioning individuals and close family members (DeLong & Dwyer, 1988). The rate of bipolar disorder in ASD has been reported as 7-8 per cent (Hofvander, et al., 2009; Stahlberg, Soderstrom, Rastam, & Gillberg, 2004). Confusion with bipolar symptoms could arise from observations of fluctuating activity levels, which are common in autism (Gillberg & Billstedt, 2000), or other features associated with AS, such as sleep disorders, hyper-enthusiasm and related monologues, hyperactivity and inattention (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Woodbury-Smith & Volkmar, 2009).

Of all the relationships between ASD and mental disorders, the most entangled is that with psychosis. Asperger (1944) acknowledged that his use of the term autism was derived from the concept as described in the context of schizophrenia by Bleuler (1950). Asperger asserted that the difference was a disturbance in social contact 'from the start' in autism, rather than a progressive deterioration and 'disintegration of personality' as seen in schizophrenia. He concluded that what he observed in his case studies, which he termed 'autistic psychopathy', was not psychosis. Nevertheless, early in its conception, autism was considered by many to be a form of childhood schizophrenia. It was not until much later that it was clearly demonstrated that early-onset schizophrenia and autism were distinct conditions (Kolvin, Ounsted, Richardson, & Garside, 1971; Rutter, 1972; Wing & Gould, 1979), leading to a reliable separation and what was described as 'one of the best-validated distinctions in psychiatry' (Sporn et al., 2004). However, the relationship between the two disorders is still far from resolved despite continuing genetic research (see Crespi, 2010). Some researchers have pointed to evidence of shared genetic vulnerability in proposing a model of overlapping pathogenesis that arises from neurodevelopmental disturbance (Craddock & Owen, 2010). An alternative theory, drawing on observations of chromosome deletions and duplications at particular loci, suggests that autism and schizophrenia are diametric opposites mediated by reciprocal genetic variants (Crespi & Badcock, 2008; Crespi, Stead, & Elliot, 2010).

In a follow-up study of 74 autistic adults only one developed schizophrenia (P. Howlin, 1997). Similarly, in a study examining case records of 163 adolescents and adults with ASD, only one case of schizophrenia was found, a frequency comparable to the general population, leading the researchers to conclude that the two conditions do not occur together more than would be expected by chance (Volkmar & Cohen, 1991). However, this conclusion has not been supported by other research, with higher rates of psychotic disorders being reported. For example, a study of 129

adults with ASD found a rate of 7.8 per cent (Stahlberg, et al., 2004). A follow up study of 85 AS adults reported a rate of 10.6 per cent (Tantam, 1991). Recent research including a sample of 122 high-functioning ASD adults found that 12 per cent met criteria for a psychotic disorder (Hofvander, et al., 2009). Conversely, premorbid signs of autism were found in a significant proportion of individuals going on to develop schizophrenia (McKenna et al., 1994), although it could be argued that symptoms may have been misattributed.

The wide variation in the above findings could be due to a number of factors, including: age range and level of functioning of the samples; methods of diagnosis; inclusion of psychosis in the context of other disorders, such as depression and epilepsy; possible inclusion of those with psychotic symptoms without any formal diagnosis. A very recent study (Lugnegård, et al., 2011) found two individuals with psychotic disorders in a sample of 54 adults with AS, but pointed out that 13 per cent of their sample had experienced recurrent hallucinations (mostly auditory) without other signs of psychosis.

A study examining clinical referral trends in specialist mental health services reported that schizophrenia was the most common psychiatric diagnosis (16.1 per cent) in those with ASD (Tsakanikos, Sturmey, Costello, Holt, & Bouras, 2007). However, it should be noted that psychotic disorders such as schizophrenia are sometimes misdiagnosed, in place of or along with ASD, when the clinical distinction is not obvious and symptoms are misattributed (Burke, 2005; Dossetor, 2007; Hare, 1997; Perlman, 2000; Raja & Azzoni, 2001; Woodbury-Smith, Boyd, & Szatmari, 2010). This will often result in the use of inappropriate pharmacological treatment that is potentially harmful and may exacerbate existing difficulties (Ryan, 1992; Tantam, 1991). People with ASD seem to be very sensitive to the side effects of psychotropic medication, but due to lack of response to treatment may be given high doses (Woodbury-Smith, et al., 2010). Taking a comprehensive history that reaches back into childhood is clearly essential in making differential diagnosis when there is such potential for confounds (Tsakanikos, Sturmey, et al., 2007; Woodbury-Smith, et al., 2010).

Features commonly observed in ASD such as social withdrawal, stereotyped behaviour and poor communication could be likened to negative symptoms seen in those experiencing psychosis (Fitzgerald & Corvin, 2001; C.D. Frith, 1992; McKenna, et al., 1994). Sometimes, 'odd' behaviours and speech patterns, which can become 'quite bizarre' in response to stress, unusual interpretations of events (National

Autistic Society, 2011; Ryan, 1992) and strongly-held 'strange' beliefs relating to special interests and obsessions (Tsakanikos, Sturmey, et al., 2007), may be taken as evidence of psychosis. Anomalous sensory experiences often reported in ASD, such as distortion and difficulties with source identification (Bogdashina, 2003; Harrison & Hare, 2004; O'Neill & Jones, 1997), could be interpreted as delusions or hallucinations. Higher levels of delusional beliefs have been reported in individuals with AS compared with the general population, which could also add to difficulties with differential diagnosis (Abell & Hare, 2005; Blackshaw, et al., 2001; Craig, Hatton, Craig, & Bentall, 2004).

Treatment of mental health problems in ASD

Available evidence, from a number of clinical case studies (Bauminger, 2002; Hare, 1997; Reaven & Hepburn, 2003; Sze & Wood, 2007, 2008) and randomised control trials (RCTs; Sofronoff, Attwood, & Hinton, 2005; Sofronoff, Attwood, Hinton, & Levin, 2007; Sung et al., 2011; J. Wood et al., 2009), indicates that Cognitive Behavioural Therapy (CBT), with appropriate adaptations, is the most effective psychotherapeutic approach to use with individuals with ASD experiencing psychological difficulties (see Hare, 2012 for a review). However, it should be noted that most of this research involved children and not adults. Factors that were found to contribute to the success of therapeutic interventions included: structure and organisation of sessions; the use of written work, visual techniques (such as comic strips and diagrams) and idiosyncratic metaphors to convey information and enhance communication; the involvement of family/carers; incorporation of special interests into the sessions; clear schedules, rules and boundaries that were collaboratively agreed before commencing; and sometimes a more directive role is required of the therapist, but direct challenges of cognitions and beliefs may not be received well. Additionally, people with ASD have been shown to perform better on experimental tasks if given support in the form of cues (Bowler, et al., 2008; Bowler, et al., 2004), a finding that could be incorporated into clinical work by providing sufficient structure, clarity of goals and expectations, prompts, and by utilising techniques to aid memory and communication of information.

2. SCHIZOPHRENIA, PSYCHOSIS AND PARANOIA

Schizophrenia is a term used to describe a clinical syndrome involving impairments in cognition, emotion, perception and behaviour, characterised by severely impaired reality testing (Kaplan, Sadock, Sadock, & Ruiz, 2009). A combination of psychotic features is usually experienced, such as delusions, hallucinations and thought disturbances [positive symptoms] and the individual may experience flat affect, anhedonia and loss of motivation [negative symptoms], observable as reduced emotional responsiveness and social withdrawal. The lifetime prevalence is estimated to be 0.3-0.7 per cent (McGrath, Saha, Chant, & Welham, 2008) and onset is typically in early adulthood.

Genetic susceptibility and altered brain development have been indicated in schizophrenia, possibly shared partly with other disorders, such as ASD and bipolar disorder. Combined with environmental stressors these may give rise to cognitive deficits, possibly mediated by dopamine dysfunction, in turn leading to psychotic symptoms (van Os & Kapur, 2009; van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009). Taking a different aetiological line, which challenges the 'causal priority of biological explanations of schizophrenia', Harrop & Trower (2001, 2003) proposed a cognitive-developmental model of psychosis implicating severe disruption of a typically difficult psychological maturation process that normally takes place during adolescence. It was suggested that problems in relation to individuation from parents and/or in bonding with peers can interfere with the process of defining the self and psychosis can emerge out of this 'blocked' development.

The validity and utility of the concept of schizophrenia has been called into question, with serious concerns raised about its diagnostic reliability, construct validity and predictive validity (Bentall, 1990; Boyle, 1990). This has led to the proposal that psychiatric classification systems should either be radically re-organised, taking a dimensional approach, or that the diagnostic category of schizophrenia should be abandoned altogether in favour of a focus on symptoms (Bentall, 1990; Claridge, 1990). The proposed changes to the DSM-5 schizophrenia category, and other psychotic disorders, explicitly include dimensional assessments of all core symptoms (APA, 2011). As a result of the lack of progress that has been made in schizophrenia research, due at least partly to the inherent heterogeneity of samples, a symptom-based approach has become increasingly popular (Corcoran, Mercer, & Frith, 1995). This involves classifying individuals in terms of the nature of their

symptoms and making predictions based upon these, then devising tests to investigate the underlying cognitive processes suspected of being deficient.

Delusions are defined for clinical purposes as false personal beliefs 'based on incorrect inference about external reality...' (APA, 1994). Delusions are complex and multidimensional phenomena, existing on a continuum with ordinary beliefs (Bentall, 2001; Garety, 1985; Garety & Hemsley, 1994; Kendler, Glazer, & Morgenstern, 1983; Oltmanns, 1988) and a belief is increasingly likely to be considered delusional if it is more implausible, unfounded, held with conviction, not shared by others, distressing and preoccupying (Freeman, 2007).

Paranoid delusions (including 'ideas of reference' and persecutory beliefs) are the most commonly observed forms of delusions experienced by people with schizophrenia diagnoses, occurring in around 50 per cent of cases (Cutting, 1997; Sartorius et al., 1986). Ideas of reference involve beliefs that events have special significance and refer to the individual personally (e.g. being watched, being talked about, messages being sent through the media) typically involving themes of observation and communication (M. Startup & Startup, 2005). Persecutory delusions involve beliefs that others plan to cause, or already are causing, intentional harm and as such, beliefs are sometimes secondary elaborations of ideas of reference (Freeman & Garety, 2000). Although most commonly associated with psychosis, paranoid delusions can also occur in other psychiatric conditions (e.g. depression, bipolar disorder and post traumatic stress disorder; PTSD) as well as some neurological disorders (e.g. dementia and epilepsy) and can also be induced by certain drugs (Freeman & Garety, 2004).

Paranoia is not confined to psychiatric and medical populations but is also reported in non-clinical samples (Martin & Penn, 2001; E. R. Peters, Joseph, & Garety, 1999; Verdoux, Maurice-Tison, Gay, & van Os, 1998). It has been indicated that at least 10-15 per cent of the general population regularly experience paranoid thoughts (Freeman, 2007). In a recent study using a virtual reality situation more than 40 per cent of a general population sample reported having paranoid thoughts in what was designed to provide a neutral social experience (Freeman, Gittins, et al., 2008). Although there is evidence for the continuity of psychotic symptoms with normal experiences, it is not necessarily a normally distributed variable and is more likely to be positively skewed or bimodal (see Johns & van Os, 2001 for a discussion of this issue).

Psychological research has elucidated some of the cognitive processes underlying various features of psychosis. A number of different abnormalities have been identified as possible mechanisms and explanations for the major signs and symptoms of psychosis, including paranoid delusions, which will now be considered.

Theory of mind in psychosis

Noting the similarities with ASD in terms of presentation, C.D. Frith (1992) proposed a theory that ToM deficits were central to the development of paranoid beliefs in psychosis. It was hypothesised that specific ToM difficulties fitted within a 'metarepresentational' system responsible for the ability to infer possible beliefs and intentions of others, with different types of cognitive impairment leading to the various signs and symptoms of schizophrenia. It was suggested that people with impaired mentalising abilities must also have an abnormal state of self-awareness and difficulty describing inner experiences. A lack of self-monitoring could also give rise to symptoms such as auditory hallucinations. According to Frith's theory, a newly-acquired difficulty in understanding the mental states of others (as opposed to the life-long difficulties that characterise ASD) could result in the misinterpretation of people's communication or actions, leading to the assumption that others are trying to deceive in order to disguise malevolent intent. As ToM ability is intact pre-morbidly in the person with schizophrenia, Frith's model proposed that they will go on trying to use these abilities once impaired (i.e. a 'state' deficit) and will be less ready to accept alternative explanations for what they feel they know to be true. On the other hand, if mentalising ability is impaired from the outset, as it is in people with autism (i.e. a 'trait' deficit), those individuals will expect to make wrong inferences and may be more willing to accept other people's interpretations of situations. However, Frith's (*ibid*) theory does not take into account high-functioning individuals with ASD who possess better ToM abilities but may not be successful at mentalising consistently, which could make them more susceptible to faulty inferences and, consequently, suspicious thoughts, similar to individuals with psychosis.

Experimental studies conducted to test Frith's theory demonstrated that patients with paranoid delusions did perform significantly less well than control groups on a variety of measures designed to examine ToM abilities, including: second-order false belief tasks (C. D. Frith & Corcoran, 1996); visual and linguistic jokes (Corcoran, Cahill, & Frith, 1997); the use of context-specific social conventions (Corcoran & Frith, 1996); and the Hinting Task, requiring inferences to be made about the real meaning intended behind indirect speech acts (Corcoran, et al., 1995). Further

support for a link between ToM deficits and persecutory delusions has been demonstrated (Harrington, Langdon, Siegert, & McClure, 2005), but this association has not always been found and ToM deficits have been linked with other symptoms (see Harrington, Siegert, & McClure, 2005).

A recent meta analysis of 29 studies found significant ToM impairments in schizophrenia (with a large overall effect size) across symptom subgroups, as well as in those whose symptoms were in remission (Sprong, Schothorst, Vos, Hox, & Van Engeland, 2007). A further meta analysis of 36 ToM studies found evidence for significant impairment (again with large effect sizes) influenced by acute psychosis, while remitted patients had reduced but still significant ToM impairment (Bora, Yucel, & Pantelis, 2009). The conclusions of both meta analyses are contrary to Frith's theory and other previous research (Bertrand, Sutton, Achim, Malla, & Lepage, 2007; Corcoran, et al., 1995; Drury, Robinson, & Birchwood, 1998; C. D. Frith & Corcoran, 1996; Pickup & Frith, 2001) in that they suggest that ToM deficits may be trait, rather than state related. However, it is also possible that ToM abilities do not return to pre-morbid levels after a psychotic episode.

Several studies have employed the Hinting Task to investigate ToM in psychosis on the grounds of its ecological validity, as it is comprised of everyday scenarios, such as Corcoran & Frith's (2003) investigation of ToM deficits in schizophrenia and links with autobiographical memory problems. An association has also been found between ToM impairment, as measured by the Hinting Task, and positive psychosis symptoms in affective disorders, as well as in schizophrenia (Marjoram et al., 2005), and Hinting Task scores have been found to predict social functioning in schizophrenia (Brüne, 2005; Pinkham & Penn, 2006; Roncone et al., 2000).

The Eyes Test has also become a popular measure of ToM ability in psychosis research with, for example, poor performance on the task found in early phases of psychosis (Couture, Penn, Addington, Woods, & Perkins, 2008) and first-episode schizophrenia (Kettle, O'Brien-Simpson, & Allen, 2008). Another study revealed an association between poor performance on the Eyes Test and left prefrontal underactivation fMRI in patients with schizophrenia (T. Russell et al., 2000).

A group of individuals with schizophrenia were compared with an HFA group and a non-clinical control group in a study investigating social cognitive functioning, which included the Eyes Test, along with two emotion perception tasks and a social

judgements task (Couture et al., 2010). It was reported that the schizophrenia and HFA groups were similarly impaired on all of the tasks and both groups differed significantly from the control group. Exploratory analyses indicated that the HFA group showed a pattern of social cognitive impairments more similar to a negative symptom subgroup than a paranoia subgroup.

The variety of ToM measures used in psychosis research, as in ASD research, makes it difficult to compare results and may in itself have contributed to inconsistencies in findings (Harrington, Langdon, et al., 2005). The meta-analysis conducted by Bora, et al. (2009) specifically examined results from the Hinting Task and the Eyes Test and found that the effect size distributions were much less heterogeneous for individual tasks compared with combined scores, suggesting that different aspects of ToM were being measured by the two tasks. As noted previously, some researchers have argued that there are different constituent parts of ToM. Specifically, it has been suggested that the Eyes Test measures mental state decoding (affective or 'social-perceptual' component), whereas the Hinting Task measures mental state reasoning ('social-cognitive' component), with support for this distinction at both the behavioural and the neurological levels (Bora, Eryavuz, Kayahan, Sungu, & Veznedaroglu, 2006; McGlade et al., 2008; Nettle & Liddle, 2008; Sabbagh, 2004; Shamay-Tsoory et al., 2007; Tager-Flusberg & Sullivan, 2000).

Self-esteem and causal attribution in psychosis

It is possible that the influence of ToM deficits on paranoia is indirect with causal attributions playing a mediating role (Bentall, 2001, 2009). For example, in a non-clinical sample a relationship has been demonstrated between ToM deficits and an increased tendency to believe other people are responsible for negative events (Kinderman, Dunbar, & Bentall, 1998). It was argued that to make an external situational attribution, instead of an external personal attribution, it is necessary to be able to appreciate the other person's perspective, requiring adequate ToM abilities as well as intact executive functioning, as the process is inherently complex.

People with diagnosed paranoia tend to attribute adverse experiences externally (Candido & Romney, 1990; Fear, Sharp, & Healy, 1996; Kaney & Bentall, 1992; Kinderman & Bentall, 1997). It has been proposed that 'other-blaming' attribution is an attempt to avoid feelings of low-self esteem and protect the self-concept, but this defensive process has the consequence of leading to perceptions of

persecution (Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001; Bentall & Kinderman, 1998; Bentall, Kinderman, & Kaney, 1994). A model was formulated hypothesising that potential threats to the self-concept make individuals more aware of discrepancies between the self-ideal representations and the actual self (Bentall, et al., 1994). It was proposed that attempts to minimise the gap via external attributions would be at the expense of the imagined self as perceived by others, which in turn leads to increased attention to threat-related stimuli. Furthermore, there is research evidence that a sudden decrease in self-esteem and increase in anger precedes periods of intense paranoia in individuals with psychosis (Bentall, 2009). The observation that people with paranoid delusions often have low self-esteem has been used to criticise this account (Freeman et al., 1998), but an alternative interpretation has been advanced, that the causal attribution bias is a dysfunctional process, which is not necessarily always effective at protecting against low self-esteem (Bentall, et al., 2001).

The role of emotional disturbance in delusion formation

An alternative account claims that low self-esteem and negative emotions play a central but non-defensive role in the development of psychotic symptoms. Freeman and Garety (2003; 2004) have synthesized research findings indicating a direct role for emotion in the development and maintenance of delusions. It has been proposed that paranoid delusions reflect and build upon emotional concerns (Freeman & Garety, 2004; Freeman, Garety, Bebbington, Smith, et al., 2005; Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002; Smith et al., 2006). Consistent with this idea, higher levels of both depression and anxiety have been associated with positive psychosis symptoms and, in particular, with higher levels of paranoia (C. Green et al., 2008; Guillem, Pampoulova, Stip, Lalonde, & Todorov, 2005; Norman & Malla, 1991). There is also evidence that the presence of depression, low self-esteem and negative evaluations about the self and others in those with psychosis are associated with increased severity of persecutory delusions, as well as more distress and preoccupation with the delusional beliefs (Smith, et al., 2006).

Anxiety is considered to play a central role in the development of paranoid delusions because suspicious thoughts often occur in the context of emotional distress related to the anticipation of threat, commonly triggered by stressful events (Freeman, 2009). There are consistent findings for a relationship between anxiety and both

paranoid thoughts and persecutory delusions (Fowler, 2000; Freeman, Dunn, et al., 2005b; Freeman & Garety, 1999; Huppert & Smith, 2005; Johns et al., 2004; Martin & Penn, 2001; Naeem, Kingdon, & Turkington, 2006), with some research studies further indicating that anxiety is predictive of paranoid thoughts (Freeman, Garety, Bebbington, Slater, et al., 2005; Freeman et al., 2003) and directly contributes to the persistence of persecutory delusions (Harrow, Jobe, & Astrachan-Fletcher, 2008; H. Startup, Freeman, & Garety, 2007). Additionally, social anxiety and poor social adjustment in adolescence have been demonstrated to be long-term risk factors for the development of psychosis in adulthood (Kugelmass et al., 1995; Malmberg, Lewis, David, & Allebeck, 1998).

In a virtual reality study involving a general population sample, paranoid thinking was predicted by a number of factors, including higher levels of anxiety, worry and depression (Freeman, Pugh, et al., 2008). The same virtual reality paradigm was used in a further study comparing three groups (low paranoia, high non-clinical paranoia and persecutory delusions) and as per the initial study, affective factors increased with levels of paranoia and this association was evident across all three groups (Freeman, Pugh, Vorontsova, Antley, & Slater, 2010). Anomalous experiences and reasoning biases were also associated with paranoia in both of these studies. Social anxiety and paranoia frequently co-occurred in a general population sample in another, similar, virtual reality study and the added presence of perceptual anomalies increased the chance of paranoid reactions (Freeman, Gittins, et al., 2008). It was concluded that in the context of an individual feeling anxious, the occurrence of 'odd internal feelings' in social situations might lead to delusional ideas.

Reasoning bias in delusions

There is now substantial research data supporting the observation that individuals holding delusional beliefs often make judgements on the basis of minimal and insufficient information (Fine, Gardner, Craigie, & Gold, 2007). Garety and colleagues have identified this bias in reasoning style, associated with data gathering, as being characterised by a tendency to accept hypotheses early. It was demonstrated that individuals holding delusional beliefs would often 'jump to conclusions' under conditions of uncertainty on reasoning tasks (Garety & Freeman, 1999; Garety & Hemsley, 1994; Garety, Hemsley, & Wessely, 1991; Huq, Garety, & Hemsley, 1988), which is referred to as a 'jumping to conclusions bias' (JTC bias). The experimental task most commonly used to investigate this

bias in data-gathering style is the Beads Task, which is based on a Bayesian model of probabilistic reasoning⁶ (Phillips & Edwards, 1966). Participants are asked to view two jars of coloured beads (containing two different colours in opposite but equal ratios), which are then hidden. Next, they are required to guess from which jar the beads are being drawn one at a time, based on the colours of the beads that are emerging (for a full description see method section).

Further studies, employing a version of the Beads Task that requires participants to request information until they are ready to make a decision, have consistently discriminated between people with a diagnosis of schizophrenia who hold delusional beliefs and both clinical and non-clinical control groups (Conway et al., 2002; R. E. Dudley, C.H. John, A.W. Young, & D.E. Over, 1997a; Fear & Healy, 1997; Menon, Pomarol-Clotet, McKenna, & McCarthy, 2006; Moritz & Woodward, 2005; E. R. Peters, Thornton, Siksou, Linney, & MacCabe, 2008; E. R. Peters, Thornton, Siskou, Linney, & MacCabe, 2006). Although most studies have not distinguished between different types of delusion, the JTC bias has been noted as being specifically associated with persecutory delusions in some studies (Dudley, et al., 1997a; H.F. Young & Bentall, 1995; H. F. Young & Bentall, 1997). Evidence for a JTC bias has also been found in people with prodromal symptoms who are 'at risk' of developing psychosis (Broome, et al., 2007); in those in remission from delusions (Moritz & Woodward, 2005; E. R. Peters & Garety, 2006), in non-clinical 'delusion-prone' individuals (Colbert & Peters, 2002; Linney, Peters, & Ayton, 1998; Van Dael et al., 2006; Warman, Lysaker, Martin, Davis, & Haudenschild, 2007); and in first degree relatives of people with a diagnosis of schizophrenia (Van Dael, et al., 2006). Although these studies suggest that the JTC bias may be a trait variable, it appears to exist in an 'exposure-response' relationship with conviction increasing with the level of delusional symptoms (Bell, Halligan, & Ellis, 2006).

Theoretical accounts of the JTC bias have hypothesised that the phenomenon: 1) is due to problems with 'information integration' in that abnormal salience is attributed to stimuli and too much value is placed on current evidence (Kapur, 2003; Menon, et al., 2006; Menon, Woodward, Pomarol-Clotet, McKenna, & McCarthy, 2005); 2) results from a difficulty and avoidance of making use of sequential information (H.F. Young & Bentall, 1995); 3) arises from a motivation to confirm beliefs due to a 'need for closure' and intolerance of ambiguity (Bentall, et

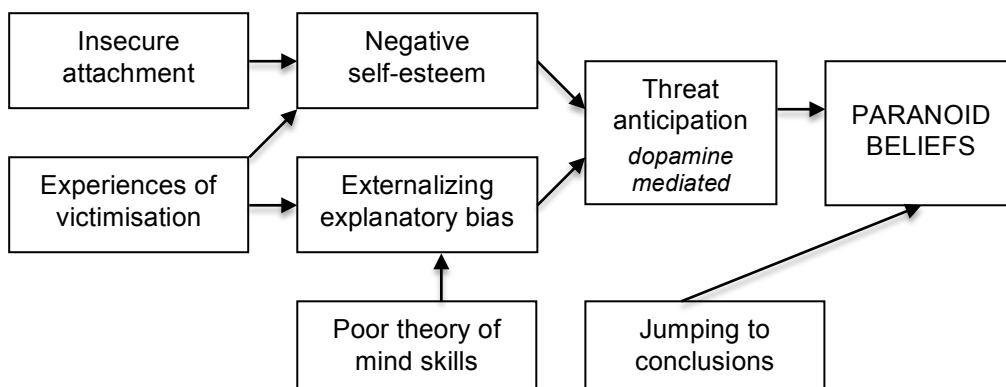
⁶ Bayesian probability relies on Bayes' theorem, which has been used to explain attitude formation and related behaviour as it provides 'a mathematical rule for deciding how prior opinion or choices should optimally be modified in the light of new evidence' (Reber, 1995).

al., 2001; Bentall & Swarbrick, 2003; Colbert & Peters, 2002); 4) relates to a need for threat confirmation that is extended to non-threatening situations due to misperceived danger (Dudley & Over, 2003).

A model of the development of paranoid beliefs

A major study was conducted by Bentall and colleagues to investigate ToM, self-esteem and jumping to conclusions in psychosis and to assess the relative importance of each mechanism in the development of paranoia. Taking a transdiagnostic approach, the sample of more than 230 included individuals experiencing paranoia with differing diagnoses, with the aim of identifying whether the factors under investigation could specifically be attributed to symptoms. The study resulted in a range of findings (Bentall et al., 2008; Bentall et al., 2009; Corcoran et al., 2008; R. Moore et al., 2006; Shryane et al., 2008), but the overall conclusion was that ‘all three factors seemed to be involved in paranoid delusions’ Bentall (2009). Based on the findings from this study and incorporating findings from previous research, a model of the development of paranoid beliefs was proposed (see Figure 4; Bentall, 2009) . The model starts with the observation that paranoid thinking is more prevalent in those who have experienced victimisation (Gracie et al., 2007; Johns, et al., 2004) and is associated with an insecure attachment style (Dozier & Lee, 1995; Dozier, Stevenson, Lee, & Velligan, 1991). These factors make it more likely that an individual will develop low self-esteem and a defensive attributional style, which may be influenced by ToM deficits. The final step is excessive anticipation of threat, which is highly correlated with paranoia (Bentall, et al., 2008; Corcoran et al., 2006; Kaney, Bowen-Jones, Dewey, & Bentall, 1997) and may involve a sensitised dopamine system. Once a thought with delusional content has arisen, a JTC bias can come into play, influencing the decision to accept the idea and determining the level of conviction (Fine, et al., 2007).

Figure 4: A model of paranoia (Bentall, 2009)



Facial expression recognition in psychosis

Emotion perception in schizophrenia has been extensively researched (for reviews see Edwards, Jackson, & Pattison, 2002; Mandal, Pandey, & Prasad, 1998). A recent meta-analysis of 86 studies showed a large deficit in facial expression emotion perception ability in patients with schizophrenia relative to non-clinical controls, irrespective of task type (Kohler, Walker, Martin, Healey, & Moberg, 2010). The severity of impairment varied widely, moderated by methodological, illness-related and demographic factors. It remains unclear whether deficits are specific to emotion identification or are more generalised face processing impairments.

No clear or consistent associations between emotion perception deficits and specific symptoms emerged in the meta-analysis, with both positive and negative symptoms being indicated. According to the results of certain studies, individuals with a diagnosis of schizophrenia who experience paranoid delusions have more enhanced emotion perception sensitivity, particularly for negative emotions, than do those with non-paranoid schizophrenia (Kline, Smith, & Ellis, 1992; Lewis & Garver, 1995). Other research indicates that individuals with more severe paranoid symptoms (e.g. persecutory delusions) show poorer emotion recognition than 'sub-clinical' groups with low or moderate levels of paranoia (Combs, Michael, & Penn, 2006). In this study, the recognition of anger was reported to be especially difficult for the clinical participants. Impaired emotion recognition in schizophrenia has been associated with reduced social competence and has also been shown to predict functional outcomes (Hooker & Park, 2002; Ihnen, Penn, Corrigan, & Martin, 1998; Kee, Green, Mintz, & Brekke, 2003; Mueser et al., 1996; Vauth, Rüscher, Wirtz, & Corrigan, 2004).

Individuals with schizophrenia, autism and a non-clinical control group were compared on their ability to recognise emotions through a facial expression recognition task (Bölte & Poustka, 2003). It was reported that the autism group performed less well than both of the other two groups, which did not differ significantly. However, the task only presented full expressions of emotion and the stimuli exposure time did not appear to have been limited. Additionally, there was much wider variation in the IQ scores in the autism group, which could have influenced the group differences found. These results are contrary to Couture, et al.'s finding of no significant difference between psychosis and autism groups on emotion perception tasks, albeit using different paradigms to assess abilities (Couture, et al., 2010), which may account for the discrepancy between the two

studies. Paranoid individuals with schizophrenia and individuals with autism were shown to have similar patterns of reduced neural activation in several areas of the brain (right amygdala, the fusiform face area and the left ventrolateral prefrontal cortex), compared with a non-clinical control group, while viewing faces and rating them for trustworthiness in a study investigating the neural bases for social cognition (Pinkham, Hopfinger, Pelphrey, Piven, & Penn, 2008). It was concluded from an eye-tracking study investigating social cognition that individuals with schizophrenia and with autism make less use of facial information in social scenes than do non-clinical controls, based on the finding that both groups fixated significantly less on faces during a task used to assess emotion processing (Sasson et al., 2007).

Psychological interventions for delusions

Recent advances in psychological treatment of schizophrenia have focused on addressing cognitive deficits and biases that may contribute to the development of delusions, including ToM, emotion processing, JTC bias and attributional style (Moritz & Woodward, 2007b; Ross, Freeman, Dunn, & Garety, 2009). Early indications are that these new approaches, described by some as 'metacognitive' are feasible and effective complements to standard psychiatric treatment (Aghotor, Pfueller, Moritz, Weisbrod, & Roesch-Ely, 2010; Favrod, Maire, Bardy, Pernier, & Bonsack, 2011; D. Kumar et al., 2010; Moritz et al., 2010; Moritz, Vitzthum, Randjbar, Veckenstedt, & Woodward, 2010; Moritz & Woodward, 2011; Moritz & Woodward, 2007a; Waller, Freeman, Jolley, Dunn, & Garety, 2011).

3. ASPERGER SYNDROME, SYMPTOMS OF PSYCHOSIS & PARANOIA

As already indicated, individuals with AS have been reported to experience symptoms that can be confused with schizophrenia. This section presents the details of a number of clinical case series and quantitative research studies regarding delusional beliefs and other symptoms of psychosis in AS.

Clinical accounts of psychotic symptoms in AS

A range of psychotic symptoms have been described in clinical case studies of individuals with AS, from a description in 1951 of a woman who exhibited classic symptoms of AS and developed persecutory delusions (Darr & Worden, 1951), through to a recent case series of three men diagnosed with AS for the first time in adulthood after presenting to services with psychotic symptoms. The latter described a young man with grandiose and persecutory delusions, another with 'delusional misinterpretation' and another with auditory hallucinations (Arora, Prahraj, Sarkhel, & Sinha, 2011). Other case studies have described adults with AS who appear to have various psychotic symptoms, primarily paranoid delusions (both ideas of reference and persecutory beliefs) and auditory hallucinations (Clarke, Baxter, Perry, & Prasher, 1999; Clarke, Littlejohns, Corbett, & Joseph, 1989; Raja & Azzoni, 2001, 2007; Szatmari, Bartolucci, Bremner, Bond, & Rich, 1989; Wing, 1981; Wing, 1996; Woodbury-Smith, et al., 2010). It has been reported that these psychotic symptoms are typically precipitated by extreme emotional responses, such as anxiety, to the core difficulties of autism (Clarke, et al., 1999).

Without discounting reports that delusions and hallucinations occur with AS, it is important for clinicians to consider that there might be alternative explanations for what appear to be psychotic symptoms. For example, misunderstanding of social situations and exchanges could result from deficiencies in concrete thinking, difficulties decoding non-verbal behaviours and ToM problems, leading to inappropriate responses that create the impression of paranoia (Fitzgerald & Corvin, 2001; Woodbury-Smith, et al., 2010). Frith (2004) suggested that individuals with AS are prone to suspicion and hostile attributions due to limitations in their ability to appreciate multiple perspectives. As noted earlier, there are certain features and behaviours observed in ASD that can be misattributed as psychosis. For example, it is not uncommon for people with AS to speak their thoughts out loud or to display

other language abnormalities, which could be misinterpreted as responding to auditory hallucinations (Fitzgerald & Corvin, 2001).

In a case series of older children (aged 8-16 years), Dossetor (2007) described features that were mistaken for psychotic phenomena, including hallucinations and delusions, which were later explained and successfully treated in the context of pervasive developmental disorder (two of the children were diagnosed with AS). The symptoms noted in these cases were attributed to unusual ideas, unusual perceptions and pseudo-hallucinations, which had been exacerbated by elevated anxiety. It was concluded that the recognition of delusions and auditory hallucinations 'will be especially difficult to establish reliably in this clinical group' due to problems with language and communication, emotional recognition, social reciprocity, stereotypic preoccupations, poor ToM abilities and problems with central coherence.

In some cases, paranoid thoughts may be understandable and well founded due to negative social experiences and may not necessarily be psychopathological. Tantom (2000) has observed clinically that the common experience in AS of victimisation can lead to frustration, poor self-esteem and suspiciousness of others. Frith (2004) stated that suspicion is an unsurprising consequence that is 'likely to flourish' in AS when the fact that other people have points of view, thoughts and interests sometimes incompatible with one's own, is not automatically realised and may lead to the feeling that others are hostile.

Research evidence for delusional beliefs in AS

Significantly higher paranoia scores were reported in a group of 25 individuals with AS, compared with a non-clinical control group (Blackshaw, et al., 2001) in a study designed to test the causal attribution theory of paranoia in this population (Bentall, et al., 1994). A range of measures were administered to assess factors considered to be relevant to the development of paranoia including attributional style, self-representations, self-consciousness (private and public), ToM and executive functioning, as well as measures of anxiety and depression. Although the AS group did score significantly lower on the ToM test as expected, the AS and control group did not differ in self-concept or causal attributions, contrary to the proposed theory. Those with AS were equally as likely to attribute negative and positive incidents to themselves and used both personal and situational attributions. One other significant group difference was found in this study, for private self-consciousness, which was

the only measure associated with paranoia and found to predict it in a regression analysis. However, a flaw of the study was the fact that results for the two groups were combined in the correlational analyses, so no conclusions could be drawn about potential associations with paranoia specifically in AS. Other methodological problems included a lack of group matching (with regard to age, sex and IQ scores), an incomplete data set, the study was underpowered and an invalidated measure (Projective Imagination Test) was used to assess ToM.

Subsequent research (Craig, et al., 2004) also found significantly higher levels of paranoia in individuals with AS compared with healthy control participants, and this study also included a group of schizophrenia patients with paranoid delusions. The clinical group, unsurprisingly, had the highest levels of paranoia and made significantly more external-personal attributions for negative events than the other two groups. Consistent with the previous research study by Blackshaw, et al. (2001), the AS group did not display a causal attribution bias. The AS and clinical groups both performed significantly poorer on two ToM tasks than the control group. Unlike the results from Blackshaw et al.'s study, ToM scores were negatively correlated with levels of paranoia but, again, the groups were not considered separately in the statistical analyses so no clear conclusions could be drawn specifically about associations with paranoia in the AS group. It should also be noted that the group sizes in this study were uneven and not large (clinical N=11; AS N=17; controls N =11), which might explain why the researchers combined them in correlation analyses, and they were not matched for age. A further methodological issue involves the use of the Paranoia Scale in this study (Fenigstein & Venable, 1992), which is a measure devised for non-clinical populations that is considered to reflect a 'broad conception' of paranoia with some items reflecting depressive rather than persecutory themes (Freeman, Garety, Bebbington, Smith, et al., 2005; C. Green, et al., 2008).

Relatively high levels of delusional ideation were reported in a cross-sectional survey exploring the phenomenology of delusional beliefs in people with AS (Abell & Hare, 2005). As a control group was not included, estimates were based on comparisons with norms that were reported by the authors of the scale used, Peters' Delusions Inventory (PDI; E. R. Peters, et al., 1999). The AS participants' mean score fell approximately half way between that reported for people experiencing psychosis and a healthy control group. There were mostly paranoid and grandiose delusional ideas reported in the AS group. The survey also assessed ToM ability, executive function, autobiographical memory, self-consciousness, anxiety and depression. High levels of

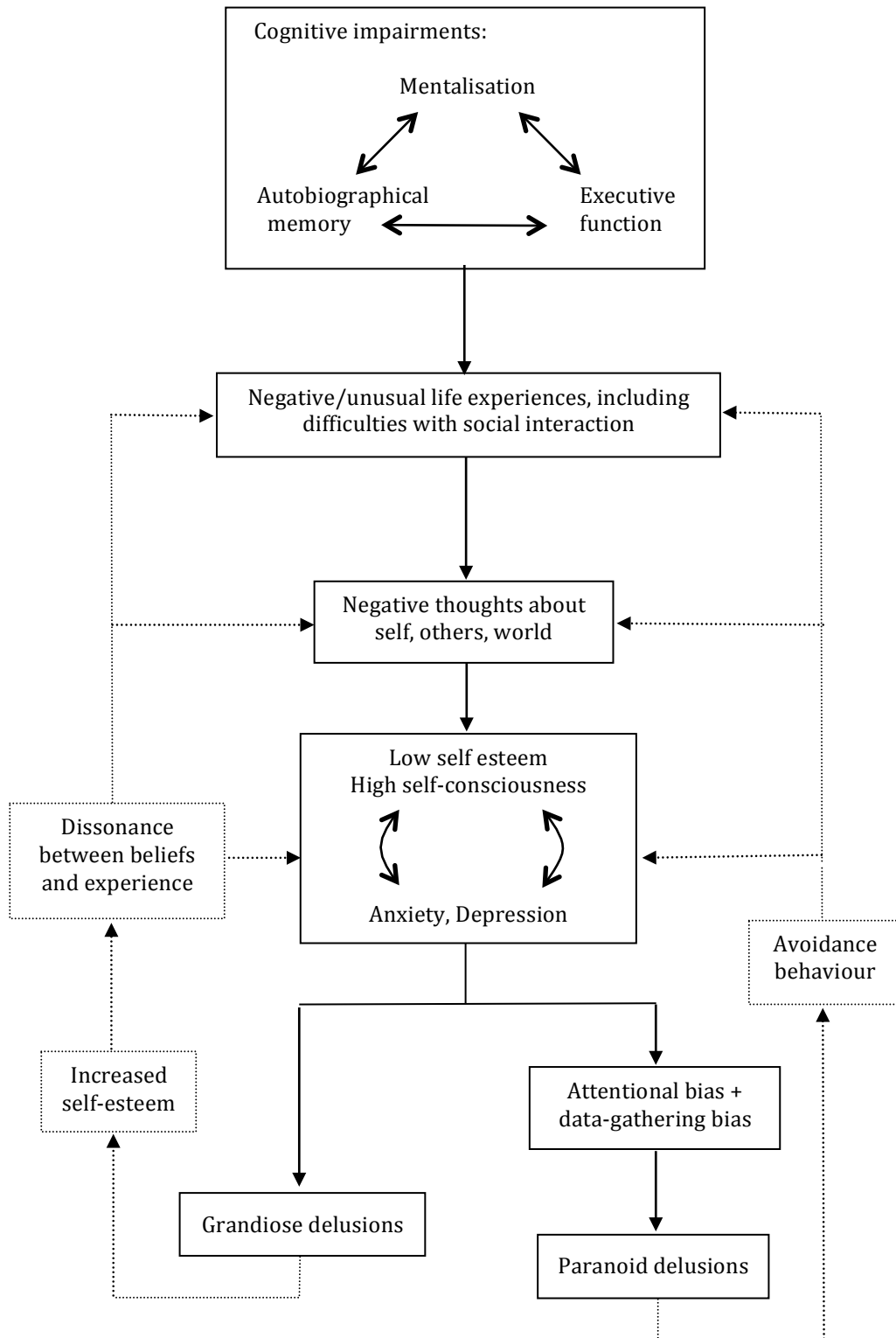
depression and anxiety were found in the sample. Delusion scores significantly correlated with anxiety, social anxiety, private self-consciousness and a smaller association was found with depression. Anxiety was the only variable to predict delusions in a regression analysis. A separate cluster of relationships was found between ToM, autobiographical memory and executive functioning.

Perceived daily 'hassles' were associated with anxiety scores in an AS sample in a study investigating factors mediating the development of grandiose delusions in particular. Anxiety scores were in turn associated with the reported frequency of grandiose beliefs, as well as with the distress, pre-occupation and conviction associated with those beliefs (Meraj & Hare, 2004).

A model of the development and maintenance of delusional beliefs in AS

Abell and Hare (2005) devised a preliminary model of the development and maintenance of delusional beliefs in AS (see Figure 5) based on their own findings, together with aspects of other theoretical accounts of emotional disorder (Beck, 1976; Wells & Matthews, 1995) and previous findings from psychosis research (Bentall & Kaney, 1989; Fear, et al., 1996; Garety & Freeman, 1999). It was proposed that underlying intercorrelated cognitive impairments (ToM, autobiographical memory, executive functioning) contribute to difficulties with social interaction and poor social adjustment. Such social difficulties can lead to negative thoughts about the self, others and the world, which in turn may lead to low self-esteem and high self-consciousness, factors implicated in the development of anxiety and depression. To protect the vulnerable self-concept, grandiose delusions may arise. Alternatively, attention and data-gathering biases, resulting from negative affective states, could cause the individual to focus on information that confirms negative thoughts leading to the development of paranoid delusions. A maintenance cycle can develop if avoidance behaviour arises, preventing the individual from experiencing disconfirmatory evidence.

Figure 5: Model of the development and maintenance of delusional beliefs in AS



Abell & Hare (2005)

RATIONALE FOR THE CURRENT STUDY

ToM difficulties are considered central to the social and communication difficulties experienced in ASD but are not clearly understood, particularly in high-functioning individuals with a diagnosis of AS, who perform well on some first-order and second-order tasks. It appears that mentalising involves different abilities, with various measures tapping into different aspects of ToM. One distinction that has been made is between mental state decoding and mental state reasoning and it would be useful to specifically examine these different aspects in AS, via The Eyes Test and the Hinting Task. The Eyes Test is one of the few ToM measures previously found to demonstrate mentalising difficulties in AS samples. Both the Eyes Test and the Hinting Task have been employed in psychosis research and have been found to be sensitive to ToM deficits.

Facial emotion expression recognition has been extensively researched in ASD but findings are unclear, conflicting, and difficult to interpret, possibly due to the wide range of tasks employed and commonly found methodological limitations. A robust paradigm is required to elucidate emotion processing abilities in AS. The Facial Expression Recognition Task (FERT) is a suitable candidate for this purpose as it has been demonstrated to be particularly sensitive and to discriminate well between groups in research studies investigating a variety of mental health problems. In particular, it has been used extensively in depression research (Harmer, et al., 2003; Harmer, Cowen, & Goodwin, 2010; Harmer et al., 2009; Hayward, Goodwin, Cowen, & Harmer, 2005; Horder, Browning, Di Simplicio, Cowen, & Harmer, 2011) and in a number of eating disorder studies (Jänsch, Harmer, & Cooper, 2009; L. Jones, Harmer, Cowen, & Cooper, 2008; Pringle, Harmer, & Cooper, 2010), but so far has not been utilised in either ASD or psychosis research. It has the benefit of being computerised so administration is straightforward and well-controlled, it includes all basic emotions with ecologically valid exposure times, stimuli are morphed to represent differing levels of intensity of emotions and it provides measures of reaction time as well as accuracy.

Deficits in ToM and facial emotion recognition, abilities that are critical for understanding and interacting with others, have also been observed in psychosis. Mentalising difficulties may be involved in the development of paranoid beliefs specifically, although this is inconclusive. It is currently unclear how emotion processing difficulties and psychotic symptoms are related. Other cognitive

mechanisms that have been implicated in the development of paranoid beliefs are causal attribution biases, with affective states thought to play a key role, and data-gathering biases.

There appears to be significant phenomenological, and possibly neural, overlap between psychotic disorders and AS, but a key question is to what extent do these reflect similarities in underlying psychological mechanisms? Clarifying the relationship is crucial for a deeper understanding of social cognitive processes in AS and their possible contribution to the development of paranoia. This in turn is essential for clinicians to be able to formulate the difficulties of those with AS and to provide appropriate and well-targeted interventions and support.

Delusional beliefs have been observed clinically in individuals with AS and research efforts have begun to investigate this phenomena in more detail, drawing upon theory and evidence from psychosis literature. A relationship between paranoia and self-consciousness has been proposed, but evidence for this is limited and the analyses from which this finding was derived may be questionable. Anxiety is considered to play a central role in the development of delusional beliefs in AS. There is mixed evidence for the contribution of ToM to paranoia. The theory that causal attribution biases are involved has not been supported. As far as can be ascertained, no research has tested for data-gathering biases in AS.

As findings so far regarding paranoia in AS are mixed and inconclusive and studies in this area have had a number of limitations, there is clearly a need for further investigation through well-controlled studies using appropriate, relevant and reliable measures. The model of the development and maintenance of delusional beliefs in AS could benefit from further testing. In ASD research, social cognitive mechanisms are typically studied separately and although recent work has begun to consider how impairments in these abilities are associated, further studies are required to clarify possible interdependencies.

In conclusion, it is proposed that a number of social cognitive mechanisms in AS should be further investigated (facial emotion expression recognition, mental state decoding, mental state reasoning and data-gathering style) and their possible contribution to the development of paranoia should be assessed.

AIMS OF THE CURRENT STUDY

The main aim of this research study was to explore social cognitive mechanisms in AS, specifically, to test whether individuals with a diagnosis of AS differ from controls when making judgements about social stimuli, using four experimental tasks:

1. a facial expression recognition task (FERT);
2. a probabilistic reasoning task designed to highlight a JTC bias (Beads Task);
3. a ToM task assessing mental state reasoning abilities (Hinting Task);
4. a ToM task assessing mental state decoding abilities (Eyes Test).

A secondary aim was to look for any association between performance on social cognitive tasks and scores on a paranoia measure.

HYPOTHESES

Social cognitive tasks, between-group comparisons

Compared with a control group, it was predicted that those with AS would:

1. a) correctly identify fewer emotions in a facial expression recognition task,
b) but respond more quickly;
2. make decisions based on less information in a probabilistic reasoning task;
3. infer the real intention behind hints expressed through speech utterances less often in a ToM task;
4. a) correctly identify fewer mental states of people from photographs of just their eyes in a ToM task,
b) but respond more quickly.

Paranoid thinking, correlational analyses

5. It was predicted that there would be higher levels of paranoia in the AS group than the control group
6. and that performance on each of four experimental tasks (FERT, Beads Task, Hinting Task, Eyes Test) would be associated with levels of paranoia.

METHOD

PARTICIPANTS

Sample size and power

Power calculations were conducted using the software programme nQuery Advisor Version 7.0 (Elashoff, 2007). For analysis of between-group differences, it was established that 60 participants were required. With 30 participants in each group, the study would have 80 per cent power to detect effect sizes⁷ of 0.7 or more between groups (based on a simple t-test with the conventional significance level), which is the recommended acceptable level of power (J. Cohen, 1992). It was also determined that with this number of participants the study would have 80 per cent power to detect correlations between measures of 0.35 or more, overall, and 0.5 or more for each group separately.

Experimental group

The experimental group consisted of 30 individuals with a diagnosis of AS: 26 males, 4 females. The mean age was 32.23 (SD 9.43). The average age of receiving a diagnosis of AS was 24.27 (SD 11.45). There were 70 per cent who received a diagnosis as adults (aged 18 or over). The mean estimated full-scale Intelligence Quotient (IQ) score was 112 (SD 11.77). There were 16 individuals in this group receiving pharmacological treatment for depression and/or anxiety.

To be included in the AS group, individuals were required to:

1. have a formal, verifiable diagnosis of AS from a relevant health professional (e.g. psychologist, psychiatrist);
2. have a score ≥ 26 on The Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelright, Skinner, Martin, & Clubley, 2001); and
3. be aged 18 years or above.

Exclusion criteria included:

1. any learning disability diagnoses;
2. IQ score < 90;
3. and/or sensory impairments considered to have the potential to affect performance on experimental tasks.

⁷ Effect size = difference in means divided by standard deviation.

Control group

The control group consisted of 30 individuals and was group-wise matched with the AS group for age (mean 31.63, SD 10.35), sex (26 males, 4 females) and estimated IQ score (107.67, SD 10.34). Only one person in this group was taking pharmacological treatment for anxiety.

To be included in the control group, individuals were required to be aged 18 years or above. The same exclusion criteria were applied to the control group as had been applied to the AS group, with the additional requirement of them having no ASD diagnoses.

Recruitment

Participants for the experimental group were recruited through a number of voluntary organisations including The National Autistic Society (NAS), The Autistic Society Greater Manchester Area (ASGMA), Leeds Asperger Adults and Action for ASD. The University of Manchester Disability Support Office also supported recruitment. Participants for the control group were recruited through the university (both staff and students) and through local community social groups, leisure centres and libraries.

A total of 41 people with a diagnosis of AS were recruited into the study but 11 were not included. Of the latter, three dropped out before starting the study, two did not meet the AQ inclusion criteria, three did not complete all of the measures, one asked for his data to be deleted, one was excluded because of concerns about ability to concentrate on the tasks and a low IQ score and one had significant eyesight problems. At least 20 more people with a diagnosis of AS expressed an interest in taking part in the study but were not required.

A total of 52 people were recruited into the study as control participants but 22 were not included. Twelve dropped out before starting the study, six did not complete all of the measures, and four had a low estimated IQ score. A further 10 individuals expressed an interest in taking part but were not required.

At the preliminary analysis stage, the data of four participants (with the lowest estimated IQ score in the control group) were removed one at a time from the data set, and new participants were recruited and tested until the groups were matched on that variable. The data of another three participants (one AS, two controls) were removed and replaced with new participants, due to very extreme scores on some of

the variables that had a significant impact upon mean values and skewed the distributions of the data.

DESIGN

A between-groups design was used to compare performance of the two groups (AS and control) on four social cognitive experimental tasks, viz. FERT, Beads Task, Eyes Test, Hinting Task. Between-groups comparisons were also employed for measures of paranoia, depression, general anxiety, social anxiety and self-consciousness. Correlation tests were conducted to look for any associations between paranoia scores and the experimental task scores. Further (post-hoc) analyses involved correlation tests to explore relationships between paranoia and all other self-report questionnaire variables (i.e. depression, general anxiety, social anxiety and self-consciousness).

MEASURES

Screening

Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999)

The two-subtest version of the WASI was used to estimate IQ score. It takes approximately 15 minutes to administer and provides an estimation of IQ derived from scores on the Vocabulary and Matrix Reasoning subtests of the WASI, which are taken as measures of verbal and non-verbal cognitive functioning. The Vocabulary subtest is a verbal assessment requiring examinees to give oral definitions of a list of words. Matrix Reasoning is a non-verbal assessment requiring the examinees to look at matrices with missing sections and complete them by choosing from several response options. High internal consistency has been reported for the two subscales (for both, $\alpha = 0.94$) and good test-retest reliability ($r = 0.90, 0.79$).

The AQ (Baron-Cohen et al, 2001)

The AQ is a brief self-administered screening assessment for measuring 'the degree to which an individual of normal intelligence shows autistic traits' (Appendix 1). It consists of 50 statements in total, made up of 10 questions assessing each of 5 different domains: social skill, attention switching, attention to detail, communication

and imagination. The respondent is asked to indicate the degree to which they agree or disagree with each statement on a four-point scale. The original cut off point suggested was 32 (out of 50) as Baron-Cohen and colleagues found that 80 per cent of adults with a diagnosis of AS or high-functioning autism scored above this, whereas only two per cent of controls did so, demonstrating reasonable face validity. Internal consistency for the five domains was moderate ($\alpha = 0.63$ to 0.77) and test-retest reliability was good ($r = 0.70$). For the purpose of this study, a more conservative threshold of 26 was used, as suggested by Woodbury-Smith, Robinson, Wheelwright and Baron-Cohen (2005), to minimise false negatives. They found that at this cut off, the AQ's sensitivity and specificity meant that 83 per cent of patients referred for assessment of possible AS were correctly classified when compared with 'more rigorous assessment' in the form of a detailed diagnostic interview.

Online self-report questionnaires

Self-Consciousness Scale Revised (SCS-R; Scheier & Carver, 1985)

The Self-Consciousness Scale was originally designed by Fenigstein, Scheier, & Buss (1975) but a revised 22-item version, SCS-R, is used in the current study (Appendix 2). Three components together provide an overall measure of self-consciousness and separate scores are available for the three subscales: private self-consciousness, public self-consciousness and social anxiety. Private self-consciousness refers to a tendency to focus on personal aspects of the self, such as feelings, beliefs and values. Public self-consciousness is concerned with qualities observable by others, such as behaviour, mannerisms and appearance. The related construct of social anxiety refers to apprehension about being evaluated negatively by others in a social context. Respondents are asked to indicate how much each statement is like them (e.g. "*I get embarrassed very easily*") using a four-point response scale (3 = a lot like me, 2 = somewhat like me, 1 = a little like me, and 0 = not at all like me), with some items being reverse scored. Scores range from 0 to 66 with higher scores representing higher levels of self-consciousness. The questionnaire has satisfactory internal consistency (alphas = private 0.75, public 0.84, social 0.79; Scheier & Carver, 1985).

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998)

The SIAS is a 20-item self-report questionnaire developed as a screening tool for social phobia that assesses fear of general social interaction and associated anxiety and avoidance behaviours (Appendix 3). Respondents are asked to indicate how much statements are 'characteristic or true' of them (e.g. *"I worry about expressing myself in case I appear awkward"*) reflecting their own typical reaction to social situations in terms of cognition, affect and behaviour. Responses are on a five-point scale (0 = not at all, 1 = slightly, 2 = moderately, 3 = very, 4 = extremely), some of which are reverse scored. Scores range from 0 to 80 with higher scores representing higher levels of social interaction anxiety. The SIAS has also been shown to demonstrate good internal consistency ($\alpha = 0.88\text{--}0.94$) and high test-retest reliability ($r = 0.92$; Mattick & Clarke, 1998). The measure has been shown to discriminate between individuals with social anxiety, other anxiety disorders and non-clinical controls, with a cut off point of 36 or more (sensitivity 0.93) suggested as indicative of social phobia (L. Peters, 2000). The SIAS has also been found to significantly correlate with other measures of social phobia (Ries et al., 1998).

PHQ-9 (Kroenke, Spitzer, & Williams, 2001)

The PHQ-9 (Appendix 4) is the depression module from the Patient Health Questionnaire (a self-administered version of The Primary Care Evaluation of Mental Disorders; Spitzer et al., 1994). Consisting of diagnostic criteria for major depressive disorder (DSM-IV, 2000), nine items are scored on a four-point scale ranging from 'not at all' to 'nearly every day' in terms of occurrence (score is out of 27, with higher scores indicating more severe levels of depression). Scores of 5, 10, 15 and 20 represent cut-off points for mild, moderate, moderately severe and severe depression, respectively. Validity of the diagnostic ability of the PHQ-9 has been established by two large studies (Spitzer, Kroenke, & Williams, 1999; Spitzer, Williams, Kroenke, Hornyak, & McMurray, 2000) that demonstrated the measure's high internal consistency (alphas = 0.89 and 0.86) and test-retest reliability ($r = 0.84$). Despite its brevity, the PHQ-9 also appears to be a reliable and valid measure of depression severity and has good construct and criterion validity (Kroenke, Spitzer, & Williams, 2002). A meta-analysis was carried out on validation studies conducted in primary care, community and hospital settings to evaluate the psychometric properties of the PHQ-9 as a screening instrument for depression (Gilbody, Richards, Brealey, & Hewitt, 2007). It was concluded that the measure is as good as longer clinician-administered instruments with comparable sensitivity and specificity.

GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006)

The GAD-7 (Appendix 5) is an efficient 7-item screening tool for generalised anxiety disorder (GAD) capable of assessing severity, which has been incorporated into the Patient Health Questionnaire. Each item is scored on a four-point scale ranging from 'not at all' to 'nearly every day'. The total score is out of 21, with higher scores indicating higher levels of anxiety. Scores of 5, 10 and 15 are taken as cut-off points for mild, moderate and severe anxiety, respectively. Spitzer et al., (2006) reported excellent internal consistency ($\alpha = 0.92$) and good test-retest reliability ($r = 0.83$) and GAD-7 was found to have strong criterion validity for identifying probable cases of GAD and good construct, factorial and procedural validity. As well as proving to be accurate in diagnosing GAD (Swinson, 2006), a large study has provided evidence that GAD-7 is a reliable and valid measure of anxiety in general populations (Lowe, et al., 2008).

Paranoid Thought Scales (PTS; Green et al., 2007)

The PTS (Appendix 6) is a self-report tool for assessing paranoid thinking comprised of two 16-item subscales, measuring ideas of reference and persecution, which can be scored independently and combined. Total scores can range from 32 to 160, with higher scores indicating higher levels of paranoia. Respondents are presented with statements that refer to thoughts and feelings that they may have had about others over the last month (e.g. *People talking about me behind my back upset me*) and are asked to indicate the extent of these from 1 (not at all) to 5 (totally). The PTS was developed as an instrument capable of measuring paranoid thoughts 'multi-dimensionally' in the general population as well as in clinical samples. The PTS has been shown to have high internal consistency in both non-clinical ($\alpha = 0.95$) and clinical samples (0.90), as well as good test-retest reliability ($r = 0.87$; Green et al, 2007). Convergent validity has been shown with other relevant measures including the PDI (E. R. Peters, et al., 1999), the Paranoia Scale (Fenigstein & Vanable, 1992) and the Psychotic Symptoms Rating Scale (Haddock, McCarron, Tarrier, & Faragher, 1999).

Experimental Tasks

Facial Expression Recognition Task (FERT; Harmer et al., 2003)

The FERT features six basic emotions (anger, disgust, fear, happiness, sadness and surprise), as facial expression stimuli (posed by 10 actors) taken from Ekman and Friesen's (1976) Pictures of Affect Series (see Figure 6). Each emotion was morphed between neutral expression and full expression prototypes, using the procedure described by Young et al., (1997). This involved taking a variable percentage of the shape and texture differences between the two standard images, 0% intensity (neutral) and 100% (full emotion), in 10% increments. Four examples of each emotion at each intensity were presented one at a time on a computer screen for 500ms, as well as a neutral expression posed by actors for each of the 10 faces, giving a total of 250 stimuli (presented in randomised order). Each face presentation was immediately replaced with a blank screen. Participants were asked to indicate the emotion they thought they saw, as quickly and accurately as possible, by pressing one of seven labelled keys on the keyboard. The task was broken into two blocks, with an optional untimed rest period in between to prevent fatigue, and took approximately 10 minutes to complete. The computer recorded participant responses. Total scores on the task and results for each emotion separately were computed for accuracy (percentage correctly identified) and speed of response (reaction time in milliseconds).

Figure 6: Example stimuli representing each basic emotion on the FERT



Note: Photographs displayed here are not at the same scale as presented in the FERT

Beads Task (Garety et al., 2005)

The Beads Task is a standard probabilistic reasoning task designed to assess data-gathering style. A computerised version of the task was employed in the current study, with two variants (Garety, et al., 2005). On a computer screen, participants were shown a picture of two jars filled with beads of two different colours in the ratio 85:15 (see Figure 7). The jar on the left contained 85 orange and 15 black beads

and the one on the right contained the reverse proportion of beads. They were then told that one of the jars had been selected at random and that beads would be drawn from the chosen jar one at a time and presented in the centre of the computer screen. They were tasked with deciding which jar the beads were coming from based on the colours of beads that emerged. Participants were informed that they could ask to see as many beads as they wanted to until they felt certain. Previously drawn beads stayed at the bottom of the screen as a memory aid (see Figure 8).

Figure 7: Beads Task jars as viewed on the computer screen

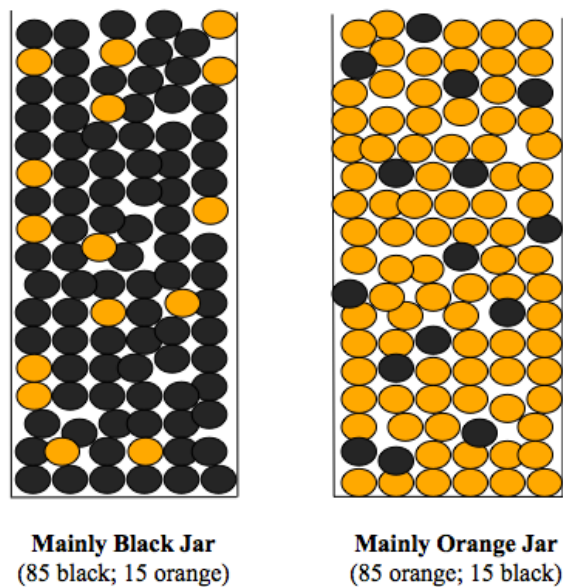
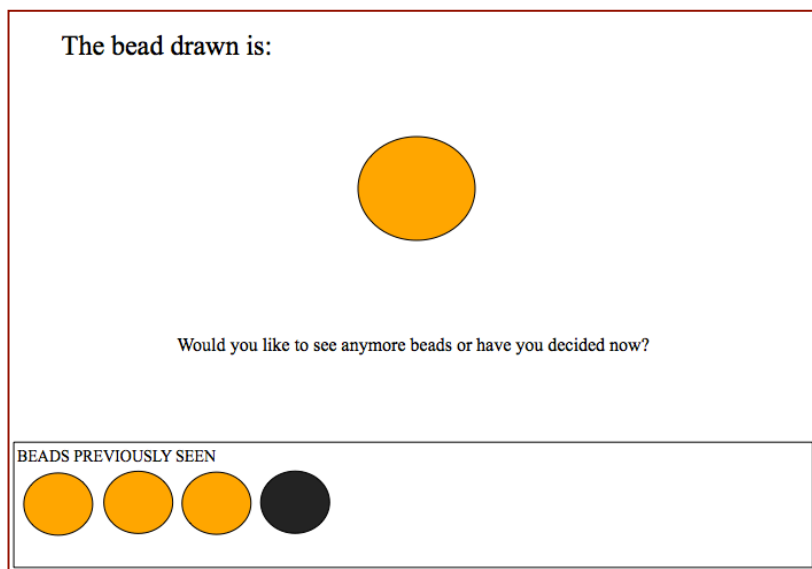


Figure 8: Example stimuli on the Beads Task



In a second version of the Beads Task (R. E. Dudley, C. H. John, A. W. Young, & D. E. Over, 1997b), the ratio of beads was changed to 60:40 to make the task more difficult, and the colour of the beads was changed (to red and blue). In both versions, the task was stopped once the participant made a decision and the number of beads requested up to that point was recorded. In previous research, a 'jumping to conclusions' response has been defined as requesting only one or two beads (Garety, et al., 2005). From here onwards the two versions of the task will be referred to as Beads Task A and Beads Task B.

Hinting Task (Corcoran, et al., 1995)

The Hinting Task is a simple social cognition measure that assesses the ability of individuals to infer intentions behind indirect speech comments (Appendix 7). The test is comprised of 10 short vignettes, each describing a brief interaction between two people, ending in one of the characters dropping a hint. Each of these stories was read out loud (for correct prosody) and was repeated if participants requested this. They were then asked what the character really meant by what they said. A more obvious hint was added if no appropriate inferences were made after the first hint. A score of 2 was awarded if the hint was guessed at the first stage and 1 if guessed at the second stage, with a maximum score of 20.

Eyes Test (Baron-Cohen, Wheelwright, Hill, et al., 2001)

Described by Baron-Cohen and colleagues (2001) as an 'advanced' test of ToM, this task examines the ability to attribute complex mental states to people from photographs of just the eye area of the face (see Figure 9). For the current study, a computerised version of the task was developed to allow reaction times to be recorded as well as responses. Participants were presented with 36 black and white photographs in the centre of the computer screen and were asked to decide which of four words, presented underneath the photograph, best described what the person was thinking or feeling (three words were distracters with the same emotional valence as the correct answer). They were asked to indicate their choice, as quickly and accurately as possible, by pressing one of four labelled keys on the keyboard that corresponded with each of the adjectives. To avoid comprehension problems with the words affecting results, a glossary was available and participants were encouraged to ask the researcher for definitions if they were unsure. The total number of correct responses was recorded by the computer, as well as speed of response (reaction time in milliseconds).

Figure 9: Example stimuli on the Eyes Test



ETHICAL CONSIDERATIONS

Ethical approval

Ethical approval was obtained from The University of Manchester School of Psychological Sciences Ethics Committee (Appendix 8). Prior to this, the project was approved by The University of Manchester Division of Clinical Psychology Research Subcommittee (Appendix 9). The NAS also formally approved the research and supported recruitment (see Appendix 10).

Consent

Those taking part received a participant information sheet (PIS) about the study (Appendix 11), including an explanation of the voluntary nature of participation and the right to withdraw at any time without giving a reason. They were encouraged, and were given a number of opportunities, to ask any questions before taking part in the study. Informed consent was sought verbally and in writing by asking each participant to complete a printed consent form (Appendix 12).

Confidentiality

Participants' demographic details, completed questionnaires and task scores were coded with an anonymous participant identification number, known only to the principal investigator. Personal information (such as name and contact details) was stored separately and securely in an encrypted document.

Debriefing

At the end of their involvement in the study, individuals were given the opportunity to ask any further questions about the research or to discuss how they felt about taking

part. Although none showed any signs of distress as a result of participation in the research, or expressed any worries, they were reminded of the support and information contact details on the PIS should these be required. Those individuals who indicated possible self-harm or suicidal ideation on the PHQ-9 were risk assessed (i.e. the respondent is asked to indicate how often they have been bothered by a number of problems over the last two weeks, including: *'Thoughts that you would be better off dead or of hurting yourself in some way'*). None of the participants indicated any immediate or serious risk and were subsequently advised to contact their G.P. to get support with their difficulties.

PROCEDURE

The organisations supporting the recruitment of participants distributed a short advert describing the study (Appendix 13) on websites, intranets, newsletters, via email and on notice boards. Anybody who was interested in taking part or in finding out more about the study was invited to contact the researcher by phone or email. Those who made contact were sent a copy of the PIS (and in the case of those volunteering for the AS group an AQ was also sent) and were encouraged to ask any questions they had about the study. If they wished to take part after reading the PIS it was established whether they met the inclusion/exclusion criteria of the study (with the exception of IQ scores) and if appropriate, an appointment time was arranged for them to meet with the researcher to complete the experimental tasks.

Participants were then required to complete the five questionnaires online, delivered as a survey through a specially designed closed website (see Appendix 14). They were asked to complete the questionnaires in advance of meeting the researcher, as close to the testing session as possible. To do this, they were sent a link to a restricted access area of The University of Manchester School of Psychological Sciences website (the host for the survey), which could only be accessed with a personal unique ID and password provided by the researcher. It took approximately 15 minutes to complete, started with an introduction page and online consent form (Appendix 15), followed by the questionnaires, then the option of submitting feedback on the last page. Before the experimental testing session, the researcher checked answers on the questionnaires.

The experimental testing session typically took approximately one hour. To start with, if applicable, any matters of concern were raised by the researcher, such as possible risk issues indicated on the online questionnaires. The plan for the session

was outlined and participants were given the opportunity to ask questions. They were requested to sign a second, paper format consent form.

The first assessment completed was the WASI. Scores on this determined whether individuals proceeded. If no longer needed, at this point they were thanked and debriefed. Those continuing involvement in the study went on to participate in the four experimental tasks, in the following order: FERT, Beads, Eyes, Hinting. All individuals were offered to take short comfort breaks between tasks if desired. After completing the experimental tasks, participants were thanked for their time and debriefed.

STATISTICS

Data

The dependent variables (scores on experimental tasks and questionnaires) were all continuous data. There was no missing data, probably because participants were alerted to any unanswered questions on the online survey and some of the key experimental tasks were computerised with results recorded automatically. When assessed for normality through inspection of histograms, normal Q-Q plots, box plots and formal tests of normality (Shapiro-Wilk), significant skewness and kurtosis were apparent in the distribution of a number of the variables.

Attempts were made to enable the data set to meet the requirements for parametric statistical analysis, including the removal and replacement (through additional data collection) of those participants whose data contained very extreme values on any of the measures or tasks. As significant skewness and kurtosis still remained in the distribution of some variables following this procedure, they were then transformed via formulae (e.g. square root, log 10) indicated by Tabachnick and Fidell (1983) depending on the type and degree of non-normality. This step reduced the levels of skewness and kurtosis to an acceptable level, but significant results were still returned by Shapiro-Wilk tests for two variables (paranoia and general anxiety). In addition, there was a ceiling effect observed for the Hinting Task scores and there was a restricted range of scores on the Beads Task. These factors taken together led to the decision to employ non-parametric statistics to analyse the data. The data met the assumptions for non-parametric techniques viz. random samples and independent observations.

Statistical tests

Mann-Whitney U tests were employed to test for between-group differences on descriptive variables (depression, anxiety, social anxiety, self-consciousness, paranoia), as well as between-group differences of performance on the experimental tasks to test hypotheses (FERT, Beads, Eyes, Hinting). Further hypothesis testing involved exploring associations between paranoia and performance on each of the experimental tasks using Spearman's Rank Order Correlations.

Post-hoc exploratory analyses considered the possible effect of a number of the factors (medication, depression and anxiety levels) on experimental task performance, which involved splitting the AS group into subgroups and conducting Mann-Whitney U tests for between subgroup differences. This stratified approach was employed because a conventional multivariate analysis was inappropriate due to the non-normality of the data. Further Spearman's Rank Order Correlations were conducted to look for any relationships between paranoia and the other self-report questionnaire variables (depression, general anxiety, social anxiety and self-consciousness), as well as possible associations between the experimental tasks.

It should be noted that as multiple comparisons were conducted, the application of Bonferroni corrections (Bonferroni, 1935) was considered beforehand. However, the use of this procedure was decided against because the argument has been advanced (Nakagawa, 2004) that it can substantially reduce the statistical power of rejecting an incorrect null hypothesis in each test (Holm, 1979; Perneger, 1998; Rice, 1989). Instead, the use of a more conservative significance level was employed. It was decided that only p values of less than 0.01 (1% level) would be taken as evidence of a statistically significant difference between groups on Mann-Whitney U tests.

RESULTS

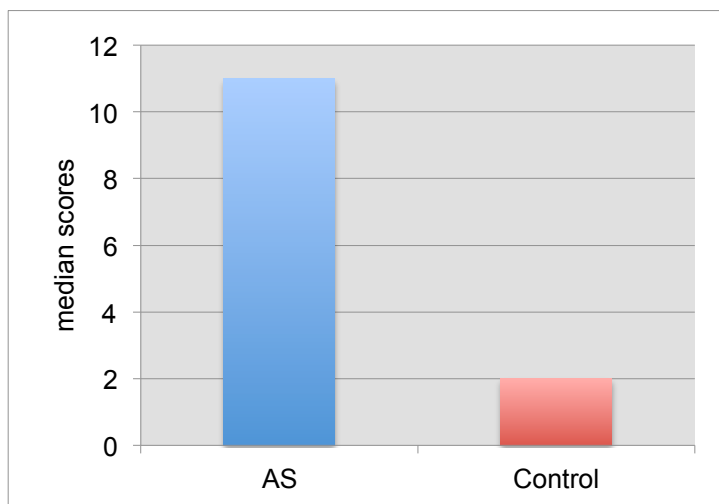
DESCRIPTIVE DATA

The two samples (AS and control group) were matched group-wise on the variables of sex, age and IQ scores. The male:female ratio was 26:4 in both groups. There were no significant group differences for age (AS group $Mdn=29.5$, $IQR=16$; control group $Mdn=33.5$, $IQR=18$; $U=440$, $z=-.15$, $p=0.88$) or for IQ scores (AS group $Mdn=11$, $IQR=10$; control group $Mdn=11$, $IQR=10$; $U=331$, $z=-1.77$, $p=0.08$).

Depression and general anxiety

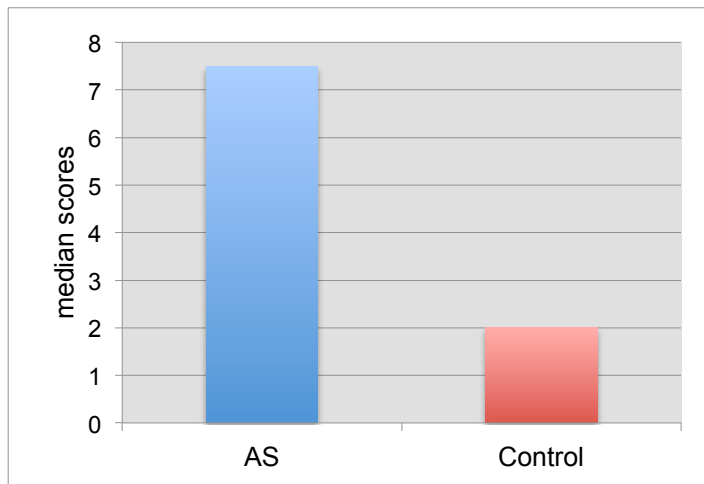
Depression and anxiety scores (PHQ-9 and GAD-7 scores) were much higher in the AS group (depression $Mdn=11$, $IQR=10$; anxiety $Mdn=7.5$, $IQR=10$) than in the control group (depression $Mdn=2$, $IQR=5$; anxiety $Mdn=2$, $IQR=3$), as can be seen in Figures 10 and 11. Mann-Whitney U tests confirmed that differences between the groups on these variables were statistically significant (depression $U=101.5$, $z=-5.17$, $p<.001$; anxiety $U=130$, $z=-4.75$, $p<.001$) and effect sizes⁸ were large (depression $r=-0.67$; anxiety $r=-0.61$).

Figure 10: PHQ-9 scores (depression)



⁸ Effect size calculation $r = z / \text{square root of } z$. Cohen (1988) proposed 'conventional' values for small, medium and large effects: $r = .10$, $.30$, and $.50$, respectively.

Figure 11: GAD-7 scores (anxiety)



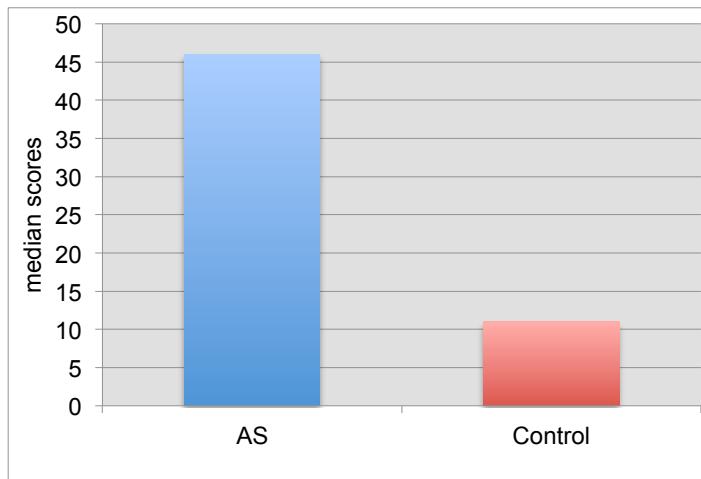
According to severity ratings suggested for the PHQ-9, 60 per cent of the AS group had moderate or higher levels of depression, but nobody in the control group did. Similar numbers of participants were rated as having mild levels of depression in each group (7 AS = 26.6%, 9 controls = 23.3%).

Severity ratings for the GAD-7 suggested that 46.7 per cent of the AS group had moderate or higher levels of anxiety and that nobody in the control group did. In the mild anxiety category were 29.9 per cent of the AS group and 13.3 per cent of the control group.

Social anxiety and self-consciousness

There were also much higher social anxiety scores in the AS group ($Mdn=46$, $IQR=22$) than the control group ($Mdn=11$, $IQR=21$), as can be seen in Figure 12. A Mann-Whitney U test indicated that this difference was statistically significant ($U=78$, $z=-5.5$, $p<.001$) with a large effect size ($r=-0.71$). According to the suggested cut-off point of 34, as many as 80 per cent of the AS group would be classified as socially phobic.

Figure 12: SIAS scores (social anxiety)

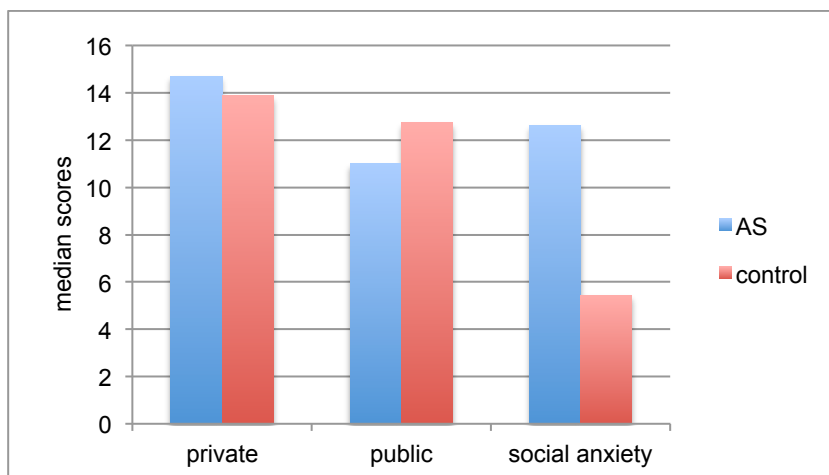


Overall SCS scores were higher in the AS group ($Mdn=37.5$, $IQR=14$) than the control group ($Mdn=27.5$, $IQR=15$) and this difference was statistically significant on a Mann Whitney U test: ($U=260.5$, $z=-2.8$, $p=.005$) with a medium effect size ($r=-0.36$). However, on examining the scores from the individual subscales, social anxiety was the only one of three (the others being private and public self-consciousness) to demonstrate a statistically significant difference between groups (see Table 1), with a large effect size ($r=-0.66$). Therefore, it is likely that the social anxiety subscale score had the strongest influence on the overall SCS score. Median SCS subscale scores can be seen in Figure 13.

Table 1: Mann-Whitney U results for SCS subscale scores

Subscale	U	z	P value
private	383.5	-.986	.293
public	362	-1.307	.246
social anxiety	105.5	-5.107	.000

Figure 13: SCS subscale scores (self-consciousness)



HYPOTHESIS TESTING

Part 1: Social cognitive tasks, between-group comparisons

Facial Expression Recognition Task

Hypothesis 1: *Compared with controls, those with AS will correctly identify fewer emotions in a facial expression recognition task, but will respond more quickly.*

1a) Accuracy

The AS group were less accurate at identifying emotions on the FERT, with a median percentage accuracy of 48.20 (IQR=14.30) compared with the control group (Mdn=52.60, IQR=8.30). A Mann-Whitney U test indicated that the difference between the groups was statistically significant ($U=255.50$, $z=-2.88$, $p=.004$) and the effect size was medium ($r=-0.37$).

1b) Reaction time

A Mann-Whitney U test indicated that there was no statistically significant difference between the AS group and the control group with regard to speed of response to face stimuli on the FERT (AS group Mdn=2214.50, IQR=597.27; Control group Mdn=2167.75, IQR=480.72; $U=431$, $z=-2.81$, $p=.779$).

Beads Task

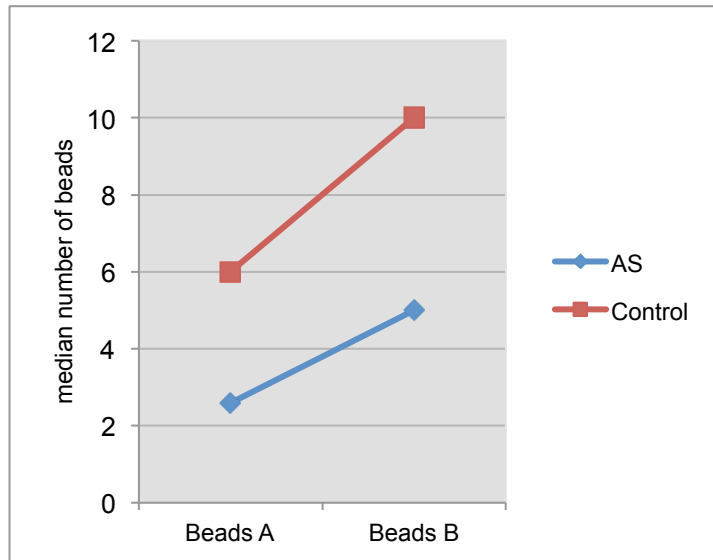
Hypothesis 2: *Compared with the control group, those with AS will make decisions based on less information in a probabilistic reasoning task.*

Those in the AS group did make decisions based on less information in two versions of a probabilistic reasoning task (see Figure 14). In the first condition (Beads A), the median number of beads requested by the AS group was 2.50 (IQR=2) compared with the control group median of 6 (IQR=2). In the second condition (Beads B), the median number of beads requested by the AS group was 5 (IQR=6) and in the control group it was 10 (IQR=3). Both of these between-group differences were statistically significant on Mann-Whitney U tests (Beads A: $U=49$, $z=-6.01$, $p<.001$; Beads B: $U=19$, $z=-6.43$, $p<.001$) with large effect sizes ($r=-0.78$ and $r=-0.83$ respectively).

A JTC bias (i.e. requesting only one or two beads before reaching a decision) was demonstrated by 50 per cent of the AS group on Beads A and 33.3 per cent of the AS group on Beads B. None of the control group exhibited a JTC bias on either

task. None of the control participants chose answers on either version of the Beads Task that were counterintuitive, whereas 5 per cent of the AS group picked the least likely jar on Beads A and 10 per cent chose the least likely jar on Beads B.

Figure 14: Beads Task scores



Hinting Task

Hypothesis 3: Compared with the control group, those with AS will infer the real intention behind hints expressed through speech utterances less often, in a ToM task.

Both the AS and control group achieved high scores on the Hinting Task (AS: $Mdn=18$, $IQR=2$; controls: $Mdn=19$, $IQR=1$). Despite all scores being close to the ceiling, the control group were slightly better at inferring the real intention behind hints expressed through speech utterances and the between-groups difference was found to be significant on a Mann-Whitney U test ($U=248.50$, $z=-3.14$, $p=.002$), with a medium effect size ($r=-0.41$).

Eyes Test

Hypothesis 4: Compared with the control group, those with AS will correctly identify fewer mental states of people from photographs of just their eyes in a ToM task, but will respond more quickly.

1a) Accuracy

The AS group were less accurate at identifying emotions on the Eyes Test, with a median percentage accuracy of 69.44 ($IQR=23.61$) compared with the control group

($Mdn=80.56$, $IQR=11.80$). A Mann-Whitney U test indicated that the difference between the groups was statistically significant ($U=182$, $z=-3.98$, $p<.001$) and the effect size was large ($r=-0.5$).

1b) Reaction time

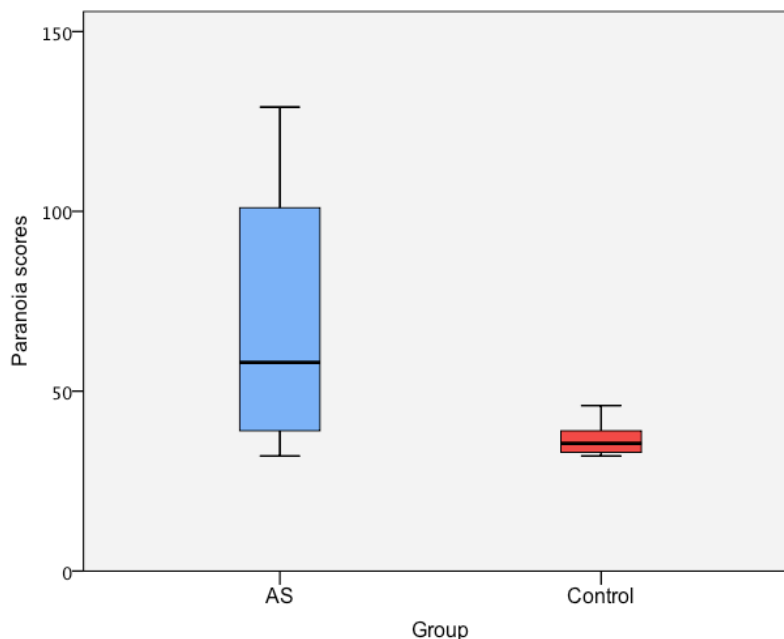
The AS group responded more quickly to stimuli on the Eyes Test ($Mdn=6327.95$, $IQR=3687.22$) than the control group ($Mdn=7981.6$, $IQR=10771.60$). The difference was statistically significant ($U=698$, $z=-3.21$, $p=.001$) on a Mann-Whitney U test and the effect size was medium ($r=-0.41$).

Part 2: Paranoid thinking, correlational analysis

Hypothesis 5: *There will be higher levels of paranoia in the AS group than the control group.*

There were much higher paranoia scores in the AS group ($Mdn=58$, $IQR=63$) than the control group ($Mdn=35.5$, $IQR=6$), with a notably wider range of scores on the PTS in the AS group (see Figure 15). A Mann-Whitney U test indicated that the difference between groups was statistically significant ($U=153$, $z=-4.39$, $p<.001$) and the effect size was large ($r=-0.57$).

Figure 15: Spread of paranoia scores in the AS and control groups



Hypothesis 6: Performance on each of the four experimental tasks (FERT, Beads Task, Hinting Task, Eyes Test) will be associated with levels of paranoia.

When looking at the sample as a whole (i.e. the AS group and control group together), Spearman’s correlation coefficient indicated a statistically significant negative relationship between paranoia scores and both conditions of the Beads Task (A: $\rho = -.596, p < .001$; B: $\rho = -.603, p < .001$), thus indicating that *higher* scores on the paranoia scale were associated with *lower* numbers of beads requested. There was also a statistically significant negative correlation between paranoia scores and accuracy on the Eyes Test, suggesting that higher levels of reported paranoid thoughts were associated with poorer performance on this task ($\rho = -.400, p = .002$). There was a smaller negative association between paranoia scores and Hinting Task scores ($\rho = -.269, p = .037$) that did not reach the predetermined alpha level (0.01). No significant relationships appeared in the correlation matrix between paranoia and reaction time on the Eyes Test or accuracy and reaction time on the FERT. When the two groups were considered separately using Spearman’s correlation coefficient, none of the above relationships remained significant for either the AS group or the control group (see Table 2).

Table 2: Correlation statistics for AS and control groups separately

		Beads Task A	Beads Task B	Hinting Task	Eyes Test accuracy
AS	Correlation coefficient	-.339	-.317	-.117	-.219
	p value	.067	.088	.539	.246
Control	Correlation coefficient	-.337	-.289	.111	-.089
	p value	.069	.121	.559	.642

On inspection of scatter plots displaying both groups’ data, it appeared that the original correlations, observed when the whole sample was considered together, were likely to have been artefacts, that is, just illustrating group differences rather than genuine monotopic relationships (see Figures 16 to 19)

Figure 16: Scatter plot of paranoia scores and Beads Task A

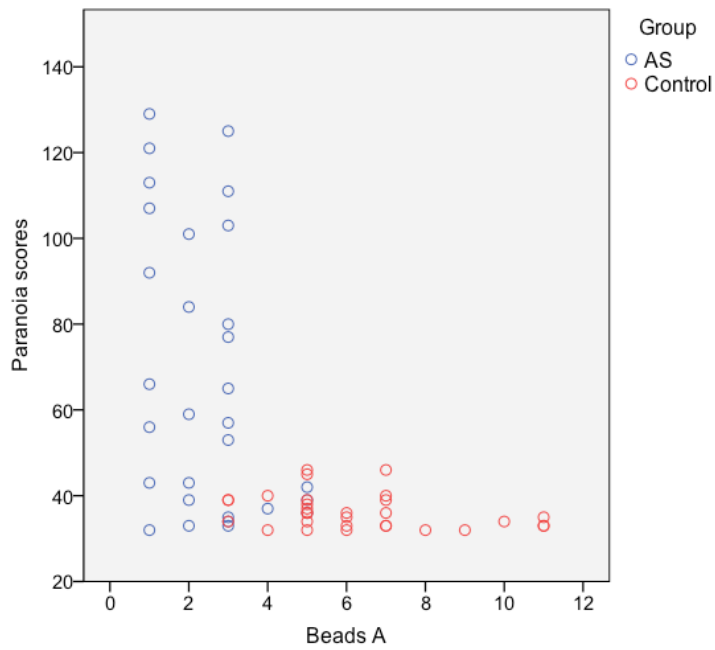


Figure 17: Scatter plot of paranoia scores and Beads Task B

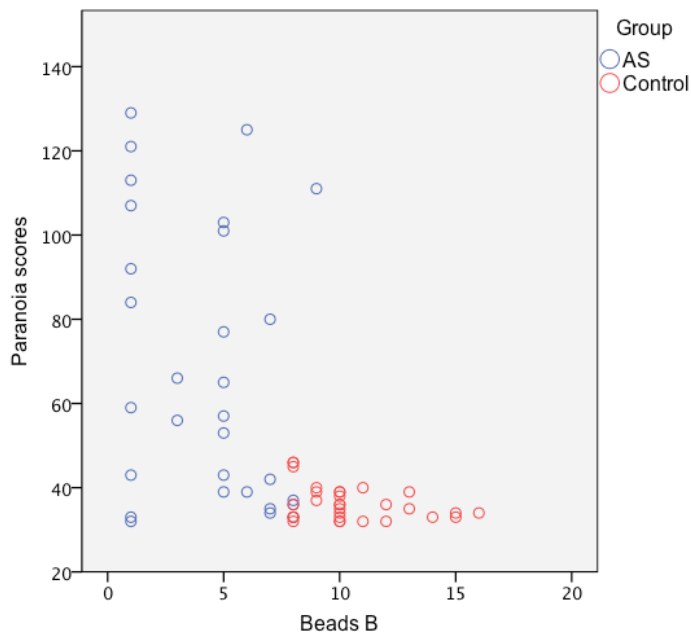


Figure 18: Scatter plot of paranoia scores and Hinting Task scores

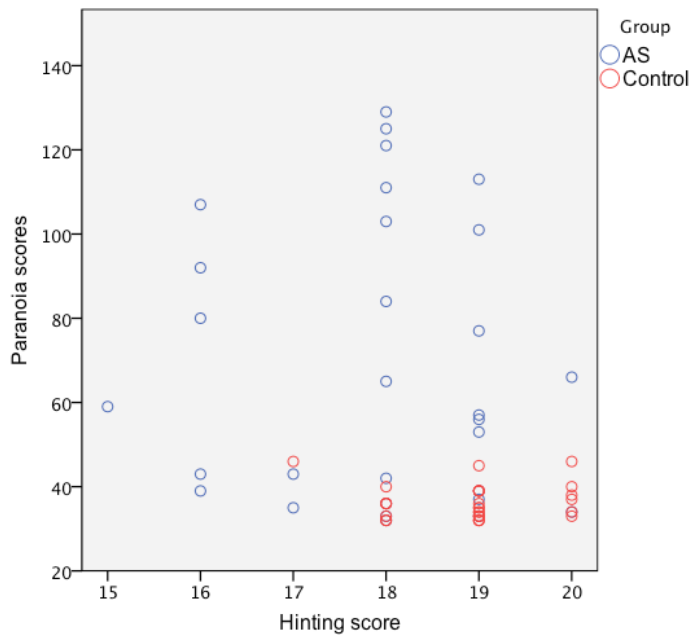
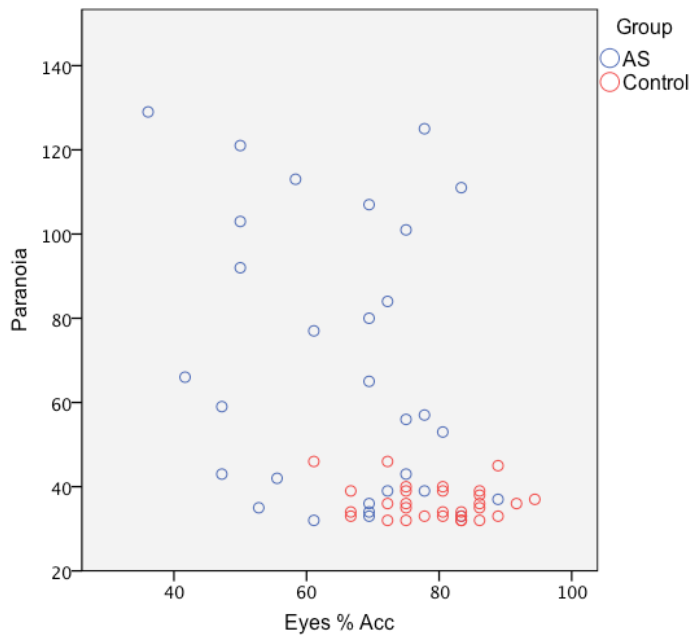


Figure 19: Scatter plot of paranoia scores and Eyes Test accuracy



EXPLORATORY POST-HOC ANALYSIS

Further exploratory analysis was conducted to consider whether a number of key factors (medication status, depression and general anxiety) had influenced the performance of the AS group in the main experimental tasks. Due to the small sample sizes that resulted from splitting the groups into subgroups, the investigations in this section should be treated as tentative and the results viewed with caution. In addition, associations between the descriptive variables (depression, general anxiety, social anxiety and self-consciousness) and levels of paranoia in the AS group were explored, as well as possible relationships between experimental task scores, to identify any significant relationships of interest.

Medication

Psychotropic medications have been found to attenuate performance on the FERT (Harmer, et al., 2003; Harmer, et al., 2009; Jänsch, et al., 2009). As more than half of the AS group were taking medication, it was deemed appropriate to assess whether they performed differently on the FERT than those who were not taking medication. In the same way, a between-groups comparison was undertaken to evaluate performance on the other experimental tasks for the medicated and unmedicated subgroups. On Mann-Whitney U tests, no significant differences in performance on the main experimental tasks were found between these two subgroups (see Table 3).

Table 3: Comparison of medicated/unmedicated subgroups on experimental tasks

	<i>U</i>	<i>z</i>	<i>p</i>
Beads Task A	92	-.869	.385
Beads Task B	109	-.129	.898
Hinting Task	94	-.802	.423
Eyes % Accuracy	91	-.878	.380
Eyes Mean RT	106	-.249	.803
FERT % Accuracy	100	-.499	.618
FERT Mean RT	102	-.416	.678

Depression

Depression has been shown to influence performance on the FERT (Jänsch, et al., 2009) and 60 per cent of the AS group were reported to be experiencing moderate or higher levels of depression. To investigate whether levels of depression had affected scores on the FERT, or any of the other experimental tasks, the AS group

was split into subgroups according to severity ratings on the PHQ-9: none or mild levels of depression; moderate to severe levels of depression. Comparisons between these two subgroups were conducted using Mann-Whitney U tests and no significant differences were detected (see Table 4). Additionally, depression scores in the complete AS group were not found to correlate with any of the experimental task scores.

Table 4: Comparison of depression score subgroups on experimental tasks

	<i>U</i>	<i>z</i>	<i>p</i>
Beads Task A	101	-.310	.757
Beads Task B	90	-.786	.432
Hinting Task	86	-.971	.331
Eyes % Accuracy	106	-.106	.915
Eyes Mean RT	106	-.085	.933
FERT % Accuracy	99	-.402	.687
FERT Mean RT	78	-1.27	.204

Anxiety

As the descriptive analyses had also revealed high levels of general anxiety in the AS group, any possible effects that this might have had on the outcomes of experimental testing were explored. The AS group was split into subgroups according to severity ratings on the GAD-7: none or mild levels of anxiety; moderate to severe levels of anxiety. Mann-Whitney U tests did not find any significant differences between the subgroups (see Table 5). Additionally, anxiety scores in the complete AS group were not found to correlate with any of the experimental task scores.

Table 5: Comparison of anxiety score subgroups on experimental tasks

	<i>U</i>	<i>z</i>	<i>p</i>
Beads Task A	65	-0.406	.684
Beads Task B	61	-0.615	.539
Hinting Task	56	-0.892	.372
Eyes % Accuracy	68	-0.209	.835
Eyes Mean RT	47	-1.296	.195
FERT % Accuracy	70	-0.104	.917
FERT Mean RT	55	-0.881	.378

Although there were very high levels of social anxiety in the AS group, splitting them into subgroups according to the suggested cut-off point of 34 resulted in very uneven sized groups (26 and 4) and therefore it was not considered worthwhile

conducting analyses of this type. However, social anxiety scores in the complete AS group (on both the SIAS and the SCS social anxiety subscale) were not found to correlate with any of the experimental task scores.

Paranoia scores correlations

As can be seen in Table 6, Spearman's correlation coefficient examining the whole sample (AS and control together) indicated there were medium to large statistically significant positive relationships between paranoia scores and the following variable scores: depression, general anxiety, social anxiety and self-consciousness (but only the social anxiety subscale of the SCS). When the groups were split, in the AS group paranoia scores were only significantly associated (positively) with depression and anxiety. In the control group, there were statistically significant (medium to large) positive correlations between paranoia scores and anxiety, social anxiety and self-consciousness scores (but again, only the social anxiety subscale of the SCS).

Table 6: Selected output from correlation matrices of questionnaire variables

		PHQ-9	GAD-7	SIAS	SCS	SCS private	SCS public	SCS social anxiety
Total sample	Correlation coefficient	.602	.647	.622	.434	.257	.088	.536
	p value	.000	.000	.000	.001	.047	.503	.000
AS	Correlation coefficient	.484	.537	.231	.320	.312	.319	.126
	p value	.007	.002	.219	.085	.093	.085	.508
Control	Correlation coefficient	.304	.385	.589	.367	.216	.196	.466
	p value	.102	.035	.001	.046	.251	.298	.010

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Experimental tasks correlations

Spearman's correlation coefficient was employed to investigate possible associations between experimental tasks scores (see Appendix 16 for correlation matrix). The only significant relationship found at the 0.01 level was between the FERT and the Eyes Test ($\rho = -.543, p = .002$), with a large effect size. No equivalent correlation between these two variables was found in the control group. There was also medium-sized relationship observed at the 0.05 level between the Beads Task and both the FERT and the Eyes Test in the AS group.

DISCUSSION

Summary of findings

The primary purpose of this study was to investigate a range of social cognitive mechanisms in AS. As predicted, the AS group showed impairments in performance on all of the experimental tasks that were employed to assess various social cognitive abilities. Compared with controls, the AS group were less accurate at identifying emotions in a facial expression recognition task (FERT) and performed less well on two ToM tasks assessing mental state reasoning (Hinting Task) and mental state decoding (Eyes Test).

In terms of data-gathering style, the AS group tended to make decisions based on less evidence than the control group, as demonstrated on both conditions of the Beads Task. Half of the AS group showed a JTC bias on the easier first condition (Beads A). Furthermore, although the AS group overall were more cautious about making a decision on a more difficult version of the task (Beads B), there were still 33 per cent who showed a JTC bias, but it was noted that on the second condition the range of scores was much wider. Although there were no absolute correct answers on the Beads Task, AS participants were more likely than those in the control group to quickly choose counter-intuitive answers (i.e. the least likely possibility of two options) instead of waiting for more evidence before deciding. Coupled with this, the AS group responded more quickly on the Eyes Test, despite their poorer performance in terms of accuracy, which was taken as further possible evidence of a tendency to jump to conclusions. There was no significant difference between the groups with regard to reaction time on the FERT.

The AS group reported experiencing significantly more paranoid thoughts than the control group overall. It was noted, however, that the AS group was heterogeneous in this regard, with a wide spread of scores on the paranoia measure. Even though paranoia scores appeared to be associated with a number of social cognitive impairments when the combined groups were considered together, no significant relationships remained when the AS and the control group were analysed separately, although a medium-sized but non-significant negative correlation could still be observed between paranoia and Beads Task scores for both groups.

With regard to mental health problems, significantly higher levels of depression and general anxiety symptoms were reported in the AS group than the control group, including 60 per cent with moderate or higher levels of depression and nearly half of the group having moderate or higher levels of anxiety, according to the assessment measure scores. It was also noted that more than half of the AS group were taking medication for these affective difficulties. There were comparatively high social anxiety scores in the AS group and, additionally, although overall scores on the SCS suggested that the AS group had significantly higher levels of self-consciousness than the control group, this appeared to be influenced by social anxiety, rather than public or private self-consciousness (as demonstrated by scores on the SCS subscales). Affective problems and medication status did not appear to have an effect on participants' performance on any of the experimental tasks.

Paranoia scores were significantly associated with depression and general anxiety scores in the AS group, but not social anxiety or self-consciousness scores. In the control group, paranoia scores correlated with social anxiety scores, and to a lesser extent general anxiety and self-consciousness scores, but due to the low levels of all of these factors in those without AS, these findings are not informative and, therefore, can be disregarded.

Interpretation of findings and theoretical implications

Theory of mind

Previous research has shown that individuals with AS and HFA are able to pass traditional first and second-order ToM tasks (e.g. Bowler, 1992). They are less likely to perform well on 'advanced' ToM tasks (e.g. Jolliffe & Baron-Cohen, 1999) and, specifically, have been found to be significantly impaired on the Eyes Test (e.g. Baron-Cohen, et al., 2001). Although ToM deficits in AS populations have been demonstrated before, the combination of measures chosen for use in the current study reflected the high level of functioning of the sample as well as acknowledging the likelihood that ToM is not a homogenous concept. It has previously been proposed that one distinction that can be made is between mental state reasoning and mental state decoding skills (e.g. Tager-Flusberg & Sullivan, 2000). As previously stated, the Eyes Test is thought to rely on perceptual, affective processes and so assess mental state decoding ability. On the other hand, the Hinting Test requires the participant to make inferences about indirect speech and is considered

to measure mental state reasoning. There was no significant association between scores on these two tasks in the AS group, supporting the notion that they are measuring different skills. Interestingly, accuracy on the Eyes Test was significantly correlated with scores on the FERT in the AS group, a preliminary finding that taken alone might indicate that the Eyes Test measures emotion recognition ability rather than ToM. However, the same variables (FERT and Eyes Test scores) were not associated in the control group, therefore, these findings are inconclusive.

Prior to the current study, there was preliminary evidence that adults with AS performed less well than controls on both the Eyes Test and the Hinting Task (Craig, et al., 2004). The AS sample in Craig et al.'s study had significantly higher paranoia scores than the control group, but had lower scores than a group of patients with paranoid delusions. However, sample sizes were relatively small and were not well matched, so the conclusions of the study were tentative.

ToM deficits have been linked to delusional beliefs in psychosis (Corcoran, et al., 1995; Harrington, Langdon, et al., 2005) and a possible association between these factors has also been explored in autism. ToM ability appeared to be negatively associated with paranoia scores in the study by Craig, et al., but this was not demonstrated specifically for the AS group. This contradicted an earlier study that found no relationship between ToM ability and reported levels of paranoia (Blackshaw, et al., 2001). However, as with the Craig, et al. study, results from the study were limited because correlational analyses were not reported for the two separate groups assessed (AS and non-clinical controls), therefore conclusions could not be drawn about paranoia in the AS group. A further study, which did consider individuals with AS specifically, did not find a relationship between ToM ability and paranoia scores (Abell & Hare, 2005). Taking this previous research into account along with the findings from the current study, which did not find any association between scores on the Eyes Test and the Hinting Task and paranoia scores in an AS sample, it seems unlikely that deficits in ToM directly contribute to the development of paranoid beliefs in AS.

Jumping to conclusions

Another factor that differed in the current study compared with previous ToM research was the recording of reaction time to stimuli on the Eyes Test, which was implemented in order to additionally investigate data-gathering style, resulting in the finding that those with AS responded more quickly than controls on this particular

task. This fits with the observation that AS participants made decisions based on significantly less evidence on the Beads Task, with 50 per cent demonstrating a JTC bias, as has been found repeatedly in psychosis (see Fine, et al., 2001). Individuals with delusions become more cautious in their decision-making on harder versions of the Beads Task, but still view less beads than non-clinical controls (Dudley, et al., 1997b; H. F. Young & Bentall, 1997). Similarly, AS participants in the current study were less hasty in their decision making when the proportion of beads was closer (e.g. 60:40 as opposed to 85:15), but their decisions were still based on significantly less information than was the case for control participants. Biases in reasoning of this type have not previously been explored in autism research, so these are novel findings. The fact that this bias in data-gathering style, as demonstrated on both the Eyes Test and the Beads Task, was unrelated to paranoia scores in the AS sample was contrary to expectation. It could be that there is an indirect affect with, as yet, unknown mediating factors playing a role. For example, a tendency to jump to conclusions might increase the chance of developing negative assumptions (about other people's beliefs and intentions), especially in the context of social cognitive difficulties such as poor mentalising and emotion recognition, which could increase vulnerability to anxiety and depression, and in turn paranoia. An association was found between accuracy on both the Eyes Test and the FERT with Beads Task scores. Therefore, it is possible that difficulties with facial expression recognition of emotion and mental state decoding could directly contribute to an increased tendency to jump to negative conclusions.

Although some research has linked the JTC bias specifically to persecutory delusions in psychosis, the majority of studies do not distinguish between different types of delusion. A JTC bias has also been demonstrated in those 'at risk' of psychosis (Broome, et al., 2007) and in 'delusion prone' individuals (e.g Colbert & Peters, 2002). Therefore, despite the fact that no relationship was found between paranoia and scores on the Beads Task in the current study, this does not necessarily exclude the possibility that common factors might explain this finding in AS and other populations that have been studied. As there is no previous autism research to draw upon for possible explanations of this particular data-gathering style, it might be useful to consider hypotheses offered in psychosis literature about the existence of JTC biases.

One theory is that a JTC bias could arise when there is the experience of discomfort in the presence of uncertainty, which results in a desire to confirm beliefs in an

attempt to gain 'closure' (Bentall, et al., 2001; Bentall & Swarbrick, 2003; Colbert & Peters, 2002). Clinical and anecdotal evidence has been reported suggesting that some individuals with AS may dislike ambiguity and have an intense need for closure (Attwood, 2008; Docter & Naqvi, 2010; Stokes, 2002; Winter, 2003).

Evidence from eye-tracking studies indicating that people with autism look less at eyes than control participants in emotion processing tasks (Corden, et al., 2008) may be of relevance in explaining the faster reaction times observed in the AS group on the Eyes Test in the current study. Corden, et al. found that performance was poorer for more threatening stimuli, such as fearful and sad expressions, and concluded that those with ASD were avoiding eyes because they were emotionally arousing, resulting in impaired expression recognition. It is possible that the same could be true of the participants with AS in the current study. Sasson, et al.'s (2007) eye-tracking study also found that schizophrenia and autism groups spent less time fixating on faces in a social scene than non-clinical controls. Corden, et al.'s theory is in concordance with the explanation for reduced data gathering offered by Dudley & Over (2003) implicating an over-extension of confirmatory reasoning style, normally only evident when there is perceived threat, in the development JTC biases. It could be that individuals with AS avoid threatening stimuli and jump to erroneous conclusions in order to confirm threat-related hypotheses.

Difficulties with the use of sequential information have also been implicated in data-gathering biases (H.F. Young & Bentall, 1995), based on the finding that individuals with delusions were less likely than non-clinical controls to systematically narrow down hypotheses in the light of sequentially presented information on a rule discovery task. People with ASD perform poorly on a similar task designed to assess an aspect of executive functioning, the Wisconsin Card Sorting Test (Heaton, et al., 1993). A related theory suggests that deficits in information integration are related to JTC biases, whereby abnormal salience is attributed to stimuli resulting in excessive value being placed on current evidence (Kapur, 2003; Menon, et al., 2006; Menon, et al., 2005). In theory, this could also be connected to problems with mental flexibility as indicated in autism research examining executive functioning (Prior & Hoffmann, 1990; Szatmari & Tuff, 1990).

Facial emotion expression recognition

Unlike responses to stimuli on the Eyes Test, there was no significant difference between groups with regard to reaction time to facial stimuli on the FERT in the current study. Difference in length of presentation could explain this difference in findings between the FERT and the Eyes Test in terms of the speed of response. The presentation of stimuli on the FERT was very brief in order to represent ecologically valid emotion expressions and thus participants had only a very short period to process the faces, whereas stimuli remained on the screen during the Eyes Test until a response was given. All participants were instructed to answer as quickly and accurately as possible on both tasks, but it appears that the AS group were less inclined to make use of extra time to work out the answers when given the opportunity (as on the Eyes Test) despite a tendency to make more errors.

The FERT discriminated between the two groups in the current study in terms of accuracy for recognising emotion via facial expression stimuli, highlighting a deficit in this ability in the AS group. Overall, previous autism research into facial emotion expression recognition has produced inconsistent findings and has been hampered by methodological limitations, which makes comparisons with the current findings difficult and of limited use. However, it is worth noting that the current study does concur with several recent studies that have similarly used the more complex and sensitive morphing techniques, which despite other limitations have also found emotion recognition deficits in ASD (Bal, et al., 2010; Greimel, et al., 2010; Law Smith, et al., 2010; Philip, et al., 2010).

Although facial emotion recognition impairment has been observed in psychosis (Kohler, et al., 2010) no clear links have been made with paranoia specifically. Similarly, no association was found between scores on the FERT in the current study and paranoia scores. An association was found in the current study between the FERT and the Beads Task. One interpretation of this finding is that poor emotion recognition ability could make it more likely for individuals with AS to misinterpret facial expressions and possibly jump to negative conclusions.

Given the very brief presentation times of the FERT stimuli, which leave little opportunity for piecemeal processing strategies that are thought to be favoured by individuals with AS (Celani, et al., 1999; Homer & Rutherford, 2008), a larger difference between groups was expected on this task. As scores on the FERT and

the Eyes Test were correlated in the AS group, it is interesting to note that the difference between the groups with regard to accuracy on the FERT yielded a medium effect size, whereas on the Eyes Test the effect size for the difference between groups with regard to accuracy was large. The larger group difference on the Eyes Test is likely to have been influenced by the fact that the stimuli on this task represent emotions that are more complex and only the eye region of the face is viewed. Previous research has indicated that individuals with ASD pay more attention to the mouth area of the face (Hernandez et al., 2009; Neumann, et al., 2006), spend less time fixating on the eye region and are more impaired at decoding mental states from the eye-region alone (Baron-Cohen, Wheelwright, et al., 1997; Corden, et al., 2008; Pelphrey, et al., 2007). The availability of all of the features of the faces on the FERT for viewing may have facilitated the recognition of emotion on this task despite the shorter exposure time to the stimuli.

Affective problems

The finding of high levels of anxiety in the AS group in the current study is consistent with previous research. Existing literature indicates that anxiety is common in individuals with AS (e.g. Tantam & Girgis, 2009) and is an unsurprising emotional consequence of living with social and communication difficulties (Tantam, 1991, 2000). The proportion of the current AS group with moderate or higher levels of anxiety (46.7 per cent), according to scores on the GAD-7, is remarkably similar to levels reported by Abell & Hare (2005) who found that 47 per cent of AS participants scored within the moderate to severe range for anxiety on the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). Comparably, Tantam & Girgis (2009) reported that more than 40 per cent of patients with AS seen in their clinic were diagnosed with anxiety or anxiety-related disorders of clinically significant severity before presentation. The fact that anxiety scores correlated with paranoia scores in the AS group in the current study concurs with Abell & Hare's (2005) finding that anxiety scores were correlated with, and predicted, reported levels of delusional ideation in an AS sample, although their results were not specific to paranoia. Additionally, the size of these correlations was strikingly similar in these two studies.

The prevalence of clinically significant depression (moderate or higher levels) detected in the AS group in the current study was very high at 60 per cent in comparison to previous research. For example, Abell & Hare (2005) found that 15 per

cent of AS participants obtained depression scores within the moderate to severe range on the HADS (although 50 per cent of the sample reported depression when asked if they had any current mental health problems). Higher rates of depression were reported in a clinical case series of individuals with AS (Ghaziuddin, et al., 1998), but at 37 per cent, this level is still not as elevated as in the current AS sample. It is not clear why there should be such a discrepancy in these findings, but one possible contributing factor could be the significant proportion (70 per cent) of the AS group in the current study who received a diagnosis of AS in adulthood, which is a factor that influences the likelihood of individuals developing depression (Barnard, et al., 2001). The lower rate of depression reported in the Abell & Hare study could have been due to the choice of self-report questionnaire, which may not have been suited to AS participants, and this would explain the gap between reported rates of depression and HADS scores in that study. The significant correlation between depression and paranoia scores in the AS group in the current study fits with previous research findings. Even though the Abell & Hare study may not have picked up the true extent of depression in the AS sample, a medium-sized (but non-significant) correlation was still found between depression scores and levels of delusional beliefs.

The relationship found in the current study between paranoia scores and both depression and anxiety scores was unsurprising because the link between affective symptoms and paranoia has been established in psychosis literature (C. Green, et al., 2008; Guillem, et al., 2005; Norman & Malla, 1991) and it has been proposed that paranoid delusions build on emotional concerns (Freeman & Garety, 2004; Freeman, Garety, Bebbington, Smith, et al., 2005; Freeman, et al., 2002; Smith, et al., 2006). Furthermore, increased anxiety has even been shown to be predictive of paranoid thoughts (Freeman, Dunn, et al., 2005b; Freeman, et al., 2003).

Social anxiety and self-consciousness

The findings in the current study with regard to social anxiety and self-consciousness differ from previous research in a number of ways that may be of theoretical importance. Firstly, it is worth noting that the reported levels of social anxiety symptoms in the AS group in the current study, according to the SCS social anxiety subscale, were similar to levels found in AS samples in previous research (Abell & Hare, 2005; Blackshaw, et al., 2001; a comparison of all three SCS subscale scores reported in previous studies can be seen in Appendix 17). However, a significant difference was found between the AS and control group in

the current study with regard to social anxiety, but no difference was found between groups in Blackshaw, et al.'s research. The current finding (via the SCS social anxiety subscale) was backed up by scores on the SIAS, which also demonstrated a large, significant group difference with the majority of AS participants falling into the clinically significant range. Social anxiety in AS may be a consequence of accumulating negative social experiences such as victimisation (Ranta, et al., 2009), resulting from core difficulties with social interaction and communication, which over time become more aversive and are increasingly avoided. The current findings concur with clinical estimations that social phobia is probably the most commonly experienced anxiety-related disorder in individuals with AS (Tantam & Girgis, 2009) and typically leads to social withdrawal, resulting in a lack of social practice that can compound core social difficulties and may lead to further affective problems (Tantam & Girgis, 2009).

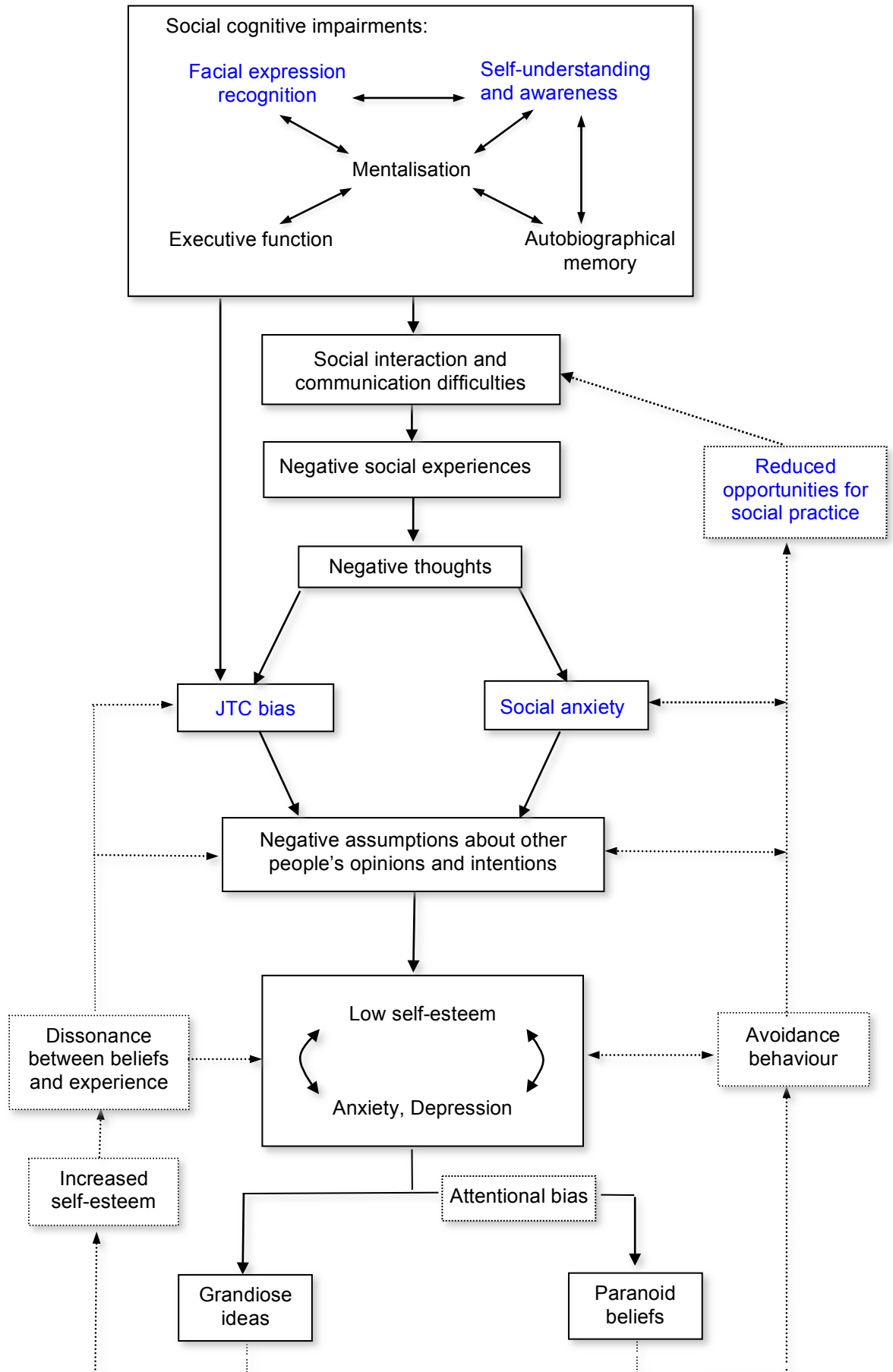
Fenigstein & Venable (1992) found that public self-consciousness, but not private self-consciousness, was associated with paranoia and that increased self-attention predicted feelings of being watched. However, these results were gained from questionnaire-based and experimental studies with college students, not individuals with AS. The existing literature does not provide convincing evidence that there are elevated levels of self-consciousness in AS (see appendix 17 for self-consciousness scores across studies). In the current study, there were no significant group differences for private or public self-consciousness scores, but Blackshaw, et al. reported significantly higher levels of private self-consciousness in their AS sample compared with a control group. It was also reported that private self-consciousness predicted levels of paranoia in the combined AS and control groups. However, the Blackshaw, et al. study had a smaller sample and unequally-sized groups that were not matched on key demographic variables such as age and sex, which may account for the discrepancies between the studies. Abell & Hare (2005) administered the SCS to a larger AS sample and found similar levels of private self-consciousness, public self-consciousness and social anxiety as found in the Blackshaw, et al. study. The difference was that none of these variables predicted paranoia scores in Abell & Hare's study, as was the case in the current study. Similarly, no difference in private self-consciousness was reported between an AS/HFA sample and control group in a study investigating self-referential cognition and, additionally, ASD participants were found to have less self-focus (Lombardo, et al., 2007). Hobson (1995) proposed that individuals with ASD have a reduced capacity for self-awareness and reflection, which was illustrated in a recent study

reporting that individuals with AS showed impaired self-understanding and an underdeveloped self-concept compared with a matched control group (Jackson, et al., 2011). It has also been established that self-awareness and self-understanding are interdependent with mentalising ability (Cooley, 1902; Lombardo, et al., 2007; G. Mead, 1982; Moriguchi, et al., 2006).

A revision of the model of the development and maintenance of delusional beliefs in AS

Abell & Hare (2005) proposed a preliminary model (see Figure 5) based on research evidence and drawing upon other cognitive models, which mapped out possible relationships between factors that were hypothesised to be involved in the development and maintenance of delusional beliefs in AS. Findings from the current study, other recent empirical evidence and the subsequent theoretical interpretations offered here, have been incorporated into this model to refine the formulation of mental health problems in AS, as a basis for future research. The new speculative revised model is presented in Figure 20 (new elements are indicated in blue) and it is suggested that this could serve as a guide for further examination of potential associations between the various factors included (recommendations for future research are outlined later). Facial expression recognition (of emotion) and self-understanding have been added to the 'cognitive impairments' cluster and self-consciousness has been removed from the model. These changes are based on findings from the current study of emotion recognition impairments in the AS group and no evidence of elevated self-consciousness, along with Jackson, et al.'s (2011) observation of a lack of self-understanding and awareness, which has previously been shown to be associated with mentalising ability (e.g. Moriguchi, et al., 2006). A specific role for the JTC bias has been included in the model based on current findings, which was tentatively placed in the previous version, but was perhaps not in the most appropriate position given the lack of a direct relationship with paranoia scores in the current study. As a relationship was evident between both the Eyes Test and the FERT with the Beads Task, a preliminary direct link has been suggested between social cognitive impairments and a JTC bias. Social anxiety has also been added to the model reflecting the elevated scores found in the current study, which feeds into avoidance behaviour, reducing opportunities for social practice, which in turn impacts upon social interaction difficulties. It is suggested that a tendency to jump to conclusions and/or vulnerability to social anxiety might be increased by negative thoughts resulting from negative social experiences and this

Figure 20: A model of the development and maintenance of mental health problems in AS



could lead to an increase in negative assumptions about others' opinions and intentions towards the self. This may in turn impact upon self-esteem and increase vulnerability to anxiety and/or depression, which could influence the development of paranoia. Responses on delusion assessment measures could reflect social misunderstanding and distress rather than actual delusions, as suggested by Abell & Hare (2005), and it has previously been discussed that at least in some cases, paranoid thoughts in individuals with AS may not be pathological but rather may be normal responses to negative social experiences (e.g. U. Frith, 2004). In acknowledgement of these points, the boxes in the model labelled 'paranoid delusions' and 'grandiose delusions' in the previous model have been changed to 'paranoid beliefs' and 'grandiose ideas'.

Critical analysis of the current study

This was a robust research study employing a range of appropriate assessment tools, including well-established experimental paradigms and a number of targeted, valid and reliable self-report questionnaires. The study included adequately sized samples and the AS and control participants were closely matched group-wise on age, sex and IQ scores. Preparation and consideration of the data pre-analysis was thorough and the subsequent choice of statistical analysis was appropriate to the sample size and the distribution of scores on the measures employed.

With regard to the specific experimental assessment tools utilised, the FERT is a sensitive measure of the ability to recognise emotions in facial expressions with proven discriminative power. Compared with other emotion recognition tasks that have previously been used in ASD research, the FERT has a number of advantages: the use of morphing techniques to produce a range of intensities of all basic emotions, the use of ecologically valid stimuli presentation times that are digitally controlled, a large number of presentations to increase reliability of findings and precise recording of reaction times and accuracy scores. Responses to each separate emotion were collected with this task, but were not analysed, as this was beyond the scope of the current study due to the amount of other data collected that was deemed necessary to test the hypotheses. There is always a chance when using facial expression tasks to assess emotion recognition that general perceptual processing deficits could influence results. However, this possibility was minimised by using the FERT because the length of stimulus presentation, which was precisely controlled, was long enough to be ecologically valid whilst leaving little time for local

versus global processing strategies. A clear benefit of using static, timed, computer-delivered stimuli is that it allows for a greater degree of control and precision in testing. However, it is not the same as real life interaction, which is a limitation of many experimental paradigms used to explore social cognition (and also applies to the Eyes Test and Beads Task). Therefore, it does not necessarily follow that findings can be generalised.

The version of the Beads Task used in the current study was chosen because it has been shown to highlight a data-gathering bias with consistency in the psychosis literature and it involves neutral stimuli, which ensures that reasoning biases are studied alone without potential confounding influences from more meaningful material. Other benefits included the control gained from computer presentation of the task, a memory aid for beads previously drawn and the use of the 'draws-to-decision' rule for discontinuation of the task, which has proved more informative in previous research than alternative approaches such as 'draws-to-certainty' (Fine, et al., 2007). Two conditions of the Beads Task were used in the current research to allow for comparisons at different levels of probability in order to explore whether this difference influenced data-gathering style. There is evidence to suggest that the harder condition of the Beads Task is more sensitive at discriminating differences between groups with attenuated biases such as those 'at risk' of psychosis (Yung et al., 1998), so the additional use of this in the current study increased the chance of finding group differences. It could be argued that the use of emotionally neutral stimuli such as beads in a jar does not reflect real life situations. Certain studies have employed more ecologically valid, self-referent or emotionally salient materials (Dudley, et al., 1997a; Warman, et al., 2007; Woodward, Mizrahi, Menon, & Christensen, 2009) that have similarly demonstrated a JTC bias in individuals with delusions. Some research has indicated that the emotionally-laden material increases the bias in data-gathering style (Dudley, et al., 1997a) but other studies have failed to find this effect (Fine, et al., 2007; Garety, et al., 2005). On balance, however, as the JTC bias has never been explored in AS before it was decided that the Beads Task should be used in the current research because it had been well tested and shown to be an uncomplicated and reliable paradigm.

A key benefit of using the Hinting Task was its good face validity as the stories included in it represent day-to-day scenarios that individuals could feasibly encounter. It was sensitive enough to detect group differences in mental state reasoning in this study but the control group scores were very close to ceiling and

the AS group scores were not far behind. There was one item in particular that consistently failed to elicit the required response from both groups after one hint, which obviously contributed to the control group not achieving full marks (Story 4, see Appendix 7 for details). Normally-functioning typical adults are not expected to demonstrate difficulties with ToM and this issue has been acknowledged as a problem in previous research (Corcoran & Frith, 2003), so the close-to-ceiling scores are not surprising but fortunately did not affect the analysis of data in the current study.

As stated previously, the choice of ToM tasks was intended to reflect different aspects of mentalisation, including the assessment of mental state decoding and mental state reasoning abilities, as well as being adequately pitched at the population under investigation. The results of the current study do indicate that different skills are measured with the Eyes Test and the Hinting Task and, furthermore, they raise concerns about the validity of the Eyes Test and question what it actually measures, which is unclear considering the association with the FERT. It may not be the best choice of ToM task in future research because of this ambiguity. However, its use in the current context served as a useful catalyst for discussion points. Methodological problems reflect wider issues with ToM research regarding the heterogeneous nature of tasks designed to measure mentalisation, lack of clarity about the possibility of sub-types of ToM skills and a lack of consensus about what the term ToM fundamentally describes. Considerable doubt has been cast upon the existence of ToM as a unitary and meaningful concept (Bowler, 2007) and for this reason it is debatable how much the conclusions of this particular study with regard to ToM, as with previous studies, are of importance in furthering understanding of AS.

This is not the first study to employ self-report measures to investigate cognitive and affective factors in AS, but the disadvantages of using questionnaires with this population should be acknowledged. The ability to self-reflect is required from participants when responding on self-report questionnaires and the possibility that this is a skill that is problematic for individuals with AS has already been discussed and may have come into play in this context. However, some of the factors measured through questionnaires, such as paranoid thoughts, can only be assessed by self-report due to their nature and all of the questionnaires used in the current study were carefully chosen from those available and proved to be fit for purpose. As an example, the PTS was a novel and suitable choice of measure for this study that

proved to be a sensitive and valid method for assessing paranoid thoughts and ideas in AS. It was chosen for its good psychometric properties, the fact that it was designed and validated for use in clinical and non-clinical populations, and it had the advantage of focusing solely on paranoia, rather than all types of delusions. Another potential issue, concerning the content of self-report questionnaires that are not specifically validated for use with AS individuals, is that the language used may not always be worded in the best way to facilitate understanding by this population and to elicit the most accurate reflection of their emotional and cognitive states. For example, it has been suggested that literal interpretations of questions can cause difficulties when administering psychometric measures (Attwood, 1998). Another issue that arose concerned qualitative feedback from one of the participants who admitted that he had been trying to choose the 'right' answers, which he explained was because he had 'obsessive tendencies' and that he wanted 'to please and be liked'.

There are benefits to using Internet-mediated research methods, such as surveys, particularly with AS populations. A qualitative study investigating social relationships in AS reported that participants cited the Internet as a preferred and important means of social communication (R. Jones & Meldal, 2001). In the current study, this method kept the amount of face-to-face contact required to a comfortable and practically manageable level for the participants. The online survey also allowed respondents to work through the questions at their own desired pace and the fact that they were able to answer on a computer rather than in person may have facilitated increased openness and reduced social desirability bias (Chang & Krosnick, 2010; Joinson, 2001). Internet-mediated research has also successfully been employed to investigate paranoia in non-clinical populations (Freeman, Dunn, et al., 2005a; Freeman, Garety, Bebbington, Smith, et al., 2005). The delivery of self-report questionnaires in the current study via an online survey also reduced the chance of inaccurate scoring as responses were automatically recorded in a database. The electronic delivery may also have contributed to the lack of missing values in the data as prompts were provided on screen to highlight missing answers, to give participants an opportunity to go back and fill them in.

AS participants were all recruited through specialist voluntary sector organisations, which could have introduced a potential selection bias. A large proportion (43 per cent) of individuals recruited into the AS group were from the same organisation, which provides a range of support services, as well as social and creative activities

for people with AS/HFA. The life experiences and level of satisfaction of members of this service was generally expected to differ positively from individuals without support and regular social contact. However, despite this, high levels of emotional disturbance were reported in the AS group as a whole. One of the inclusion criteria for the AS group was a formal, verifiable diagnosis of AS from a relevant health professional such as a psychologist or psychiatrist. Relying on the diagnoses of other professionals could have potentially introduced inconsistencies in the sample due to variation in diagnostic assessment approaches favoured by different clinicians, or could have led to people being included in the study who had been misdiagnosed. Diagnoses of AS are not made consistently in clinics or in research settings (Bristol et al., 1996; Volkmar, 2009) and it was beyond the scope of the current study to repeat a full diagnostic assessment, but an AS screening questionnaire was administered to minimise potential for recruitment errors.

Clinical considerations

The social cognitive abilities shown to be impaired in the current study and data-gathering style (i.e. mentalising, emotion recognition, JTC bias) could be assessed prior to clinical interventions to highlight any adaptations that may be necessary and to inform which therapeutic techniques are likely to be effective. Consideration of impairments in other, possibly related areas may also be useful, such as autobiographical memory, executive functioning, alexithymia and attentional biases. However, as previously suggested, it is important to be aware that performance on social cognitive tasks does not necessarily translate and generalise to real-life contexts, so abilities could be overestimated (Ponnet, Roeyers, Buysse, De Clercq, & Van Der Heyden, 2004).

Generally, it is suggested that interventions are not focused on attempts to change core deficits in those with ASD, but rather should emphasise finding ways of working around them (Hare, 2012). However, recent research has provided promising evidence indicating that underlying social cognitive impairments may be amenable to some improvement. For example, a group-based cognitive behavioural intervention called Social Cognitive and Interaction Training (SCIT; Roberts, Penn, & Combs, 2006), which was originally designed for adults with psychotic disorders, was modified and piloted in a small sample of adults with HFA (Turner-Brown, Perry, Dichter, Bodfish, & Penn, 2008). The intervention included 18 x 50-minute sessions covering three areas: 'emotion training', 'figuring out situations' and 'integration' of

ideas into real life. Unfortunately, aspects of the content present in the original package regarding paranoia and data-gathering biases were not considered relevant by the researchers for the ASD version and so were reduced. During the second phase, it was noted that individuals with HFA often did not reach useful conclusions about social situations and tended to focus more on irrelevant factors rather than socially relevant information. Significant improvements in mentalising skills and facial emotion recognition abilities were reported in the group receiving the SCIT intervention. However, there was no evidence that the improvements that were indicated via assessment measures translated to real-life interactions.

The current study found that data-gathering biases were associated with impairments in mental state decoding ability and facial emotion recognition deficits. Therefore, it is plausible, hypothetically, that any interventions that can help individuals with ASD to learn to take more time to consider available information in social situations before making assumptions or decisions could influence mentalising and emotion recognition abilities favourably. Conversely, targeting impairments in mentalising and emotion recognition might help to reduce JTC biases in individuals with ASD.

An interactive computer software programme was developed, *Mind Reading: The interactive guide to emotions* (Baron-Cohen, Golan, Wheelwright, & Hill, 2004), with the aim of systematically teaching emotion recognition to individuals with ASD. A number of studies have been conducted to test the efficacy of the programme, which have reported improvements in facial emotion expression recognition in small samples of adults and children with ASD (Golan & Baron-Cohen, 2006; Lacava, Golan, Baron-Cohen, & Smith Myles, 2007; Weinger & Depue, 2011) but as with the SCIT interventions, the generalisability of these effects is uncertain.

Other recent treatment approaches that have been developed to address social cognitive deficits and biases in individuals with psychosis could be adapted and tested in individuals with ASD. These new approaches, described by some researchers as 'metacognitive' therapy, typically combine psychoeducation, cognitive remediation and CBT with the aim of increasing awareness of cognitive biases (the metacognitive element) and to increase social insight. There is some preliminary evidence for the ability of these new approaches to improve JTC biases, emotion recognition and mental flexibility (Aghotor, et al., 2010; Moritz, Vitzthum, et al., 2010; Roncone et al., 2004; Ross, et al., 2009; Waller, et al., 2011). The processes involved in these types of interventions include both implicit

and explicit challenges of dysfunctional cognitive styles, an aspect that could be problematic for individuals with AS, who might experience this as personal value judgements, if not pitched appropriately (see Hare, 2012). Therefore, previously tested and successful adaptations using traditional CBT for people with ASD should be incorporated into any new therapeutic strategies, where possible.

The findings of the current study have added to the evidence base indicating that adults with AS are at increased risk of experiencing affective problems such as depression, general anxiety and social anxiety. It is mental health problems, such as these, that are likely to lead to an individual with AS presenting to services, despite the fact that psychosocial difficulties may have reduced the quality of life of the person well before support is received. CBT is currently considered to be the most appropriate psychotherapeutic approach to use with individuals with ASD who are suffering with mental health problems, with various adaptations to facilitate the process, as detailed by a number of case studies and RCTs (Bauminger, 2002; Hare, 1997; Reaven & Hepburn, 2003; Sofronoff, et al., 2005; Sofronoff, et al., 2007; Sung, et al., 2011; Sze & Wood, 2007, 2008; J. Wood, et al., 2009).

Any interventions offered to people with ASD should be needs-led, person-centred and driven by shared idiosyncratic formulations, which are derived from an assessment of presenting problems and concerns as well as an assessment of social cognitive limitations. Individual therapeutic work should ideally be combined with attempts to provide a broader support package, involving other relevant agencies, and the focus should be on helping the person to cope with the challenges of day-to-day life (Hare, 2012).

A final note on psychological interventions comes from the personal clinical experience of the current researcher. A young man was referred to an adult secondary care psychology service with 'suspected schizophrenia' who was already receiving antipsychotic medication. Following an extended assessment, it was considered that a diagnosis of AS was appropriate, which was confirmed formally about a year later. In the meantime, an individualised formulation was developed (based on the Abell & Hare, 2005 model) and a CBT intervention was undertaken (based on ideas from Freeman, Freeman, & Garety, 2006; Freeman & Garety, 2002) to deal with his suspicious thoughts, delusional beliefs, and associated anxiety, low mood and social avoidance, which was adapted to the individual's needs and level of functioning. An interesting example of one of the delusional beliefs that the client

divulged was the assumption that his parents had tried to poison him. When the situation was analysed carefully, it became apparent that he had jumped to this conclusion because he had misinterpreted concerned and caring social signals from them. They were 'behaving differently' towards him at a time when he was presenting as particularly low in mood, which involved paying him more attention than usual, sitting closely on the side of his bed and talking to him in a 'strange' tone of voice, and regularly bringing him cups of tea. To him, this behaviour was unfamiliar and 'suspicious'. He interpreted their facial expressions as 'a bit sinister', which he demonstrated to the therapist as an exaggerated grin. When a formulation of what might be happening for him was collaboratively developed, alternative explanations were generated and explored, the client was willing and able to accept that his initial ideas might be erroneous. Various psychometric and idiosyncratic outcome measures revealed significant improvement in self-esteem, mood, levels of anxiety and day-to-day functioning by the end of six months of weekly therapy sessions. The client was also beginning to re-engage in hobbies and interests and was taking small steps towards increasing his independence.

Recommendations for future research

The findings of the current study have highlighted a number of potentially useful areas of enquiry for future research, which fall into three categories: the development of clinical interventions, the further refinement of a model of the development of mental health problems (Figure 20) and methodology-related issues.

Although it remains unclear whether any shared underlying mechanisms and processes are involved in the difficulties experienced by people with ASD and those with psychosis, the common features that are observed suggest it would be premature to rule out adapting interventions developed for psychosis to this population. In particular, there are early indications that therapeutic programmes such as SCIT can be modified to this end so further trials of this sort would be beneficial. As previously suggested, the new wave of metacognitive therapies developed for psychosis could also be targets for modification for people with ASD, which would need to be developed empirically and piloted. Additionally, considering the positive outcomes of the single case described by the current researcher, it may be worth investigating the use of CBT for paranoid thoughts in AS further, initially as a case series, and if this meets with success, in small trials.

Further research is needed to clarify the components, processes and relationships between factors that are involved in the development of mental health problems, including 'delusional beliefs, in individuals with AS. A foundation has been laid with the Abell & Hare (2005) model, which would benefit from further refinement and testing, as suggested previously with the presentation of a revised model (Figure 20). For example, low self-esteem is thought to be an important contributory factor towards depression and anxiety, which in turn is hypothesised to lead to the development of paranoid or grandiose beliefs, but the differing mechanisms determining which of these emerges is unconfirmed.

Negative self-esteem also has a central role in Bentall's (2009) model of paranoia based on evidence that paranoid thinking is more prevalent in those who have experienced victimisation (Gracie, et al., 2007; Johns, et al., 2004). Paranoid thinking is also associated with an insecure attachment style (Dozier & Lee, 1995; Dozier, et al., 1991). The Bentall model states that both of these factors make it more likely that an individual will develop low self-esteem leading to paranoid beliefs via dopamine-mediated elevated threat anticipation. It may, therefore, be fruitful to explore similar possible relationships in AS samples, as experiences of victimisation (Tantam, 2000) and insecure attachment styles (Lau & Peterson, 2010) are more prevalent in ASD than the general population.

Attentional bias (for threat-related stimuli) also has a place in the AS model, as a mediating factor between depression/anxiety and paranoid beliefs, which could be examined more closely in future research. Attentional bias also has a key role in the Bentall (2009) model of paranoia. It would be valid to test whether individuals with AS pay more attention to potentially threatening social factors, as might be expected based on evidence in other populations (e.g. Wells and Matthews, 1994; Bentall, 2009), or less, as has recently been indicated in an emotion recognition eye-tracking study (Corden, et al., 2008). As the FERT has proved to be a valid and sensitive measure for use with an AS sample, which discriminated well between groups, it would be useful to explore this issue by combining the FERT with eye-tracking technology.

Negative life experiences, particularly those involving social interactions, could be at the root of most mental health problems in individuals with ASD (Kim, et al., 2000; Shtayermman, 2007; Tantam, 2000). Therefore, any future research aiming to explore these relationships further should include systematic measures of life

experiences. This would serve to facilitate empirical evaluation and consideration of the mediating position of these factors, in the current revised model, between social cognitive deficits and mental health difficulties.

Additionally, the inclusion of social anxiety in the revised model should be tested through further studies, in particular the hypothesis that negative social experiences may lead more directly to social anxiety in AS, rather than being mediated by increased public self-consciousness. Other factors to consider include the relationships between increased social anxiety, social withdrawal/avoidance and reduced opportunities to develop social competence.

The novel finding of a data-gathering bias that was revealed in the current study in the AS group could be investigated in more detail. The currently suggested position of the JTC bias in the revised model should be tested further, including the proposed direct links with facial expression recognition and ToM. Associations with the other social cognitive factors could also be explored, including executive function, autobiographical memory and self-understanding. The contribution of negative thinking towards data-gathering style and its potential influence on the formation of negative assumptions about other people's opinions and intentions should be empirically tested. It may also be informative to test out the theories that have been proposed for JTC biases in psychosis with AS samples to find out if they have any application, such as an elevated 'need for closure', over-extended confirmatory reasoning style and difficulties with the use of sequential information. Now that a JTC bias has been established in an AS sample through the use of the traditional Beads Task, it might be useful to test for this data-gathering style in AS with other tasks that have been used in psychosis research that are more self-referent and relevant to social experience and to assess whether this finding generalises well (i.e. if less information is collected in social environments before reaching conclusions about situations). It is relevant in this context to restate an observation from the SCIT study (Turner-Brown, et al., 2008) that individuals with autism frequently failed to reach useful conclusions about social situations and tended to focus more on irrelevant factors rather than socially relevant information.

A factor that has not previously been explored with regard to paranoia in AS is unusual sensory experiences, which are not uncommon in this population (Bogdashina, 2003; Harrison & Hare, 2004; O'Neill & Jones, 1997) and may be worth considering in future research. Similarly, the experience of auditory

hallucinations that has also been reported in a significant proportion of individuals with AS (Lugnegård, et al., 2011) appears to be under researched. Of relevance, a series of virtual-reality studies have indicated that 'anomalous perceptual experiences' are a mediating factor between elevated anxiety and paranoid reactions in social situations, in clinical and non-clinical samples (Freeman, Gittins, et al., 2008; Freeman, Pugh, et al., 2008; Freeman, et al., 2010). It would also be of interest to investigate whether the presence of a JTC bias in individuals with AS has any influence on the interpretation of unusual sensory experiences, which may increase the likelihood of misinterpretation and faulty inferences.

All of the previous quantitative investigations of 'delusional' beliefs in ASD have only studied AS samples, rather than the wider autism spectrum (Abell & Hare, 2005; Blackshaw, et al., 2001; Craig, et al., 2004; Meraj & Hare, 2004), as was the case with the current study. Therefore, more research is needed to explore these experiences and other psychosis-like phenomena in ASD more widely. This is likely to be more challenging for researchers due to the possibility of complicating variables, such as intellectual disability and language impairments, so it would be necessary to carefully design studies, taking these factors into account.

With regard to methodologies, it proposed that future research in the field of autism would benefit from the development of more assessment measures and experimental tasks that are designed specifically for this population. Approaches that have previously proved to be feasible and useful, such as personal construct techniques, time-sampling, computer-mediated assessment and more visual methods of psychometric assessment, could be used to explore some of the issues already raised here for future research. Virtual-reality has successfully been used to investigate paranoia and would allow more realistic social scenarios to be presented to individuals with ASD to assess a variety of factors such as processing biases, emotional reactions, mentalising ability and paranoid thinking.

The FERT was demonstrated in the current study to be an appropriate task for use with an AS sample and it provided precise and detailed data, however, information about individual emotion variables was not utilised. There is scope for investigating emotion recognition further with this paradigm in terms of the effect of various factors on the recognition of each of the six basic emotions. For example, the preliminary link that has previously been found between social anxiety and poor fear recognition (Corden, et al., 2008) could be one line of further enquiry. A new task, based on the

design and technology of the FERT, could be developed to investigate the recognition of more complex emotions in AS. It would also be interesting to combine the FERT with other technologies such as eye tracking and brain imaging for a more detailed analysis of emotion recognition in ASD.

CONCLUSION

This study investigated social cognitive mechanisms in a group of individuals with AS and found evidence that difficulties were experienced with mental state reasoning, mental state decoding and the recognition of emotions in facial expressions. The current findings contribute to existing evidence of impairments in these particular abilities, which has been inconclusive. Additionally, the study has demonstrated, for the first time, that those with AS tend to make decisions on the basis of limited evidence and many display a JTC bias in their data-gathering style. The association observed between performance on a probabilistic reasoning task (Beads Task) and both a facial expression recognition task (FERT) and a mental state decoding task (Eyes Test) indicates that these abilities may be affected by insufficient data gathering in individuals with AS. It was also found that the AS group reported higher levels of paranoid thoughts than the control group but these were not associated with any of the social cognitive processes that were examined. Higher levels of depression, general anxiety and social anxiety symptoms were also reported in the AS group compared with the control group. Levels of depression and general anxiety symptoms were found to be associated with levels of paranoid thoughts in the AS group. Further studies are needed to replicate the novel finding of a JTC bias in AS, to investigate its causes, to explore the implications of such a data-gathering bias for social experience and to further refine the model of the development of mental health problems in this population.

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APPENDICES

Appendix 1: The Autism Spectrum Quotient

How to fill out the questionnaire

Below is a list of statements. Please read each statement very carefully and rate how strongly you agree or disagree with it by circling your answer.

DO NOT MISS ANY STATEMENT OUT.

Examples

E1. I am willing to take risks.	definitely agree	slightly agree	slightly disagree	definitely disagree
E2. I like playing board games.	definitely agree	slightly agree	slightly disagree	definitely disagree
E3. I find learning to play musical instruments easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
E4. I am fascinated by other cultures.	definitely agree	slightly agree	slightly disagree	definitely disagree

1. I prefer to do things with others rather than on my own.	definitely agree	slightly agree	slightly disagree	definitely disagree
2. I prefer to do things the same way over and over again.	definitely agree	slightly agree	slightly disagree	definitely disagree
3. If I try to imagine something, I find it very easy to create a picture in my mind.	definitely agree	slightly agree	slightly disagree	definitely disagree
4. I frequently get so strongly absorbed in one thing that I lose sight of other things.	definitely agree	slightly agree	slightly disagree	definitely disagree
5. I often notice small sounds when others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
6. I usually notice car number plates or similar strings of information.	definitely agree	slightly agree	slightly disagree	definitely disagree
7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.	definitely agree	slightly agree	slightly disagree	definitely disagree
8. When I'm reading a story, I can easily imagine what the characters might look like.	definitely agree	slightly agree	slightly disagree	definitely disagree
9. I am fascinated by dates.	definitely agree	slightly agree	slightly disagree	definitely disagree
10. In a social group, I can easily keep track of several different people's conversations.	definitely agree	slightly agree	slightly disagree	definitely disagree
11. I find social situations easy.	definitely agree	slightly agree	slightly disagree	definitely disagree

12. I tend to notice details that others do not.	definitely agree	slightly agree	slightly disagree	definitely disagree
13. I would rather go to a library than a party.	definitely agree	slightly agree	slightly disagree	definitely disagree
14. I find making up stories easy.	definitely agree	slightly agree	slightly disagree	definitely disagree
15. I find myself drawn more strongly to people than to things.	definitely agree	slightly agree	slightly disagree	definitely disagree
16. I tend to have very strong interests, which I get upset about if I can't pursue.	definitely agree	slightly agree	slightly disagree	definitely disagree
17. I enjoy social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
18. When I talk, it isn't always easy for others to get a word in edgeways.	definitely agree	slightly agree	slightly disagree	definitely disagree
19. I am fascinated by numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree
20. When I'm reading a story, I find it difficult to work out the characters' intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
21. I don't particularly enjoy reading fiction.	definitely agree	slightly agree	slightly disagree	definitely disagree
22. I find it hard to make new friends.	definitely agree	slightly agree	slightly disagree	definitely disagree
23. I notice patterns in things all the time.	definitely agree	slightly agree	slightly disagree	definitely disagree
24. I would rather go to the theatre than a museum.	definitely agree	slightly agree	slightly disagree	definitely disagree
25. It does not upset me if my daily routine is disturbed.	definitely agree	slightly agree	slightly disagree	definitely disagree
26. I frequently find that I don't know how to keep a conversation going.	definitely agree	slightly agree	slightly disagree	definitely disagree
27. I find it easy to "read between the lines" when someone is talking to me.	definitely agree	slightly agree	slightly disagree	definitely disagree
28. I usually concentrate more on the whole picture, rather than the small details.	definitely agree	slightly agree	slightly disagree	definitely disagree
29. I am not very good at remembering phone numbers.	definitely agree	slightly agree	slightly disagree	definitely disagree
30. I don't usually notice small changes in a situation, or a person's appearance.	definitely agree	slightly agree	slightly disagree	definitely disagree
31. I know how to tell if someone listening to me is getting bored.	definitely agree	slightly agree	slightly disagree	definitely disagree
32. I find it easy to do more than one thing at once.	definitely agree	slightly agree	slightly disagree	definitely disagree
33. When I talk on the phone, I'm not sure when it's my turn to speak.	definitely agree	slightly agree	slightly disagree	definitely disagree
34. I enjoy doing things spontaneously.	definitely agree	slightly agree	slightly disagree	definitely disagree
35. I am often the last to understand the point of a joke.	definitely agree	slightly agree	slightly disagree	definitely disagree

36. I find it easy to work out what someone is thinking or feeling just by looking at their face.	definitely agree	slightly agree	slightly disagree	definitely disagree
37. If there is an interruption, I can switch back to what I was doing very quickly.	definitely agree	slightly agree	slightly disagree	definitely disagree
38. I am good at social chit-chat.	definitely agree	slightly agree	slightly disagree	definitely disagree
39. People often tell me that I keep going on and on about the same thing.	definitely agree	slightly agree	slightly disagree	definitely disagree
40. When I was young, I used to enjoy playing games involving pretending with other children.	definitely agree	slightly agree	slightly disagree	definitely disagree
41. I like to collect information about categories of things (e.g. types of car, types of bird, types	definitely agree	slightly agree	slightly disagree	definitely disagree
42. I find it difficult to imagine what it would be like to be someone else.	definitely agree	slightly agree	slightly disagree	definitely disagree
43. I like to plan any activities I participate in carefully.	definitely agree	slightly agree	slightly disagree	definitely disagree
44. I enjoy social occasions.	definitely agree	slightly agree	slightly disagree	definitely disagree
45. I find it difficult to work out people's intentions.	definitely agree	slightly agree	slightly disagree	definitely disagree
46. New situations make me anxious.	definitely agree	slightly agree	slightly disagree	definitely disagree
47. I enjoy meeting new people.	definitely agree	slightly agree	slightly disagree	definitely disagree
48. I am a good diplomat.	definitely agree	slightly agree	slightly disagree	definitely disagree
49. I am not very good at remembering people's date of birth.	definitely agree	slightly agree	slightly disagree	definitely disagree
50. I find it very easy to play games with children that involve pretending.	definitely agree	slightly agree	slightly disagree	definitely disagree

**Developed by:
The Autism Research Centre
University of Cambridge**

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Appendix 2: Self-Consciousness Scale Revised

Questionnaire 1

Please answer the following questions about yourself by clicking the appropriate option. For each of the statements, indicate how much each statement is like you by using the following scale:

- 3 = a lot like me
- 2 = somewhat like me
- 1 = a little like me
- 0 = not like me at all

I'm always trying to figure myself out.

3 - a lot like me

1. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I'm concerned about my style of doing things.

3 - a lot like me

2. 2 - somewhat like me

1 - a little like me

0 - not like me at all

It takes me time to get over my shyness in new situations.

3 - a lot like me

3. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I think about myself a lot.

3 - a lot like me

4. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I care a lot about how I present myself to others.

3 - a lot like me

5. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I often daydream about myself.

3 - a lot like me

6. 2 - somewhat like me

1 - a little like me

0 - not like me at all

It's hard for me to work when someone is watching me.

3 - a lot like me

7. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I never take a hard look at myself.

3 - a lot like me

8. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I get embarrassed very easily.

3 - a lot like me

9. 2 - somewhat like me

1 - a little like me

0 - not like me at all

I'm self-conscious about the way I look.

3 - a lot like me

10. 2 - somewhat like me

1 - a little like me

0 - not like me at all

- It's easy for me to talk to strangers.**
 3 - a lot like me
11. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I generally pay attention to my inner feelings.**
 3 - a lot like me
12. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I usually worry about making a good impression.**
 3 - a lot like me
13. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I'm constantly thinking about my reasons for doing things.**
 3 - a lot like me
14. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I feel nervous when I speak in front of a group.**
 3 - a lot like me
15. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- Before I leave my house, I check how I look.**
 3 - a lot like me
16. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I sometimes step back (in my mind) in order to examine myself from a distance.**
 3 - a lot like me
17. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I'm concerned about what other people think of me.**
 3 - a lot like me
18. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I'm quick to notice changes in my mood.**
 3 - a lot like me
19. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I'm usually aware of my appearance.**
 3 - a lot like me
20. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- I know the way my mind works when I work through a problem.**
 3 - a lot like me
21. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all
- Large groups make me nervous.**
 3 - a lot like me
22. 2 - somewhat like me
 1 - a little like me
 0 - not like me at all

Continue

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Appendix 3: Social Interaction Anxiety Scale

Questionnaire 2

For each question, please select a number to indicate the degree to which you feel the statement is characteristic or true of you. The rating scale is as follows:

- 0 = **Not at all** characteristic or true of me
1 = **Slightly** characteristic or true of me
2 = **Moderately** characteristic or true of me
3 = **Very** characteristic or true of me
4 = **Extremely** characteristic or true of me

I get nervous if I have to speak with someone in authority (teacher, boss, etc.)

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
1. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I have difficulty making eye contact with others

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
2. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I become tense if I have to talk about myself or my feelings

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
3. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I find difficulty mixing comfortably with the people I work with

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
4. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I find it easy to make friends of my own age

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
5. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I tense-up if I meet an acquaintance in the street

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
6. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

When mixing socially, I am uncomfortable

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
7. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I feel tense if I am alone with just one other person

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
8. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

I am at ease meeting people at parties, etc.

- 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
9. 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

- I have difficulty talking with other people**
10. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I find it easy to think of things to talk about**
11. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I worry about expressing myself in case I appear awkward**
12. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I find it difficult to disagree with another's point of view**
13. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I have difficulty talking to attractive persons of the opposite sex**
14. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I find myself worrying that I won't know what to say in social situations**
15. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I am nervous mixing with people I don't know very well**
16. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I feel I'll say something embarrassing when talking**
17. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- When mixing in a group, I find myself worrying that I will be ignored**
18. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I am tense mixing in a group**
19. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me
- I am unsure whether to greet someone I know only slightly**
20. 0 - **Not at all** characteristic or true of me
 1 - **Slightly** characteristic or true of me
 2 - **Moderately** characteristic or true of me
 3 - **Very** characteristic or true of me
 4 - **Extremely** characteristic or true of me

Continue

Appendix 4: PHQ-9

Questionnaire 3

Over the last 2 weeks, how often have you been bothered by any of the following problems?

1. Little interest or pleasure in doing things

- Not at all
- Several days
- More than half the days
- Nearly every day

2. Feeling down, depressed, or hopeless

- Not at all
- Several days
- More than half the days
- Nearly every day

3. Trouble falling or staying asleep, or sleeping too much

- Not at all
- Several days
- More than half the days
- Nearly every day

4. Feeling tired or having little energy

- Not at all
- Several days
- More than half the days
- Nearly every day

5. Poor appetite or overeating

- Not at all
- Several days
- More than half the days
- Nearly every day

6. Feeling bad about yourself - or that you are a failure or have let yourself or your family down

- Not at all
- Several days
- More than half the days
- Nearly every day

7. Trouble concentrating on things, such as reading the newspaper or watching television

- Not at all
- Several days
- More than half the days
- Nearly every day

8. Moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual

- Not at all
- Several days
- More than half the days
- Nearly every day

9. Thoughts that you would be better off dead or of hurting yourself in some way

- Not at all
- Several days
- More than half the days
- Nearly every day

(Continue)

Appendix 5: GAD-7

Questionnaire 3

Over the last 2 weeks, how often have you been bothered by any of the following problems?

Feeling nervous, anxious or on edge

Not at all

1. Several days
 More than half the days
 Nearly every day

Not being able to stop or control worrying

Not at all

2. Several days
 More than half the days
 Nearly every day

Worrying too much about different things

Not at all

3. Several days
 More than half the days
 Nearly every day

Trouble relaxing

Not at all

4. Several days
 More than half the days
 Nearly every day

Being so restless that it is hard to sit still

Not at all

5. Several days
 More than half the days
 Nearly every day

Becoming easily annoyed or irritable

Not at all

6. Several days
 More than half the days
 Nearly every day

Feeling afraid as if something awful might happen

Not at all

7. Several days
 More than half the days
 Nearly every day

[Continue](#)

Appendix 6: Paranoid Thought Scales

Questionnaire 5

Please read each of the statements carefully. They refer to thoughts and feelings you may have had **about others over the last month**. Think about the **last month** and indicate the extent of these feelings from **1 (Not at all)** to **5 (Totally)**. **Please complete both Part A and Part B.** (N.B. Please do not rate items according to any experiences you may have had under the influence of drugs.)

Part A	Not at all	Totally
1. I spent time thinking about friends gossiping about me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
2. I often heard people referring to me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
3. I have been upset by friends and colleagues judging me critically	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
4. People definitely laughed at me behind my back	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
5. I have been thinking a lot about people avoiding me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
6. People have been dropping hints for me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
7. I believed that certain people were not what they seemed	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
8. People talking about me behind my back upset me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
9. I was convinced that people were singling me out	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
10. I was certain that people have followed me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
11. Certain people were hostile towards me personally	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
12. People have been checking up on me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
13. I was stressed out by people watching me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
14. I was frustrated by people laughing at me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
15. I was worried by people's undue interest in me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
16. It was hard to stop thinking about people talking about me behind my back	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
Part B	Not at all	Totally
1. Certain individuals have had it in for me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
2. I have definitely been persecuted	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
3. People have intended me harm	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
4. People wanted me to feel threatened, so they stared at me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
5. I was sure certain people did things in order to annoy me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
6. I was convinced there was a conspiracy against me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
7. I was sure someone wanted to hurt me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
8. I was distressed by people wanting to harm me in some way	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
9. I was preoccupied with thoughts of people trying to upset me deliberately	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
10. I couldn't stop thinking about people wanting to confuse me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
11. I was distressed by being persecuted	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
12. I was annoyed because others wanted to deliberately upset me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
13. The thought that people were persecuting me played on my mind	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
14. It was difficult to stop thinking about people wanting to make me feel bad	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
15. People have been hostile towards me on purpose	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	
16. I was angry that someone wanted to hurt me	○ 1 ○ 2 ○ 3 ○ 4 ○ 5	

Continue

Appendix 7: The Hinting Task

HINTING TASK

Instructions: I am going to read out a set of 10 stories involving two people. Each story ends with one of the characters saying something. When I have read the stories out I am going to ask you some questions about what the character said. Here is the first story. Listen carefully to it.

Story 1

George arrives in Angela's office after a long and hot journey down the motorway. Angela immediately begins to talk about some business ideas. George interrupts Angela saying:

"My, my! It was a long, hot journey down that motorway!"

QUESTION: What does George really mean when he says this?

Answer: George means either "Can I have a drink" and/or "Can I have a few minutes to settle down after my journey before we start talking business". Either of these responses would score 2.

If a correct response is not give for the first hint (e.g. the participant just replies something like "He means exactly what he says") then introduce next part of the story / hint.

ADD: George goes on to say:
"I'm parched!"

QUESTION: What does George want Angela to do?

Answer: George wants Angela to get him or offer to get him a drink. This response would score 1. Anything else would be given a score of 0.

Story 2

Melissa goes to the bathroom for a shower. Anne has just had a bath. Melissa notices the bath is dirty so she calls upstairs to Anne:

"Couldn't you find the Ajax, Anne?"

QUESTION: What does Melissa really mean when she says this?

Answer: Melissa means "Why didn't you clean out the bath" or "Go and clean out the bath now". This response would be given a score of 2 and next item would be introduced

If the participant fails to give the correct answer at this stage then:

ADD: Melissa goes on to say:
"You're very lazy sometimes, Anne!"

QUESTION: What does Melissa want Anne to do?

Answer: Melissa wants Anne to clean out the bath. This response would score 1. Any other response would be given a score of 0.

Story 3

Gordon goes to the supermarket with his mum. They arrive at the sweetie aisle. Gordon says:

"Cor! Those treacle toffees look delicious."

QUESTION: What does Gordon really mean when he says this?

Answer: Gordon means "Please buy me some sweets, mum"

ADD: Gordon goes on to say:

"I'm hungry, mum."

QUESTION: What does Gordon want his mum to do?

Answer: Buy him some sweets.

Story 4

Paul has to go to an interview and he's running late. While he is cleaning his shoes, he says to his wife, Jane:

"I want to wear that blue shirt but it's very creased."

QUESTION: What does Paul really mean when he says this?

Answer: Paul means "Will you iron my shirt for me please?"

ADD: Paul goes on to say:

"It's in the ironing basket."

QUESTION: What does Paul want Jane to do?

Answer: Iron his shirt

Story 5

Lucy is broke but she wants to go out in the evening. She knows that David has just been paid. She says to him:

"I'm flat broke! Things are so expensive these days."

QUESTION: What does Lucy really mean when she says this?

Answer: Lucy means "Will you lend me some money David?" OR "Will you take me out tonight and pay?"

ADD: Lucy goes on to say:

"Oh well, I suppose I'll have to miss my night out."

QUESTION: What does Lucy want David to do?

Answer: She wants David to lend her money or offer to take her out and pay.

Story 6

Donald wants to run a project at work but Richard, his boss, has asked someone else to run it. Donald says:

"What a pity. I'm not too busy at the moment."

QUESTION: What does Donald really mean when he says this?

Answer: Donald means " Please change your mind Richard and give the project to me"

ADD: Donald goes on to say:

"That project is right up my street."

QUESTION: What does Donald want Richard to do?

Answer: Change his mind and give the project to him to run

Story 7

Rebecca's birthday is approaching. She says to her Dad:

"I love animals, especially dogs."

QUESTION: What does Rebecca really mean when she says this?

Answer: "Will you buy me a dog for my birthday Dad?"

ADD: Rebecca goes on to say:

"Will the pet shop be open on my birthday, Dad?"

QUESTION: What does Rebecca want her dad to do?

Answer: to say he'll buy her a dog for her birthday/ buy her a dog for her birthday

Story 8

Betty and Michael moved into their new house a week ago. Betty has been unpacking some ornaments. She says to Michael:

"Have you unpacked those shelves we bought, Michael?"

QUESTION: What does Betty really mean when she says this?

Answer: Betty means "Will you put those shelves up now please?"

ADD: Betty goes on to say:

"If you want something doing you have to do it yourself!"

QUESTION: What does Betty want Michael to do?

Story 9

Jessica and Max are playing with a train set. Jessica has the blue train and Max has the red one. Jessica says to Max:

"I don't like this train."

QUESTION: What does Jessica really mean when she says this?

Answer: Jessica means, "I want your train and you can have mine".

ADD: Jessica goes on to say:

"Red is my favourite colour."

QUESTION: What does Jessica want Max to do?

Story 10

Patsy is just getting off the train with three heavy cases. John is standing behind her. Patsy says to John:

"Gosh! These cases are a nuisance."

QUESTION: What did Patsy really mean when she said this?

Answer: Patsy means " Would you help me with my luggage please"

ADD: Patsy goes on to say:

"I don't know if I can manage all three."

QUESTION: What does Patsy want John to do?

Answer: help her with her cases.

Appendix 8: School of Psychological Sciences Ethics Committee approval

The University of Manchester
School of Psychological Sciences
Research Ethics Committee

Monday 15th February 2010

1. Minutes

Minutes of the meeting on 1st February 2010 were approved.

2. Matters arising

3. Decisions of the Ethics Committee

When applicants have found their application below, they should note the following instructions on what to do next:

If the decision is: Final Approval

Correct any minor points mentioned and submit copies of any amended documentation to the SREC in advance of collecting data. The project may commence.

If the decision is: Conditional approval

Overall, the project is satisfactory but some changes are required. The project may not start until you receive Final Approval.

1. Download the Amendments Coversheet from the Intranet. Detail the changes you have made in the space provided. Submit the documents you have been asked to amend or include (highlighting any changes made).
2. Leave the documents in the Ethics Amendments/Resubmissions pigeon hole. Amendments are reviewed between meetings wherever possible, however if this is not possible they will be taken to the next scheduled meeting.

If the decision is: Resubmission required

There are several major concerns with the project and the Committee have tried to make suggestions to fix some of these issues. Please note that when you resubmit your application it will be reviewed as a complete new study and therefore there may be additional issues. Please read your revision carefully before submitting, to avoid unnecessary delays.

1. Re-submit all documents, including the resubmission cover sheet, making the changes requested by the SREC. Use the original reference number unless instructed otherwise.
2. Leave the documents in the Ethics Amendments/Resubmissions pigeon hole by 5pm on the Monday one week prior to the meeting in which you would like your resubmission reviewed.

The following projects have been reviewed:

1. Amendments received and noted.

Decision: Approved

Ref: 594/07P
Title: An investigation of social cognitive mechanisms in Asperger Syndrome and their contribution to the developmental of delusional beliefs.
Type: PG research
Level: Level 2
Research Group: Clinical Psychology
Participants: 60
Methodology: questionnaire and testing
Supervisor: Dougal Hare
Author1: Claire Jansch
Comments: Amendments received and noted.

Appendix 9: Division of Clinical Psychology Research Subcommittee letter

The University
of Manchester

MANCHESTER
1824

Division of Clinical Psychology
2nd Floor Zochonis Building

School of Psychological Sciences
The University of Manchester
Oxford Road
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M13 9PL

tel +44(0)161 306 0280
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Tel: +44(0)161 306 0400 /0400
Fax: +44(0)161 306 0406
Email: joyce.d.russell@manchester.ac.uk

Claire Jansch
3 Dalveen Avenue
Davyhulme
Manchester
M41 7DP

17 November 2008

Dear Claire,

Re: Feedback from Research Sub-committee

Thank you for your revised research proposal which was considered by the Research Sub-Committee Meeting on 17 November 2008. The committee were satisfied that the revisions made were appropriate and in accordance with the feedback from the meeting of 13 October 2008 and you may now proceed with the research project as set out in your revised proposal.

However, the panel would like you to consider the following recommendations before proceeding with your project:

1. Specify your hypotheses further by making predictions about the direction, i.e. which group will be higher in scores on which tests.
2. Specify your mediators.
3. Consider including a screen questionnaire for the non-AS group.
4. You may want to revise your proposal to reflect these changes.

For the purposes of ethical scrutiny by relevant NHS and/or University bodies, this letter may be taken as confirmation that your research proposal has been independently reviewed and that it is considered to meet necessary scientific and methodological standards.

On behalf of the Research Subcommittee, we wish you good luck with your research work.

Yours sincerely



Dr Anja Wittkowski
Lecturer in Clinical Psychology
Panel Chair, Research Subcommittee

cc Dr Dougal Hare

Appendix 10: NAS approval and recruitment support form

School Research Ethics Committee
 School of Psychological Sciences
 The University of Manchester
 Coupland 1 Building
 Oxford Road
 M13 9PL

Re project: An investigation of social cognitive mechanisms in Aspergers Syndrome and their contribution to the development of delusional beliefs

Conducted by: Claire Jansch

	Please tick
I confirm that I have read the protocol for the above named study	✓
I agree to assist the researcher named above in the recruitment of participants for the project named above, through our organisation.	✓
I understand that participation will be on the basis of opt-in consent (i.e. potential participants will be given the participant information sheet and will then decide whether they want to take part or not and will be asked for written consent).	✓
I agree for the study to be conducted on our premises (if applicable)	✓

Name of Organisation: THE NATIONAL AUTISTIC SOCIETY.

Your name: RICHARD MILLS

Title: DIRECTOR OF RESEARCH

Signature: [Handwritten Signature] Date: 30/03/2010

Comments: Please let me know if I can be of further assistance.

Thank you for completing the form. We appreciate your opinions and find them very helpful. Please bear in mind that the School Research Ethics Committee is required to implement strict ethical guidelines from both the University and from the British Psychological Society. In some cases, we may feel that a study requires a higher level of consent than you have agreed to. In these cases, the researchers will inform you and, provided that you agree with the revised level of consent, we would ask you to sign an amended form.

**This project has been approved by the
 School of Psychological Sciences Research Ethics Committee (ref 594/07P)**

Appendix 11: Participant Information Sheet

SCHOOL OF PSYCHOLOGICAL SCIENCES

Participant Information Sheet

Title of project: An investigation of social cognitive mechanisms in Asperger Syndrome

Lead researcher: Claire Jansch

Project supervisor: Dr Dougal Hare

Introduction

The study aims to investigate the way that people with a diagnosis of Asperger Syndrome (AS) manage social information and whether they differ from people without AS on tasks that measure different types of social information processing.

For example, one task will examine the way participants recognise emotions in facial expressions, a second task will test whether people 'jump to conclusions' when making decisions. In another task participants will be presented with a number of different short stories about social situations followed by questions about the intentions of the people in the situations.

Some previous research has suggested that factors such as self-consciousness or social anxiety, and low-mood might affect the way an individual copes with social information. Therefore, the current study will also investigate whether there are links between these things.

What will I be asked to do if I take part?

Firstly, you will be asked to complete several questionnaires online (or paper if you do not have access to a computer). This first part will take approximately 20-minutes.

You will then be invited to meet with the researcher to complete a number of tasks – some will be on a computer and some will involve being asked questions by the researcher. This second part is likely to take between 1-2 hours. The researcher will arrange a place to meet that is convenient to you and you will be reimbursed for any travel expenses.

Will my information be confidential?

Your personal information (name and contact details) will be kept confidential and will be stored separately from the information you provide during the study, such as your answers to questionnaires and scores on tasks. You will be assigned a number, which will be used on all of your data instead of your name so that you will be anonymous.

Only the lead researcher will have a record of your name and contact details and this will be kept securely in an encrypted document. After completion of the project all data will be stored in a completely anonymous format and your personal details will be deleted.

However, you should be aware that there are situations where confidentiality cannot be upheld - if any information that you give during the study suggests that you or someone else could be at risk of being harmed, this would have to be passed on to other professionals.

Do I have to take part?

You do not have to take part in the study. It is entirely your choice. If you decide to take part and then later change your mind, either before you start the study or during it, you can withdraw without giving your reasons, and, if you wish, your data will be destroyed. As all data will be stored in a completely anonymous format after completion of the project, it will not be possible to identify or delete specific participant data.

Where can I obtain further information if I need it?

If you would like further information or would like to ask any questions about the study before deciding whether or not to take part please contact Claire Jansch either by email at claire.jansch@postgrad.manchester.ac.uk or call the Division of Clinical Psychology on 0161 306 0400 and leave your contact details and she will get back to you.

What if I feel concerned about any of the issues raised during the study?

If you are concerned by any of the issues raised during this study you can contact Dr Dougal Hare on 0161 306 0400.

Generally, if you feel you need to talk to someone about anxieties or any other personal distress, or are concerned about any symptoms mentioned in the questionnaires you complete, you should contact your GP or the National Autistic Society help line: 0845 070 4004 open 10am-4pm, Monday-Friday.

**This project has been approved by the
School of Psychological Sciences Research Ethics Committee (ref 594/07P)**

Appendix 12: Consent form (paper version)

The University of Manchester



Project no 594/07P

SCHOOL OF PSYCHOLOGICAL SCIENCES

Consent form

Title of Project: An investigation of social cognitive mechanisms in Asperger Syndrome

	please delete as necessary and initial
1. Have you read the Participant Information Sheet?	YES/NO Initials:.....
2. Have you received enough information about the study?	YES/NO Initials:.....
3. Do you understand that you do not need to take part in the study and if you do choose to enter the study you are free to withdraw at any time, without having to give a reason for withdrawing and without detriment to you?	YES/NO Initials:.....
4. Do you understand that confidentiality will be broken in the event that you or anyone else is believed to be at risk of harm?	YES/NO Initials:.....
5. Do you agree to take part in this study?	YES/NO Initials:.....

Name of participant: **Signed:** **Date:**

Name of researcher: **Signed:** **Date:**

**This project has been approved by the
School of Psychological Sciences Research Ethics Committee (ref 594/07P)**

Appendix 13: Recruitment advertisement

Participants needed for research about how individuals with Asperger Syndrome process social information

A doctoral researcher at the University of Manchester is looking for people with Asperger Syndrome to take part in a new study. The research aims to investigate the way that people with a diagnosis of Asperger Syndrome (AS) manage social information and whether they differ from people without AS on tasks that measure different types of social information processing.

For example, one task will examine the way participants recognise emotions in facial expressions, a second task will test whether people 'jump to conclusions' when making decisions in social situations. In another task, participants will be presented with a number of different short stories about social situations followed by questions about the intentions of the people in them.

Some previous research has suggested that factors such as self-consciousness or social anxiety, and low mood might affect the way an individual copes with social information. Therefore, the current study will also investigate whether there are links between these things.

Anyone with a diagnosis of AS, above the age of 16, can take part, you do not necessarily need to have experienced any of the above problems.

Participants are asked to fill in some questionnaires online (or paper), which would take approximately 15 minutes. You would then meet with the researcher to carry out the experimental tasks, which usually takes about an hour. All results will be confidential.

If you would like further information and might be interested in taking part, please email Claire Jansch at claire.jansch@postgrad.manchester.ac.uk or call The Division of Clinical Psychology on 0161 306 0400 and leave your contact details and she will get back to you.

This project has been approved by the School of Psychological Sciences Research Ethics Committee (ref 594/07P) at the University of Manchester

Appendix 14: Front page of online survey

The University of Manchester

MANCHESTER 1824

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An investigation of social cognitive mechanisms in Asperger Syndrome

Welcome to the first part of the study. This involves completing five short questionnaires that will ask you about social interaction, self-consciousness, mood, anxiety and suspicious thoughts. This will take approximately 15-minutes.

Please answer all questions to the best of your ability, even if you think they do not really apply to you. You don't need to spend too long thinking about the questions, just go with the answer that sounds most accurate, even if it is not exactly what you would say.

Remember that your answers are confidential so please respond honestly.

If you have not yet received and read through a copy of the Participant Information Sheet, please click [here](#).

[Please click here to start the study](#)

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Appendix 15: Consent form (online)



School of Psychological Sciences

An investigation of social cognitive mechanisms in Asperger Syndrome

Consent Form

Before you register to take part in this study, we are required to ask you to indicate your consent by answering the questions below.

1. Have you read the Participant Information Sheet?

- Yes
 No

2. Have you received enough information about the study?

- Yes
 No

3. Do you understand that you do not need to take part in the study and if you do enter you are free to withdraw:

- at any time
- without having to give a reason for withdrawing
- and without detriment to you?

- Yes
 No

4. Do you agree to take part in this study?

- Yes
 No

5. Log in.

Please enter the ID code you have been given for this study

Please enter the password you have been given

To print this page, please click on the print button in your browser.

This project has been approved by the School of Psychological Sciences Research Ethics Committee.

Research Ethics Committee
School of Psychological Sciences
The University of Manchester
Oxford Road
Manchester
M13 9PL

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Appendix 16: Experimental tasks correlation matrix

Group			Beads A	Beads B	Hinting score	Eyes % Acc	Eyes Mean RT	FERT Tot % Acc	FERT Mean RT
AS	Beads A	Correlation	1.000	.771**	.024	.363*	.060	.319	-.027
		Sig. (2-tailed)	.	.000	.898	.048	.754	.086	.887
		N	30	30	30	30	30	30	30
	Beads B	Correlation	.771**	1.000	.138	.407*	-.044	.362*	-.201
		Sig. (2-tailed)	.000	.	.466	.026	.818	.050	.286
		N	30	30	30	30	30	30	30
	Hinting score	Correlation	.024	.138	1.000	.265	.115	.306	.168
		Sig. (2-tailed)	.898	.466	.	.157	.546	.100	.375
		N	30	30	30	30	30	30	30
	Eyes % Acc	Correlation	.363*	.407*	.265	1.000	.267	.543**	.119
		Sig. (2-tailed)	.048	.026	.157	.	.153	.002	.529
		N	30	30	30	30	30	30	30
Eyes Mean RT	Correlation	.060	-.044	.115	.267	1.000	.238	.615**	
	Sig. (2-tailed)	.754	.818	.546	.153	.	.206	.000	
	N	30	30	30	30	30	30	30	
FERT Tot % Acc	Correlation	.319	.362*	.306	.543**	.238	1.000	-.026	
	Sig. (2-tailed)	.086	.050	.100	.002	.206	.	.892	
	N	30	30	30	30	30	30	30	
FERT Mean RT	Correlation	-.027	-.201	.168	.119	.615**	-.026	1.000	
	Sig. (2-tailed)	.887	.286	.375	.529	.000	.892	.	
	N	30	30	30	30	30	30	30	
Control	Beads A	Correlation	1.000	.251	-.042	.021	-.138	-.257	.030
		Sig. (2-tailed)	.	.181	.828	.913	.469	.171	.874
		N	30	30	30	30	30	30	30
	Beads B	Correlation	.251	1.000	.032	.389*	.354	-.157	.089
		Sig. (2-tailed)	.181	.	.868	.033	.055	.407	.641
		N	30	30	30	30	30	30	30
	Hinting score	Correlation	-.042	.032	1.000	.272	-.282	.463*	-.182
		Sig. (2-tailed)	.828	.868	.	.146	.131	.010	.337
		N	30	30	30	30	30	30	30
	Eyes % Acc	Correlation	.021	.389*	.272	1.000	-.017	.160	-.026
		Sig. (2-tailed)	.913	.033	.146	.	.928	.399	.891
		N	30	30	30	30	30	30	30
Eyes Mean RT	Correlation	-.138	.354	-.282	-.017	1.000	-.097	.491**	
	Sig. (2-tailed)	.469	.055	.131	.928	.	.608	.006	
	N	30	30	30	30	30	30	30	
FERT Tot % Acc	Correlation	-.257	-.157	.463*	.160	-.097	1.000	-.117	
	Sig. (2-tailed)	.171	.407	.010	.399	.608	.	.539	
	N	30	30	30	30	30	30	30	
FERT Mean RT	Correlation	.030	.089	-.182	-.026	.491**	-.117	1.000	
	Sig. (2-tailed)	.874	.641	.337	.891	.006	.539	.	
	N	30	30	30	30	30	30	30	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Appendix 17: Mean scores on SCS subscales across studies

Study	N=	Private SC	Public SC	Social anxiety
Current AS sample	30	14.7	11	12.6
Current controls	30	13.4	12.2	5.4
Abell & Hare (2005) AS sample	46	24.7	15.8	14.2
Blackshaw e.al. (2001) AS sample	25	23	17	13.4
Blackshaw et al. (2001) controls	18	18.7	18.2	13.9
Fenigstein et al. (1975) students	432	26	19	13