

**SELF REFERENTIAL AND SOCIAL COGNITION IN ADOLESCENTS WITH
AUTISTIC SPECTRUM DISORDERS**

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Submitted in accordance with the requirements for the degree of

Doctor of Clinical Psychology (D. Clin. Psychol.)

The University of Leeds

Academic Unit of Psychiatry and Behavioural Sciences

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August 2012

The candidate confirms that the work submitted is his/her own and that appropriate credit has been given where reference has been made to the work of others

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ACKNOWLEDGEMENTS

I would like to sincerely thank Dr Chris Moulin for his excellent, tireless support and supervision. In particular, I would like to thank him and Sylvie Collins for their understanding and advice during a difficult period part way through my Dclin Psych Doctorate. Chris's speedy feedback during write up has also been greatly valued.

I would like to thank all the participants who kindly took part in the study; without them research would grind to a halt.

I would also like to thank my family, in particular Michael, Glenys and John, for their constant, unconditional support, and for helping with proof reading. I'm also very grateful to my wonderful niece Bethany for helping me trial my testing.

Finally, due appreciation is given to my friends, both on and outside the doctorate course, but particularly those who shared the Dclin journey. Long may putting the world to rights over a pint at the Fav continue.

Damian Woods,

Leeds, 29/07/12

ABSTRACT

A dominant social cognition model has construed the central socio-communicative impairments in Autistic Spectrum Disorders (ASDs) as deficits in understanding others' minds- what other people know, intend, believe and feel. Difficulties for individuals with ASD have been well documented on "Theory of Mind" (TOM) tasks designed to tap these skills (Boucher, 2012). Recently however, research has shifted toward exploring how individuals with ASD understand their *own* minds, and to look at the cognitive mechanisms involved in thinking about "the self". The present thesis is situated in the context of this emerging self-referential cognition (SRC) research, including its close connection to social cognition.

This thesis explored the quantitative and qualitative differences in neurotypical (NT) adolescents and those with ASD in generating self-images (e.g. concepts such as *I am a female, I am a footballer, I am kind*) through use of novel fluency tasks (the 'I Am' and '(s)he is' tasks) based on the Twenty Statements Test (TST; Kuhn and McPartland, 1954). Relationships between these tasks and social cognition (TOM measures) were also explored. The results indicated that both NT adolescents and those with ASD exhibited a self-reference effect (SRE), generating more statements about themselves than other people. The magnitude of the SREs was found to be significantly related to several TOM measures such as performance on the Mind in the Eyes task of emotion recognition. Moreover, the ASD group produced significantly less personal attributions across all fluency tasks, but a similar number of social and physical attributions, compared to the NT group. This mirrored emerging findings that indicate a specific deficit in psychological but not physical self awareness in ASD (e.g. Williams, 2010). Additionally, the ASD group were found to make significantly fewer spontaneous social stereotypes on the (s)he is tasks, such as the "Beauty is Good" stereotype, a finding which contrasts with previous research showing preserved social stereotyping in children with ASD (Fonesca et al, 2011). The theoretical and clinical implications of these findings for individuals with ASD are discussed with reference to the "absent-self hypothesis" (e.g. Frith, 2003). Additionally, the promising utility of fluency measures in capturing important aspects of SRC are also noted, including suggestions for further research.

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ABBREVIATIONS

ASD: Autistic Spectrum Disorder

AS: Asperger Syndrome

EAM: Episodic Semantic memory

EF: Executive Functions

FOTOM: First Order Theory of Mind

HFA: High functioning autism

LTM: Long Term Memory

NT: Neurotypical

PFC: Prefrontal cortex

SAK: Semantic Autobiographical memory

SOTOM: Second Order Theory of Mind

SMT: Social Motivation Theory

SRC: Self Referential Cognition

SRE: Self Reference Effect

SUI: Self Understanding Interview

TOM: Theory of Mind

TST: Twenty Statements Task

WCC: Weak Central Coherence

1.0 GENERAL INTRODUCTION

“He that knows himself knows others”

-Charles Caleb Colton (1780–1832)

1.1. OVERVIEW

Autistic Spectrum Disorders (ASDs) are characterized by wide ranging and varied impairments in three broad areas: social communication, social interaction, and in narrow, repetitive behaviours (Wing, 1996). One of the dominant social cognition models has conceptualised the central socio-communicative impairments seen in ASD as deficits in the cognitive mechanisms employed in understanding others’ minds (Baron-Cohen, Leslie and Frith, 1985; Baron-Cohen 2008). This model encompasses the abilities used to understand what others know, believe, intend and feel in various social situations. Deficits in ASD have been extensively documented utilising various “theory of mind” tasks designed to tap these abilities (Boucher, 2012). Recently however, research has shifted towards exploring the cognitive differences and deficits in how individuals with ASDs understand their *own* minds (e.g. Williams, 2010; Lind 2010; Lombardo, Barnes, Wheelwright & Baron-Cohen, 2010). That is, research has begun to look at the cognitive mechanisms involved in thinking about “the self”. A picture of the deficits seen in ASD relating to this kind of self referential cognition (SRC) is beginning to emerge. Many questions relating to SRC and its relationship to social cognition await further research. The present thesis is situated in the context of these questions and explores quantitative and qualitative differences in adolescents with ASD relating to the generation of self-images (e.g. concepts of self such as “I am a male, I am a hiker, I am kind) through use of a novel fluency paradigm (The “I Am” and “(s)he is” tasks) based on the Twenty Statements Test (TST; Kuhn and McPartland, 1954).

This chapter will first provide an overview of Autistic Spectrum disorders and the theoretical perspectives available in understanding their causes and symptomatology, with an emphasis on social cognition theories. I will then introduce research and theoretical issues relating to “the self” and its close connection to memory, before reviewing findings relating to the autistic self and self-referential cognition (SRC) and related autobiographical memory research. Finally I will consider the connection between SRC and social cognition before presenting a programme of research for the present thesis.

1.2. AUTISM

1.2.1 The changing faces of Autism

The term 'autism' did not exist one hundred years ago. The condition was defined almost simultaneously by Leo Kanner and Hans Asperger, working independently, in the 1940's. It took until the 1970's, however, before the first specialist journal on autism was published: *Journal for Autism and Childhood Schizophrenia*. In the 1970's, the rate of Autism was cited as 4 in 10,000 and the condition was seen as 'categorical'- people either met criteria for a diagnosis, or they did not (Gilberg, 1991).

This categorical condition, or 'classic autism', was based largely on Kanner's work and comprised of: 1) *social difficulties* e.g. lack of interest in people; inappropriate non-verbal gestures connected with eye contact and physical distance; aloofness; difficulties accepting other perspectives; difficulties understanding, reading and responding to other's emotions, thoughts and intentions, 2) *Communication abnormalities* e.g. Echolalia; neologisms; understanding speech in a literal way; language delay; inappropriate use of speech in social situations 3) *Repetitive behaviour and narrow interests* e.g. Hand-flapping; spinning; obsessive interests; lining things up; constant repeating of behaviours and restrictive routines; severe tantrums and anxiety at change and a need for sameness; unusual memory and other isolated areas of intelligence. Additional features were also noted, such as: "learning difficulties; high-risk of epilepsy; self-injury and hypersensitivity to sounds, textures, tastes, smells and temperatures" (Kanner, 1943; reported in Baron-Cohen, 2008).

The 'categorical' perspective was first challenged by Lorna Wing, who introduced Hans Asperger's work to the English-speaking world in 1981. Hans Asperger had concentrated on a different set of features to those comprising classic autism, including: "no language delay; pedantic style of speech; precocious vocabulary development; narrow interests; preference for adult company rather than peer company; social oddities that seem either aloof or intrusive; desire for things to be done in the same way constantly; bossy and controlling; excellent memory and attention to detail with IQ in the average or above average ranges" (reported in Baron-Cohen, 2008). This subgroup was later recognised in 1994 and added to the *Diagnostic and Statistical manual of mental disorders* (DSM), aptly named 'Aspergers syndrome'.

The addition of Aspergers syndrome was joined by two other subgroups, "atypical autism" (with characteristic features only partially present) and "Pervasive developmental disorder-not

otherwise specified" (PDD-NOS) (which usually consists in a milder form of the key features). Additionally, 'high functioning' autism (HFA), though not itself a diagnostic category, increased in parlance and was used to denote a diagnosis of autism with milder symptoms and/or 'normal' cognitive abilities. Some use the term simply as a synonym for Aspergers syndrome.

As a consequence, autism has been reconceptualised as a "spectrum of disorders", bound together by certain key features yet differentiated in terms of severity, individual emphasis and presentation. Nevertheless, a "triad of impairments" hold over the whole autistic spectrum (Wing, 1996), relating to socialisation, communication and imagination ('imagination' here relates to "flexibility of thought" and encompasses difficulties in dealing with change, narrow interests, empathy and generalisation). Wing (1996) also highlighted the fact that social impairments come in different varieties, including the aloof, the passive and the 'sociable but odd'.

In contrast to the 4 in 10,000 prevalence rate of autism in the 1970's, current estimates for Autistic spectrum disorders (ASD) are close to 1 percent, meaning that in Britain around half a million have been diagnosed with the disorder (Michel et al, 2010). There have been a number of public scares as to the reason for this increased prevalence, including a supposed link with the Measles, Mumps and Rubella (MMR) vaccine. This claim, though evoking widespread fear and panic and still a cause of concern among the public, has been unequivocally refuted in the scientific literature (e.g Uno et al, 2012; Flaherty, 2011). Rather, the reasons for the increased prevalence seem largely due to the shift to a spectrum view of autism (allowing the inclusion of milder cases), the addition of new subgroups (as related above) and also better recognition, better training and better services involved in the assessment of ASDs than ever before (Leonard et al, 2010).

Today diagnosing a person with ASD usually takes 2 to 3 hours, and is based upon interviews and observation, usually with the input of a multidisciplinary team. Classic autism is often diagnosed by the age of three, and early signs include lack of 'joint attention' (such as engaging another's attention through pointing); failing to follow an adult's gaze; and not engaging in simple pretend play. Most typically developing children of 18 months can master these things whereas most autistic children cannot. There is often regression or lack of progress in language abilities, and autistic children may show intense interest in the mechanical and tactile features of toys or in lining toys up (Frith, 2008). In distinction, Asperger Syndrome is often not diagnosed until at least 6 years of age, and often much later than this, including in late adulthood (Baron-Cohen, 2008).

1.2.2 The causes of Autistic Spectrum Disorders

Initial theories for the cause of autism were psychogenic, implicating a “lack of maternal warmth”; parenting that is cold, distant and rejecting (Kanner, 1949; Bettelheim, 1967). As Kanner (1949) expressed it, autistic children “were left neatly in refrigerators which did not defrost. Their withdrawal seems to be an act of turning away from such a situation to seek comfort in solitude”. This concept of “refrigerator mothering”, though somewhat persistent, is without foundation in the research literature. Today the consensus is that autism is a neurodevelopmental disorder with a strong genetic basis (Baron-Cohen, 2008; Frith, 2008).

Genes inherited from one or both parents play a causal role in the development of the autistic brain. Twin studies have demonstrated that there is a 60-90% concordance rate of autism in monozygotic twins whereas there is only a 5-10% concordance rate in dizygotic twins (Bailey et al, 1995). Additionally, autism and related conditions run in families, as do echoes of the broader autism phenotype, particularly social and communication difficulties (Bernier, 2012). Research has identified several rare but high risk genetic variants associated with ASD, and several common variants as risk factors, but the interaction and combination of these genes remains difficult to understand at the present time (Mouren et al, 2012). Nonetheless, heritability is not 100% and so environmental components must play a role too. Existing evidence indicates a possible role for low birth weight (Losh et al, 2012) and vitamin D deficiency during pregnancy or early childhood (Kocovska et al, 2012), though by and large the environmental factors are as yet unidentified and little understood in their interaction with genetic predispositions (Dietert et al. ,2011).

There is not yet a biological marker for diagnosing ASDs. However, existing evidence indicates atypical brain development pre and post nately, particularly impacting the processing of social information. Children with autism exhibit macrocephaly (head and brain growing faster) in the first few years of life (White et al, 2009). It is unclear what is causing this overgrowth. Other consistent findings include those with ASD having a smaller amygdala (involved in recognising and responding to emotions), hippocampus (key area in memory) and caudate nucleus and cerebellum (implicated in attention switching and coordination). Additionally, there is increased grey and white matter in the autistic brain, especially in frontal regions such as the dorsolateral and medial prefrontal cortex (PFC). There is also evidence for a decreased number of Purkinje cells in the cerebellum, and global electrical dysfunction (epileptiform EEGs) (Cavezian et al, 2012).

Functional neuroimaging studies show that when autistic individuals engage in tasks involving thinking about other people's thoughts, feelings, emotions or intentions there is underactivity in areas comprising the social brain, such as medial PFC, Orbito-FC, Amygdala, Temporal-Parietal Junction (TPJ), Superior temporal gyrus (STG), Inferior Frontal Gyrus (IFG), anterior cingulate cortex and precuneus. Finally, studies investigating brain connectivity have suggested abnormal functional and structural connectivity (Cavezian et al, 2012). Further neuroimaging evidence will be discussed in section 1.5.1.

1.2.3 Psychological theories of autism: an overview

Regardless of the current dearth of specific information regarding the causes and neurobiology of autism, an essential perspective for understanding autism would enable us to know *what it is like* to be autistic. This has been the endeavour of psychological theories of autism, attempting to explain the core deficits in social communication, social interaction and narrow interests/repetitive behaviour. In the final analysis, psychological theories will ultimately need to explain all autistic traits across the spectrum and to integrate with neurobiological theories. Though we are still some way from achieving that, there have been several promising psychological theories put forth. One of the main theories- lack of 'Theory of Mind' (TOM) or 'mindblindness'- will be considered later in connection with social cognition (Section 1.3), due to its centrality in the present study. Prior to this, an overview of other theories will be presented.

1.2.3.1 The Executive Dysfunction theory

Executive function (EF) is an umbrella term for several skills involved in the control of behaviour, such as planning, working memory, inhibition, shifting attention, and the initiation and monitoring of action. These functions are known to depend upon the frontal lobes, in particular the PFC. Executive dysfunction is characteristic of patients who sustain damage to the PFC (e.g. Jurado & Roselli, 2007).

People with an ASD often exhibit deficits on EF tasks related to planning, cognitive flexibility and sometimes fluency (Hill, 2004). In regard to planning, deficits are seen on the Tower of London and related tasks, in which discs need to be moved between three pegs from a starting position to a goal state in as few moves as possible (Ozonoff & Jensen, 1999).

Another classic EF task is fluency- the ability to generate ideas or concepts with a time limit. Fluency deficits are seen in classic autism on tasks requiring the generation of novel responses such as words or ideas in a specified time limit (Turner, 1999; Beversdorf et al. 2011). Fluency tasks have long been used to give an indication of a person's cognitive "access" to information under timed conditions, with varying degrees of implicit structure present in the task. For example, the "animals" category fluency task requires the generation of as many items (i.e. animals) in a minute, thereby giving a measure of access to semantic information. The phonemic fluency task (e.g. generate as many words beginning with the letter "S" as possible in one minute) provides less semantic structure and simply asks for the generation of words beginning with a given letter (Lezak et al, 2004), but nonetheless measures access to a critical lexical structure. EF's are relied on in fluency tasks to set up instructions, monitor outputs and to create novel search strategies.

In respect of Cognitive flexibility, deficits are seen in tasks such as on the Wisconsin Card Sorting Task (WCST). Here cards must be sorted along one of three dimensions (colour, number or shape) according to unspoken rules learnt only through feedback as to whether a card has been placed correctly or not. The experimenter will shift rules without telling the participant. Children and adolescents with autism are highly perseverative, failing to learn the new rule and continuing to sort according to the first rule (Ozonoff & Jensen, 1999). These EF deficits are put forth as possible explanations for the repetitive and narrow behaviour seen in autism, particularly an inability to shift attention, as well as the difficulties in coping with change (Hill, 2004).

The explanatory power of the theory is however limited in terms of giving an account of the central social impairments of autism. Moreover, the EF deficits are often inconsistent when viewed across the wider autistic spectrum. For example, children and adolescents with High Functioning Autism (HFA) and Asperger syndrome (AS) often do not show deficits in the planning tasks (Hill, 2004) or fluency tasks. Indeed, the findings on fluency tasks are increasingly shown to be inconsistent, with some finding a specific deficit in only category fluency tasks ("professions") in an Adult AS group (Spek et al, 2009), whilst a majority of studies find no deficits in high functioning ASD adolescents and adults in respect of even category fluency tasks (Boucher, 1988; Crane and Goddard, 2008; Robinson et al, 2009; Kleinhans et al, 2005). These findings relating to fluency are of particular interest to the present thesis, which will utilise the fluency paradigm in creating novel experimental tasks connected with self-concepts and other-concepts (see thesis aims in Section 1.7).

1.2.3.2. Weak Central Coherence theory (WCC)

This theory was first proposed by Frith (1989) in order to account for the unique profile of cognitive strengths and weaknesses seen in ASD. Indeed, superior visuospatial skills on tasks such as visual search and puzzle assembly tasks have been reported in ASD (Happe, 1994), whereas other visual tasks appear to be deficient, such as face processing (Dakin, 2005). The WCC theory describes such cognitive and perceptual biases by claiming that in ASD visual scenes are perceived as a sparse set of details as opposed to a congruent and meaningful whole, and as such they often fail in extracting a coherent global configuration. One of the theory's strengths is that it attempts to make sense of the "islets of ability" in ASD, such as excellent attention and memory for details, and skills in a narrow topic, whilst simultaneously accounting for common diagnostic features of ASD such as "preoccupation with the parts of objects, and a literal understanding of language" (Happe & Frith, 2006).

The WCC has been tested through paradigms such as the embedded-figure test (Shah and Frith, 1983), visual illusions tasks (Happe, 1996) and perhaps most extensively with Navon stimuli, such as a letter 'A' made up of tiny letter 'H's (Mottron et al, 2003). Biases are also seen in completing sentences such as "you can go hunting with a knife and ..." where ASD groups are more likely to answer 'fork' as opposed to "catch an animal", showing a tendency for local versus global processing of the sentence (Happe, 2006). In a review of over 50 studies, Happe and Frith (2006) suggest that the supposed inability to process global information may actually be a bias rather than a deficit, for in the presence of explicit and overt instructions ASD groups tend to perform the same as neurotypical participants on global tasks. Moreover their analysis shows that local bias is not a side effect of EF deficits and seems to be independent of deficits in social cognition tasks. Consequently, whilst helping to understand unique aspects of the autistic presentation, WCC is incomplete as an explanation of the social impairments.

1.2.3.3 The Magnocellular theory

This relatively recent theory focuses on perceptuo-cognitive processes in autism and suggests that there is a specific dysfunction in the magnocellular visual pathway in the brain connected with processing motion, whereas the other major visual parvocellular pathway is intact (Milne et al, 2002, Spencer et al, 2000). In ASD this impairment generalises across several types of motion, including coherent and biological motion, response to optic flow and in the detection

of translational, rotational and radial motion, whereas deficits in other developmental disorders appear to be related to coherent motion only (Milne, Swettenham & Campbell 2005). There is a potential connection between the magnocellular theory and the WCC theory (section 1.2.3.2), in that those exhibiting local bias in a task involving hierarchical figures had reduced motion sensitivity whereas those with a global bias had normal motion sensitivity thresholds (Milne et al. 2004). Further research is needed to confirm whether magnocellular integrity can be related directly to coherent motion detection, ASD severity, and for direct evidence of abnormalities in magnocellular neurons in ASD (Milne et al, 2005).

1.2.3.4. The Social Motivation theory of autism (SMT)

The social world exerts an influence upon most of us like no other area. Indeed, social motivation is subserved by dedicated biological mechanisms in the social brain and can be understood as an evolutionary adaptation to our highly collaborative environment: social information is prioritised by attention, social interactions are intrinsically rewarding, and a drive to maintain social relationships infuses interpersonal actions (Chevalier et al, 2012). SMT proposes that early impairments in social attention set in motion a cascade of developmental processes that finally deprive the child of sufficient social learning experiences, and that the decrease in “attentional weight” placed on social information further disrupts social skill and social cognitive development (Schultz, 2005).

Recent evidence in support of this highlights a lack of social orienting in ASD. Indeed, diagnostic criteria, and descriptions of the first year of life demonstrate relative disregard of one’s own name, diminished eye contact and aloofness (Osterling et al, 2002). Additional evidence shows children with ASD, in comparison to controls, looking more at the background than at characters in social photographs (Riby et al, 2008), and ASD adults and adolescents fixating less on faces and eyes in films (Nakano et al, 2010). Indeed, preference for non-social geometric shapes in infants has recently been identified as a robust predictor of ASD (Pierce et al, 2011).

In terms of ‘seeking and liking’, despite lower overall acceptance by peers, increased loneliness in children with ASD is either not reported or is not connected with the amount of social involvement (Bauminger and Kausari, 2000). Moreover, a lack of pointing, bids for joint attention, spontaneous collaborative engagement and responsiveness to verbal praise are seen in children with ASD (Leekam and Ramsden, 2006). Social anhedonia is also prevalent in

adolescents with ASD (Chevalier et al, in press). In respect of social *maintaining*, it has long been anecdotally reported that ASD individuals are less influenced by impression management. Indeed, the presence of an experimenter had little influence on the ASD group ratings of an experimenter's drawing, whereas it had significant impact on a control group. Moreover, this "flattery index" correlated negatively with social anhedonia (Chevalier et al, 2012b).

A key difference between SMT and social cognition accounts (see Section 1.3) of ASD is that in SMT the causal direction is from diminished social interest leading to diminished social cognition, whereas in social cognition accounts, such as Theory of mind (TOM)/Mindblindness (see Section 1.3), the difficulties in understanding the social world give rise to an eventual loss of interest in social interactions. In respect of this, we would expect the cause to be more prevalent than the effect in ASD presentations, however neither TOM deficits or lack of social motivation are universal (Chevalier et al, 2012 c, Wing 1996). The inability of any single psychological theory to account for all the symptoms of autism is only problematic however if we insist on a single theory rather than a multiple-deficit perspective of ASD. As time goes on, theories may become more integrated and complementary rather than opposing.

1.2.3.5 The Empathising-Systemising theory of Autism (EST)

This theory is an example of an integrative theory, which attempts to pull several elements of the autistic presentation together. Difficulties in social communication and understanding are understood with reference to "empathy"- both cognitive empathy (e.g. classic TOM/mind-reading) and affective empathy (having an appropriate emotional reaction to another person's thoughts and feelings). Affective empathy may depend more on the mirror neuron system also postulated to underlie some of the ASD deficits (Gallese and Goldman, 1998). The distinction between cognitive and affective empathy also relates to differences in 'theory-theory' and 'simulation theory' accounts of how we understand others' mental states, which remains a controversy far from being resolved (Wilkinson et al, 2012). Theory-theory suggests we use theoretical posits to explain and predict behaviour, whereas simulation theory suggests we use our own self as an anchor to imagine ourselves in others' positions and use the resonant states of our own minds to infer others' mental states. Simulation theory is further discussed in section 1.5.

The systemising factor in EST relates to abilities that tend to be average or above average in ASD (Baron-Cohen, 2008). Systemising refers to the drive to construct and analyse systems. Evidence for EST is multi faceted and shows an Autism>Male>Female ability profile on several systemising tests such as Systemising Quotient (SQ), Intuitive Physics tests and embedded figures tests among others, whereas the converse Female>Male>Autism profile is seen on tests requiring empathy such as the Empathy Quotient (EQ), Faux pas test, Mind in the eyes test, friendship and relationship Quotient, (Evidence reviewed in Baron-Cohen, 2011).

These findings have led to extensions of the EST theory to an 'Extreme Male Brain' theory of autism, attempting to explain these even stronger biases toward systemising over empathising than those found in normal males, and to account for the much increased prevalence of ASD in males. Indeed, classic autism has a male:female ratio of 4:1 (Chakrabarti and Fombonne, 2001) and as high as 11:1 in individuals with AS (Gillberg et al, 2006). Interested readers are directed to Baron-Cohen et al.'s (2011) review for some of the supportive biological evidence for these theories.

1.3 SOCIAL COGNITION IN AUTISM

1.3.1 The 'Theory of Mind' construct

Socio-communicative impairments form the core of the autistic presentation. This section looks more closely at the primary social cognitive theory that has been used to explain these deficits in ASD. The theory builds on findings in developmental psychology relating to "Theory of Mind" (TOM). The TOM construct refers to the capacity to recognise, comprehend and make inferences regarding other peoples' mental states. It encompasses the ability to 'represent' mental states, and from this to explain and predict the behaviours of self and others: to 'mentalise' (Leslie, 1987). In other words TOM makes it possible to infer what others' know, intend, believe and feel; to create 'theories' about the state of others' minds- to have a 'theory of mind'.

1.3.2 TOM and Developmental Psychology

The TOM paradigm largely evolved in the context of Developmental Psychology, where there appears to be a graded emergence of the ability to "mentalise" in children. Various

experimental measures have been developed to assess this ability, which vary in their degree of difficulty, presentation modes (verbal or visual), and more recently in their relative dependence on cognitive processing and affective processing (Muller et al, 2010, Shamay-Tsoory et al, 2007).

Broadly, children as young as 3-4 years can comprehend that another person may hold a belief that is incorrect ('First-Order false belief' or FOTOM ability, Wimmer and Perner, 1983). See the next section for an example of the Sally Ann false belief task. Around age 6-7 yrs children begin to pass so called Second-Order TOM tasks (SOTOM ability), which relates to being able to think about "what someone thinks about what someone else thinks".

Around age 9 to 11yrs, children develop more complex TOM abilities. These include understanding Social "faux pas" (tested with the social faux pas tasks, Baron-Cohen et al, 1997) and involve recognising when someone says the wrong thing without realising the inappropriateness of saying it, and "Indirect speech" tasks (understanding irony, sarcasm, metaphors and jokes). These more advanced tasks are thought to require "applied use of TOM inferencing" and are categorised as "TOM pragmatic tasks" (McDonald and Flanagan, 2004). To solve these tasks, inferences must be drawn from verbal and/or nonverbal behaviour arising in a specific social context; it involves more complex reasoning about the beliefs, emotions and intentions at play during interactions between characters; abilities that are summed up as "social perspective taking". Indeed there is ample evidence that the development of TOM abilities within children show a fixed and universal (the same across cultures) sequence and trajectory (Wellman, 1990, Leslie, 1987).

1.3.3 TOM as a modular ability

There has been significant debate over whether TOM represents a specialised modular ability with a "dedicated cognitive mechanism" (Fodor, 1992) or whether the TOM ability draws on more general inferential abilities (Gopnik and Wellman, 1992). If TOM is a dedicated module, independent of more general cognitive functioning, we should expect to find evidence of dissociation: impaired TOM in the presence of intact cognitive abilities. Ideally, this should be a 'double dissociation' with evidence of intact TOM alongside impaired general cognitive functioning too.

In a landmark study, Baron Cohen, Leslie and Frith (1985) employed the Sally-Ann False belief experiment with three groups of children: an autistic group (with IQ in the normal range), a Down's syndrome group (presenting with global intellectual disability), and a normal control group. In this task, the child is introduced to two dolls, Sally and Ann, and it is confirmed the child knows the name of each doll. A skit is then enacted, where Sally hides a marble in her basket. Sally then leaves the room, and whilst she is away, Ann moves the marble from the basket into her own box. When Sally returns the child is asked the "belief question": "Where will Sally look for the marble?". The results revealed that approximately 80% of the autistic group failed the experimental task, whereas the majority of the Down's syndrome group and all the normal controls passed the task. These and related findings have been taken to imply a "double dissociation" between TOM abilities and general intellectual functioning.

Subsequent research has confirmed that people with ASDs generally have difficulties passing age-appropriate TOM tasks. Consequently a deficit in TOM, described as "mindblindness", has often been cited as a primary hallmark of autism and the basis of the social and communication difficulties (Baron-Cohen, 1995; Kaaland et al, 2002). Adding further weight to the argument that TOM represents a "hard-wired" innate and highly specialised cognitive module are findings from other studies assessing children with William's syndrome: these children exhibit preserved social understanding in the context of marked impairments in non-social cognitive domains (Tager-Flushberg et al, 1998).

1.3.4 TOM and Executive Functions (EF)

TOM theories of autism clearly have close relationships with some of the other theories of ASD (reviewed in Section 1.2.3) such as the Social Motivation theory and the Empathising-Systemizing Theory, however there is cognitive neuropsychological support for the idea that TOM is related to EFs (whilst not being reducible to EFs). Aboulaflia-Brakha et al. (2010) conducted a systematic review of 24 articles relating to this topic of dissociation between TOM and EF in neurological group studies. They point out that the broad conception of EFs as "the abilities that enable autonomous, goal directed behaviours to be carried out" has more recently been refined to incorporate a more multifaceted conception (Jurado & Rosseli, 2007).

In light of this, Aboulaflia-Brakha et al. (2010) based their analysis on conceptions of EF derived from Factor analytic studies. These studies have distinguished EF subcomponents: *Shifting*, *inhibition* and *updating* (Miyake et al, 2000) and a fourth component, *Access* (Fisk and Sharp,

2004). *Shifting* denotes the ability to engage/disengage attention, *Updating* is related to working memory and requires constantly monitoring, updating and discarding information based on its relevance. *Inhibition* involves suppressing preponderant or automatic responses when necessary and is considered central to planning abilities. *Access* refers to the process involved in verbal fluency tasks and is believed to mediate access to semantic, lexical and other long-term memory representations (Aboulafia-Brakha et al, 2010).

Aboulafia-Brakha et al. (2010) included for analysis only clinically-used TOM tasks (FOTOM and SOTOM stories, the Faux pas test, Happe's stories, the Mind in the Eyes task, and cartoon tasks). They examined patterns of "congruency and incongruency" across the 138 crossings recorded between different TOM tasks and EF domains. En masse, 71% showed congruent results (either both impaired or preserved), while 29% showed incongruent results (more or less equally in both directions). On the basis of this and more fine-grained analyses, they concluded that despite EF and TOM being closely associated, they cannot be reduced to one function. They note that though this analysis demonstrates a close relationship between TOM and EF, the nature of this relationship is still not clear: it could be that there is a functional dependency (EF underlies many aspects of advanced TOM functioning) or it could be that deficits tend to co-occur due to the overlap of neuroanatomical circuits.

In autism research, a study by Pellicano (2010) assessed the longitudinal relationships among three aspects of cognition in 37 children with an ASD relating to TOM (false-belief tasks), EF (planning, flexibility, and inhibitory control), and "Central Coherence" (CC; local processing) at "Time 1" and again after three years had passed. It was found that "Time 1" EF and CC skills were predictive of change in TOM task performance 3 years later, and this was independent of age, IQ, and "Time 1" TOM performance. Predictive relationships in the reverse direction were not found, and no developmental connections between EF and CC were found. These results suggest that early "domain-general" EF and CC skills have a central role in shaping the development of children's TOM abilities. Taken together, these findings imply a close relationship between EFs and TOM abilities in autism, both neuro-cognitively and developmentally. It is not however possible to reduce TOM abilities to underlying EF abilities (Aboulafia-Brakha et al, 2010).

1.3.5 TOM and the socio-communicative impairments of autism

As mentioned in the overview of psychological theories of autism (see section 1.2.3), ‘single cause’ explanations of autism are not considered tenable (Boucher 2011; Happe, 2006; Chevalier 2012). Consequently it is assumed that impaired TOM constitutes a contributory cause of the social-communicative impairments rather than other non-social, behavioural or often comorbid features of autism. Even here however, significant problems have challenged the impaired TOM hypothesis.

Firstly, not all children with ASD failed the Sally Ann task in the original Baron-Cohen et al. (1985) study, which was a pattern confirmed in later studies (Happe 1995), challenging the ubiquity of TOM impairment. Additionally, Boucher (1992) showed that adults with HFA or AS can pass FOTOM and SOTOM tasks, yet remain socially impaired in everyday life. However, it has since been demonstrated that individuals with ASD learn to “hack out” appropriate responses on FOTOM and SOTOM tasks using compensatory reasoning (Happe, 1995). This reliance on compensatory reasoning suggests that the intuitive or specialised abilities upon which neurotypicals depend for TOM understanding are impaired in ASD. Indeed, HFA and AS individuals remain impaired on more complex TOM tasks such as the “Strange stories test” that assesses the comprehension of non-literal language involving irony, sarcasm or metaphor (Happe 1994); “the Mind in the eyes test” in which the mood has to be identified from pictures of eyes only (Baron-Cohen, 2001) and the “Faux pas” task (described earlier, Baron-Cohen, 1999).

Additional challenges to TOM accounts include the finding that other groups of individuals fail TOM tasks, such as those with learning disabilities (Yirmiya et al, 1998) and those with sensory disabilities (Minter et al, 1998) yet do not display autistic like socio-communicative deficits (Boucher, 2012). Also, research points out that recognisable social impairments in autistic children emerge long before TOM is present in normal development (Klin et al, 1992). This however depends on a rigid definition of TOM relating to passing FOTOM and related tasks, whereas the term has broadened hugely and now relates interchangeably with ‘mindreading and mentalizing’ to refer to a range of processes involved in understanding others’ minds (Boucher, 2012). Whilst it is no longer possible to construe impaired TOM as *the* major cause of socio-communicative impairments in ASD, or to disentangle the complex causes and effects of this neurodevelopmental disorder, it nonetheless remains an important contributory cause (Boucher, 2012). Interested readers are directed to reviews in Belmonte (2009), Gallagher (2004) and Boucher (2012) for in depth discussions regarding the causal pathways possibly

underlying the core ASD deficits, and interactions between social motivation and social cognition theories.

The present thesis will be exploring relationships between social cognition in ASD and experimental measures of self-referential cognition. To this end, various complex TOM tasks will be used, such as the mind in the eyes task, the Faux pas task and Character intentions task and the experimental Yoni task as indexes of social cognition abilities (described in detail in section 2.1.4). Recent research in autism has turned attention to differences not just in the processing of others' mind, but in the processing of one's own mind and mental states- that is, cognition that refers to the "self". This research will be reviewed in the next section (1.4), and will set the stage for the aims of the present thesis.

1.4 SELF REFERENTIAL COGNITION (SRC)

1.4.1 The Self

The idea of 'the self' is an absorbing topic and one which is philosophically extremely hard to conceptualise. Questions around whether 'the self' as the subject of experience, or as the 'knower' of knowledge, can ever be itself known, examined or objectified (or even whether it exists) has been the subject of spiritual and philosophical discourse for thousands of years. Indeed, the ancient Greek aphorism *gnothi Seauton* ("Know Thyself") alludes to the centrality and primacy of this question in understanding human behaviour, thought, morals and life itself. The present thesis can do naught but nod in the direction of these issues and direct the interested reader to works that examine the nature of conscious experience and selfhood from a western philosophical perspective (Nagel 1979; Hofstadter & Dennett, 1981; Chalmers, 1996,) and from eastern schools of thought such as Vedanta and Buddhism. The present thesis seeks to use a working definition of the self from a psychological perspective. Given that there is a shared understanding of the nebulous set of qualities and characteristics that make up a "self", a cognitive and sociological investigation of its nature can uncover important information concerning it and its relationship to other psychological constructs, and indeed psychopathology and neurological impairment.

William James (1892/1961) made a key distinction between the *self-as-object* (The Me) and the *self-as-subject* (The I). The 'Me' constitutes everything that can objectively define the self including "material characteristics" (e.g. physical embodiment and possessions), "social

characteristics” (roles, relationships and personal attributes) and “psychological/spiritual characteristics” (mental mechanisms, consciousness and thoughts), (Jackson et al, 2012). In contrast ‘the I’ relates to the experiential aspects of the self and is subjective (including Agency, Distinctness, Continuity and Self-Reflection as experiential characteristics). Broadly speaking, ‘the I’ denotes the self involved in initiating, organising and interpreting experience and which is crucial for the development of “personal identity” (Damon and Hart, 1988).

In this sense, “the I” (subjective self) is necessary for a “Me” (personal identity) to exist at all. Only when the self becomes an “object” of experience- “a Me”- can one be ascribed “self-awareness”. Butterworth (1995) distinguishes between “primary self awareness” when the self is an object of one’s own “perception”, and “higher-order self-awareness” when the self is the object of one’s own “cognition”. Gillihan and Farah (2005) make a further distinction between physical and psychological aspects of self identity. It seems reasonable to separate experience and cognition relating to one’s own body and experience and cognition relating to one’s own mind (Williams, 2010). I shall return to these distinctions in more detail in section 1.4.3.1. By and large, the present thesis is concerned more with the “me” than with the “I”. That is, it is concerned with cognition relating to the self-as-object, or “self-referential cognition” (SRC).

1.4.1.2 Multi-dimensional selves

The self has been viewed from narrative, constructionist, social-constructionist and relational perspectives (Harter, 2012). Indeed what holds these perspectives together is the notion that the self is not unidimensional, but instead is composed of multidimensional constructs and processes (e.g. Goldberg, 1990). In this sense the self is envisaged as a host of distinct yet overlapping “self-schemata”, embedded in rich social contexts, and comprising many cognitive representations developed from various autobiographical memories (AM) as well as more semantic representations such as “I am a student”. The ‘self constructs’ generated at any given moment from these “self-schemata” are both context dependent and fluid. As one example, Wang (2008) showed that when Asian American’s were primed with their Asian self as opposed to their American self, they generated memories and self-descriptions that were more socially oriented and less self-focussed than those primed with their American self.

The numerous forms of self-conception could be broadly classified in terms of the self-as-objects distinctions described in section 1.4.1 (James, 1892/1961, Jackson et al, 2012). James further suggested that individuals organise “the Me” into a hierarchical structure, with relative

importance assigned to each material, social and psychological constituent. Indeed, more recent hierarchical models of the self have also emphasised a distinction between “central” and “peripheral” self conceptions, determined by the relative degree of descriptiveness and importance (Rosenberg, 1979). Interestingly, peripheral self-conceptions are processed more slowly and show greater fluctuation relative to mood than do central self conceptions (Sedikides, 1995).

In spite of the multidimensional, dynamic and context dependent nature of the self, most people have the experience of an integrated, unified self. Epstein (1981) considered this “unity principle” as one of the most basic needs of an individual. Though postmodern theorists tend to view this continuous and stable self as illusory, in large part due to its multidimensional nature (Gergen 1991), it is clear that a continuous and stable *sense-of-self* is critical for everyday functioning (Maslow, 1954; Rogers, 1951), and is the basis of personal identity (Erikson, 1950). More recent theorists have posited the view that it is possible to maintain a “transmodern” view of the self (Vitz, 2006) which “transcends” the fragmentation of self implied by postmodern social constructionist perspectives with a view of the self as emergent, changing, yet with identifiable and understandable core patterns all of which give meaning to one’s existence. A philosophical account of these issues is unfortunately beyond the scope of this thesis however.

Instead, the present thesis will explore the multiple self-constructs spontaneously used by neurotypical people (NT) and people with ASD to define themselves and others. In this sense, the self is seen as comprising many separate self-constructs and self-images (e.g. Conway 2005) connected with any number of the self-as-object categories (James 1892/1961, Jackson et al, 2012). These issues will be discussed in greater detail in section 1.4.3.2. First however it is important to review the intimate relationship between the self and aspects of memory and cognition.

1.4.2 The Self and Memory

A concept of self implies memories of the self upon which to base those concepts. Indeed, memories pertaining to the self are called autobiographical memories (AM), and they form the basis for identity and a context in which identity change can occur (Conway et al, 2002). AM also supports a sense of the “temporal continuity of identity” through connecting the current self with past memories (Addis and Tippett, 2004). AM is a form of long term memory (LTM),

and it is widely accepted that one fundamental distinction in LTM is between “episodic” and “semantic” declarative memory, based upon functionally distinct neuro-cognitive systems (Tulving, 2001). Episodic memories are memories of events *experienced* first-hand in a distinct place and time and are associated with “autonoetic awareness”- the subjective sense of being aware of one’s continuity through time. Semantic memory on the otherhand is defined as memory of decontextualised, “timeless” facts connected with “knowing” but not autonoetic awareness (Tulving, 1984).

Though AM and episodic memory are closely connected, they are not synonymous. Lind (2010) makes a distinction between 4 types of memory with relevance to the self: “a) episodic AM (e.g. remembering one’s last birthday celebration), b) episodic non-autobiographical memory (e.g. remembering what happened on last nights soap opera), c) semantic autobiographical knowledge (knowing one’s surname) and d) semantic non-autobiographical knowledge (e.g. knowing the alphabet)”. Lind (2010) argues that episodic AM requires a self-concept at encoding (tagging the memory as “self-relevant”) and at retrieval (re-experiencing the self as the *object* of experience (‘the me’). However, non-autobiographical memory does not require a self-concept at encoding and only tacitly involves re-experiencing the self as the *subject* of experience (“The I”) at retrieval. Lind (2010) suggests autonoetic awareness may differ qualitatively between these two types of episodic memory.

The self concept (made up of distinct self-constructs and self images, e.g. *I am white, I am a father, I am kind*) is largely based upon semantic autobiographical knowledge (SAK). Here the self-concept acts as a “fixed referent” and category around which new AMs are organised. It would not be possible to encode new AMs as “self relevant” without this self-concept. Indeed, there is evidence that both self-concept and episodic AM co-occur at around age 2 (Harley and Reese, 1999). However the development of a self-concept is unlikely to be the sole factor involved in the development of episodic AM. Improvements in “memory binding” are also implicated in the development of episodic memory (Sluzenski et al. 2006). This “binding together” of the multiple features comprising an episode involves linking them at encoding and bringing them back together at retrieval (Baddeley 2000) including an ‘autonoetic awareness’ of the past state of self. This fact may certainly have relevance to ASD where Weak central coherence (WCC) is indicated (Frith, 1989, see section 1.2.3.2). I shall shortly consider important effects seen in memory research connected with self referential cognition, and how they differ in ASD (namely the Self-reference effect, section 1.4.4.2). First however, an overview of the self in autism will be presented.

1.4.3 The Self in Autism

ASDs are named after the ancient greek “autos”, which translates as “self”. Indeed early characterisations by Kanner (1943) described aspects of the condition as “extreme egocentrism” leading to “autistic aloneness”. From the very beginning then it has been suggested that “the self” is fundamentally altered in ASD and is strongly implicated in the deficits underlying social and communicative abilities. As was outlined in the social cognition section 1.3, people with ASD are impaired in understanding minds and in ‘mentalising’ (Baron-cohen et al, 1985). Moreover, this deficit is not reducible to general problems with meta-representation (distinguishing events and reality) as ASD participants are unimpaired on tests of “out of date” pictorial representations (false pictures) but remain impaired on “out of date” beliefs tasks (false beliefs) (Charman & Baron-Cohen, 1992). As discussed earlier, the “mindblindness” theory of autism remains one of the primary cognitive explanations for the deficits seen in representing others’ minds, and the present section now looks at evidence for deficits and differences in representing their *own* minds.

It would be improbable to suggest that ASDs involve not having a “subjective experience” of the self (“the I”) at all, though it is possible that these experiences are qualitatively different from those of NTs. Indeed, Hurlburt, Happe and Frith (1994; reported in Williams et al, 2010) used an “introspective sampling method” to assess reports of internal experiences of HFA adults. Three adults wore a device that blipped at random moments throughout the day, and the subject was required to write down what they were thinking about immediately prior to the blip. One adult had good TOM skills and was able to report his own thoughts relatively easily, another had mixed TOM skills and mixed ‘reporting’ skills and the third adult had poor TOM skills and was unable to do the task at all. Furthermore, all the reports that were given consisted entirely of “visual images”, whereas for NT people thoughts are found to be verbally mediated 80% of the time (Hurlburt, 1990). The evidence is somewhat mixed around the use of “inner speech” in ASDs (e.g. see Joseph et al, 2005, Lidstone et al, 2009). Nonetheless these findings highlight some of the potential differences in the self-as-subject processes in ASD. The focus of the remaining evidence reviewed in this thesis focuses on the difficulties of becoming aware of the self-as-object (i.e. the “Me”) for individuals with ASD.

1.4.3.1 Self awareness in ASD

One useful distinction, described earlier, is between physical and psychological aspects of the self (Gillihan and Farar, 2005). In respect of physical self-awareness, Williams (2010) reviews four studies that have explored mirror self-recognition amongst children with ASDs. These tasks involving marking the child's face with a coloured spot and seeing how they respond to their reflection. Touching the spot implies that they have a "body schema" of how their own face usually looks like and which is mapped onto the one seen in the mirror. Williams (2010) found that 74% of children with autism were successful in this test. A further physical mark of the self is the sense of agency and ownership of action. Behavioural studies find no differences in ASD individuals with respect to action monitoring or attribution (David et al, 2008) or visuospatial perspective taking (David et al, 2010). These studies show that physical self-awareness seems to be intact and relatively strong in ASD individuals.

In terms of psychological self awareness the picture is somewhat different. It is well known that children with ASD show difficulty in using 1st person pronouns (Lind and Bowler, 2009), and even HFA individuals show lessened awareness of their own emotions (Silani et al. 2008), mental states including recognising their own intentions (Williams & Happe, 2010) and ASD traits (Johnson et al, 2009). Lind (2010) suggests that these difficulties in psychological self-awareness are "downstream consequences" of the socio-communicative deficits seen in ASD. She also suggest that these deficits, compounded by reduced opportunities for effective social interactions, leads to a lack of self-knowledge in the psychological domain which in turn leads to significantly less elaborate self concepts. This idea is explored next.

1.4.3.2 Self concepts in ASD

Hobson and Lee (1998) used Damon and Harts' (1988) "self understanding interview" (SUI) to explore self-understanding. Their results found impairment in social and psychological aspects of the self-concept in children with ASD. In a recent extension of these findings, Jackson, Skirrow & Hare (2012) have explored self-understanding using the SUI in adolescents with Aspergers syndrome. The model of self-concept used for coding in the SUI stems from William James (1892/1961) theories on the experiential domains of the self, and divides the self into two main components, the "self-as-object" (me), and the "self-as-subject" (I), described earlier. Jackson et al. (2012) used a coding scheme in this study which has formed the basis of a coding scheme utilised in the present thesis for an experimental measure of self-concepts

and other-concepts. I shall therefore report the coding scheme used in the Jackson et al, (2012) study here:

The “self-as-object” chunks were coded into four distinct categories:

- “1) *Physical* – this includes an individual’s body and material characteristics
- 2) *Active*- this includes an individual’s activity-related abilities e.g. a biker, a walker
- 3) *Social*- this includes attributions and schema relating to social interactions and social relationships
- 4) *Psychological*- this includes the individual’s ability-related emotions, thoughts, preferences or other cognitive processes.”

Jackson et al. (2012).

In respect of the self-as-object self concepts, Jackson et al. (2012) found that the Asperger group generated less self-characteristics overall than the control group, and showed a distinct pattern of reporting significantly less psychological and social descriptions of themselves, but no difference in the number of physical self-characteristics reported, and some suggestion of less responses in the active category. These findings strongly conform to the pattern of findings described above showing intact and “normal” physical self awareness and related representations, but impoverished psychological self awareness. This distinction appears then to hold downstream in the relative poverty of psychological and social self-concepts compared to physical self-concepts and understanding (Hobson & Lee, 1998, Jackson et al. 2012). A central aim of the present thesis will be to further explore self-concepts in ASD using novel fluency tasks, described later.

1.4.3.3 Conceptualising the self of others in ASD: Stereotyping

ASD deficits in holding theories of other minds and in psychological self awareness would seem to suggest the likelihood of other differences in processing social information such as in social stereotyping. This would be further predicted on the basis of “atypical face processing” widely demonstrated in ASD (Grelotti, Gauthier, and Schultz, 2002; Rosset et al, 2009) as well as deficits in reading emotions in faces, such as in the Mind in the eyes task (Baron-cohen, 2001; Kalland et al, 2008). Stereotypes are a type of categorisation providing one means of enabling us to predict others’ behaviour. Social stereotypes emerge robustly in childhood and are known to play a central role in social interaction (for a review see Mackie et al, 1996). One of the most documented and robust stereotypes is the “Beauty is Good” (BIG) stereotype, where

children and adults attribute “goodness” and other positive traits (e.g. greater intelligence, competence) to attractive rather than to unattractive faces (see review in Langlois et al, 2000). Similar stereotypes around emotions and happiness (“Happy is Good” HIG) are also seen (Hess, Adams & Kleck, 2008).

Surprisingly few studies have explored social stereotypes in ASD populations. One study examining gender and race stereotypes found that ASD children appear to make stereotypical judgements in a similar manner to NTs (Hirschfeld et al, 2007). A more recent study by Fonseca, Santos, Rossett & Deruelle (2011) presented ASD and NT children faces and asked them to judge how friendly and intelligent the faces appeared. The results revealed that the ASD group produced BIG stereotypes in a similar manner to the NTs, with both groups considering attractive faces as more friendly and intelligent. These preserved social stereotyping abilities seem surprising in the context of impaired TOM and Psychological self awareness seen in ASD. One aim of the present thesis was to explore social stereotypes further in ASD, by assessing spontaneous judgements made about attractive versus unattractive faces, and happy versus sad faces (see section 2.3.3.5).

1.4.4 Memory and the Autistic Self

A close relationship between Autobiographical Memory (AM) and the self has been described in section 1.4.2. Lind (2010) made a distinction between episodic AM (EAM) and Semantic Autobiographical Knowledge (SAK). Section 1.4.3 highlighted selective impairments in the autistic self-concept related to SAK, in that initial research indicates psychological and social self-concepts in ASD appear to be diminished whilst physical self-concepts are intact (Jackson et al. 2012). Further evidence for differences in AM and in the paradigmatic “self-reference effect” are considered in next.

1.4.4.1 Autobiographical memory (AM)

Crane and Goddard (2008) assessed HFA adults with matched NTs across several autobiographical tasks: 1) an *interview* task asking questions such as “can you tell me something that happened while you were at primary school that stands out in your mind?” 2) *Fluency* task involving participants generating as many events (EAM) and people’s names (SAK) from selected lifetime periods in ninety seconds 3) *Narrative* tasks eliciting “detailed descriptions” such as “what did you do for your last birthday?”. The interview task did not

elicit any ASD differences. However, in the fluency task the ASD group showed impaired EAM. No differences were found on the SAK fluency or on general fluency tasks (on either letter or category fluency, described in section 1.2.3.1). This suggests the group differences were not due to “generativity based” explanations. In the narrative task the ASD participants produced significantly less specific EAMs.

The above study is of particular interest to the present thesis due to its use of a fluency measure to assess AM. The present thesis will assess self-concept directly through a novel fluency measure (see later). Crane and Goddard (2008) found significant differences on EAM fluency but not SAK fluency (people’s names). However Bruck et al. (2007) whilst assessing HFA children also found deficits in SAK for personal facts when asking questions such as: “What’s your father’s name?”. Goddard et al. (2007) have suggested that impaired EAM is related to impoverished self-concepts in that the self-concept is insufficiently structured to act as a fixed referent to ‘organise and tag’ self-relevant experiences. Alternative explanations may include relating impaired EAM in ASD to poorer “binding”. This would connect with the WCC theory and would imply atypicalities in related brain structures connected with memory such as the Hippocampus, Medial temporal lobe, amygdala and related connections with the frontal lobes (Bowler, Gaigg and Lind, 2011). These considerations are yet to be systematically explored, however.

1.4.4.2 The Self Reference Effect (SRE)

The Self reference effect (SRE; Rogers, Kuiper & Kirker, 1977) relates to the firmly established finding that memories encoded in relation to the self are enhanced relative to other memories. The SRE is thought to relate to the “encoding specificity hypothesis” (Tulving and Thompson, 1973) which suggests enhanced memory when *encoding* conditions match *retrieval* demands. Symons and Johnson (1997) construed the self as a “well developed cognitive structure that promotes the organisation and elaboration of knowledge” and which consequently promotes compatible encoding and retrieval conditions. The kinds of cognitive structure involved at encoding give rise to various specific degrees or depths of processing, and so in this sense the SRE is an extension of the “depth-of-processing” effect (DOP; Craik and Tulving, 1975). If self-concepts are impoverished in ASD it would be reasonable to assume that the encoding of self-relevant information will also be effected. In this section, findings for a reduced SRE in ASD in memory paradigms will be considered. These effects are particularly

interesting from the point of view of the present thesis, which will be exploring SREs more directly in relation to self-concepts versus other-concepts (see later).

In her review- *Memory and the self in autism*, Lind (2010) reports studies by Toichi et al. (2002), Lombardo et al, (2007) and Henderson et al. (2009) in connection with the SRE in ASD groups. An overview of these studies is also presented here. Toichi et al. (2002) explored DOP and SREs in 18 HFA adults compared to age and IQ matched controls. They were shown 30 target words (personality trait adjectives e.g. "sensitive"). Prior to the presentation of each target word, they were asked one of three questions: 1) Phonological condition with least DOP: "Does the word rhyme with?" 2) Semantic condition: "Is the meaning of the word similar to?" and 3) Self-reference condition with the most DOP: "Does this word describe you?". This task was then followed by a "surprise recognition test" in which the individuals were asked to select the target words from amongst new words. The control group showed the usual DOP and SREs (Phonological < Semantic < Self-referring) whereas the ASD group showed significant DOP (Phonological < Semantic) but not SREs (Semantic ≈ Self-referring). It should be noted however that the ASD and controls did not differ significantly in terms of total number of word recognised for semantic or self-referring words.

Lombardo, Barnes, Wheelwright & Baron-Cohen (2007) explored DOP and SREs in 30 HFA adults and 30 age and IQ matched controls with a similar paradigm to Toichi et al, (2002). Participants made judgements concerning the descriptiveness of trait adjectives (using likert scales) to 1) Themselves 2) best friend 3) Harry Potter (dissimilar non-close other) and 4) syllables contained in the trait words. Following the "surprise recognition task" it was found that ASD group performed similar to controls on Syllables and Harry Potter but significantly poorer in the Self and best friend conditions. However, in this study both groups showed DOP and SRE effects (Syllable < Potter < Friend < Self). Lombardo et al. (2007) compared the "difference scores" for Self vs Potter conditions as an indicator of SRE effect size, and found that the ASD group had a smaller SRE that approached statistical significance ($p=.068$). Henderson et al. (2009) used a similar methodology in HFA children and found the same DOP effect but no SRE effect in the ASD group whereas the control group showed the usual SRE. In a further analysis of the self vs Potter scores they showed a significantly smaller SRE than comparison children (Henderson et al, 2009). These SRE findings are often cited as showing a diminished access to self relevant information in ASD.

1.5 THE RELATIONSHIP BETWEEN SRC AND SOCIAL COGNITION

Evidence for social cognition impairments in ASD was presented in section 1.3, and indications of important differences relating to self-referential cognition were considered in sections 1.4.3 and 1.4.4. Both types of cognition depend on representing “minds”, either one’s own mind or another’s mind. The present section will look at evidence from NT people and ASD in respect of whether these (dis)abilities are related.

1.5.1 A Neuropsychological Perspective

1.5.1.1 Neurotypicals

Self-referential cognition (SRC), particularly involving evaluation of oneself, has been connected to the “cortical midline structures” (Northoff and Bermpohl, 2004). For example, the ventromedial PFC shows increased activation during tasks requiring judging whether personality trait adjectives describe the self or not (Kelley et al, 2002). Moreover, tasks involving “self knowledge” (i.e. SAK) also activate the anterior rostral medial FC, which is known to be engaged during “mentalising” (Amodio and Frith, 2006). Indeed, SRC and social cognition demonstrate substantial overlap in the cortical midline structures (Tamir & Mitchell, 2010). This has led some researchers to suggest that these areas may subserve simulation mechanisms (connected with simulation theory) that are recruited in using one’s own mind to understand others’ minds (Gallese, 2003).

Indeed, the ventromedial PFC has been found in NTs to respond preferentially to information that is self-relevant as opposed to other-relevant (particularly non close but familiar others, such as Harry Potter), (Kelley et al, 2002; David et al, 2006; Pfeifer et al, 2007). This preference in the Ventromedial PFC for self-relevant information is found even when thinking about others’ impressions of ourselves (Ochsner et al, 2005; Izuma et al, 2008). These findings make the Ventromedial PFC a central neural mechanism in distinguishing self from other and in the coding of “self-information”. Lombardo et al. (2010) suggest that this “neural distinction between self and other enables us to appreciate the similarities and differences between our own and others’ minds”. This is central to simulation theories, in that successful mentalising, empathising and appropriate social behaviour all rely upon the use of “the self” as the fixed referent and “anchor point” for modelling others’ minds (Epley et al, 2004).

1.5.1.2 Autistic Spectrum Disorders

Kennedy and Courchesne (2008) have found reduced Ventromedial PFC activation across personality trait judgements involving both self and other, in ASDs compared to NTs. Moreover, a recent metaanalysis of 24 neuroimaging studies (allowing estimation of the likelihood of activation of certain areas during social processing) found the medial PFC to be underactive in ASD compared to NTs (Di Martino et al. 2009). Finally, Lombardo et al. (2010) employed fMRI whilst asking ASD and NTs to make “reflective mentalising” or “physical judgments” about either themselves or the British Queen (a familiar non close other). In line with the above studies in NTs, they found the usual greater activation in the Ventromedial PFC for self versus other (the Queen) processing. However, the ASD participants did not show differential responses in this region for self versus other judgements. ASD participants showed an absence of this neural “self-reference effect” (SRE). Moreover, the magnitude of the neural self-other distinction in the ASD group whilst mentalising was strongly related to the magnitude of early childhood social impairments in autism, such that the greater the early social impairments the smaller the neural SRE.

These findings strongly suggest that atypical neural circuitry, especially the reduced role of the ventromedial PFC coding for self-relevant information, is central to both the self-referential and social impairments seen in ASD (Lombardo et al, 2010). Given the complexity of ASD however, and the wide range of symptoms found, it is likely that disruptions in interactions within and between large-scale brain networks as opposed to simple focal deficits are needed to account for all the symptomatology (Uddin & Menon, 2009).

1.5.2 The “Absent Self” hypothesis

The co-occurrence of both self-referential and social cognition deficits in ASD have led to the proposal of the “absent self” (Frith 2003; Baron-Cohen, 2005; Hobson et al. 2006 reported in Lombardo et al, 2010). Rather than suggesting a total lack of self, it relates to the idea that a specific kind of self awareness, perhaps involved in administering “top-down” control, may be absent in ASD. In connecting this idea to neuropsychological data, Lombardo et al. (2010) noted that focal lesions in the ventromedial PFC have ruinous consequences for social behaviour (Beer et al, 2006). They suggest that the absence of this higher-order self awareness may have consequences in ASD such as difficulties in appreciating the “dual nature of oneself in the social world, as an agent who is both similar to and yet different from others” (frith

2003; Hobson et al. 2006). This would be another facet of the kinds of deficits in “psychological” self awareness explored in sections 1.4.3.1 and 1.4.3.2. It also suggests that we would expect to find a relationship between self-referential and social cognition deficits.

These ideas are a relatively new area in autism research, and to date studies exploring self referential processing and its relationship to social cognition in ASD are sparse. There are some indications however. In the study reported earlier Lombardo et al. (2010) found a connection between the neural SRE and social impairment in childhood. Further to this, Lombardo et al.’s (2007) study exploring the SRE across the self, friend, Harry Potter and syllables (reported in section 1.4.4.2) provides some additional evidence. They found that self-referential and social cognition are inextricably linked. Firstly, within the SRE memory paradigm, they found that mentalising abilities accounted specifically for performance in the self-condition but not in the best friend-condition or the syllable-condition (this was indicated through adding the Mind in the eyes test as a covariate which removed group differences in self condition only). Additionally, in both the ASD and control groups, they found that as performance in the self condition increased, performance on the eyes test also increased and the endorsement of autistic traits decreased (measured by the Autistic Spectrum Quotient (AQ)- Baron-Cohen et al. 2001). These findings are of particular note for the present thesis, which will also be exploring the relationship between measures of self-referential and social cognition in ASD.

1.6 MEASURING THE SELF

As discussed in section 1.4.1, the self is notoriously hard to define. This also makes it extremely difficult to measure. However, by carefully construing the sense of self under investigation, valid studies can be undertaken. The present study is concerned more with the self-as-object (the me) than the self as subject (the I) (James 1892/1961). In particular, it is concerned with exploring self-concepts in NT adolescents and those with ASD. From the perspective of the self-as-object, the self is clearly not a unitary concept but a multidimensional and multifaceted set of self-images (e.g. *I am male, I am a father, I am kind*). Though it is possible to measure the self-images directly, it is important to bear in mind the intimate link with memory, explored in sections 1.4.2 and 1.4.4. Self images and concepts are a form of semantic autobiographical memory (SAK).

In order to use self-images in research, a method of collecting them is needed. For example, the “Tennessee Self Concept Scale” (Fitts, 1965) asks individuals to rate statements for “self-

descriptiveness". Jones, Sensenig & Haley (1974) have noted problems with such "rating" methods however in that they restrict individuals to pre-determined items and may not provide categories of self-definition that are meaningful to a persons' set of self-concepts. Alternative methods are more open-ended allowing individuals to describe freely their sense of self. One such task is the "Twenty statements Test" (TST, Kuhn and McPartland, 1954). Individuals are asked to complete a series of statements beginning "I am..." allowing them to draw on trait knowledge (a form of SAK) and more narrative information (e.g. *I am training to be a clinical Psychologist*). Such open ended methods are intuitively appropriate for measuring a construct as complex, diverse, multidimensional and personal as "the self" (Mcguire & Padawer-Singer, 1976).

Indeed, there has been a recent upsurge of interest in 'the self' as a cognitive structure (e.g. see Klein, 2012), and a corresponding increase in the use of cognitive paradigms attempting to measure 'the self', especially in relation to memory (for a review, see Conway 2005). The generation of 'I am' statements, very similar to those generated in the TST, have been employed as one method to explore the role of 'the self' in human memory. For instance, Rathbone, Moulin & Conway (2008) used self images generated from 'I am' cues to explore the accessibility and organisation of memories connected with it. They found that memories generated from "I am cues" clustered around the 'time of emergence' of that particular self concept and remained highly accessible later in life.

Such paradigms have shown that 'the self' exists as a powerful organisational structure in human memory, including for representations of past and future events (Rathbone et al, 2011). It has also illustrated "intact" self-function for people with epilepsy and head injury (Rathbone et al, 2009; Illman et al, 2011), insofar as 'the self' operates to organise what few autobiographical memories are available. Though a detailed review of this research is beyond the scope of this thesis, it illustrates that the generation of 'I am' statements has been particularly useful as a measure of 'the self' in experimental memory paradigms. The present thesis aims to extend the basic "I am statement" method in order to more directly measure the accessibility of self concepts and the types of self-concepts generated.

One difficulty with open-ended methods such as the TST is that they can be hard to appropriately quantify and score objectively (Strong and Feder, 1961). These problems can be overcome however through using either validated coding schemes (e.g. the eight categories of Rhee et al, 1995) or through using theoretically driven distinctions and classifications. The present thesis is an instance of the latter and will employ an adaptation of Jackson et al.'s

(2012) coding scheme to a novel fluency version of the TST (The I Am task). This is theoretically motivated on the basis of key distinctions in self awareness and self concept explored in sections 1.4.3.1 and 1.4.3.2.

1.7 AIMS OF THE THESIS

The central aim of the thesis was to explore self-concepts and other-concepts in ASDs and NTs with novel fluency measures that enable both quantitative and qualitative assessment. More specifically, to ascertain whether the timed open ended generation of self-statements (see the “I Am task”, section 2.1.1) would show a self reference effect (SRE) in comparison to the generation of other-statements (see the (s)he is tasks, section 2.1.2), and to assess whether these statements differed qualitatively (e.g. whether the statements were physical, social or psychological self-concepts; see section 1.4.3.2).

Study 1 explores these novel fluency measures in a piloting sample of NT adolescents and Study 2 assesses the quantitative and qualitative differences between an ASD group and an age and IQ matched NT group of adolescents. Study 2 had two additional aims. First, to explore social stereotyping in ASDs and NTs (such as the “Beauty is Good” (BIG) and the “Happy is Good” stereotypes, see section 1.4.3.3) through an analysis of the other-statement tasks. And second, to explore whether potential quantitative and qualitative differences between ASDs and NTs in generating self and other statements are related to measures of social cognition in the “Theory of Mind” paradigm.

In summary, the research questions for each study are as follows:

Study 1

What are the quantitative and qualitative differences between the open ended generation of self-statements and other-statements in a large NT pilot group? Is it possible to measure the generation of self concepts using ‘I am’ cues which present psychologically meaningful results, interpretable in a self framework? Can a self-reference effect be found in a series of identity statements produced in fluency tasks?

Study 2:

Pilot Study 1 indicated Fluency tasks were a meaningful and useable measure of the accessibility of self concepts, and so Study 2 went on to ask: 'what can they uncover regarding the self in ASD?' More specifically:

- a) What are the quantitative and qualitative differences between an ASD and NT group in generating self and other statements?
- b) What are the differences between an ASD and NT group in spontaneously generating social stereotypes?
- c) What is the relationship between the generation of self/other statements and TOM measures?

2.0 THE STUDIES

Moses: "Who are you?". God: "I Am that I Am"

-a paraphrase of Exodus 3:14

2.1 Overview and rationale of the key tasks in Study 1 and Study 2

This section introduces the experimental tasks designed for the present thesis. As stated in the thesis aims (section 1.7), the main purpose of these measures was to enable quantitative and qualitative assessment of self and other concepts through open-ended fluency measures.

2.1.1 The I Am task

The 'I Am' fluency task is an adaption of the "twenty statements task" (TST, Kuhn and McPartland, 1954, see section 1.6). The TST is open ended, requesting participants to generate "I am" statements in response to the question: "who am I?". This approach enables participants to define their own sense of self in their own words, giving free scope to focus on any selection of the numerous and multifaceted self-images that a person may have. The twenty generated 'I am' statements are then coded using one of several available scales, for example, Rhee et al.'s (1995) eight categories: "traits, social identities, specific attributes, evaluative descriptions, physical descriptions, emotional states, peripheral information, and global descriptions". The I Am fluency task differs in that the participant performs the task under timed conditions, with just one minute to generate as many self-statements as they can. Additionally, the number of coding categories for the "I am" statements has been simplified (see section 2.1.1.1).

Fluency tasks were introduced in section 1.2.3.1. They have long been used to give an indication of a person's cognitive "access" to information under timed conditions, with varying degrees of implicit structure present in the task (Lezak et al, 2004). For example, semantic category fluency tasks require the generation of as many items (e.g. pig, cow, goat) in a given category (e.g. "animals") in one minute. The category thereby provides semantic structure to the task. Findings on Category fluency measures in ASD are revisited below in section 2.1.3.

Goddard and Crane (2008) found reduced fluency on a task tapping episodic autobiographical memory (EAM) but not on a fluency measure tapping semantic autobiographical memory (SAK;

people's names) in an ASD group (the study was discussed in section 1.4.4.1). They suggested impaired self-concepts as a possible explanation for the impaired EAM seen in this study (Goddard et al. 2007), though other hypotheses include deficits in memory binding (Bowler, Gaigg and Lind, 2011). Though Goddard and Crane (2008) didn't find impaired SAK fluency for peoples' names connected with AMs in ASD, the present I Am fluency task involves tapping SAK (and possible EAM) that is more complex and multifaceted in nature. Indeed, the I Am task attempts to tap self-concepts directly, and thereby involves more complex and elaborated self-knowledge.

In the I Am task the self is essentially construed as a single construct, though multidimensional, and is left loosely defined. The task instructions have however been modified to allude to some of the different categories that self-statements might relate to (see Appendix 1). Nonetheless, response options are left open and each participant is encouraged to respond in whatever way seems most appropriate to them. Consequently the I Am task provides a measure of both quantitative and qualitative significance, yielding fluency totals that can be coded into distinct self categories.

2.1.1.1 Coding

Jackson et al. (2012) studied self understanding in adolescents with aspergers using the "self understanding interview" (SUI; Damon and Hart, 1988). This study was reported in section 1.4.3.2. They used a coding scheme based upon William James (1892/1961) theories on the domains of the self divided into the self-as-object (me) and self-as-subject (I) components, see section 1.4.1. It is the "self-as-object" chunks that incorporate qualities that objectively define the self and which make up a person's self-concepts, and it is with these that the present study is concerned. Jackson et al. (2012) had found that in the SUI the asperger group generated less self-characteristics than the control group, and showed a distinct pattern of reporting significantly less psychological and social descriptions of themselves whereas there was no difference in the number of physical self-characteristics reported.

The I Am fluency task has been designed with the aim of providing an index for quantitative differences in fluency and qualitative differences in the nature of self statements generated between NT adolescents and those with an ASD. It also enables comparison across different types of fluency task (e.g. category fluency tasks and (s)he is fluency tasks). In terms of coding categories, Jackson et al.'s (2012) study provides a simplified yet no less cogent model for the

coding of self-statements than Rhee et al.'s (1995) eight categories (often used in conjunction with the TST). Moreover, these categories have yielded significant differences in ASD populations on the SUI (Hobson and Lee, 1998; Jackson et al, 2012).

In respect of these considerations, the I Am fluency statements were coded into Physical, Social and Personal (psychological) categories corresponding to three of the four self-as-object categories used in Jackson's study, see section 1.4.3.2. One difference however is that the "Active" category in Jackson's study, relating to individuals' activity-based abilities, has in the present study been incorporated under the "Social" categorisation, in so far as it largely relates to a socially defined ability or active role (e.g. a biker, a poker player). This further simplifies the coding model. See Appendix 2 for a description and examples of coding rules used with the I Am and (s)he is fluency tasks.

2.1.2 (S)he is picture fluency task

This novel task has been designed to tap the fluency of participants in mapping the self of "other" people. The task follows the same general principles as the I Am fluency task, except that instead of making statements about themselves, the participant is asked to generate statements about known and unknown persons in 6 distinct pictures (one minute per picture, so that the (s)he is task comprises 6 task conditions). As part of the instructions, participants are encouraged to make any type of attribution that they consider appropriate, including what they imagine the person to be like (see instructions in Appendix 1).

The main impetus behind creating this task was to explore potential differences in fluency between self (I am task) and other ((s)he is task). In particular, to discern if a self-reference effect (SRE) is present with participants finding it easier to generate more statements about themselves than known and unknown others (see section 1.4.4.2), and to explore if there are any qualitative differences in the self-as-object attributions (physical, social and personal) commonly made for self, known and unknown others (see section 1.4.3). In brief, the aim of Study 1 was to explore these considerations in a normal population sample of 99 participants, and Study 2 aimed to test experimentally if there are significant differences between NT adolescents and those with an ASD.

2.1.2.1 Six Picture Conditions

Two “known” pictures were chosen for the task: Harry Potter and the Queen. These choices reflect the existing usage of these known others in related memory research (e.g. Lombardo et al, 2007; Henderson et al, 2009; Lombardo et al, 2011). In short, Lombardo et al. (2007) found a reduced SRE in the self vs Harry potter encoding conditions in an adult ASD group compared to matched controls, Henderson et al. (2009) found no SRE effect in the same comparison with HFA children (see section 1.4.4.2), and Lombardo et al. (2011) found distinct differences in neuro-cortical self and other (British Queen) representation between ASD and control groups, for example demonstrating an absent “neural SRE” in the ASD group (see section 1.5.1.2).

Four “unknown” pictures were taken from an online database, two male and two female. A happy and a sad male face, and an attractive and unattractive female face were chosen based on existing ratings of happiness and attractiveness for these faces (data available from the online database, see Oosterhof & Todorov, 2008). Alongside providing “unknown other” fluency task conditions, these pictures also enabled exploration of potential differences relating to happiness and attractiveness dimensions.

Robust findings in the literature relating to social stereotypes were reported in section 1.4.3.3. In particular, they document the “Beauty is Good, BIG” stereotype, where attractive faces are more likely to be judged as friendly and intelligent and where unattractive faces are more likely to be judged as unfriendly and unintelligent (Langlois et al, 2000). Similar stereotypes exist for happiness and goodness (HIG; Hess, Adams & Kleck, 2008).

In one of the first studies to look at this issue, Fonseca et al. (2011) found a similar BIG stereotype in an ASD group compared to an age and IQ matched group of children when judging pictures of faces (see section 1.4.3.3). This is a little surprising, given the hallmark deficit of difficulties in social understanding, interaction and development seen in ASD. An additional aim of study 2 was therefore to explore whether differences are present between NT adolescents and those with an ASD in spontaneous social stereotyping across the “unknown” (s)he is tasks. To this end, responses for the unknown pictures will be qualitatively assessed and coded for comparison on the basis of spontaneous BIG and HIG stereotypes (see Study 2). The 6 pictures are presented in Figure 2.1.

Figure 2.1. The six pictures of the (s)he is tasks

<p>Harry Potter</p>	<p>The Queen</p>
 <p>He is.....</p>	 <p>She is.....</p>
<p>Happy</p>	<p>Unattractive</p>
 <p>He is....</p>	 <p>She is....</p>
<p>Attractive</p>	<p>Sad</p>
 <p>She is</p>	 <p>He is.....</p>

2.1.3 Category Fluency (Animals) Task

This commonly used verbal category fluency task (Benton and Hamsher, 1978) has been included as an index of general fluency abilities. Participants are asked to generate as many different animals as they can in one minute. Findings for ASD populations regarding verbal fluency are mixed. Some find deficits in semantic and phonemic fluency in High functioning autistic children (Turner, 1999) adolescents and adults (Beversdorf et al, 2011) and others a specific deficit in only semantic category fluency tasks (“professions”) in an adult asperger group (Spek et al, 2009). Other studies find no deficits in high functioning ASD adolescents and adults in respect of semantic category fluency tasks (Boucher, 1988; Crane and Goddard, 2008; Robinson et al, 2009; Kleinhans et al, 2005). The weight of this evidence would suggest that in an HFA adolescent population, “animals” category fluency would not be markedly impaired.

2.2 STUDY ONE

2.2.1 Aims

The aim of Study 1 was to investigate fluency and self-as-object attribution type (physical, social or personal) across the “I Am” task and the 6 picture conditions of the “(S)he is” task in a large NT adolescent population. The main emphasis of Study 1 was on piloting the experimental fluency measures and to index any self-reference effects (SREs) and/or other observed effects across the task conditions. SREs are robustly seen in memory research (Rogers, Kuiper & Kirker, 1977; see section 1.4.4.2). Here “the self” is construed as a well developed cognitive structure which acts as a fixed referent around which self-concepts and other memories are organised and elaborated (Symons and Johnson, 1997). This is thought to increase the depth-of-processing at encoding and the related ease of cognitive access and recall for memories and concepts connected with “the self” (Craik and Tulving, 1975). Consequently it is predicted that participants in this study will show an SRE in terms of significantly greater fluency for the self compared to other conditions.

2.2.2 Method

2.2.2.1 Participants

99 healthy volunteers were recruited for this within subject design. The study was approved by University of Leeds Research Ethic Committee. Volunteers were recruited through cooperation with a Leeds based Secondary School. All volunteers were students who took part in school form time, for 10 minutes, upon written agreement of the school head teacher acting as “in loco parentis” as well as verbal consent of parent and student. All students were between 12.5 and 15.5 years of age (mean 13.7, SD: 0.61), and 48 were female and 51 male.

2.2.2.2 Procedure

Participants were verbally instructed as per the guidelines in Appendix 1. The Animals fluency task was administered first, followed by the I Am task and then the 6 conditions of the (s)he is task. These tasks have been described in sections 2.1.1 and 2.1.2. A teacher assisted in the collection of data for the pilot study and he was trained in person allowing for clarification and

in order to ensure the written guidelines (see appendix 1) were understood accurately. The data for the I Am and (s)he is tasks were coded into physical, social and personal categories by a colleague at the University of Leeds as per the instructions and table in Appendix 2. Together with a third colleague, we discussed a sample of coded answers to ensure we interpreted the coding system in the same way. Furthermore, for a minority of responses in the pilot data where my colleague felt there was some ambiguity, she marked the answer for attention and we agreed together on an appropriate category.

2.2.3 Results

The central aim of the study was to index an SRE in terms of total fluency scores across all the fluency tasks. Moreover it was also intended to explore differences in the fluency totals for the 3 distinct types of attribution (physical, social, personal) across the I Am and (S)he is tasks. In order to do this, a repeated measures 7 x 3 (Task x type) analysis of variance (ANOVA) was first conducted to ascertain main effects and interaction effects. This was followed by 3 separate ANOVAs for each of the attribution types (each with 7 levels of task) so as to gain a clearer picture of the interaction effects. Finally, fluency on the I Am and (S)he is tasks was compared to fluency on the animal category fluency task using paired sample t-tests and bivariate correlations.

2.2.3.1 Repeated measures ANOVA

For the initial analysis, a within subjects 7 x 3 ANOVA was conducted in order to detect possible differences in fluency between the 7 task conditions and the 3 types of attribution (Task x Type). See Table 2.1 for a summary of the descriptive statistics from the data analysis. Note that where Mauchly's test indicated that the assumption of sphericity has been violated, the Greenhouse-Geisser correction has been reported. All effects are reported as significant at $p < .001$ level.

There was a significant main effect of Task condition, $F(5.1, 498.2) = 54.97$ $p < .001$, Attribution Type $F(1.5, 143.8) = 80.30$, $p < .001$ and a significant Task*type interaction effect, $F(7.9, 779.6) = 43.3$, $p < .001$. Due to the multitude of potential contrasts, these main effects and interactions were interpreted based on Table 2.1 and individual contrasts and effect sizes of those contrasts (see tables 2.2, 2.3 and 2.4). To obtain all the relevant contrasts, 3 separate ANOVAs were calculated for each of the three types: physical, social and personal, with Bonferroni corrections to allay family-wise error. Note that effect sizes have been calculated correcting for

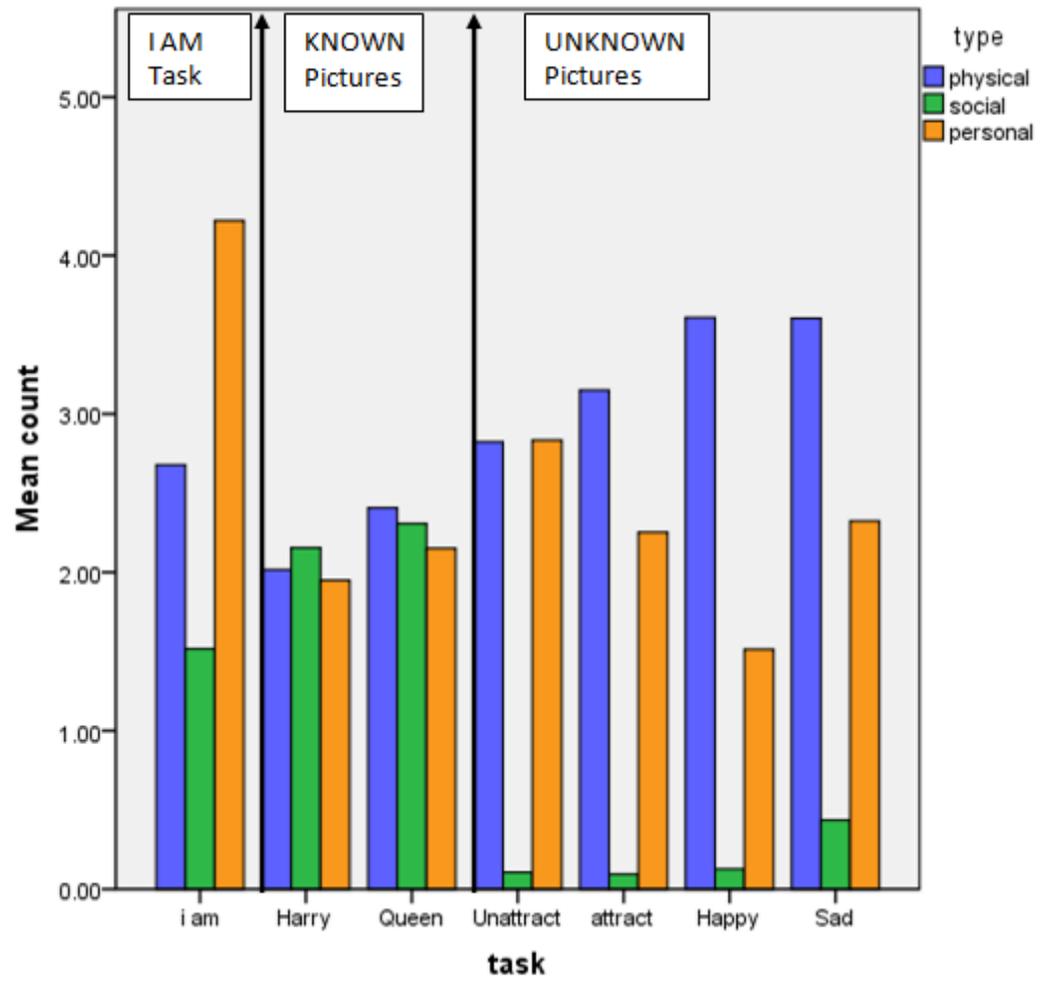
the pairwise correlations between tasks in this within subjects design, enabling more accurate future comparisons with other studies and between subjects conditions (Morris & Deschon, 2002).

Table 2.1. Summary of fluency scores for the different task conditions and attribution types, means and (SDs), from Study 1.

Task Condition	Attribution Type			Total
	<i>physical</i>	<i>social</i>	<i>personal</i>	
I Am task	2.68 (1.53)	1.52 (1.59)	4.22 (2.49)	8.39 (2.73)
Known Harry Potter	2.02 (1.70)	2.16 (1.24)	1.95 (1.91)	6.09 (2.12)
Known Queen	2.41 (1.83)	2.31 (1.20)	2.15 (1.80)	6.84 (2.09)
Unknown Unattractive	2.82 (1.67)	0.11 (0.37)	2.83 (1.67)	5.75 (2.03)
Unknown Attractive	3.15 (1.77)	0.10 (0.35)	2.25 (1.73)	5.48 (2.06)
Unknown Happy	3.61 (1.64)	0.13 (0.41)	1.51 (1.31)	5.23 (1.64)
Unknown Sad	3.60 (2.19)	0.44 (0.71)	2.32 (1.70)	6.34 (2.21)
Animal task				14.24 (3.91)

Table 2.1 indicates some clear general patterns across the fluency scores. In terms of total fluency and the significant main effect of Task, The I Am task (8.39) has a greater fluency total than all the (s)he is tasks (means ranging from 5.23 to 6.84). This is indicative of a clear Self Reference Effect (SRE). A similar pattern seems to hold for the personal attributions but not for the physical and social attributions. These patterns are examined in more detail in the separate contrasts that follow. A graphic representation of these fluency scores by task and type can be found in Figure 2.2.

Figure 2.2 to show mean fluency scores across all types and tasks in Study 1



2.2.3.2 Physical attributions

A repeated measures ANOVA with 7 levels of Task was significant $F(6, 588) = 21.89, p < .001$. To help understand the effect of task on the generation of physical attributions, table 2.2 shows the significant pairwise contrasts and the effect size of the differences. Effect sizes provide a more meaningful summary of the contrasts than the differences in marginal means (means are reported in Table 2.1).

In terms of physical attributions, Figure 2.2 indicates that there are more physical attributions for the unknown pictures (particularly happy and sad) than for Harry Potter, the Queen and the I Am task. Indeed, as indicated in Table 2.2 Harry Potter has significantly less physical attributions than unattractive ($d = 0.42$), attractive ($d = 0.62$), happy ($d = 0.88$) and sad ($d = 0.81$), all $p < .001$. With the exception of unattractive ($d = 0.21$) the pattern of significant differences is very similar for the Queen ($d = 0.41, d = 0.67$ and $d = 0.59$ respectively, $p < .001$). These significant effect sizes are in the medium and large ranges. Furthermore, Harry Potter, the Queen and the I Am task are not significantly different from each other, with the exception of a small effect size difference between the I Am task and Harry Potter ($d = 0.34, p < .05$).

In respect of the Study 1 aim to index a self-reference effect, we can see that for physical attributions the only evidence is for I Am task vs Harry Potter ($d = 0.35, p < .05$). In fact the pattern reveals that participants tend to generate more physical attributes for unknown people than themselves, with significantly fewer physical attributions for the I Am task than Happy ($d = 0.57, P < .001$) and sad ($d = 0.43, p < 0.01$), and no significant differences to attractive and unattractive pictures.

Table 2.2 A table to show the effect sizes (Cohen's d) for differences in marginal means across pairwise task comparisons for physical attributions.

Task Condition	Physical Attributions					
	<i>I Am</i>	Harry	Queen	Unattract	Attractive	Happy
Known Harry Potter	0.35*					
Known Queen	0.14	-0.23				
Unknown Unattractive	-0.07	-0.42**	-0.21			
Unknown Attractive	-0.25	-0.62**	-0.41**	-0.24		
Unknown Happy	-0.57**	-0.88**	-0.67**	-0.54**	-0.34*	
Unknown Sad	-0.43**	-0.81**	-0.59**	-0.46**	-0.32	0.01

Note: effect sizes are calculated on the basis of the paired sample t-statistic and the correlation between conditions. A correction for the correlation is important, otherwise effect sizes are overestimated and unsuitable for comparison with other studies (Morris and Deschons, 2002, equation 8). * indicates significant at the $p < .05$ level, and ** indicates significant at the $p < .01$ level. Positive values equal the item in the column being greater than in the row.

2.2.3.3 Social Attributions

A repeated measures ANOVA with 7 levels of Task was significant $F(6, 588) = 121.60, p < .001$. Table 2.3 shows the significant pairwise contrasts and the effect size of the differences in fluency for social attributions.

In terms of social attributions, Figure 2.2 indicates significantly more social attributions for the “known pictures” (Harry and the Queen) than the other tasks. Harry Potter and the Queen are not significantly different from each other. Table 2.3 confirms significantly more social attributions for Harry Potter and the Queen than all other tasks, with huge effect sizes compared to all the unknown pictures (ranging from $d=1.34$ to $d=1.97$), and small to medium effect sizes compared to the I Am task ($d=.35$ and $d=.40$ respectively). The I Am task similarly shows significant and large effect size differences with all the unknown pictures (ranging from $d=.69$ to $d=1.14$). There is some variation in the unknown pictures, where “sad” shows significantly more social attributions than the other unknown pictures, with medium effect sizes (ranging from $d=.45$ to $d=.52, p < 0.01$).

In respect of indexing a self-referencing effect, we do not see an SRE in comparing the I Am task to Harry Potter and the Queen. In fact, significantly more social attributions are apparent for the known others (Harry and the Queen) than for all other tasks. However, there are significantly more social attributions for the I Am task than unknown others. In the social world then, the results indicate a greater number of social attributions made about known others than about the self. However there is an SRE with respect to unknown others.

Table 2.3 A table to show the effect sizes (Cohen's d) for differences in marginal means across pairwise task comparisons for social attributions.

Task Condition	Social Attributions					
	<i>I Am</i>	Harry	Queen	Unattract	Attractive	Happy
Known Harry Potter	-0.35*					
Known Queen	-0.40**	-0.11				
Unknown Unattractive	1.06**	1.90**	1.90**			
Unknown Attractive	1.14**	1.88**	1.97**	0.03		
Unknown Happy	1.01**	1.77**	1.34**	-0.06	-0.01	
Unknown Sad	0.69**	1.66**	1.58*	-0.52**	-0.51**	0.45**

* indicates significant at the $p < .05$ level, and ** indicates significant at the $p < .01$ level. Positive values equal the item in the column being greater than in the row.

2.2.3.4 Personal Attributions

A repeated measures ANOVA with 7 levels of Task was significant $F(6, 588) = 33.79, p < .001$. Table 2.4 shows the significant pairwise contrasts and the effect size of the differences in fluency for personal attributions.

In terms of personal attributions, Figure 2.2 clearly indicates more personal attributions for the “I Am” task compared to all the known and unknown pictures. Indeed this is significant for all contrasts (see Table 2.4), $p < .001$, and the effect sizes are mainly large (ranging from $d = 0.59$ to $d = 1.10$). Moreover, Harry and the Queen are not significantly different to each other or the unknown pictures, with the exception of small effect size differences with Unattractive ($d = 0.38$ and $d = 0.35$ respectively, $p < .05$) and between the Queen and Happy ($d = 0.38, p < .05$) pictures. Amongst the unknown pictures, Happy shows significantly fewer personal attributions than the other pictures, with medium effect sizes (ranging from $d = .49$ to $d = .68, p < .001$). Here we find clear evidence of a self-referencing effect, with much greater fluency for personal attributions in the I Am task than all other tasks.

Table 2.4 A table to show the effect sizes (Cohen's d) for differences in marginal means across pairwise task comparisons for personal attributions.

Task Condition	<i>I Am</i>	Personal Attributions				
		Harry	Queen	Unattract	Attractive	Happy
Known Harry Potter	0.9**					
Known Queen	0.8**	-0.09				
Unknown Unattractive	0.59**	-0.38**	0.35*			
Unknown Attractive	0.78**	0.14	0.05	0.37*		
Unknown Happy	1.10**	-0.23	0.38*	0.68**	0.49**	
Unknown Sad	0.76**	-0.16	0.09	0.32*	0.05	0.5**

* indicates significant at the $p < .05$ level, and ** indicates significant at the $p < .01$ level. Positive values equal the item in the column being greater than in the row.

2.2.3.5 Comparisons with Category fluency

The animal fluency task enabled a comparison of the generation of attributes across the I Am and (s)he is tasks with a commonly used fluency measure. The animals category fluency task correlated significantly with the total fluency score across all other tasks, with medium correlations ($r=.267$ to $r=.449$, $p<.01$). The sole exception to this was 'Animals' with Harry Potter, which was nonetheless very close to significance ($r=.181$, $p=.07$). This finding indicates that performance on the I Am tasks and (s)he is tasks were significantly related to more general fluency abilities. A full table of the correlations can be found in Appendix 3.

The central focus of Study 1 was on the generation of self attributes in the I Am task and its design construction as a fluency measure. Therefore additional comparisons were made with the Animals task. Overall, the I Am task total fluency score had a large and significant correlation with the animals task ($r=.429$, $p<.001$). Regarding the types of attribution, fluency of both personal and social attributions correlated significantly with the animals task ($r=.248$ and $r=.218$ respectively, $p<.05$). Fluency with physical attributions did not correlate significantly ($r=.083$).

A paired samples T-test compared the means across fluency totals for the I Am task and the Animal task. Participants produced significantly more attributions for Animals ($M=14.24$, $SE=0.39$) than in the I Am task ($M=8.39$, $SE=0.27$), $t(98) = 15.8$, $p<.001$, $d=1.65$, indicating a very large effect size. Overall, these findings indicate that the I Am task is significantly related to fluency abilities (particularly in terms of generating social and personal statements). It is however a more difficult task than animals category fluency, as indicated in the very large effect size difference between I Am total fluency scores in comparison to the animals category fluency task.

2.2.4 Discussion of Study 1

The main effect of Task revealed a significant SRE with the "I Am" task showing greater fluency than all the (s)he is conditions. This SRE was however specific to attribution type, with more personal attributions in the I Am task than the (s)he is tasks, with mainly large effect sizes. This indicated that participants were able to access more self-as-object concepts in the personal domain for themselves compared to other people. We can therefore index a clear SRE in total fluency and fluency for personal attributes in a NT adolescent population.

This SRE did not hold for physical and social attributes however. Indeed, the results here indicate that in connection with social attributes, participants generated significantly more social attributions for known others than in the I Am task and all unknown others. Knowledge of Harry Potter and the Queen in the social world appears to make it easier to access information about their social identity and roles than for unknown others (large effect sizes). Though more social attributes are made for Harry and the Queen compared to the self (I Am task), this may reflect the fact that personal attributes are more accessible in the self and are possibly prioritized over social attributions. We can however index increased salience in social attributions for known others compared to unknown others.

In respect of physical attributions, the pattern is more mixed. There is an indication that participants generated more physical attributions for unknown others compared to known others and oneself. This effect was more pronounced for Happy and sad than for the attractive and unattractive pictures. In the dearth of social knowledge about other selves, participants were more likely to focus on physical attributes than social or personal ones for unknown others. Conversely, it is likely that for the known others and for the self, social and personal attributes respectively are more salient and are given priority over physical attributions. Overall, this appears to lead to increased generation of physical attributions toward unknown others than in other task conditions.

The findings indicated that the I Am task is also a much harder fluency task in comparison to the Animals category fluency task, with a very large effect size. Category fluency performance was significantly correlated with fluency performance across all other tasks except Harry Potter, indicating the role of general fluency abilities in I Am and (s)he is fluency performance.

Overall, Study 1 has enabled the indexing of some clear findings in respect of cognitive access and generation of self-concepts. The I Am and (s)he is fluency measures, utilizing 'I am' and '(s)he is/picture' cues, demonstrated clear quantitative findings in connection with SREs and fluency scores. They also highlighted some clear qualitative differences across task conditions in terms of the types of self-concepts generated, according to the physical, social and personal coding framework. In short, fluency measures have proved a workable measure of access to self concepts, and the coding framework has uncovered distinct differences across task conditions. Attention is now turned to the main experimental Study 2 where these fluency measures were used to explore differences in generating self concepts between NT adolescents and those with an ASD.

2.3 STUDY TWO

2.3.1 Overview and Aims

Recent research into ASDs have begun to report impairments in self-referential cognition (SRC), such as reduced or absent SREs for self vs known others at recall in memory paradigms (e.g. Lombardo et al, 2007; Henderson et al, 2009, see section 1.4.4.2). Also, research into self-awareness in ASD suggests a selective deficit in psychological as opposed to physical self awareness (Williams, 2010, see section 1.4.3.1), and initial research incorporating the Self understanding interview (SUI; Damon and Hart, 1988) with ASD populations has found reduced reporting of psychological and social descriptions of themselves but typical reporting of physical descriptions (Hobson and Lee, 1998; Jackson et al, 2012). Finally, Goddard and Crane (2008) found impaired EAM fluency but typical SAK fluency in ASD. They advanced impoverished self-concepts as a possible explanation for the EAM impairments (see section 1.4.4.1). These findings tie in with the recent “absent self” hypothesis for ASD, connecting the emerging findings in SRC with the long established social cognition deficits (Frith 2003; Baron-Cohen, 2005; Hobson et al. 2006, see also section 1.5.2). However, contrary to what might be expected on the basis of a lack of selfhood and TOM abilities seen in ASD, a study examining social stereotyping found no differences between ASD and NT children in making the “Beauty is Good, BIG” stereotype (Fonseca et al, 2011, see section 1.4.3.3). The aims of Study 2 were situated in the context of this research.

The present thesis has involved developing direct open-ended fluency measures of self and other concepts. Study 1 piloted these new I Am and (S)he is fluency tasks in 99 NT adolescents. The findings revealed a clear SRE in terms of a greater total fluency on the I Am task compared to the (S)he is tasks. It was shown that the SRE was largely connected with increased personal attributions in the I Am compared to the (S)he is tasks and other clear findings with respect to attribution type were also found. The fluency measures therefore seem suited to exploring potential SRE and attribution differences between NT adolescents and those with an ASD.

The main aims of Study 2 were to explore whether a lack of selfhood in ASD adolescents could be seen in terms of an absent or reduced SRE in comparison to an age and IQ matched control group, and to investigate potential group differences in the types of attributions made (physical, social, personal) across the I Am and (s)he is tasks. These aims were addressed first in the results sections 2.3.4.1 to 2.3.4.4. A further aim of Study 2 was to explore whether there

are differences in spontaneous social stereotyping between groups i.e. to see if there are differences in “Beautiful Is Good” (BIG), HIG and related stereotypes. These issues are covered next in the results section 2.3.4.5. Finally, Study 2 aimed to explore possible relationships between measures of social cognition (advanced TOM tasks: Mind in the eyes, Character intentions task, Faux pas task and the experimental Yoni task, all described in section 2.3.2) and differences in Self-referential cognition, and these issues are covered last in the result section 2.3.4.7. In connection with these aims, the following hypotheses were made on the basis of existing literature.

2.3.1.1 Hypotheses

Firstly, there will be a reduced SRE in the ASD group (i.e. smaller differences between self and known other fluency). This prediction is based primarily on paradigms in memory research that demonstrate a reduced SRE in ASD populations between self and known others (e.g. Lombardo et al, 2007; Henderson et al, 2009).

Secondly, the ASD group will generate less social and personal attributions than the control group across all fluency tasks. This is predicted on the basis of Jackson et al.’s (2012) study using the SUI which found significantly less social and psychological (personal) statements in an asperger group, but not less statements about physical characteristics. It is also based on the finding of selective impairments in psychological but not physical self awareness (Williams, 2010).

Thirdly, if the finding of typical social stereotyping (e.g. “Beauty is Good (BIG)” stereotype) found in ASD children is taken as representative (Fonseca et al, 2011), then no group differences are expected for spontaneously generated BIG, HIG and related stereotypes for the unknown other pictures. It is to be noted however that this prediction is somewhat counterintuitive in the context of impaired social cognition and SRC generally seen in ASD.

Fourthly, there will be a significant relationship between performance on the TOM tasks (which are expected to be impaired in the ASD group, see section 2.3.2) and SRC tasks. More specifically, TOM performance will be significantly related to the magnitude of SREs and the generation of personal and social attributes that are expected to differ between groups. This is predicted on the basis of the “absent self hypothesis” and findings demonstrating a connection between SREs and the Mind in the eyes task (Baron-Cohen et al. 2007), and upon the

neuropsychological overlap found between SRC and social cognition, particularly in the ventromedial prefrontal cortex, including a neural SRE for NT individuals but not those with an ASD (Lombardo et al. 2010, see section 1.5.1.2).

2.3.2 Social Cognition Measures used in Study 2

As detailed in section 1.3, one of the primary social cognitive models used to explain the socio-communicative impairments in ASD is the impaired “Theory of Mind” (TOM) model. The related TOM tasks come in degrees of difficulty, from first order (FOTOM), then second order (SOTOM) tasks to advanced “pragmatic tasks” involving “social perspective taking”, described in section 1.3.2. Given the High functioning adolescent participants taking part in the present research, a range of advanced TOM tasks were selected. These tasks cover a range of verbal, non-verbal, affective, cognitive and pragmatic elements. All the selected TOM tasks have shown deficits in HFA and ASD adolescents (with the exception of the experimental Yoni task which has not yet been tested in this population, see section 2.3.2.4). These TOM tasks are described in the following sections and examples of each can be found in Appendix 5.

2.3.2.1 Adult Mind in the Eyes Task

The Adult Mind in the eyes task (Baron-Cohen et al, 2001) comprises 36 separate pictures of eyes and requests participants to select one of four emotion-related words that they think best describes the emotion in the eyes. The task is not timed and participants are instructed that they can refer to a vocabulary sheet if they are uncertain of the meaning of an emotion-word. Children and adolescents with ASD and HFA are impaired on this task (Baron-cohen, 2001, Kaland et al, 2008).

2.3.2.2 Character Intentions Task

The Character Intentions task (Brunet et al, 2000) is a non-verbal theory of mind task. Participants are shown 28 picture stories, comprising three scenes each. Participants are asked to choose one of 3 additional pictures that best complete the story. In order to solve the task participants have to gage the intentions of the characters in the pictures. Children and adolescents with ASD and HFA are impaired on this task (e.g. Duverger et al, 2007).

2.3.2.3 Adult Faux Pas Task

The adult Faux Pas Task (Stone et al, 1998) is an advanced theory of mind task involving social perspective taking. Twenty faux pas stories comprise this task, which are read out and placed in front of participants. 10 stories contain “social faux pas” and 10 stories do not. Both children (Baron-cohen, 1999) and Adults (Zalla et al, 2009) with HFA and Aspergers syndrome are impaired on this task, failing to understand the nature of the social faux pas and also over-detecting faux pas in non-faux pas stories.

2.3.2.4 Yoni Task

This experimental computer based Yoni task (Shamay-Tsoory et al, 2007) was included to assess participants’ accuracy and response times in determining which of 4 objects a fictional character (Yoni) is referring to. The participant must deduce this based on a sentence and other cues in the picture such as eye gaze and emotional expression. The task is divided into 24 first order TOM trials (Yoni is thinking of...) and 42 second order TOM trials (Yoni likes the object that __ likes) with a mixture of cognitive (“thinking of”) and affective (likes/loves/does not love...) sentences. In the second order tasks some trials have Yoni looking straight ahead in which case the answers must be deduced on other cues such as expression in these trials. The ‘straight ahead’ conditions inhibits participants from thinking they can deduce answers solely from eye gaze direction. The task also includes some physical conditions that act as control tasks: First order “Yoni is close to...”, and second order: “Yoni has the object that __ has”. This task has been included as a TOM task with a timed element to parallel the timing pressure present in the experimental fluency tasks. Existing studies show Second order Yoni speed deficits in “Traumatic Brain Injury” populations, and Parkinson’s disease (Bodden et al, 2010), though no studies have yet used the task in ASD populations.

2.3.3 Method

2.3.3.1 Participants

16 participants with a diagnosis of an Autistic Spectrum Disorder (ASD) were recruited for the experimental group. The ASD diagnosis for all participants had been confirmed through an Autism Diagnostic Observation Scale (ADOS; Lord, Rutter and Goode, 1989) assessment

conducted in previous research with the participants for a different PhD (Wojcik, 2011). All reached ADOS cut-off scores for an ASD diagnosis, and 12 participants were clinically defined as having Aspergers and 4 as having High functioning Autism. The participants with an ASD all attended a mainstream school. Additionally, 18 age and IQ matched control participants were recruited. IQ scores were obtained for all participants using the Wechsler Abbreviated Scale of Intelligence (WASI). The study and recruitment process were approved by the Leeds Research Ethics Committee (see Appendix 4). There were no significant differences in age between the ASD (M 15.2 years, SD 2.7) and Control (M 14.5, SD 1.4) groups, $t(32)=1.03$, $p=.31$. Similarly, no significant differences in IQ between the ASD (M 115.3, SD 13.8) and the control (M 116.3, SD 10.7) groups were found, $t(31)= -0.23$, $p=.82$. In terms of gender, the ASD group composed of 14 males and 2 females, and the control group composed of 10 males and 8 females.

2.3.3.2 Procedure

All participants were tested individually. WASI scores for the ASD participants had already been acquired in previous doctoral research. The WASI test was administered to the Control group after all the experimental testing had been completed. Experimental tests were administered in the following order: Animals, I Am task, (S)he is tasks, Eyes test, Yoni computer task (performed on a laptop), Character intentions task and Faux pas task. Instructions and examples for each task can be found in the Appendix 5. All data collection and coding into physical, social and personal attribution categories was undertaken by the author to ensure reliability and consistency.

2.3.4 Results

The first part of the results focuses on group differences across all the fluency tasks and attribution types (7 (task) x3 (type) x2 (group)) ANOVA. The main focus was to determine if SREs are different between groups and if attribution patterns are different between groups. Additionally, any effects will then be analysed for their relationship with general fluency (animals) ability using correlations and ANCOVA. The second part of the results section focuses on possible group differences in social stereotyping using Chi-Square analyses. The final section concentrates on social cognition including group differences on TOM tasks (and the impact of group variation on TOM tasks) and the effects discovered on the fluency tasks, using ANCOVA.

2.3.4.1 Repeated measures ANOVA

For the initial analysis, a Mixed (within and between subjects) Analysis of variance (ANOVA) was conducted in order to detect possible differences in fluency in the 7 task conditions and the 3 types of attribution between the ASD and Control group (Task x Type x Group). See Table 3.1 for a summary of the descriptive statistics from the data analysis.

The results revealed a significant effect of Group, with overall impaired fluency in the ASD group compared to the control group, $F(1,32) = 9.92, p < .01$. Similar to Study 1, there was a significant main effect of Task $F(6,192) = 18.51, p < .001$, Type $F(2,64) = 22.49, p < .001$ and Task*Type interaction $F(12,384) = 21.29, p < .001$. There was also a significant Type*Group interaction effect $F(2,64) = 9.21, p < .001$. The Task*Group interaction was not significant $F(6, 192) = 0.62, p = .72$. The Task*Type*Group interaction was also not significant at the $p < .05$ level, $F(12, 384) = 1.58, p = .095$.

Table 3.1. Summary of fluency scores for the ASD and control groups across task conditions and attribution types, means and (SDs).

Task Condition	Attribution Type			Total
	<i>physical</i>	<i>social</i>	<i>personal</i>	
I Am task				
ASD	2.13 (1.54)	2.63 (1.78)	2.00 (2.16)	6.75 (2.07)
Control	1.83 (0.84)	3.06 (1.77)	4.44 (2.04)	9.11 (2.14)
Known Harry Potter				
ASD	2.06 (1.53)	2.13 (2.67)	0.69 (1.20)	4.88 (1.67)
Control	2.28 (1.23)	2.17 (1.76)	2.44 (1.92)	6.89 (2.52)
Known Queen				
ASD	2.62 (1.86)	1.87 (1.67)	0.56 (0.63)	5.06 (1.98)
Control	2.06 (1.31)	3.11 (1.88)	1.67 (1.68)	6.83 (2.20)
Unknown Unattractive				
ASD	3.25 (2.27)	0.06 (0.25)	1.13 (1.5)	4.50 (2.34)
Control	2.56 (1.38)	0 (0)	3.50 (1.62)	6.11 (1.68)
Unknown Attractive				
ASD	2.94 (2.11)	0.50 (1.75)	0.75 (1.53)	3.69 (2.12)
Control	3.33 (1.53)	0.11 (0.32)	2.44 (1.69)	5.83 (2.20)
Unknown Happy				
ASD	3.88 (1.89)	0 (0)	0.69 (1.01)	4.56 (1.90)
Control	3.83 (1.51)	0.39 (0.78)	2.06 (1.47)	6.22 (1.77)
Unknown Sad				
ASD	3.88 (2.06)	0 (0)	0.69 (1.08)	4.13 (2.09)
Control	3.44 (1.85)	0.33 (0.69)	3.11 (1.75)	6.89 (2.10)
Animal task				
ASD				14.19 (3.31)
Control				17.56 (2.87)

Upon initial inspection, Table 3.1 indicates the same main effects as those found in Study 1. Namely, in terms of the significant main effect of Task, both groups appear to have greater total fluency for the I Am task compared to the (s)he is tasks, demonstrating an SRE, though the overall fluency in the ASD group appears to be much lower. To better understand these effects, further specific contrasts will be made in connection with the main aims and hypotheses.

2.3.4.2 Self-Reference Effect

A central expectation was that a reduced SRE in the ASD group would be found. The main effect of Task in the 7 (task)x3 (type) x2 (group) ANOVA revealed significant differences between the I Am task and (S)he is Tasks. The between subjects effect also highlighted significant group differences, with impaired total fluency in the ASD group. However, the Task*Group interaction was clearly non-significant suggesting that the main effect of Task was not different between groups.

To pursue these effects further, a separate 3 (task) x2 (group) ANOVA was performed for total fluency across the I Am and known other tasks (Harry Potter and the Queen) and experimental groups. This was done primarily to be representative of other studies investigating SREs which usually only compare self to known other conditions (Toichi et al. 2002; Lombardo et al, 2007; Henderson et al, 2009). Separate ANOVAs were also performed for each group in order to obtain all the relevant contrasts, with bonferroni corrections to allay family-wise error.

The 3 (task) x2 (group) ANOVA revealed a main effect of Task $F(2,64)= 25.68, p<.001$, and significant between group differences $F(1,32)= 9.39, p<.01$. The Task*Group interaction was again non-significant $F(2,64)= 0.42, p=.66$. The significant between group effect revealed impaired overall fluency in the ASD compared to the control group with large effect sizes: I Am ($d = 0.97$), Harry Potter ($d = 0.96$) and Queen ($d=0.84$).

The main effect of Task revealed a clear SRE that was not different between groups. In the ASD group, fluency in the I Am task (6.75) was significantly greater than in Harry (4.88, $d=1.09, p<.01$) and the Queen (5.06, $d=0.88, p<.05$). Harry and the Queen did not differ significantly from each other. Similarly in the control group, fluency in the I Am task (9.11) was significantly greater than in Harry (6.89, $d=1.15, p<.001$) and the Queen (6.83, $d=1.02, p<.01$), and Harry and the Queen did not differ from each other. The large effect sizes of these SREs were comparable between groups. Similarly, an SRE was also seen in an additional 3 (task) x2 (group) ANOVA for personal attributions only, mirroring the findings in Study 1, main effect of Task, $F(2,64)=22.17, p<.001$. This SRE in personal attributes did not significantly differ between groups, indicated by an insignificant Task*group interaction $F(2,64)=2.02, p=.14$. In short, the ASD group did show a typical SRE.

2.3.4.3 General Fluency abilities

The ASD group ($M=14.19$, $SD=3.31$) showed significantly reduced fluency in an independent samples t-test compared to controls ($M=17.56$, $SD=2.87$) on the animals semantic category fluency task, $t(32)=-3.18$, $p<.01$, $d=-1.09$, with a very large effect size. In the ASD group, there were large significant correlations between animal category fluency and total fluency scores on the I Am task ($r=.566$, $p<.05$) and known others tasks, Harry ($r=.632$, $p<.01$) and Queen ($r=.557$, $p<.05$). In the control group, there was a trend toward significant correlations: I Am task ($r=.391$, $p=.054$), Harry ($r=.334$, $p=.088$), Queen ($r=.276$, $p=.13$). These medium correlations in the control group, though not significant at the $p<.05$ level, are comparable in size to those found in Study 1 (see section 2.2.3.5).

The large significant correlations in the ASD group indicate a connection between reduced general fluency abilities on the animals task and the finding of reduced fluency on the I Am and known other tasks. Indeed, when animals is entered as a covariate the significant differences between groups in the 3 (task) x 2 (group) ANOVA (reported in section 2.3.3.2) becomes non-significant $F(1,31)= 2.07$, $p=.16$. Animals is a significant covariate $F(1,31)= 10.96$, $p<.01$. The task*group interaction remains non significant $F(2,62)= 0.05$, $p=.95$. As with Study 1, paired sample t-tests showed that animal fluency was significantly greater than fluency on the I Am task in both the ASD group, $t(15)=10.43$, $p<.001$, $d=2.63$ and the Control group $t(17)=12.65$, $p<.001$, $d=2.92$, with very large effect sizes.

It should be noted however that category fluency in the high functioning ASD group (14.19) is not significantly different to category fluency found in the large pilot sample (14.24) in Study 1. It is possible that the above average IQ of the control group in the present study is one reason for their increased category fluency compared to the piloting study and ASD participants (given that the pilot sample of 99 NT adolescents were taken from a range of ability sets in an average school, it is not unreasonable to assume that the IQ of the group will be roughly average). This would imply that general IQ abilities differentially affect fluency in NT adolescents and those with an ASD. Indeed, correlations between IQ and category fluency give some indication of this, in that for the ASD group ($r=.219$, $p=.43$) the correlation was somewhat smaller than for the Control group ($r=.389$, $p=.11$). Moreover, in a univariate analysis, IQ was a significant covariate for group differences in animal category fluency, $F(1,31)=4.33$, $p<.05$, though the group difference nonetheless remained significant. A sample with a wider range of IQs would be needed to test this further.

2.3.4.4 Physical, Social and Personal Attributes

The central expectation of the study was that the ASD group would generate fewer social and personal attributes. In line with findings in Study 1, the 7 (task) x 3 (type) x 2 (group) ANOVA (see section 2.3.3.1) revealed a significant effect of Type and a Type*Task interaction. It also revealed the significant Type*Group interaction indicating differences between groups.

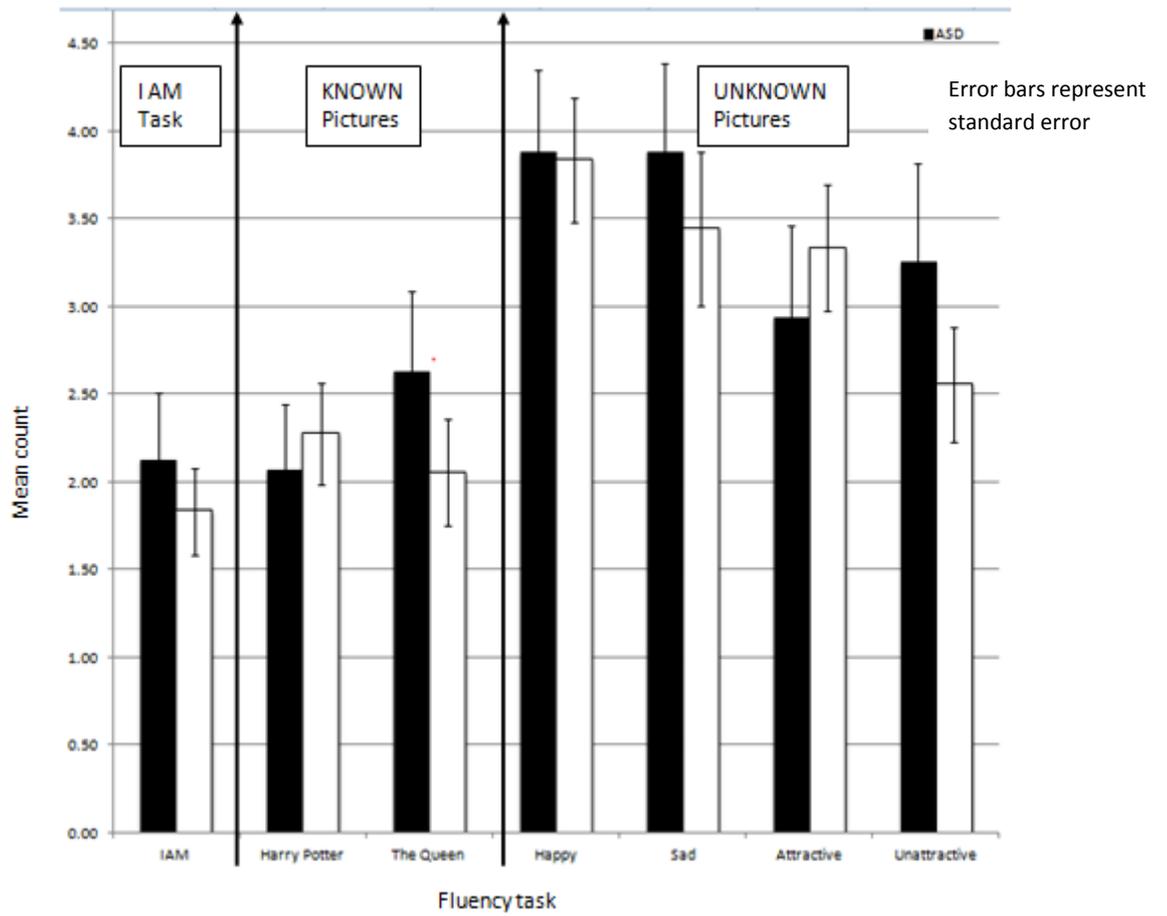
To better understand these effects, 3 separate ANOVAs were calculated for physical, social and personal attributions, in order to parallel the analysis done in Study 1, with the addition of the between subjects Group factor. Given the clear patterns delineated in Study 1, only the planned contrasts of interest were made, with the required Bonferroni corrections.

2.3.4.4.1 Physical Attributions

The mixed 7 (task) x 2 (group) ANOVA for physical attributions revealed no significant differences between the ASD and control group, $F(1,32) = 0.23$, $p = .63$. As in Study 1, there was a significant effect of Task, $F(6,192) = 11.99$, $p < .001$. The Task*group interaction was non-significant.

Inspection of Figure 3.1 clearly shows a similar overall pattern across tasks delineated in Study 1 (e.g. see figure 2.2), and very little difference between groups. The pattern of increased production of physical attributions toward unknown others compared to known others or oneself is clearly evident. Contrasts revealed significantly greater fluency in the following pattern: Happy and Sad > Attractive and Unattractive > Harry, the Queen and I Am, all $p < .05$, with the sole exception of a non-significant contrast between the Queen and unattractive pictures. As expected, there were no differences in the number of physical attributions generated between groups.

Figure: 3.1 A figure to show the mean number of physical attributions made by each group on each of the fluency tasks



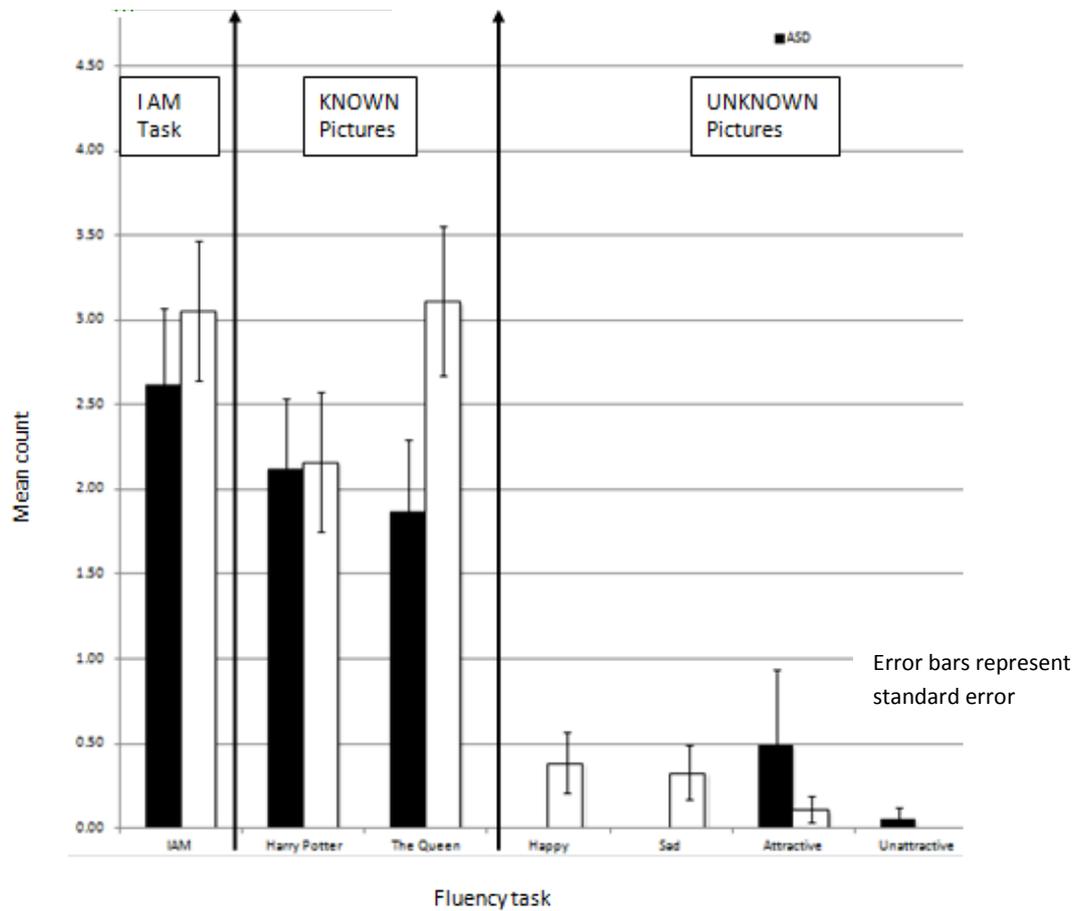
2.3.4.4.2 Social Attributions

The mixed 7 (task) x 2 (group) ANOVA for social attributions revealed no significant differences between the ASD and control group, $F(1,32) = 1.61, p = .21$. As in Study 1, there was a significant effect of Task, $F(6,192) = 38.22, p < .001$. The Task*group interaction was not significant $F(6,192) = 1.58, p = .154$

Figure 3.2 shows a largely similar pattern of results to those found in Study 1. Contrasts revealed significantly increased production of social attributions in the I Am task and Known other tasks compared to the Unknown other tasks (all $p < .001$), with non-significant differences between groups. The I Am task and the known other tasks were not significantly different from each other. As with Study 1, no SRE was found for social attributions compared to known others.

One difference that stands out between Study 2 and Study 1 is increased production of social attributions in the I Am task in the current Study. Indeed this difference between the Study 2 (combined mean = 2.84) compared to Study 1 ($m = 1.52$) for the I Am task is significant in an independent samples t-test, $t(52) = -3.86, p < .001$. This difference does not appear to be related to the 'above average' IQ of the experimental groups compared to Study 1, as IQ does not correlate significantly with fluency for social I Am attributions, $r = -.14, p = .45$. However further study would need to investigate this further including participants with IQ's over a wider range. The difference may also be related to additional factors such as differences in the testing conditions in Study 1 (e.g. tested in a social setting with members of a group around) and Study 2 (tested individually). Overall, the hypothesis that there would be group differences in the generation of social attributes has not been corroborated; no significant group differences were found.

Figure: 3.2 A figure to show the mean number of social attributions made by each group on each of the fluency tasks

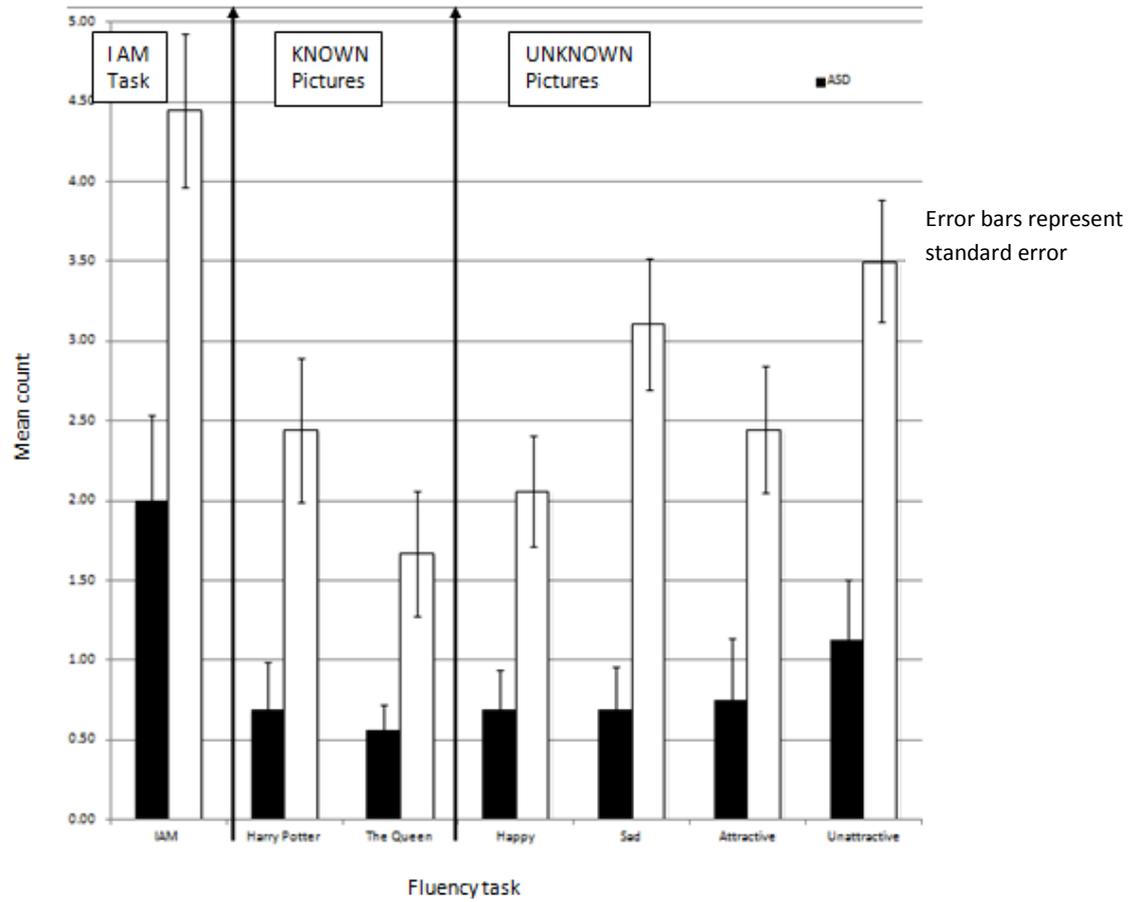


2.3.4.4.3 Personal Attributions

The mixed 7 (task) x 2 (group) ANOVA for personal attributes revealed significant differences between the ASD and control group, $F(1,32) = 86.56$, $p = .001$. As in Study 1, there was a significant effect of Task, $F(6,192) = 12.79$, $p < .001$. The Task*group interaction was not significant $F(6,192) = 1.88$, $p = .086$

Figure 3.3 shows a large reduction in the number of personal attributes made by the ASD group compared to the Control group, across all tasks. These group differences all have very large effect sizes: I Am task ($d = 1.16$), and (s)he is tasks (ranging from $d = 0.96$ to $d = 1.71$). In line with the hypothesis, we have found reduced generation of personal attributes in the ASD group across all tasks. The group difference remains significant when controlling for general fluency abilities by entering category fluency (animals) as a covariate $F(1,31) = 11.70$, $p < .01$. Category fluency is not a significant covariate $F(1,31) = 2.31$, $p = .14$. The task*group interaction remains just outside the $p < .05$ significance level $F(6,186) = 2.06$, $p = .06$. Individual contrasts reveal an SRE, like Study 1, with significantly more personal attributions in the I Am task compared to all other tasks, with the sole exception of the Unattractive picture.

Figure: 3.3 A figure to show the mean number of personal attributions made by each group on each of the fluency tasks



2.3.4.4.4 Group differences on the I Am task

A separate 3 (type) x 2 (group) ANOVA was performed on the I Am task, revealing a significant group difference $F(1,32) = 348.84$, $p < .001$, a significant effect of Type $F(2,64) = 3.85$, $p < .05$, and a significant Group*Type interaction $F(2,64) = 4.77$, $p < .05$. Separate individual contrasts (with Bonferroni corrections to allay family wise error) revealed that the NT group produced significantly more personal attributions (4.44) than physical attributions (1.83, $p < .001$, $d = 1.8$) and a trend of the same in respect of social attributions (3.06, $p = .11$, $d = .55$). In contrast, the ASD group showed no significant differences between attribution type: personal (2.00), social (2.63) or physical (2.13).

2.3.4.5 Social Stereotypes

The inclusion of the four unknown faces, Happy and Sad, and Attractive and Unattractive, enabled an assessment of whether there are any group differences between spontaneous judgements made about them. Statements made by each individual participant were qualitatively assessed and coded. For Happy and Sad, if a participant had made a statement relevant to mood about the Happy and Sad pictures, this was determined as either positively or negatively valenced (e.g. Happy, feeling good versus sad, feeling bad, miserable). If a participant had not made a statement relevant to mood then that participant was coded as "neutral". Each participant is coded as judging each picture as either "Happy" or "Sad" or "neutral". Similarly for the Attractive and unattractive pictures: each participant is coded as judging the picture as either "attractive" (e.g. beautiful, pretty, gorgeous) or "unattractive" (e.g. ugly, unpretty) or "neutral". Additionally, for each picture, the participants were coded as judging the person in the picture as either "good" (e.g. friendly, nice, trustworthy) or "bad" (e.g. unfriendly, horrible person, scary, criminal) or "neutral". No participant referred to the same picture as both "good *and* bad", "happy *and* sad" or "attractive *and* unattractive". This justified the use of a classification scheme at the participant level.

2.3.4.5.1 Judging Happiness and Attractiveness

Only one participant made an unexpected judgement, judging the Attractive Picture as ugly. This participant makes the 5.6% in the table 3.2. This made it possible to understand the findings largely in terms of percentages of participants making the expected judgements

versus not making any judgements, though the Chi-square is still calculated between groups across all judgement types.

Chi-Square tests revealed that significantly fewer ASD participants (50%) made spontaneous "Happy" judgements about the Happy picture than in the control group (83.3%), $\chi^2(1) = 4.3$, $p < .05$. Similarly, significantly fewer "sad" judgements were made for the sad picture in the ASD (18.8%) than control group (61.1%), $\chi^2(1) = 6.28$, $p < .05$.

There was a trend toward fewer ASD participants (6.2%) making spontaneous "Attractive" Judgements for the Attractive picture compared to the controls (33.3%), though this was not significant at the $p < .05$ level, $\chi^2(2) = 5.09$, $p = .079$. A similar trend was found for "Unattractive" judgements about the Unattractive picture between ASD (12.5%) and controls (38.9%), though not significant at the $P < .05$ level, $\chi^2(1) = 3.03$, $p = .082$.

Table 3.2 to show percentage of participants making various judgement types about each unknown picture.

Picture	Judgement Type		
	<i>"Happy"</i>	<i>"Sad"</i>	<i>Neutral</i>
Happy*			
ASD	50%	0%	50%
Control	83.3%	0%	16.7%
Sad*			
ASD	0%	18.8%	81.3%
Control	0%	61.1%	38.9%
	<i>"Attractive"</i>	<i>"Unattractive"</i>	<i>Neutral</i>
Attractive			
ASD	6.2%	0%	93.8%
Control	33.3%	5.6%	61.1%
Unattractive			
ASD	0%	12.5%	87.5%
Control	0%	38.9%	61.1%

Significant group differences (χ^2) across judgements are indicated next to the picture type by an *

2.3.4.5.2 Judging Goodness and Badness

Only one control participant made an unexpected judgement, judging the happy picture as bad, making it possible to understand the findings in terms of percentages making the expected judgement versus not making a judgement. Chi-Square tests revealed that significantly fewer ASD participants made spontaneous “Good” judgments about the Happy picture (6.2%) compared to controls (50%), $\chi^2(2)= 9.45$, $p<.01$. The same finding holds for the Attractive picture, ASD (6.2%) compared to controls (44.4%), $\chi^2(1)= 6.35$, $p<.05$. ASD participants were also significantly less likely to make “Bad” judgements about the Sad picture (6.2%) compared to Controls (72.2%), $\chi^2(1)= 15.22$, $p<.001$. There was a trend toward fewer ASD participants making “bad” judgments about the unattractive picture (31.2%) compared to controls (61.1%), though this was not significant at the $p<.05$ level, $\chi^2(1)= 3.03$, $p=.08$.

Judgments of attractiveness and happiness for each picture correlated significantly with the corresponding judgement of goodness and badness (using Spearman’s rho non-parametric tests): Happy picture ($r=.35$, $p<.05$), Sad picture ($r=.64$, $p<.001$), Attractive picture ($r=.44$, $p<.01$), Unattractive picture ($r=.37$, $p<.05$). Other significant correlations were less common and more mixed, see Appendix 3 for a table of all the relevant correlations.

Table 3.3 to show percentage of participants making good, bad or no/neutral character judgements about each picture

Picture	Judgement Type		
	<i>"Good"</i>	<i>"Bad"</i>	<i>Neutral</i>
Happy*			
ASD	6.2%	0%	93.8%
Control	50%	5.6%	44.4%
Sad*			
ASD	0%	6.2%	93.8%
Control	0%	72.2%	27.8%
Attractive*			
ASD	6.2%	0%	93.8%
Control	44.4%	0%	55.6%
Unattractive			
ASD	0%	31.2%	68.8%
Control	0%	61.1%	38.9%

Significant group differences (χ^2) across judgements are indicated next to the picture type by an *

2.3.4.6 Social Cognition

This section of the results focuses on group differences in the TOM tasks, and their relationship to the SRC fluency effects. The descriptive statistics are summarised in Table 3.4 on the next page.

2.3.4.6.1 Oneway ANOVAS

There were no significant group differences on the Mind in the Eyes task, $F(1)=1.30$, $p=.26$, Character intentions task, $F(1)=2.36$, $p=.135$, Faux pas stories, $F(1)=1.85$, $p=.183$ and Non-faux pas stories $F(1)=2.94$, $p=.096$. There were also no differences on the comprehension control questions to the faux pas stories $F(1)=2.42$, $P=.130$.

Significant group differences were found on the Yoni Task in terms of time taken to complete First order trials $F(1)= 10.35$, $p<.01$ $d=1.32$, and Second order trials $F(1)= 28.78$, $p<.001$, $d=2.07$, with extremely large effect sizes. No significant group differences were found in the physical Yoni control trials for either first order, $F(1)=3.32$, $p=.078$ or Second order, $F(1)=2.97$, $p=.096$. Accuracy scores for all Yoni conditions did not differ significantly between groups.

The failure to find significant differences between groups on several of the TOM tasks was unusual. As described in section 2.1.4, deficits in ASDs were expected on all these tasks. The present lack of deficits may in part be due to practice effects; the participants in the ASD group have done children's versions of the eyes and faux pas tasks on several occasions before in previous doctoral research. Indeed, they did show speed deficits on the Yoni TOM (but not Yoni physical control tasks) which they have not seen before. These issues are explored further in the discussion.

Table 3.4 Shows the Mean scores and Standard deviations for each TOM task by Group

Task Condition	Mean Scores (SD)	
	<i>ASD</i>	<i>Control</i>
Mind in the Eyes	21.88 (4.86)	23.44 (3.05)
Character Intentions	23.50 (5.57)	25.67 (2.09)
Faux Pas Stories	53.69 (12.75)	57.94 (3.54)
Non Faux Pas Stories	18.00 (2.07)	19.11 (1.71)
Yoni First Order**	48.24 (20.66)	31.72 (4.52)
Yoni Physical first order	24.26 (11.7)	18.65 (4.62)
Yoni Second Order**	278.26 (44.73)	191.17 (39.61)
Yoni Physical second order	31.57 (11.22)	24.91 (8.77)

** On a task indicates significant group differences at the $p < .01$ level. Significant correlations are * for the $p < .05$ and ** for $p < .01$. The Yoni task scores refer to time taken and not accuracy scores.

2.3.4.7 Social cognition and SRC

In order to determine if a relationship can be found between social cognition and group differences in self-referential cognition, several ANCOVAs were performed with the social cognition measures as covariates. Firstly, a 3x2 ANCOVA (Task x Group) was performed to determine if the main group difference of impaired fluency was related to differences in social cognition. The 3 tasks were I Am, Harry and the Queen, paralleling the 3x2 ANOVA in section 2.3.3.2. With Social cognition measures as covariates, the group differences became non-significant $F(1,18)=3.52$, $p=.075$, suggesting a relationship, albeit weak, between social cognition abilities and fluency on self and other concept tasks. However, none of the TOM measures taken individually were significant covariates: Character intentions $F(1,18)=2.27$, $p=.15$, Mind in the eyes $F(1,18)=1.31$, $p=.27$, Faux pas stories $F(1,18)=0.495$, $p=.491$, Non-faux pas stories $F(1,18)=0.33$, $p=.573$, Yoni First Order $F(1,18)=1.75$, $p=.20$ and Yoni Second Order $F(1,18)=0.25$, $p=.62$.

Additionally, a 7 (task) x2 (Group) ANCOVA was performed to determine whether the main group difference of less personal attributions generated in the ASD group was related to social cognition. With social cognition measures as covariates, the group differences became non-significant $F(1,18)=4.35$, $p=.051$, though caution is warranted in interpreting the result due to its being so close to significance at the $p<.05$ level. None of the social cognition measures individually were significant covariates. This implies only a weak relationship between social cognition and the generation of personal attributes.

However there were some interesting findings in relation to the SRE effect (main effect of Task) seen in the 3x2 ANOVA (see section 2.3.3.2). The SRE becomes clearly non-significant with social cognition measures as covariates in the 3x2 ANCOVA, $F(2,36)=0.687$, $p=.51$. To explore this further, the SRE was quantified in terms of mean differences between the I Am and Harry task, and the I Am and Queen Task. Bivariate correlations revealed a relationship with the eyes task, with a significant a correlation with SRE magnitude for "I Am – Harry", $r=.35$, $p<.05$, and a comparable though non-significant correlation for "I Am-Queen", $r=.23$, $p=.19$. This lends support to Lombardo et al.'s (2007) finding of a similar connection between SRE effects and the eyes task in memory paradigms. Additionally, correlations revealed a relationship with the Second Order Timed Yoni task, with a significant correlation for "I Am – Queen", $r=.47$, $p=.014$, and a comparable though non-significant correlation for "I Am- Harry", $r=.3$, $p=.13$. The direction of the correlations imply that superior performance on the eyes task

and faster performance on the Yoni task (less time) are connected with larger SREs. All other correlations with TOM tasks were smaller and non-significant.

The Task*Group interaction also remained non-significant showing no relationship between group differences in social cognition and the magnitude of SRE effects, $F(2,36)=0.57$, $p=.57$. The group differences in category fluency (animals) also became marginally non-significant when social cognition measures were added as covariates, $F(1,18)=4.27$, $p=.053$. Only the Yoni First Order Task was a significant covariate, $F(1,18)=4.68$, $p=.044$. This showed a connection between TOM and Fluency based Executive Functions.

Together, these results indicate weak relationships between measures of social cognition and impaired fluency on general category fluency (animals), self and known others tasks. However, the magnitude of SREs is significantly correlated with the eyes task and speed on the Second Order Yoni task.

2.3.5 Summary and Discussion

2.3.5.1 The SRE

Despite findings for a reduced or absent SRE in ASDs using memory paradigms (e.g. Lombardo et al, 2007; Henderson et al, 2009), the present Study did not find the predicted reduced SRE in fluency for self vs other concepts. Indeed, an SRE was present equally in the ASD group and control group with comparable large effect sizes between the I Am task and Known others (Harry and the Queen), with no significant task*group interactions. Like with Study 1, the SRE effect was found to depend mainly on personal attributes. It is concluded that in this study, individuals with ASD showed the same relative superiority in fluency tasks relating to the self compared to tasks relating to known others. The implications of this will be taken up in the general discussion.

2.3.5.2 Social and Personal Attributions

It was predicted that significantly fewer social and personal attributions across all fluency tasks would be seen in the ASD group compared to the control group, based on research findings using the SUI and psychological self awareness (Jackson et al. 2012; Williams, 2010). Study 2 indeed demonstrated significantly fewer personal attributions in the ASD group across all fluency tasks, with very large effect sizes. These group differences remained significant when

controlling for category fluency (animals). However, no significant group differences were found in fluency for social attributions across all fluency tasks. The prediction was therefore partly supported, with a clear finding of impaired generation of personal attributes in the ASD group, independent of general fluency abilities. Moreover, considering only the I Am task, the NT group showed a significant preference for more personal attributions than social and physical ones, with medium to large effects sizes, whereas the ASD group showed no differences across the three types on this task. The implications of these findings will be explored in the general discussion following this section.

2.3.5.3 General Category fluency

The ASD group showed significantly impaired category fluency (animals) compared to the age and IQ matched controls, with a very large effect size. Moreover, the ASD group showed similar impaired fluency across all fluency tasks, with large effect sizes. Indeed, category fluency (animals) correlated significantly with the I Am and (s)he is fluency scores. Furthermore, Category fluency (animals) was a significant covariate, and group differences in total fluency across all fluency tasks became non-significant when category fluency was entered into an ANCOVA. Category fluency in the ASD group was however comparable to that found in pilot Study 1. There was some indication that increased IQ abilities differentially impacted category fluency for controls compared to ASDs in Study 2. Overall, though the weight of evidence in the literature would suggest no marked category fluency impairments in HFA adolescents (see section 2.1.3), the picture is somewhat mixed. The present study adds to these mixed findings.

2.3.5.4 Intellectual abilities

One limitation of the study is that the individual breakdown for verbal and performance IQ scores are not available for analysis at the participant level. However, the average scores for the ASD group are available, and show no differences between verbal IQ (m=115), performance IQ (m=111) and full scale (m=115) intelligence quotients. Indeed, though language and communication difficulties characterise aspects of the ASD phenotype and whilst ASD samples taken as a whole tend to show lower verbal IQs compared to non-verbal IQs (e.g. Thomson et al, 2011; Charman et al, 2011), the profile for AS and HFA in the literature is somewhat different.

One study looking at children with an ASD without intellectual disability found that verbal comprehension and IQ were within the normal range for AS but in the lower boundary of the

normal range for PDD-NOS and Autistic disorder (Kjellmer et al, 2012) and another study involving Chinese young adults with an ASD but normal intelligence found no discrepancy between verbal and performance IQ (Poon Mak, 2012). Furthermore, significantly higher verbal IQ in Asperger groups is a common finding compared to other ASD subtypes (Foley-nicpon et al, 2012; Saulnier & Klin, 2007; Ghaziuddin et al, 2004). 12 of the 16 participants in the present thesis ASD group had a diagnosis of AS, and their near identical Verbal and fullscale IQs were therefore in line with the general literature, suggesting that the present thesis analyses with the fullscale IQ can be taken as indicative of general verbal and performance abilities.

Finally, though the present thesis ASD group performed significantly less well on the category fluency task compared to the control group (as discussed in section 2.3.5.3), it was shown that this in part may be due to the differential impact of IQ on each group (see section 2.3.4.3). Though it is unfortunate that the impact of verbal IQ cannot be assessed in connection with the verbal fluency task directly, it has already been noted that at least the average verbal and fullscale IQs for each group were equivalent, and at least one study has shown that for an ASD and control group matched on verbal abilities, the ASD group still showed deficits on the verbal fluency tasks (Spek et al, 2009), indicating differences between general verbal abilities and specific verbal fluency performance in ASD groups.

2.3.5.5 Executive Functions

It was noted in section 1.2.3.1 that people with an ASD often exhibit deficits on EF tasks relating to planning, cognitive flexibility and sometimes fluency (Hill, 2004). The present findings add to the mixed picture in regard to fluency, as discussed in section 2.3.4.3 and 2.3.5.3. Additionally, on the Yoni 1st and 2nd order physical control tasks, the ASD group were not significantly slower at responding than the control group, indicating that the groups were comparable for processing speed and flexibility on this task. In short, except for the significant differences in category fluency between the ASD group and the experimental control group, differences in executive function were not significant in comparison to the pilot study group for category fluency or between experimental groups in terms of either processing speed or accuracy on the Yoni control tasks.

2.3.5.6 Social Stereotypes

On the basis of Fonseca et al.'s (2011) findings of typical BIG stereotypes in ASD, it was predicted that no group differences would be found in spontaneously generated social

stereotypes in the present study. However, a clear and significantly reduced number of participants in the ASD group made spontaneous judgements relating to mood (Happy and Sad). There was also a trend approaching significance for reduced number of ASD participants making judgements relating to Attractiveness and Unattractiveness. Regarding stereotyping, BIG and HIG effects were significantly less likely to be made by the ASD group than controls. Similarly 'Sad is Bad' (SID) stereotyping was significantly reduced in the ASD group, and there was a trend toward reduced 'Ugly is Bad' (UIB) stereotyping. Additionally, making judgments of happiness and attractiveness correlated significantly with making good/bad judgements for each corresponding picture, supporting the idea that the underlying stereotypes were the basis for the good/bad judgements.

These results are more in line with what would be expected based on the social and SRC deficits seen in ASD. Moreover, the findings suggest that social stereotyping can successfully be tapped by open ended fluency measures and that important differences in ASD groups were found. It is possible that the group differences in the present study relate to the spontaneous nature of the social stereotyping on these fluency tasks, an aspect that was absent in the Fonseca et al. (2011) study. This possibility is explored further in the general discussion.

2.3.5.7 Social cognition and SRC

Impaired performance in the ASD group on all TOM tasks was expected (see section 2.1.4). However, the present study only found significant differences in a timed task involving utilising eye gaze and facial expression cues on cartoon faces. The ASD group took significantly longer to complete the tasks. These significant differences related to time taken and not overall accuracy and were present for both First and Second order TOM trials. The groups did not differ significantly on either the first or second order physical control trials, suggesting that the significant differences on Yoni TOM trials related to deficits in the ASD group in processing social cues, not speed of processing generally. The lack of other significant differences on the eyes, faux pas and character intentions tasks maybe be due to the ASD group having done these or similar tests before in previous doctoral research.

This finding suggests that Yoni is a good speeded task to assess the processing of social cues and which is sensitive to specific social deficits in a high functioning ASD adolescent population (it is the first time it has been used with ASDs). Given that the deficit related to the speed of social processing, it is perhaps a more ecologically valid measure than other TOM tasks, as it better parallels the speed at which social interactions occur in everyday naturalistic

encounters. It may therefore be capable of assessing more subtle TOM deficits relating to the speed of social processing rather than ability.

On the basis of the “absent self hypothesis” (e.g. Frith 2003), the neural SRE for NT but not ASD groups (Lombardo et al. 2010), and the relationship found between group differences in the SRE in memory research and the Mind in the eyes test (Baron-Cohen et al, 2007), it was predicted that differences between groups in SRC on the fluency tasks would be related to measures of social cognition (TOM tasks). The two clear and significant group differences in SRC were impaired total fluency and impaired generation of personal attributes across all tasks in the ASD group. When the TOM measures were entered as covariates into the initial 3x2 and 7x2 ANOVAS, the group differences were a little reduced and became marginally non-significant at the $p < .05$ level. However, none of the TOM tasks taken individually were significant covariates.

One clear finding however was that the SRE effect disappeared when the TOM tasks were entered as covariates in the ANCOVAs. Correlations revealed that superior performance on the eyes task and faster performance on the Yoni task (less time) was significantly connected with larger SREs. This paralleled the finding of Baron-Cohen et al. (2007) in memory paradigms, where the magnitude of SREs was related to the eyes task and to the endorsement of autistic traits on the AQ (see section 1.5.2). These issues are explored further in the general discussion.

3.0 GENERAL DISCUSSION

“O would some power the giftie gie us to see ourselves as others see us”

-Robert Burns (1759-1796)

3.1 Overview

This thesis has adopted a new approach for examining the differences in self referential cognition (SRC) between NT individuals and those with ASD utilising novel fluency tasks that involve the open-ended generation of self and other concepts (based on Kuhn and McPartland, 1954). The I Am and (S)he is fluency tasks represent a new paradigm in the field of SRC. They uniquely allow the quantitative assessment of cognitive access to self and other concepts, as well as qualitative assessment of the types of self and other concepts generated, whilst preserving the open-ended, multi-faceted and subjective nature of the self-construct. The (s)he is tasks also enable the assessment of social stereotypes that are found to be spontaneously generated.

Through use of these tasks the studies of this thesis have thereby investigated: the relative accessibility of self and other concepts; differences in the types of concepts generated across self, known and unknown others; the relationship between TOM measures and these areas; spontaneously generated social stereotypes; and differences between NT adolescents and those with ASD across all the foregoing. The paradigmatic SRE has been demonstrated using the novel fluency measures, and this SRE has been shown to be related to the generation of personal attributes rather than social or physical ones. Moreover, though the ASD group showed a SRE similar to the NT group, the magnitude of the SRE was significantly related to performance on the Eyes and Yoni second order TOM tasks, demonstrating a connection between this important self-referential effect and social cognition. These findings will be explored first in the discussion.

Another key finding was that adolescents with ASD demonstrate a selective impairment in generating personal attributes across all fluency measures, even when controlling for category fluency ability. This suggests a specific psychological deficit in ASD for generating self and other concepts that are more subjective and personal in nature, whilst generating social roles and activities and physical attributes that are more concrete and objective in nature are preserved. This explanation parallels the psychological vs physical self-awareness distinction (Gillihan and

Farar, 2005) and is explored second in the discussion. It was also found that significantly more NT adolescents spontaneously made BIG, HIG and related stereotypes than ASD adolescents. This finding and its implications for the difficulties in social interactions seen in ASD are explored third in the discussion. In each of these sections limitations of the present study and areas for future research will be highlighted. Lastly, the clinical implications of the present findings are discussed.

3.2 The Self Reference Effect (SRE)

The classic SRE demonstrates that memories encoded in relation to the self are better remembered (see Section 1.4.4.2). Research in memory paradigms has found reduced or absent SREs in participants with ASDs (Lombardo et al, 2007; Henderson et al, 2009), supporting the “absent self hypothesis” (e.g. Frith et al, 2003). For NT individuals, recall is thought to be enhanced through the “fixed referent” of a well developed self-construct that supports the organisation and elaboration of knowledge (Symons and Johnson, 1997). In ASD however, it appears that a diminished self construct leads to a reduced or absent SRE. Whilst these studies assessed the SRE in connection with self versus other memory recall, the present thesis explored the effect at the level of direct cognitive access and generation of self-concepts through the I Am and (s)he is tasks.

It is clear that any self-concept that might be generated on these tasks depend upon the memory of autobiographical episodic and semantic information (EAM and SAK) to some extent. Indeed, the close relationship between memory and ‘I am’ statements has been demonstrated in previous research (Rathbone et al, 2008; 2009; 2011). However, rather than exploring the ability to recall incidental memories encoded in relation to either the self or others (as in the classic SRE memory paradigm), “the self” in these tasks was construed as a loosely defined open-ended construct, and the ability to access this self-relevant information and the type of information selected were the variables of interest, as opposed to the impact of “the self” on memory.

The studies of the present thesis clearly demonstrated SREs at the level of cognitive access and generation of self versus other concepts in both NT adolescents and those with ASD. The effect sizes were very large, robustly indicating that concepts connected with the self were more readily generated than concepts connected with known others (Harry Potter and the Queen) and unknown others. This parallels the SREs for NT individuals found in memory recall research

between the self and Harry Potter (Lombardo et al, 2007, Henderson et al, 2009) and the neural SRE with the British Queen (Lombardo et al, 2010). Moreover, the present thesis found that the SREs were connected with the generation of personal attributes in both the NT and ASD group. That is, both groups were more able to generate ability-related emotions and thoughts, and traits of a more subjective nature (e.g. *I am Friendly, I am depressed, he is creepy, she is talented*) for the self rather than known and unknown others.

It is to be remembered that in the instructions to the (s)he is tasks, participants were expressly encouraged to say what they think the person in the picture is like and that no answers were considered right or wrong. Consequently the dearth of personal attributions in the (s)he is tasks compared to the self can be considered as reflecting genuine differences in the generation of self and other concepts. However, the present study did not include a “Best friend” condition, as for example Lombardo et al. (2007) had done. It might be expected that there would be greater elaboration of personal information connected with a known friend as opposed to known media figures like Harry Potter or the Queen. Lombardo et al. (2007) did find a SRE in the ‘Self-Best friend’ comparison, however this SRE was not different between groups. Further research could explore whether there is a similar SRE for the I Am task in comparison with a “known friend” condition also, and whether differences exist between NT individuals and those with ASD

Another factor that may have impacted the present study is that the I Am task did not involve picture cues whereas the (s)he is tasks do. The inclusion of a “best friend” condition (e.g. make as many (s)he is statements about your best friend in one minute) would also enable comparison of the I Am task with a task that didn’t use picture cues. Alternatively, the I Am task could be done with a picture of oneself presented to see if this had any impact on fluency or the types of statements generated.

3.2.1 The SRE in ASD

Adolescents with ASD did not show the reduced or absent SRE that was predicted. They showed a comparable SRE to the NT group, and which was connected with greater generation of personal attributes for the self versus other conditions. However, the ASD group did show impaired overall fluency across all self and other tasks, and it was found that this impairment related largely to the diminished generation of personal attributes, remaining significant even when controlling for general category fluency. These findings are explored in detail in section

3.3. They suggest however that whilst the ASD group showed a large SRE for personal attributes, there was nonetheless some pervasive difficulty in generating personal attributes per se.

One possibility is that the SRE reflects the preservation of unique cognition relating to the self in ASD. As noted in section 1.5.2, the “absent self hypothesis” is not meant to suggest the absence of any self, only the diminishment of certain kinds of self-awareness (Lombardo et al. 2010). The present fluency tasks may simply not be sensitive enough to capture diminished SREs in ASD. Another possibility is that compensatory mechanisms were at work in the self conditions (e.g. Happe, 1995). Statements such as *“I am Kind, I am talented, I am moody”* could be learnt as discrete pieces of semantic knowledge (SAK), important for social interactions and commonly called upon. In contrast, it is less often that one is required to make such personal statements about others. Consequently, without genuine psychological self awareness and intact simulation mechanisms (explored further in Section 3.3.2) it would be harder to compensate for a dearth of personal information about others than oneself.

Such compensatory mechanisms would be enough to preserve an SRE in the ASD group, but are not an adequate replacement for genuine psychological self awareness, indexed by the overall superior generation of personal attributes for NT adolescents, even in the self condition. This seems a tenable alternative explanation for the preserved SRE in ASD, given the clear finding of significantly reduced fluency for personal attributions overall, including for “the self”. These issues are taken up in more detail in connection with the generation of personal attributes in Section 3.3, and important methodological limitations of the present Study are discussed in section 3.3.3. Alternatively, the preserved SRE in the ASD group might also be related to social cognition, a possibility explored in sections 3.2.2 and 3.2.3 next.

3.2.2 SRE and social cognition

Regarding a connection between SRC and social cognition, it was found that the magnitude of the SRE (indexed in terms of mean differences between the self and both known other conditions) significantly correlated with the Mind in the Eyes task and speed on the Second Order Yoni task. Larger SREs were connected with superior ability on the eyes and faster time on the Yoni task. This indicated a connection between ascribing personal attributes to oneself (as against others) and TOM abilities. The findings closely mirror those of Lombardo et al. (2007) who also found a similar connection between SREs and the eyes task in memory

research and strengthen the hypothesis that TOM and SRC are inextricably linked (Uddin et al, 2010; Lombardo et al, 2010).

It is also noteworthy that the second order Yoni task correlated with the SREs, as this task was purposefully included to mirror the timed element in the fluency tasks. Additionally, the ASD group were significantly slower at completing this task compared to the NT group, but were not significantly different to the NT group in the time taken to complete physical Yoni control trials. It suggests that the ability to generate personal attributes about oneself was connected to the speed at which one can process socially relevant information, further strengthening the link between TOM and SRC. As noted in section 2.3.4, the Yoni task has proved a useful timed measure and is perhaps a more ecologically valid task than other TOM tasks.

One limitation of the present study was the lack of clear deficits in the ASD group on several TOM tasks, perhaps partly due to practise effects (the ASD participants had all done a children's versions of the faux pas test and eyes test in previous research whereas the NT group had not). It is also possible that the present ASD group had unusually preserved social cognition, and that this might explain the preserved SRE effect, given the connections between the SRE magnitude and performance on the eyes task demonstrated in the present study and in Lombardo et al.'s (2007) study. These possibilities are explored next.

3.2.3 Comparing the ASD group to previous samples

This section compares the present thesis ASD group to similar ASD samples used in other studies across the social cognition TOM tasks, in order to give an indication of their relative strengths in this regard. Additional comparisons with the samples used in Lombardo et al.'s (2007) study are made in Section 3.2.3.2, and provide an indication that the preserved social cognition in the present thesis sample may underlie their preserved SRE.

3.2.3.1 Comparing the ASD group on TOM tasks

A comparison of scores obtained in the present thesis to those obtained in other published studies with similar high functioning groups has indicated significantly different performances in the present sample (using independent sample t-tests). Firstly, on the adult Faux Pas test, Zalla et al. (2009) found impaired Faux pas performance in a group of fifteen individuals with asperger syndrome (AS) relative to controls. The participants in this study had comparable IQs

(AS group: IQ=114, mean age=28, control group: IQ=115, age=27) to the present thesis sample (ASD group: IQ=115, age=15; control group: IQ=116, age=14.5). For the Faux pas questions, Zalla et al.'s AS group (M=39.7, SD=9.9) performed significantly less well than the present ASD group (Mean=53.69, SD=12.75), $t(29)=3.44$, $p<.01$, $d=-1.2$ with a large effect size. Moreover, for Non-faux pas questions, Zalla et al.'s AS group (M=15.4, SD=5.2) showed a trend toward over-detecting faux pas more than the present ASD group (M=18, SD=2.07), $t(29)=1.85$, $p=.073$, $d=0.73$. In contrast, Zalla et al.'s control group (Faux pas: M=54, SD=5.8; Non faux pas: M=19, SD=1.8) were not significantly different to the present thesis control group (Faux pas: M=53.69, SD= 12.75; Non faux pas: M=19.11, SD=3.54).

Secondly, on the Character intentions task, Duverger et al. (2007) tested sixteen adolescents with high functioning autism/AS on 13 of the 28 task questions used in the present thesis. Means and standard deviations have been converted to percentages to allow a crude comparison between studies. Duverger et al.'s AS group (M=75.38%, SD=15.38) performed less well than the present thesis ASD group (M=83.93%, SD=19.89), however this difference was not significant at the $p<.05$ level, $t(30)=1.36$, $p=0.18$. Nonetheless, Duverger et al.'s AS group did score significantly less than the present thesis control group (M=91.68%, SD=7.46), $t(32)=4.00$, $p<.001$, $d=-1.43$, with a large effect size. Taken together, these comparisons suggest that the non-significant group difference in the present study was due to a superior performance in the present thesis ASD group relative to other high functioning ASD samples.

Finally, in the Mind in the Eyes test, a comparison with Baron-Cohen et al.'s (2001) study revealed a different pattern. They tested Fifteen HFA AS adults (Mean IQ=115, age=29) and fourteen controls (IQ=114, age=28). The AS group (M=21.9, SD=6.6) did not score significantly less than the present thesis ASD group (M=21.88, SD=4.86) or the present thesis control group (M=23.44, SD=3.05). However, Baron Cohen et al.'s control group (M=30.9, SD=3.0) did score significantly more than the present thesis control group, $t(30)=6.91$, $p<.001$, $d=2.46$, with a very large effect size. This may reflect the fact that the adult eyes test was a difficult test for NT adolescents, who performed less well relative to an NT adult sample. In contrast, the present thesis adolescent ASD group performed surprisingly well relative to an adult AS sample. It is to be noted that most studies testing children and adolescents have used the children's version of the eyes test. The adult version of the eyes test was chosen for the present thesis due to the ASD group having done the children's version in previous research, and because it was expected that the adult test would nonetheless show group differences. Moreover, they were provided vocabulary sheets to help understand emotion words on this non-timed task.

These findings suggest that the present thesis ASD group were superior to comparable high functioning ASD samples in published studies on the Faux pas task (Zalla et al, 2009) and the Character intentions task (Duverger et al, 2007). Moreover, the present thesis ASD group performed similarly to an adult AS group on the adult version of the Mind in the eyes test (Baron –Cohen et al, 2001), whereas the present thesis control group were significantly inferior compared to an adult control group. If the latter finding suggests that the adult eyes test is harder for adolescents, then it also suggests the present thesis ASD group performed surprisingly well relative to an adult AS group. This interpretation is in consonance with the present thesis ASD group’s superior TOM performance on the Faux pas and Character intentions tasks relative to other high functioning ASD groups, and the *similar* performance of the thesis control group to other control groups on these same tasks. Taken together, these comparisons lend support to the idea that the present thesis ASD sample did not show representative TOM impairments.

3.2.3.2 *Could preserved TOM explain the preserved SRE?*

The present study and Lombardo et al.’s (2007) study both showed a connection between the magnitude of SREs and performance on the eyes test. Moreover, Lombardo et al.’s study not only showed that decreased SREs were connected with lower scores on the eyes test, but were also connected with the endorsement of autistic traits on the AQ. In Lombardo et al.’s study, the ASD group (IQ=114, age=29) and the control group (IQ=117, age=29) were comparable to the present thesis sample for IQ. In their study, the ASD group performed significantly less well on the adult eyes task compared to controls, and the group difference on the “Self-Harry Potter” SRE showed a clear trend toward a reduced SRE in the ASD group ($p < .068$, $d = 0.49$), mirroring the finding of a significantly reduced “Self-Harry Potter” SRE in ASD found by Henderson et al. (2009) (reviewed in section 1.4.4.2).

In contrast to Lombardo et al.’s (2007) study, the present thesis did not find significant group differences on the eyes test or any difference in the SRE magnitude between groups. In comparing eyes test performance between these studies, the same pattern was discovered as was found in the comparison with Baron-Cohen et al. (2001) study (see section 3.2.3.1). That is, the present thesis adolescent ASD group ($M = 21.88$, $SD = 4.86$) were not significantly different on the adult eyes task compared to Lombardo et al.’s adult ASD group ($M = 23.73$, $SD = 6.67$), $t(44) = 0.98$, $p = .33$, whereas the present thesis Adolescent control group ($M = 23.44$, $SD = 3.05$)

were significantly impaired compared to Lombardo et al.'s adult control group ($M=27.03$, $SD=3.9$), $t(46)=3.34$, $p<.01$, $d=1.03$, with a large effect size.

In light of the relative difficulty of this adult version of the eyes task for NT adolescents then, the present thesis ASD group performed surprisingly well compared to two adult ASD samples (Baron-Cohen et al, 2001; Lombardo et al, 2007). Moreover, since the magnitude of SREs and eyes test performance were connected in both Lombardo et al.'s study and the present thesis, *and* the fact that Lombardo et al.'s ASD and control group showed clear group differences on both the eyes task and the magnitude of the SRE effect, then it can be reasonably surmised that the lack of group differences for the SRE in the present thesis was related to the ASD group performing unrepresentatively well on the eyes task. In short, there is evidence that the preserved SRE in the present thesis ASD group was related to their demonstrating unrepresentatively intact TOM skills. It would therefore be an advantage for future research to assess an ASD group who showed more typical TOM deficits.

3.3. Impaired generation of personal attributes

Emerging research in ASD has found impaired psychological self awareness (e.g. awareness of one's own emotions, intentions and ASD traits) in the presence of preserved physical self awareness (e.g. sense of agency, action monitoring and attribution, and visuospatial perspective taking), discussed in section 1.4.3.1 (e.g. David et al. 2008; David et al, 2010; Williams 2010). These selective difficulties in thinking about the psychological self as opposed to the physical self have been hypothesised to relate to the socio-communicative impairments of ASD and to lead to less elaborate self-concepts (Lind, 2010). Very recently, Jackson et al. (2012) explored the possibility of impaired self-understanding using the SUI (Damon and Hart, 1988, and it was found that the Asperger group produced significantly less social and psychological descriptions of themselves compared to NT individuals, whereas the number of physical descriptions were not different between groups.

The present thesis aimed to explore whether diminished self understanding in the psychological and social domains could be seen on fluency tasks tapping cognitive access to self-concepts. Indeed, one clear finding was the reduced generation of personal attributes across all tasks with very large effect sizes. Moreover, the NT group made significantly more personal attributions in the I Am task compared to social and physical ones, whereas the ASD group did not generate more of any particular type. These robust findings demonstrated that

high functioning ASD adolescents did not generate as many self and other concepts referring to ability-related emotions/thoughts or personality traits that involve some subjective judgement (e.g. *I am friendly, she is creepy, he is talented*). In this sense it showed that a timed fluency measure was capable of capturing clear differences in psychological self-awareness at the level of cognitive access and generation of self-concepts, mirroring recent findings in the SUI (Jackson et al, 2012).

3.3.1 Preserved social understanding

The present studies did not find significant group differences across social attributes (e.g. *he is a wizard, he is an actor, she is royalty, she is a mother*), despite predicting this on the basis of Jackson et al.'s (2012) findings with the SUI. However, the present study had collapsed together Jackson et al.'s "active" (ability related schema e.g. a biker, a walker) and "social" (schema relating to social interactions and relationships e.g. social roles such as "a mother"). Moreover it is unclear whether the "social" category in Jackson et al.'s study also included more subjective attributions connected with social relationships rather than more objectively definable social roles.

The import of this was that the "social" category in the present study by and large related to more objectively definable social roles (e.g. *I am a father, I am a student, I am a wizard*) and socially defined abilities (e.g. *I am a footballer, I am a hiker*) and attributes defined relative to society at large (e.g. *I am rich, he is famous, she is royalty*). It could be argued therefore that the "social" category in the present study does not truly reflect the "psychological self-awareness" side of the divide (Gillihan and Farar, 2005), in that it relates to *objective* information and roles pertaining to the social world.

Moreover, social information relating to Harry Potter and the Queen could be gleaned from reading books or watching TV and does not necessarily relate to genuinely acquiring psychological knowledge concerning them, or even a subjective sense of *what they are like*. This possibility was perhaps reflected in the results, where significantly more "social" statements were made about Harry and the Queen than either the self or unknown others, with no group differences. These attributions may largely have reflected semantic social knowledge, which would be expected to be more salient for known versus unknown people.

Indeed, the SAK versus EAM divide (Lind, 2010, discussed in Sections 1.4.2. and 1.4.4) may pertain to part of the distinction between social and personal attributes. Semantic knowledge is more factual and does not depend on “autonoetic awareness” in the way that episodic memories do (Tulving, 1984). Social attributions for Harry Potter and the Queen reflect semantic knowledge, whereas personal attributions may sometimes involve *experiencing* the self, or *experiencing* others’ through the self (i.e. simulation theory), a possibility explored in detail in the next Section 3.3.2. Preserved social but impaired personal attributions in the present thesis ASD group may therefore mirror the findings of Crane and Goddard (2007), who found preserved SAK but impaired EAM on a fluency task in an adult ASD group (see Section 1.4.4.1).

3.3.2 What is involved in generating personal attributes?

It is important to consider in more detail what is involved in generating *personal* attributes for other people in contrast to the potentially more objective and factual social attributions. Simulation mechanisms are posited as one important means of gaining insight into others personalities and phenomenology- that is, into their minds (Epley et al, 2004). All the variants on simulation theory share an emphasis on the privileged access one has for one’s own phenomenology as an important window into that of others. In this way one can by-pass being “behaviourists” and “theorists” in the interpretation of others by “looking inward and projecting or simulating that other person as if we are them” (Lombardo et al, 2011). Though this is not the only means of understanding others’ minds (Gopnik and Wellman, 1992) it is an especially important one in situations where not much “individuating information” is known about the target person (Ames 2004a, 2004b, Epley, 2008; reported in Lombardo et al, 2011).

Relating these ideas to the (s)he is tasks, social information is known and shared about Harry and the Queen, and social attributions (e.g. *he is a wizard, he is an actor, she is royalty, she is a mother*) were significantly more common for these pictures than for any other pictures. However, for the unknown others, little “individuating information” was known about the target people, and so the task depended more upon making physical and personal attributions. In order to make personal attributions, mechanisms such as simulating and projecting their personality, as well as through using stereotypes (see section 3.4) would be needed. Indeed, the relative difficulty in doing this was reflected in that more plainly physical attributions were made for unknown others compared to all other tasks, presumably because it was harder to

generate personal attributions through simulation and stereotypes than it was to focus on readily apparent objective physical attributes present in the pictures.

Overall then, the generation of subjective and psychological attributions relating to oneself and others, involving emotions, personality traits and character judgements, was significantly reduced in the ASD group. Moreover, the ASD group did not show the significant preference for personal attributions on the I Am task showed by the NT group. This finding suggests self-concepts were less elaborate for ASD than for NT adolescents, in line with the hypothesis. Furthermore, the nature of the personal attributes closely reflects the underlying deficits in psychological self awareness (Williams, 2010) of both self and other in ASD, lending support to the hypothesis that diminished self-concepts are a downstream consequence of deficient psychological self awareness (e.g. Lind 2010).

3.3.3 Diminished personal attributions and social cognition

Despite the strong theoretical connection between thinking about oneself and thinking about others (e.g. Lombardo et al, 2010), only weak relationships were found in respect of group differences in generating personal attributes. No individual social cognition measures were found to relate to group differences in generating personal attributes. However when the TOM tasks were taken together as covariates, group differences did become marginally non-significant. This somewhat weak connection may partly reflect the relatively spared TOM abilities in the ASD group, a limitation discussed in Sections 3.2.2. and 3.2.3

Another limitation of the present study was that the physical, social and personal *types* of self concept were confounded in single task trials. This makes it difficult to separate out the impaired generation of personal attributes from the preserved Self Reference Effect (SRE) in the present study. Possible explanations for this preserved SRE in the presence of diminished overall personal attributions were presented in Section 3.2. However, investigation of these inextricably linked issues requires further research. For example, NT adolescents and those with ASD could be asked to generate as many physical attributes for a given picture in one minute, followed by one minute for social attributes, followed by a further minute for personal attributes. Similar separate trials for the I Am task would then allow the specific and direct assessment of SREs for each attribution type across groups. However, this would come at a cost of sacrificing the open-ended nature of the tasks. It is worth noting that the open-ended and un-coerced nature of the present tasks is itself informative. ASD adolescents were not as

predisposed to generating personal attributes as the NT group. It would be interesting to see how they perform in a task that specifically requests them to generate such attributes.

3.4 Social Stereotyping

Social stereotyping emerges in childhood and plays a central role in social interactions, such as providing one means of predicting others' behaviours (Mackie et al, 1996). The "Beauty is Good" (BIG) stereotype is one of the most documented, in which children and adults attribute "goodness" and other positive traits (e.g. greater intelligence, competence) to attractive rather than to unattractive faces (see review in Langlois et al, 2000). Similar stereotypes around emotions and happiness ("Happy is Good" HIG) are also seen (Hess, Adams & Kleck, 2008). Intuitively it would seem plausible to expect impairments in ASD for social stereotyping due to "atypical face processing" (Grelotti, Gauthier, & Schultz, 2002, Rosset et al, 2009), deficits in reading emotions in faces, such as in the Mind in the eyes task (Baron-cohen, 2001; Kaland et al, 2008), TOM deficits and the emerging picture of psychological self-awareness deficits. However, Fonesca et al. (2011) found that ASD children were just as likely to make BIG stereotypes as NT children, implying preserved social stereotyping abilities in ASD.

Contrary to Fonesca et al. (2011) the present study found diminished social stereotyping in the ASD group. Significantly fewer ASD adolescents made spontaneous judgements pertaining to the goodness or badness of individuals, based upon either their mood or their attractiveness. What is more, fewer ASD participants made any judgments at all relating to mood and a trend toward fewer judgements relating to attractiveness. Across both groups, making judgements of mood and attractiveness correlated significantly with the corresponding good/bad judgement, supporting the notion that the underlying BIG, HIG, SIB, and UIB stereotypes were the basis of the good/bad judgments. These findings were more in line with what might be expected on the basis of the general socio-communicative impairments seen in ASD.

One difference between these studies was that good/bad judgements in the present study were made spontaneously whereas Fonesca et al. (2011) asked the children to rate the pictures based upon attractiveness, friendliness and intelligence. It is possible that the abilities underlying making stereotypes are intact in some way in individuals with ASD but they do not utilise those abilities spontaneously in social situations. Indeed, a recent study reported by Senju (2012) shows that high functioning ASD adults do not make anticipatory false belief

attributions through eye gaze in the Sally Ann false belief task (described in section 1.3.3) whereas NT adults do. Moreover, this was despite the ASD group showing normal anticipatory eye gaze connected with the puppets' goals in pre test familiarisation trials and despite easily passing the false belief tasks when explicitly asked to do so (Senju, 2012).

Taken together, the present thesis and Senju's study (2012) provide evidence that ASD individuals make less spontaneous judgements pertaining to social situations, even when TOM (false belief) and social stereotyping (Fonesca et al, 2011) abilities appear to be intact on explicit tests. A lack of spontaneous social judgements and TOM attributions in ASD might be expected, considering that compensatory mechanisms are thought to underlie successful TOM task completion rather than true social understanding (Happe 1995, see section 1.3.4). Indeed, this is consistent with the finding that training on false belief tasks does not improve social adaptation in ASD (Ozonoff and Miller 1995). This could potentially explain the persistence of everyday socio-communicative impairments in ASD even when aspects of TOM and social processing are preserved on certain tasks. Further research would need to assess spontaneous versus explicit social stereotyping in a single study sample to confirm the present findings.

3.5 Clinical implications

The present thesis has found that adolescents with ASD generate significantly fewer personal attributes on open ended fluency measures for the self and others, even when controlling for general fluency abilities. On the I Am task, adolescents with ASD tended to make statements like: *I am eleven, I am male, I am blond-haired, I am a daughter, I am a footballer, I am going on holiday soon*, with a similar frequency to more personal attributions. In contrast, NT adolescents made significantly more personal attributions than other attributions on the I Am task, and generated significantly more of these personal attributions across all the fluency tasks, such as: *I am quick tempered, I am passionate, I am artistic, I am sporty, I am enthusiastic, I am helpful, I am friendly, I am lonely, I am stressed*. The decreased focus on personal attributions for ASD adolescents implies that they have less elaborate self concepts than NT individuals, as suggested by other researchers (Lind, 2010; Goddard & Crane, 2008; Jackson et al, 2012). Several clinical implications follow from these findings.

3.5.1 Diminished Psychological Awareness

The findings add to and strengthen the emerging picture of preserved physical self awareness in the presence of reduced psychological self awareness in ASD (e.g. Williams, 2010). Taken together, these findings suggest that the concepts ASD individuals have about themselves and others are likely to lack key psychological dimensions that will inevitably impact on their social interactions. For example, in the context of “disease awareness”, chronic disorders are known to play a crucial role in self identity and its formation for adolescents (Roncovic et al, 2006). However, no one in the high functioning ASD group said “I am autistic”; a personal attribution that would have demonstrated such disease awareness. As one parallel example, research using the I Am tasks with individuals with temporal lobe epilepsy commonly found “I am epileptic” as self identity statements (Illman et al, 2011). The emerging finding of diminished self concepts in ASD highlights the need to anticipate unique difficulties relating to self referential cognition, self understanding, and disease awareness, even in the context of the above average cognitive skills and developed compensatory mechanisms for handling some social situations.

3.5.2 Utility of Fluency measures for tapping self-concepts

The findings demonstrate that fluency measures aimed at tapping self and other concepts are sensitive to the differences between NT individuals and those with ASD. Moreover, the differences in generating self and other concepts seen for adolescents with ASD appears to closely map the emerging psychological/physical self awareness divide. This has potential clinical value in that fluency measures are quick to administer and provide a quantifiable means of assessing the self-construct through the open ended generation of self-concepts. The robust group differences found here with large effect sizes holds promise for this approach in assessing the relative strengths and weaknesses of ASD individuals in terms of self awareness and diminished self-concepts.

More research would be needed to assess the connections between the generation of self and other concepts and the emerging picture of underlying psychological self awareness deficits. If such connections can be established the clinical value of such fluency measures could conceivably extend to aiding with diagnosis. Diagnosis of an ASD, particularly at the high functioning end where difficulties may not be recognised until adolescence or later, can take several interviews and multidisciplinary collaboration before a diagnostic decision is reached.

As research into SRC continues to shed light on this emerging dimension of ASDs, refined understanding will in time be incorporated into the ever evolving diagnostic process. Whilst such tools as fluency tasks can never be a substitute for clinical interviews, clinicians are often on the look-out for quick to administer tools with established specificity and sensitivity that can assist them in focussing, highlighting and supplementing their clinical decisions. Of course, the development and refinement of such fluency based tools would require a great deal of further research, but these present findings hold promise for the value of fluency tasks in tapping key differences at the self-concept level, showing robust and large group differences between NT adolescents and those with ASD.

3.5.3 Spontaneous application of social processing- a unique deficit?

Finally, the findings relating to a lack of spontaneous social stereotypes in the ASD group may suggest difficulties in actively applying mechanisms known to aid social interactions (Mackie et al. 1996). If further research can confirm that individuals with an ASD can have preserved TOM (Senju, 2012) and preserved social stereotyping abilities (Fonesca et al, 2011) whilst not spontaneously applying these abilities in respect of social information and situations, then this represents an important development in the way in which the socio-communicative impairments are conceptualised. It adds another dimension to the emerging picture in ASD of the “absent self”, possibly involving a lack of top-down control in governing and guiding behaviour (Frith 2003; Baron-Cohen, 2005; Hobson et al. 2006).

From the clinical perspective, such a shift would suggest a focus on developing and researching compensatory strategies for ASD individuals aimed at bringing on line these preserved mechanisms in social situations where they might be useful. The lack of information on how ASD individuals experience their world and on what therapeutic approaches may be of help to them has been noted in a recent review (Koenig & Levine, 2012). The emerging emphasis on an “absence” of a particular kind of self awareness related to top-down processing and psychological self-understanding could pave the way for a better understanding of the disorder and its treatment.

In particular, whilst several recent therapeutic interventions show improvement on measures of TOM, emotional recognition and executive functions in children and adolescents with ASD taking part in training programmes (Taghva et al. 2011; Stichter et al. 2012), this in itself may not be enough if these improved abilities are not spontaneously applied to real world social

settings. Indeed, one study found that training on false belief tasks did not improve social adaptation (Ozonoff & Miller 1995). Finding ways to compensate for a lack of the spontaneous application of otherwise preserved social processing abilities would represent a distinctly new focus for clinical interventions in ASD.

3.6 Future Research

This section briefly recapitulates the main areas of further research highlighted throughout the discussion. The addition of a “known friend” condition would allow further exploration of the SRE for self and other concepts, and furthermore would not require a ‘picture cue’ like the existing (s)he is tasks (see Section 3.2). At the cost of sacrificing the open-ended nature of the tasks, separate trials on the I Am and (s)he is tasks could explore physical, social and personal attributions individually, so as to better delineate SREs by type, and to assess deficits for those with ASD in generating personal attributions when exclusively asked to do so (see Section 3.3.3.). It would be fruitful to explore these effects and their relationships to measures of social cognition in an ASD sample with more representative TOM deficits (see Section 3.2.3).

In respect of social stereotypes, the present thesis has generated a hypothesis suggesting that individuals with an ASD may not spontaneously apply otherwise preserved social processing skills such as stereotyping (Fonesca et al, 2011; Senju, 2012). Future research would need to test this hypothesis through exploring implicit and spontaneous social stereotyping versus explicit stereotyping in a single study sample (see Section 3.4). This would have important implications for how clinicians design and test interventions aimed at helping individuals with an ASD manage their socio-communicative difficulties (see Section 3.5.3). Finally, the present thesis has demonstrated the value of fluency measures in capturing important differences in ASD groups at the level of cognitive access and generation of self concepts. Future research might profitably explore the use of such measures for both theoretical and clinical purposes (e.g. see Section 3.5.2).

3.7 Conclusions

This thesis has utilised novel fluency tasks to explore self referential cognition (SRC) in NT adolescents and those with ASD. Clear SREs have been demonstrated on these fluency tasks at the level of cognitive access and generation of self-concepts, and it has been found that these effects are connected with personal but not social or physical attributions for both groups. The

magnitude of SREs was found to relate to the eyes task, paralleling previous research (Lombardo et al, 2007), and provides further support for the proposed close link between SRC and social cognition (Lombardo et al. 2007; 2010; Baron-Cohen et al, 2010).

The ASD group demonstrated a large and significant reduction in the generation of personal attributes across all fluency tasks, even when controlling for category fluency. On the I Am task, the control group showed a significant preference for personal attributions whereas the ASD group did not. These findings support the emerging picture of a specific deficit in psychological but not physical self awareness (Williams, 2010), and suggest that the downstream impoverishment of psychological self-concepts very recently reported with the SUI (Jackson et al, 2012) can also be tapped with quick to administer fluency measures. Together, these findings provide further support for the “absent self hypothesis” of ASD (e.g. Frith, 2003)- an idea that, rather than implying a total absence of self, suggests deficits in a particular kind of top-down self awareness.

The ASD group also showed a significant lack of spontaneous social stereotyping on the unknown fluency tasks relative to the NT group. In the context of preserved social stereotyping and TOM abilities (Fonesca et al. 2011; Senju et al, 2012), this lack of spontaneous application may highlight an important development in understanding the socio-communicative impairments of ASD and a needed focus for the development of clinical interventions that are likely to help individuals with the disorder (Koenig & Levine, 2012).

Finally, the novel fluency measures used in this thesis have shown promising utility in measuring aspects of ‘the self’, capturing theoretically significant differences between NT and ASD groups. It is intended that similar fluency tasks will be taken up in future research connected with SRC and social cognition in ASD.

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APPENDIX 1

Introductory ideas to explain to pupils

Most of the tasks you'll be doing look at how you think about yourselves and other people- that is, what's important to you about who you are, and what you imagine and notice about others based on how they look to you.

All of the tasks involved are timed- usually just one minute to complete each task. But don't worry! It is not a test! You do not have to give your name on the sheets, only your age and whether you are a male or a female is needed so please don't be self-conscious or worried about what responses you give or whether you manage many responses or only a few responses in the time allowed. Just be honest and try your best on each task.

Also don't worry about asking the teacher too many questions about whether it is alright to put one type of answer down or not. For most tasks the teacher will provide some example answers. Other than that so long as YOU think your answer goes with the question then it is OK to put it down. There is no right or wrong answer.

You are helping me to design tasks to look at how children with autism think about themselves and other people, and whether this is affected by their condition.

So please accept my big THANKYOU for completing the tasks. Your answers will be used in real research!!

Instructions for ANIMAL task

Please ask pupils to put their age and gender at the top of the page.

Also, although pupils do not have to give their real name, it would be helpful if they marked the sheets they use in some way (e.g. with a fake name or initials). What is important is that they use the same name or marking on every sheet so that I can know the responses to different tasks were given by the same person. If they are happy to use their real names that is fine, but they do not have to.

The **ANIMAL task** is timed- pupils need to write down as many animals/living creatures as they can in ONE minute. Pupils should NOT add new animals after the minute is over, and should work on their own.

Instructions for "I Am Statements task"

Please describe this task to the pupils as per the instructions on the task page.

After the minute is up please ask pupils not to add any further "I Am statements". After completing the task please ask pupils to mark what they consider are the three

most important “I Am statements” they have made by putting the numbers, 1,2 and 3 next to these statements.

“In this next task, you are again being asked to write down as many different things you can think of. But in this case, we are looking at aspects of YOURSELF. These should be aspects about yourself that you consider describe important features of your identity- of who you are. Write these in by completing the phrase, *I am ...* . For example, someone might write: *I am a teacher, I am a big sister, I am red-haired, I am quick-tempered.*”

Please do not start the task below until instructed to do so.

In the space below, write as many different I AM STATEMENTS as you can (you will be given one minute).

Instructions for “He is/she is task”

This task is presented on a powerpoint slide show. There are **6 pictures** of different people in all. The first slide explains some brief instructions, but please make sure the pupils understand all the following points before they begin the actual task:

- This “He is/She is” task is similar to the “I Am task” you have just done. When you see the pictures, please write as many “(S)he is...” statements for each picture as you can in One minute.
- Once the picture is on screen you have One minute to write as many statements as you can. There are no right or wrong answers; you are encouraged to describe what you notice about the people and what you think they are like. Each picture will be presented for One minute each.
- It is highly likely you will recognise the first two pictures as very famous people (but don’t worry if you don’t!). You can make statements about these people based on the pictures OR on what you know or think of the person. Please make statements about these people in whatever way seems best to you. There are no right or wrong answers.
- You will NOT recognise the last 4 pictures on the task. Please make statements about these people based on what you think about them from the picture. For example, you might make statements about their physical appearance such as their age or looks, or what you think about their mood and “personality”. You are free to describe them in whatever way you think is best.
- **Note to teacher:** please don’t give too many examples of how pupils might describe the pictures. It is more important that pupils are not biased too much. It does not matter if pupils are only able to give a few statements for each picture. It is more important that they are not biased, and that they generate their own ideas. Many thanks.

APPENDIX 2

Rate the 'selves' and characteristics along three dimensions

1) Physical

A physical attribute will be one which is readily apparent from the picture itself, or from the person themselves. Such as age, size of facial features, gender, hair colour, distinguishing features, size, clothes.

The next two categories are character-based and are not outwardly judged by the physical appearance. These would include hobbies and socio-demographic factors, social roles, personality traits, moods, preferences, likes and dislikes.

2) Social Roles and Functions

These describe social roles, traits and features which are readily apparent and objectively verifiable – such as, mother, footballer, Leeds fan, famous

3) Personal

These describe personality traits, features and abilities which involve some subjective opinion such as, angry, hungry, scary, mean, a bully etc.

Please ignore names in the count – e.g. The Queen, Daniel Radcliffe, and all names in the I am task too.

Please see the Table below for several examples of coding....

Table to show examples of coding:

Physical	Social	Personal
Boy	Scout	Smart
Young	Hockey Player	Caring
Old	Hiker	Kind
Black-Haired	Biker	Friendly
Brown-eyed	Famous	Voldemort-hater
Bearded	Actor	Posh
Ugly	Rich	Upset
Staring eyes	Lives in a mansion	Serious
Ear piercing	In a film	Weird
Scruffy beard	Royalty	Dumb
Blonde	Mother	Happy
Wearing a uniform	A wizard	Sorted
Wrinkly	Student	Giving
Smiling	Grand-daughter	Moody
Has a weird haircut	English	Angry
Casting a spell	Hero	Creepy
Wearing a tie	A footballer	Sporty
Having a bad hair day	A punk	Concentrating
Middle-aged	Going on holiday soon	Stressed
		Daydreaming
		Depressed
		Helpful
		Glamorous
		Talented
		Lucky
		Mature

APPENDIX 3

A Table to show correlations between category fluency (animals) and the I Am and (s)he is tasks in Study 1

Correlations between tasks and Animals in the pilot study											
		iamtot	iamphysi	iamsoci	iampers	Harry	Queen	Happy	Unattract	Attract	Sad
Animals	Pearson Correlation	.429**	.083	.218*	.248*	.181	.357**	.267**	.332**	.296**	.449**
	Sig. (2-tailed)	.000	.414	.030	.013	.073	.000	.008	.001	.003	.000
	N	99	99	99	99	99	99	99	99	99	99

A table to show spearman's rho correlations between Happiness/attractiveness judgements and judgments of goodness/badness.

Correlations						
			ugpic4goodbad	beatpic5goodbad	happic3goodbad	sadpic6goodbad
Spearman's rho	ugpic4beatug	Correlation Coefficient	.369*	.093	.000	.446**
		Sig. (2-tailed)	.032	.600	1.000	.008
		N	34	34	34	34
	beatpic5beatug	Correlation Coefficient	.301	.437**	.060	.371*
		Sig. (2-tailed)	.083	.010	.736	.031
		N	34	34	34	34
	happic3happsad	Correlation Coefficient	.148	.415*	.346*	.451**
		Sig. (2-tailed)	.403	.015	.045	.007
		N	34	34	34	34
	sadpic6happsad	Correlation Coefficient	.289	.175	.452**	.636**
		Sig. (2-tailed)	.098	.321	.007	.000
		N	34	34	34	34

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

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

APPENDIX 4

**Certificate of ethical approval
#11-0115**

Title: Self-referential and Social cognition in Autistic Spectrum Disorders (ASD): Are they related?

Researcher(s):

Supervisor: Chris Moulin

Date of approval: 19 July 2011



Ethics committee of the Institute of Psychological Sciences, Leeds University

APPENDIX 5

Character Intentions task an example:

C. Character intention task (adapted from Brunet et al., 2000)

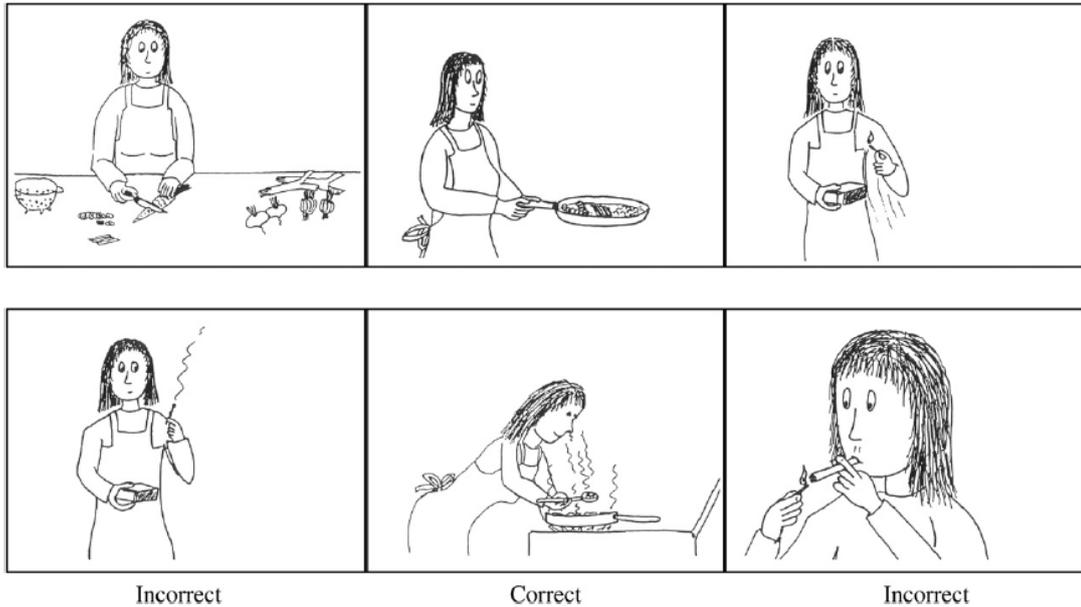


Fig. 1 – Example of an attribution of intentions comic strip. The top three pictures depict a story. The bottom three pictures are the proposed answers. Here the correct answer is the second picture.

Mind in the Eyes task, an example

D. Reading the Mind in the Eyes Test (adapted from Baron-Cohen et al., 2001)

joking

insisting



amused

relaxed

Fig. 3 – Example of a photograph of eyes.

Faux Pas question, an example:**Appendix
Example of ToM tasks****A. Faux pas test (adapted from Stone et al., 1998)**

Jill had just moved into a new apartment. Jill went shopping and bought some new curtains for her bedroom. When she had just finished decorating the apartment, her best friend, Lisa, came over. Jill gave her a tour of the apartment and asked, "How do you like my bedroom?" "Those curtains are horrible," Lisa said. "I hope you're going to get some new ones!"

Did anyone say something they shouldn't have said or something awkward?

If yes, ask:

Who said something they shouldn't have said or something awkward?

Why shouldn't he/she have said it or why was it awkward?

Why do you think he/she said it?

Did Lisa know who had bought the curtains?

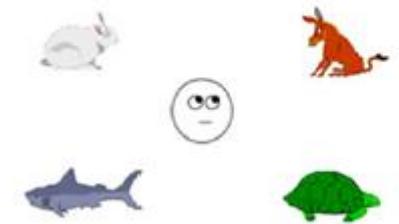
How do you think Jill felt?

Control question:

In the story, what had Jill just bought?

How long had Jill lived in this apartment?

Yoni Task, a still image of several example trials:

	1st order	2nd order
cognitive	<p>cog1 Yoni is thinking of ____</p> 	<p>cog2 Yoni is thinking of the fruit that ____ wants</p> 
affective	<p>aff1 Yoni loves ____</p> 	<p>aff2 Yoni loves the fruit that ____ loves</p> 
physical	<p>phy1 Yoni is close to ____</p> 	<p>phy2 Yoni has the fruit that ____ has</p> 