The Social and Emotional Functioning of Adults with High Functioning Autism or Asperger Syndrome

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July 2014

Thesis submitted in part fulfilment of the degree of

Doctorate in Clinical Psychology

University of East Anglia

Acknowledgements

I would first like to acknowledge and thank the University of East Anglia Doctoral Programme in Clinical Psychology for giving me the chance to pursue a career I am passionate about and for supporting me over the past three years. Special thanks go to my internal supervisor, Dr Peter Langdon (University of East Anglia), and my external supervisor, Professor Simon Baron-Cohen (University of Cambridge), without whom this research would not have been possible. Their support, time, advice, and expertise have been immeasurable and invaluable.

I would also like to thank Dr Lynne Roper (University of East Anglia) for kindly reading the first draft of my chapters and for her support and positivity about the research being undertaken. Thanks are also due to Dr Bonnie Auyeung (University of Cambridge) for her advice at the development stage of this research and to Dr Sarah Cassidy, Dr Paula Smith, and Dr Carrie Allison (Autism Research Centre) for coordinating access to datasets, contacting research volunteers, and for their advice on the research. Most importantly, I would like to thank the participants who gave their time to be part of this research and for their dedication to furthering the understanding of ASDs.

Thanks are undoubtedly also due to my family, for supporting me throughout the Clinical Psychology course, and for helping me take my mind off it when needed! Finally, I would like to thank my husband, Stephen, for believing in me even before I did. Without his unwavering encouragement and support, I would not have been able to do any of this.

I would like to dedicate this thesis to Professor Malcolm Adams, my first supervisor on this research, who sadly passed away before it was completed.

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Word Count: 25, 765

Abstract

Introduction. This research aimed to explore differences in social and emotional functioning between adults with High Functioning Autism (HFA) and adults with Asperger Syndrome (AS) through two studies. The first study aimed to explore the ability to interpret complex emotions and the perceived ability to empathise between adults with HFA and adults with AS. The second study aimed to investigate social experiences in everyday life.

Method. For Study 1, data from 43 adults with AS and 43 adults with HFA, matched for age, sex, and IQ, were obtained from an existing sample of participants. Scores on two previously completed questionnaires, The Reading the Mind in the Eyes Test (Eyes Test) and Empathy Quotient (EQ) were compared. Within Study 2, day to day social and emotional functioning was compared in a sample of 25 adults with HFA and 25 adults with AS, again matched for age and sex, using an online version of the Social and Emotional Functioning Interview (SEF-Q).

Results. The findings from Study 1 revealed that adults with AS were significantly more able to correctly interpret emotional states in others, as measured by the Eyes Test, than adults with HFA, while there were no significant differences between groups on the EQ. The findings from Study 2 indicated that adults with AS reported significantly less challenges associated with self-image on the SEF-Q, while there were no differences between those with AS or HFA with regards to reported interpersonal difficulties, friendships and social relationships as measured by the SEF-Q.

Discussion. This research suggests there are important differences between these clinical presentations. People with HFA have greater difficulty in interpreting emotional states in others and increased experiences of social and emotional difficulties associated with self-image than people with AS. The research concludes that adults with HFA may need more

social support than adults with AS do which raises questions about how the conditions should be conceptualised.

Chapter One

Introduction

1.1 Introduction to the study

Autism Spectrum Disorders (ASDs), which include Pervasive Developmental Disorders- Unspecified (PDD-NOS), Asperger Syndrome (AS), and Autism Spectrum Disorder (Autism), are pervasive neurodevelopmental disorders that affect as many as 2.64% of the population (Kim et al., 2014). In recent years, the conceptualisation of these conditions has changed. The current fifth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-5; American Psychological Association, 2013) has removed diagnostically discrete clinical presentations of ASDs and subsumed them within one, broader, "Autism Spectrum Disorders" diagnosis. The World Health Organisation has made no proposals to do the same in their planned 2017 revision of the International Classification of Diseases (ICD) manual.

This shift has raised questions as to how ASDs are conceptualised and whether a move towards a broader diagnostic category, that encapsulates all presentations, is clinically useful and beneficial to the individuals affected. The present research primarily aimed to support an understanding of the subtleties of some of the clinical presentations of ASDs. It sought to consider the most helpful way of conceptualising different presentations of ASD from a clinical and theoretical perspective by focusing on the experiences of individuals with Autism who do not have an intellectual disability (High Functioning Autism), and individuals with AS.

There are relatively few studies exploring the presentation of core features of ASD in adults with HFA compared to adults with AS (Planche & Lemonnier, 2012). This research aimed to partly address this by exploring differences between HFA and AS on two features of ASD; the ability to interpret complex emotions in others and perceptions of the ability to

empathise. To do this, the study made use of a large dataset collected by the Autism Research Centre (ARC), Cambridge. The everyday impact of these characteristics, or phenotypes, was analysed by recruiting a separate sample of participants to complete a questionnaire exploring social and emotional functioning in day to day life. The aim of this aspect of the study was to better understand perceptions of social interactions and emotional experiences. As there is an emerging body of research suggesting that autistic phenotypes are different in men with ASDs compared to women with ASDs (Frazier, Georgiades, Bishop, & Hardan, 2014; Lai et al., 2013, Rivet & Matson, 2011), the study also explored sex differences across these comparisons.

This chapter will begin with an overview of the thesis before presenting a background to ASD diagnostic criteria, clinical presentations, aetiology, and epidemiology. The chapter will then discuss the cognitive theories of ASD before exploring differences and similarities between HFA and AS, as they are currently understood, from a neuroanatomical, cognitive, and autistic phenotype perspective. The chapter concludes by presenting the research questions and hypotheses for the study.

1.1.1 Overview of the Thesis

This thesis is comprised of two studies seeking to explore social and emotional differences between adults with HFA and adults with AS. Chapter 1 is an introduction to the research which provides a background to ASD as well as details about the cognitive phenotypes associated with the conditions. The clinical presentations of AS and HFA are then presented, and the conceptualisation controversy about the conditions considered, before the aims and research questions are discussed. Chapter 2 details the methodology including research design, participant demographics, procedure, ethical considerations, and method of analysis for Study 1 and Study 2. Chapter 3 is a presentation of the results which is again divided into the analyses and results of Study 1 and Study 2. Chapter 4 discusses these

results and considers how they answer the research questions from Chapter 1 as well as how aligned they are with the background literature. Chapter 4 focuses on the theoretical and clinical implications of the findings and concludes by considering the strengths and weaknesses of the study, and suggesting areas for future research.

1.1.2 Clinical Relevance

High Functioning Autism and AS are often grouped together both in clinical practice and research design. However, studies exploring the differences between these conditions are limited (Matson & Boisjoli, 2008; Planche & Lemonnier, 2012). Within the studies that have been conducted, the results are contradictory. Although similarities do exist between the conditions, there is an emerging body of research suggesting that the presentations may be distinct from one another (Howlin, 2003; Pina-Camacho et al., 2013). Recent studies suggest that the neuroanatomical and intellectual profiles of HFA and AS may differ, and it is these profiles that have received the most attention (Planche & Lemonnier, 2012). Explorations of differences in social and emotional processing have not received as much attention despite their importance in informing clinical practice (Palmen, Didden, & Lang, 2012).

The clinical relevance of this research is therefore threefold; first, the research seeks to enhance the understanding of both HFA and AS from a social and emotional functioning perspective. Secondly, the findings will inform a consideration of the benefits or disadvantages of losing the distinction between these clinical presentations. Finally, it is hoped that clinical conclusions may be drawn from gaining an understanding of how social experiences are perceived by individuals with each condition and help to identify areas where support is most needed.

1.2 Autism Spectrum Disorders

Autism Spectrum Disorders (ASDs) are complex and pervasive neurodevelopmental disorders associated with lifelong impairment and difficulties across social, emotional, and

behavioural domains (Amaral, Schumann, & Wu Nordahl, 2008; Groen, Zwiers, van der Gaag, & Buitelaar, 2008). Autism was first described by Leo Kanner in his 1943 paper *'Autistic Disturbances of Affective Contact'*. In this paper, Kanner presented the characteristics of 'Infantile Autism' in ten children he had seen clinically, who presented with abnormal language development and a lack of interest in other people. Simultaneously, Hans Asperger was preparing his 1944 paper on his observations of a group of gifted but apparently socially challenged children that conceptualised 'Autistic Psychopathy', the presentation now known as AS. Since then, research into ASDs has excelled with discrete presentations conceptualised in diagnostic manuals. While individual variations in presentation are rightly emphasised, and the conditions are associated with further idiosyncrasies such as sensory profile abnormalities, ASD is primarily characterised by three core traits, summarised as the Triad of Impairments.

1.2.1 The Triad of Impairments

The triad of impairments (Wing & Gould, 1979) was the collective term used to describe the three key features of ASDs. These consist of an impairment in social interaction, an impairment in social communication, and markedly limited imagination. Following Kanner's and Asperger's introduction of autism and AS respectively, research was saturated with a series of accounts of similar presentations, each identifying a slightly different cluster of symptoms. The impact of this was a lack of agreement on what ASDs were and a number of new conditions, such as childhood psychosis, emerging in an attempt to cope with the observed variation of presentations. Wing and Gould (1979) sought to evaluate the number of different names and symptoms being attributed to the presentations we now understand to be ASDs by considering reported features and grouping the common phenotypes. Their review concluded that ASD features could be grouped within a single profile consisting of

difficulties across three domains; social interaction, social communications and imagination. Each of these traits is considered in turn.

1.2.1.1 Social Interaction. The social presentation associated with the condition is arguably the most prominent and easily recognised ASD trait (Schultz, 2005). Furthermore, atypical social interaction is consistently reported as being an observable trait in infancy, even before formal diagnosis would be possible (McConnell, 2002). This phenotype, clearly identified in Kanner's original depiction of ASD, is almost exclusively observed in ASDs and is not characteristic of other developmental disorders (Schultz, 2005).

Children with ASDs have been shown to spend less time than typically developed children engaging in social interactions (McConnell, 2002) and this reduced participation is reported to continue into adulthood (Orsmond, Krauss, & Seltzer, 2004). In infancy, children with ASDs are less likely to try to initiate and engage in even non-verbal social contact, such as joint play or shared attention, than children without ASDs (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012). Increased difficulty with interpreting facial expressions among children with ASDs has also been observed (Gillis, Callahan, & Romanczyk, 2011).

Deckers and colleagues' (2014) recent study explored whether children with ASDs have an underlying desire to engage in social interaction and merely lack the skills to do so, or whether engaging in social interaction is not a desired activity. Their study included 63 children with either autism, AS or PDD-NOS compared to 69 typically developed children aged 7 to 12 years old. Explicit desire for social interaction was measured by the Wish for Social Interaction Scale (WSIS) and implicit desire for social interaction was measured by a modified version of the Face Turn Approach-Avoidance Task (AAT; Voncken, Rinck, Deckers, & Lange, 2011). Levels of social anxiety were also explored using the parent or carer-completed Screen for Child Anxiety and Related Emotional Disorders (SCARED-71; Bodden, Bogels & Muris, 2009). Explicit desired for social interaction was found to be

significantly lower in children with ASDs compared to children who were typically developed and this was significantly correlated with social anxiety, $F(1,126) = 4.52$, $p < .05$, $\eta^2 = .03$. Conversely, implicit social desire, as measured by attentional biases towards social stimuli, was significantly higher in the ASD group compared to the group of children who were typically developed, $F(1,126) = 7.94$, $p < .01$, $\eta^2 = .06$. This study was limited in that the groups differed significantly in age and sex which meant these needed to be considered confounding variables. The design also grouped a number of different ASD presentations together but did not match participants on other confounding factors such as intelligence or early development. This reduces the potential to generalise the findings. Despite this, the findings illustrate significant differences between the groups and the study provides a useful insight into how social interactions may be viewed and experienced by this population.

The authors interpret the findings to suggest that children with ASDs may have an implicit desire for social interactions but in reality these interactions are too complex or demanding and so are avoided. The authors do not, however, explore whether the attentional bias observed may be linked to the observed social anxiety, rather than being indicative of a reduced desire for social attention. Ashwin, Wheelwright, and Baron-Cohen (2006b) observed the same attentional bias towards social stimuli in 17 adults with AS compared with 17 adults who were typically developed. Their interpretation of this difference was linked to theories of threat-processing in phobias (Williams, Matthews, & Macleod, 1996). The authors considered the attentional bias towards social stimuli in the AS group as being reflective of the difficulty people with AS have in interpreting facial expressions (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) causing an increased focus of attention.

The understanding of desire for, or avoidance of, social interactions is more complicated in adulthood. Some studies report a strong desire for social relationships in adults with ASDs and suggest that a significant proportion of individuals do form meaningful

friendships (Tobin, Drager, & Richardson, 2014). However, compared to friendships formed by people without ASDs, social relationships tend to be less close and less important to individuals with ASDs and have also been characterised as being less empathetic and supportive (Baron-Cohen & Wheelwright, 2003).

1.2.1.2 Communication. The second feature of the triad is an impairment in communication. Part of the diagnostic criteria for autism within the ICD-10 (WHO, 2010) and previous edition of the DSM (DSM-IV; APA 2000) is delayed or disturbed language acquisition. Phrase speech, speech involving basic structured sentences, typically develops between 18 and 24 months (Eigsti, de Marchena, Schuh, & Kelley, 2011). In ASD, phrase speech does not develop before 36 months and as a result, language development does not follow a normal trajectory. Delayed speech is only seen in autism rather than AS, according to DSM-IV and ICD-10.

This pragmatic communication impairment is augmented by deficits in social communication. It is unsurprising that impaired language acquisition and social interaction difficulties are linked given the role of language in early social exploration. Charman (2003) explored the longitudinal development of social interactions and the impact this had on communication in a population of infants with ASDs. The research looked at 18 20 month old infants with autism or related pervasive developmental disorders diagnosed through the Checklist for Autism in Toddlers (CHAT) screening study (Baron-Cohen et al., 2000). The impact of social traits observed at 20 months on language skills obtained by 42 months was explored. At 20 months, children with autism demonstrated less joint attention in social interactions, measured by observations of peer empathic responding, pretend play, gaze-switching, and imitation.

The results of this study indicate that joint attention specifically, in the form of gaze-switching at 20 months, was significantly positively correlated with language development at

42 months, measured by the Reynell Developmental Language Scales (Reynall, 1985). This was the case for both receptive language, $r = 0.74$; $p<0.001$, and expressive language, $r = 0.55$, $p<0.05$. Furthermore, gaze-switching ability was negatively correlated with social and communication symptoms, $r = -0.65$, $p<0.01$, as measured by the non-verbal domain of the Autism Diagnostic Interview (ADI-R; Lord, Rutter, & LeCouteur, 1994). Although the study is limited by small sample sizes, the impact of decreased joint attention on language development suggests that the social impairment associated with ASD impacts normal language development. Furthermore, the study is important in considering the age at which supportive interventions might be most useful.

1.2.1.3 Imagination (Restricted Behaviours). The final characteristic feature of ASDs is an impairment in imagination. This impairment is characterised by both restricted and stereotyped interests and behaviours as well as an inability to engage in tasks that require flexible social imagination, such as pretend play (Baron-Cohen, Leslie, & Frith, 1985). Although a well-established trait, this phenotype of the triad has received the least attention (Barnes, 2012). Craig and Baron-Cohen (2000) explored story-telling ability in 13 children with ASD and 14 children with AS, compared to 15 children with moderate learning disabilities and 14 TD children. In this study, children were required to elaborate on a story which had an imaginary theme and then to do the same on a story with a reality-based theme. Both children with AS and with Autism were less able than the comparative groups to introduce imaginary components to the realistic stories. The AS group were however more able to invent additional imaginative components on the imaginative story than the Autism group suggesting a greater imaginative capacity on contextual tasks.

Impairments in imagination may also be linked to theory of mind (Mar, Oatley, Hirsh, de la Paz, & Peterson, 2006). Theory of mind, detailed later in the chapter, is the ability to infer mental states in others and to think about what someone else might be thinking

(Astington, Harris, & Olson, 1988). The ability to identify emotional states in others from clips of non-fiction films has been explored in 22 adults with ASD and 22 adults who were typically developed (Golan, Baron-Cohen, Hill, & Golan, 2004). The results indicate that correctly guessing what others might be thinking or feeling is significantly harder for adults with ASD, reflecting theory of mind as well as an imaginative difficulties.

1.2.1.4 Summary. The triad of a social and communicative impairment alongside an impairment in imagination, characterised by restricted interests and repetitive behaviours, conceptualises the central features of ASDs. This profile also forms the basis of the observable characteristics required in order to receive a diagnosis according to the two international diagnostic systems for mental health disorders; the aforementioned DSM (APA, 2013) and the International Classification of Disorders (ICD; World Health Organisation, 2010).

1.2.2 Diagnosis

The DSM (APA, 2013) and ICD (WHO, 2010) are used for disorder conceptualisation and so inform both clinical diagnosis and research categorisation. ASD is diagnosed on the basis of a number of criteria, detailed in these diagnostic manuals, being met. In order to receive a diagnosis of ASD according to the DSM-IV (APA, 2000) at least two characteristics demonstrating a social impairment must be observed alongside at least one trait suggestive of a communication impairment. There must also be at least one observation of restrictive or stereotyped behaviours and lack of social imagination and these must have been observed before the age of three years of age.

The social impairment requires an observed failure to develop peer relationships which are appropriate for their developmental level, a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people, and a lack of social or emotional reciprocity. Communication impairments are assessed as a delay in, or total lack of, the

development of spoken language, a marked impairment in the ability to initiate or sustain a conversation with others, and stereotyped or repetitive use of language. Restricted interests and behaviours require a lack of varied, spontaneous pretend-play or play involving social imitation, appropriate to developmental level. This must occur alongside a preoccupation with one or more stereotyped and restricted activities or routines, stereotyped and repetitive motor mannerisms, and apparently inflexible adherence to specific routines (APA, 2000).

These criteria are mirrored in the ICD-10 (WHO, 2010) and historically, both manuals were well aligned with their conceptualisations of ASDs. Both focused on observed behaviours from each of the triad of impairments being present, and on the behaviours emerging before three years of age. Both manuals also include separate diagnostic criteria for AS if there has been no significant language delay. The fifth edition of the DSM (DSM-5; APA 2013) has however revised the previous conceptualisation of developmental disorders. In the current version, AS no longer exist as distinct diagnosis and instead there is one 'Autism Spectrum Disorder' diagnosis which incorporates all clinical presentations. In addition, DSM-5 has collapsed the social and communication impairments into a single domain (social-communication) since in practice these cannot be separated easily. It has also replaced the imagination impairments with repetitive behaviour and narrow interests, as did DSM-IV, since people with ASDs often have excellent imagination, for example in drawing, but nevertheless show excessive repetitive behaviour and develop unusually narrow interests.

The change in merging autism and AS into a single grouping of ASD has meant that there is a current lack of alignment between the two classification systems. Furthermore, there are no current proposals by the WHO for AS to be removed in the next edition, the ICD-11, in 2017, although this may change. Given this, there is a time-limited need for explorations about the differences and similarities between the clinical presentations of ASDs

so that the clinical usefulness of moving towards one inclusive diagnosis can be properly considered.

1.2.3 Clinical Presentations

1.2.3.1 Asperger Syndrome. The term Asperger Syndrome was coined by Lorna Wing (1981) following her exploration of the presentation first observed by Hans Asperger which he had termed 'autistic psychopathy' (Asperger, 1944). Gillberg (1991) subsequently proposed six core clinical features of AS; social impairments, narrow interests, repetitive routines, speech and language peculiarities, non-verbal communication problems, and motor clumsiness.

The conceptualisation of AS is, however, not straightforward. The initial presentation of 'Kanner's Autism' led to wealth of research exploring the presentation and conceptualisation of the condition (Wing & Gould, 1979). In contrast, AS received limited attention and the debate as to whether AS and autism are different presentations of the same condition, or different conditions with similar presentations has existed throughout (Matson & Wilkins, 2008).

Language development is not clinically delayed among people with AS and it is this feature which underpins the reason for AS as a discrete diagnostic category (APA, 2000; WHO, 2010). Although verbal communication impairments are less profound in AS (Fitzgerald & Corvin, 2001) idiosyncrasies in speech, such as excessive detail in conversation, may be particularly noticeable (Kaland, 2011). A consistent feature of AS is that cognitive development often follows a near-typical trajectory, with IQ falling within the normal range (Baron-Cohen, 2008). As a result of this typical early developmental trajectory, delayed diagnosis or misdiagnosis of presenting characteristics is a common problem for people with AS (Fitzgerald & Corvin, 2001).

Another factor that has been suggested to contribute to the conceptualisation of AS as a distinct ASD is in the presence of "age appropriate self-help skills, adaptive behaviour (other than social interaction) and curiosity about the environment" (APA, 2000). This feature has implications for social learning even without intuitively adaptive behaviour in social interactions. It suggests that people with AS are perhaps more able than people with other ASDs to function well socially, through the development of an understanding of social rules (Kaland, 2011).

1.2.3.2 High Functioning Autism. The conceptualisation of HFA emerged as a result of the shift towards an understanding of autism as a spectrum disorder, linked to an increased understanding of the variation in cognition among children with autism (Ehlers et al., 1997). DeMyers work on intelligence within ASDs contributed greatly to the latter. Following Kanner's (1943) presentation of Infantile Autism, it was thought that intelligence could not be measured within this population due to communicative and social impairments as well as difficulties engaging children with ASDs in standard intelligence tests (DeMyer et al., 1974). Reported islets of ability and special skills led to the prevailing hypothesis that infantile autism was associated with normal to high intelligence but that intelligence was masked by the communicative impairment (DeMyer et al., 1974; DeMyer 1975).

DeMyer and colleagues (1974) explored intelligence, communicative skills, and social functioning in 115 children with 'Infantile Autism' longitudinally over a five year period. The authors were able to show that intelligence could be reliably assessed with standardised measures in these children and by doing so, contradicted the idea of a universally superior intelligence. The authors noted the variance in IQ and functional skills among this population and described differences between 'High Autistic Children', whose IQ and functional skills were least impaired, 'Medium Autistic Children', and 'Low Autistic Children', whose IQ and functional skills were most impaired.

Today, it is understood that ASDs present on a spectrum of severity including individuals with profound intellectual disabilities and additional needs as well as extremely gifted and intellectually talented individuals (Baron-Cohen, 2008). This conceptualisation has developed to include a clearly defined category of ASD presentation; HFA. In HFA, intellectually ability falls within the normal range (IQ>70) however unlike AS, a language onset delay is present and adaptive behaviours are limited (Matson, Dempsey, LoVullo, & Wilkins, 2008).

High Functioning Autism is not a diagnostic term however and does not exist in any of the diagnostic manual conceptualisations of ASD. Despite this, HFA can be diagnosed as a clinical presentation by some of the gold standard ASDs assessment tools, for example, the Diagnostic Interview for Social and Communication Disorders (DISCO; Wing, Leekam, Libby, Gould, & Larcombe, 2002). This has led to uncertainty as to the usefulness of distinguishing this presentation of ASD. In research literature, HFA is often explored as a distinct presentation of ASD in order to ensure standardisation of participant groups (Yoshimura & Toichi, 2014). Given the range in symptom presentation and cognitive abilities across ASDs, subgrouping into HFA ensures confounding variables are minimised.

In clinical practice, the conceptualisation of HFA as a discrete clinical presentation helps provide insight into a number of difficulties that may not be as associated with lower-functioning autism (LFA). For example, children and adolescents with HFA have been observed to display significantly more symptoms associated with anxiety than children with LFA (Mayes, Calhoun, Murray, Ahuja & Smith, 2011; Tureck, Matson, Cervantes, & Konst, 2014). Children with HFA have also been shown to experience more social worries than children with LFA, who display more avoidant behaviours (White, Oswald, Ollendick, & Scahill, 2009). This implies that social support may need to differ based on level of functioning and that the categorisation of HFA is also a clinically useful one.

1.2.3.3 Diagnostic Changes relating to AS and HFA. The DSM-5 has subsumed all presentations of ASDs within a broader ASD diagnostic category which has meant the reconceptualisation of certain features of ASDs, with advantages and disadvantages. The previously distinct social interaction and communication impairment categories are now conceptualised as being the same impairment, listed under an umbrella criteria of "persistent deficits in social communication and social interaction across multiple contexts" (DSM-5 item 299.00; APA, 2013). The triad of impairments is now conceptualised as a dyad of impairments. This shift was designed so that variations in presentation between higher and lower functioning individuals can be accounted for and so incorporates, although does not distinguish between, HFA and LFA.

Another change to the conceptualisation of ASDs, which discards a former key difference between HFA and AS, is that language impairment is no longer listed as a requisite of diagnosis. The manual does however require a practitioner to specify whether a language impairment is present in the diagnostic report, as the implications for individual cognitive development and support requirements are acknowledged. In addition, any intellectual impairment, known medical or genetic conditions, pertinent environmental factors, and symptom severity must be included in the diagnostic report. The inclusion of these requirements is an asset in understanding individual presentations but the subtleties of differences in clinical presentation between categories of ASDs may have been lost.

Unsurprisingly, there has been a strong reaction to these changes from the ASDs community as well as from researchers and clinical practitioners both supporting and disagreeing with the changes (Kaland, 2011). The main reason for this is the uncertainty in the extent to which different presentations of ASDs, predominantly AS and HFA, differ from one another and whether this distinction is a clinically useful one. A frequent criticism of

DSM-5 is the answer to this remains unclear and so the removal of distinct conceptualisations within ASDs needs further consideration (Kaland, 2011).

Wing, Gould, and Gillberg's (2011) review article considered the changes in response to the DSM-5 committee's proposal publication. As discussed previously, Wing and Gould (Wing & Gould, 1979; Wing, 1981) first conceptualised the triad of impairments. A large focus of their critique is that the amalgamation of social interaction and communication. The authors argue that this shift does not allow for an appreciation of how different these skills are and how variable they are between individuals (Wing et al., 2011). The authors also highlight that the narrowed criteria might make early diagnosis more challenging, which is an important consideration given how vital early support is with ASDs (Myers & Johnson, 2007).

Lai and colleagues (2013) also reviewed the changes following the publication of the DSM-5. The authors note that the rating of symptom severity will be an asset in clinical practice and argue that the DSM-5 provides a clearer symptom description and an increased awareness of the spectrum of ASD. In terms of diagnostic use, Lai, Lombardo, Chakrabarti and Baron-Cohen (2013) report that all current available studies show DSM-5 to be better at reducing false-positive diagnoses than the DSM-IV. Despite this, the authors note that the DSM-5 suffers from reduced diagnostic sensitivity for people, particularly older children and adolescents, who would have previously met the DSM-IV criteria for PDD-NOS and AS. The authors also question one of the reported aims of the DSM-5, which was to address over-diagnosis of ASDs. The authors highlight the potential for this to be achieved not through the specificity of the new criteria, but because the other new DSM-5 developmental disorder, Social (Pragmatic) Communication Disorder (SCD), will absorb a large number of individuals with ASDs. This concern about the underrepresentation of ASDs by the DSM-5 has been raised by a number of response articles and papers (Mayes et al., 2014).

It seems that the DSM-5 will help to produce a greater understanding of the spectrum nature of autism but the broader category require markers that account for the individual's presentation, strengths, and difficulties across the core features of ASD to aid both clinical practice and research (Lai et al., 2013; Wing et al., 2011). Lai et al., (2013) suggest developmental pattern, sex/gender, clinical phenotypes, cognitive profiles, known genetic correlates, and potential environmental contributors as important individual considerations. A particularly prominent concern is that AS is not included, even as a specific presentation of ASDs rather than a discrete diagnosis (Kaland, 2011; Lai et al., 2013; Planche & Lemonnier, 2011).

1.2.3.4 Sex Differences in ASD. Possible sex differences in the presentation of ASDs are not explored within diagnostic manuals. The increased prevalence of ASDs among men compared to women is one of the most consistent and accepted features of this population. The reasons for this sex difference are still not fully understood (Schaafsmar & Pfaff, in press) and it remains unclear whether prevalence differences reflect the under-diagnosis of ASDs in women (Gould & Ashton-Smith, 2011). Given this, there is an increasing body of research exploring differences in the way ASDs present in males and females which is producing a complex picture (Rivet & Matson, 2011).

Explorations of these sex differences have demonstrated contradictory findings with some studies highlighting marked differences in autistic features between men and women and others areas of similarities (Lai et al., 2011; Lai et al., 2013, Rivet & Matson, 2011). Typical gender differences have been hypothesised to be less apparent among people with ASDs due to a profile of male dominant skills across both sexes (Baron-Cohen, 2002). Despite this, it has been reported that females with HFA and AS have a greater desire for social interaction than males, are more likely to appropriately mimic social behaviours, and are more likely to engage in imaginative play, which may mean that the social impairment of

ASD presents with less severity in females (Gould & Ashton-Smith, 2011). Lai and colleagues (2011) supported this in their study comparing 33 males with ASD to 29 females with ASD which found fewer socio-communication difficulties in women compared to men. In contrast, the authors found no difference between the sexes on measures of empathy, systemising, anxiety, depression, obsessive-compulsive traits, and mentalising abilities.

Understanding the differences between the way ASDs present in males and females is important for a number ofreasons. First, there are relatively few studies that directly explore sex differences in presentation of the core features of ASD between males and females (Rivet & Matson, 2011).This is important in addressing the issues of possible under-diagnosis of ASDs in women and also in understanding whether diagnostic criteria would be advanced by including sex-specific behaviours (Lai et al., 2011). Second, the impact of possible sex differences on everyday experiences cannot be adequately explored until this understanding is further developed (Gould & Ashton-Smith, 2011).

1.2.3.5 Clinical Presentations Summary. The debate regarding the most clinically useful way on conceptualising AS and HFA is not new (Matilla et al., 2007). Within manuals, diagnosis of ASDs is based on observed behaviours and phenotypes associated with the triad of impairments, as well as sensory-processing abnormalities, however manuals do not currently consider sex differences in presentation. The ICD-10 and DSM-IV present AS as a distinct category within ASD, highlighting a difference in language development and adaptive behaviours. The recent revision of the DSM, the DSM-5, has removed AS, and PDD-NOS as distinct diagnostic categories and presented a broader ASD diagnosis. The WHO have not published plans to do the same in the next revision of the ICD, the ICD-11. There are benefits to the revised DSM-5 diagnostic framework, including symptom-severity ratings and the accommodation of all presentations of ASDs including the previously discrete AS, and clinically conceptualised HFA. While this combined framework may better reflect

the spectrum nature of ASD, there is a risk that less severe presentations as well as subtleties between clinical presentations may be missed. It is currently unclear how the changes in diagnostic conceptualisation of ASD and its clinical presentation will impact upon the people affected (Kaland, 2011).

1.2.3 Epidemiology and Aetiology

Given the recent changes in the conceptualisation of ASDs, the prevalence and epidemiological data available uses DSM-IV and ICD-10 diagnostic data. The combined prevalence rate for all ASDs has been estimated to range from 0.7 to 2.64% (Kim et al., 2014) and is at least four times more common among men than women (Baron-Cohen, 2008). The prevalence rate for autism specifically is estimated as being between 30 per 10,000 (Yates & Le Couteur, 2008) and 60 per 10,000 (Hurst et al., 2007) with the prevalence rate for AS alone falling between 0.3 and 8.4 per 10,000 (Attwood, 2006). The prevalence of all ASDs has been shown to be steadily increasing (Matson & Kozlowski 2011) although it is important to consider whether this reflects a genuine increase in incidence or better public education about the disorder along with better diagnostic measures and services (Matson & Kozlowski, 2011; Wing & Potter, 2002). Early epidemiological studies exploring DSM-IV and DSM-5 prevalence rates suggests that most people who would have met DSM-IV criteria for a pervasive developmental disorder meet the DSM-5 criteria for either ASD or SCD (Kim, et al., 2014).

The aetiology of ASDs is not completely understood however it is unsurprising that there should be no single cause given the heterogeneous presentation of the conditions. There is little debate against the consensus that ASD have a neurobiological basis (Bailey et al., 1995; Baron-Cohen & Hammer, 1997; Folstein & Rutter, 1977; Parellada et al., 2014). Support for a genetic aetiology has been provided through twin and family studies. Characteristics associated with ASDs have heritability of up to 90% with the heritability of

diagnosed ASD falling between 2% and 6% (Skuse, 2007). Folstein and Rutter's (1977) pivotal study into same-sex monozygotic (identical) and dizygotic (fraternal) twins also validates the proposal of a genetic basis. The authors observed a 36% ASD concordance rate in monozygotic twins compared to 0% in dizygotic twins. Furthermore, the presence of cognitive abnormalities was 82% in monozygotic twins and only 10% in dizygotic twins (Folstein & Rutter, 1977). This has led to a broader phenotype theory of ASDs suggesting that although the conditions may not be present, specific traits associated with ASD may be apparent in first degree relatives of an individual with a diagnosis (Baron-Cohen & Hammer, 1997).

The comorbidity of chromosomal disorders and ASDs has meant candidate gene research has received much attention (Abrahams & Geschwind, 2008). Alternations on as many as 20 chromosomes have been associated with ASD (Schroeder, Desrocher, Bebko & Cappadocia, 2010). Duplications on chromosome 15 are one of the more consistent findings (Abrahams & Geschwind, 2008) although only appear to account for a small proportion of ASD risk (Coghlan et al., 2012). Alongside this, point-mutations, mutations that affect a specific or small number of genes, have been shown to account for approximately 10% of ASD development risk (Parellada et al., 2014). Li, Zou and Brown (2012) reviewed research on genes associated with ASD and concluded that, although consistencies among the research are emerging, and are enhanced by newer methodology such as whole-genome sequencing, larger scale explorations are required in order to fully understand the genetic profile of ASDs.

Other biological factors, including intrauterine environment, are also indicated in the development of ASDs (Parellada et al., 2014). The most consistently reported specific factors include exposure to infection or toxins, medications, and intolerance to food as well as specific perinatal and prenatal events such as prematurity, low birth weight, uterine bleeding, foetal distress or anoxia and induced labour (Harrington, Patrick, Edwards, & Brand, 2006).

One area to receive particular attention is the potential association between foetal testosterone levels and the development of autistic traits (Auyung et al., 2010). The rationale for this exploration is centred on the known sex difference in rates of ASD, and on animal studies which suggest that an elevation of this hormone prenatally masculinises the brain (Knickmeyer & Baron-Cohen, 2006). Amniotic fluid allows for an exploration of foetal testosterone and Auyueng and colleagues (2010) have reported that elevations of this hormone have been linked to reduced eye contact in infants, narrower interests at aged 4 years, less empathy between the ages of 4 to 8 years old, and an increase in systemising at 8 years; traits that are associated with ASD. A recent study confirmed that ASD is associated with elevated foetal steroids, including testosterone (Baron-Cohen et al, 2014).

Disruption of the brain systems, in terms of function, structure, or connectivity, may also be partly responsible for the development of the disorder (McAlonan et al., 2009). In terms of brain function, the inhibitory GABA system, associated with information processing styles seen in ASDs, has been shown to be different in people with ASDs compared to those without (Coghlan et al., 2012; Mendez et al., 2012). Other areas which are consistently shown to be functionally different in people with ASDs are shown across the cerebellum, frontal, and temporal lobes (Amaral et al., 2008). Specific areas of interest where differences have been observed include Broca and Wernicke's areas, responsible for language production and comprehension (Harris et al., 2006; Just et al., 2004;), as well as the amygdala which is associated with social functioning (Ashwin, Chapman, Cole, & Baron-Cohen, 2006a). Furthermore, Happé and Frith (2006) propose that problems of connectivity with the cerebellum may account the repetitive behaviours and restricted interests phenotype.

Structurally, an increase in overall weight and brain size in people with ASDs compared to typically developed, age-matched controls has been consistently observed (Amaral et al., 2008). Areas of structural differences which demonstrate some consistency are

the limbic regions, including the amygdala and hippocampus, the parietal lobe, the cerebellum, and the basal ganglia (Ecker et al., 2010; McAlonan et al., 2008).

1.2.4 Summary

ASDs are complex and heterogeneous conditions that affect a significant proportion of the population, the aetiology of ASDs is still not clearly understood. Given the complexities of the way ASDs present, it is unsurprising that such a range of factors including genetic predisposition, neuroanatomy, neuro-function and uterine environment might contribute in a non-mutually-exclusive way, to the development of the condition however it is important to note that the picture is sometimes contradictory. Cognitive theories of ASDs may therefore help explain the strengths and difficulties of the ASD profile.

1.3 Cognitive Theories of ASDs

The characteristics of ASDs are seen in a variety of combinations with varying degrees of severity. However, there are some principal theories that may help to explain the cognitive and behavioural phenotypes associated with the conditions. In this section, an overview of these theories and associated phenotypes will be discussed before an exploration of two predominant ASD theories that are central to this research, the Theory of Mind deficit and Extreme-Male Brain Theory of autism, is presented.

1.3.1 Overview of Theories and Phenotypes

Psychological research into ASDs has centred on three cognitive theories that are understood to underlie the phenotypes associated with the conditions (Rajendran & Mitchell, 2007); the *Executive Dysfunction* (ED) Theory, the *Weak Central Coherence* (WCC) Theory, and the *Theory of Mind* deficit, discussed later. Reflecting the heterogeneous nature of ASD, the theories seek to explain certain traits or behaviours rather than to explain the entirety of the ASD presentation (Charman et al., 2011). Despite this, individuals often demonstrate a

related presentation across the three domains. This indicates that the theories integrate well to account for different aspects of presentation as a whole (Valla & Belmonte, 2013).

The *Executive Dysfunction (ED) theory* of autism developed as a result of comparisons between the presentation of people with specific brain injury and those with an ASD. Executive Function is a neuropsychology term to describe a collection of skills that are understood to be linked to the same frontal lobe faculties (Hill, 2004). These executive functions are centred on the ability to develop, adapt, and maintain problem-solving strategies in order to achieve future goals (Ozonoff, Rogers, & Pennington, 1991; Rajendran & Mitchell, 2007). This involves skills such as planning, attention shifting, impulse control, and the monitoring of action (Hill, 2004). Impairments in executive function, ED, lead to a need for sameness, difficulty switching attention, tendency to perseverate, and a lack of impulse control (Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009). Strengths of ED include the ability to carry out tasks which have clear rules, that need to be followed in a precise order, in order to be completed (Hill, 2004).

Hill (2004) reviewed research exploring the performance of people with ASDs on executive function tasks. The review separated the ASD executive function literature into five domains; planning (nine papers), mental flexibility (15 papers), inhibition (seven papers), generativity (eight papers) and self-monitoring (eight papers). Overall, impairments were observed among people with ASDs across all of these domains although some studies showed a mixed profile, dependant on IQ or task complexity, or preserved function. These domains can be linked to established features of ASDs and help to explain the mechanisms underlying certain strengths and difficulties. Difficulty in generativity, for example, can be linked to the phenotypes associated with ASDs such as difficulty managing changes to routine and unexpected events (Memari et al., 2013). Deficits in mental flexibility may help to explain the profile of a desire towards repetitive and stereotyped behaviours. Impairments

in inhibition and self-monitoring may be the overarching feature that makes other executive tasks difficult (Boyd, McBee, Holtzclaw, Baraek & Bodfish, 2009). It is important to note the inconsistencies in findings, linked to confounding variables such as IQ and ASD symptom severity, as well as the complexities of measuring these constructs accurately; however, it is clear that ED is indicated in some of the core features of ASD (Memari et al., 2013).

Weak Central Coherence Theory (Frith & Happé, 1994) is another dominant theory in ASD that helps to explain some of the more idiosyncratic phenotypes. Central Coherence is the ability to integrate information in order to achieve an overview and awareness of the implications of context which adds structure and meaning (Nydén, Hagberg, Goussé, & Rastam, 2010). Weak central coherence, an information processing pattern which favours attention to detail rather than global information processing, is a well-established cognitive pattern in ASDs (Booth & Happé, 2010). People with ASDs typically show superiority on tasks designed to measure attention to local over global information such as the Embedded Figures Tasks, which require a person to locate a component shape within a larger picture (e.g. see Ring et al., 1999). This cognitive bias leads to some of the characteristic ASD strengths as well as helps to explain some of the areas of difficulty (Hill, 2004; Schroeder et al., 2010;).

As a strength, this way of processing information is associated with the ability to identify very specific information. It is this process that is most linked to savant-skills associated with ASDs (Happé and Frith, 2006). Weak Central Coherence can also help to explain some of the areas of difficulty associated with ASDs as difficulty in processing contextual information has implications for certain social skills (Hill, 2004). Holistic processing, for example processing whole faces, has been shown to be challenging for people with ASDs (Lopez, Donnelly, Hadwin, & Leekam, 2004). This has implications for so-called "mind-reading" abilities, the ability to read facial expressions (Frith, 2001), as the social and

emotional context of the information is neglected in favour of a detail-focused information. Alongside this, a superior attention to detail creates an attentional bias towards changes in environment, which can be difficult to tolerate for people with ASDs, and so leads to the observed drive for order (Frith and Happé, 2006).

1.3.2 Theory of Mind

Baron-Cohen, Leslie and Frith (1985) first proposed the Theory of Mind model of ASDs to help explain the characteristic social impairment associated with the conditions. Theory of Mind is the ability to 'mentalise' yourself and other people; that is, to be able to think about what you or others want, think, feel, or believe in given situations (Premack & Woodruff, 1978). It is a skill that is linked not only to social communication and interactions but also to aspects of imagination such as the ability to engage in pretend-play (Baron-Cohen et al., 1985).

Theory of Mind is typically tested using false-belief tasks (Wimmer & Perner, 1983), where a participant is required to demonstrate an understanding that others can hold beliefs that are different to their own. Children who are developing typically usually acquire this skill by five years of age (Wellman, Cross & Watson, 2001). People with ASDs, however, appear to struggle to attribute independent thoughts that are different to their own to other people (Happe, 1995). Understanding what other people think and feel is intrinsic to reciprocal relationships (Beall, Moody, McIntosh, Hepburn, & Reed, 2008; Tager-Flusberg & Sullivan, 2000;). It informs the ability to understand sarcasm and irony, the ability to make judgements about how to respond in social situations and to correctly interpret the intent behind comments or read between the lines (Torralva et al., 2012). The deficit in this area may therefore contribute to the social impairment of ASDs.

The Theory of Mind deficit in ASDs is not an absolute (Happe., 1995; Torralva et al., 2012). Some children with ASDs never develop strong Theory of Mind (Scheeren, de

Rosnay, Koot & Begeer, 2013), while others demonstrate an ability to understand the intent of others particularly in explicit or controlled settings (Lai et al., 2013). This skill seems to be dependent on the complexity of the task. First-order false believe tasks require an individual to say what another person is thinking (‘‘X thinks. . .’’) and people with HFA or AS show a comparatively increased ability with these tasks compared to second-order tasks, which require an individual to consider what another person thinks that someone else thinks (‘‘X thinks that Y thinks. . .’’) (Barnes, 2012). Despite this, spontaneous, implicit, or intuitive Theory of Mind does not seem to develop even in the highest functioning groups (Lai et al., 2013) and cannot be taught using repeated test paradigms (Schneider, Slaughter, Baylis & Dux, 2013). The impairment in this social cognition is more apparent in tasks that reflect the complexity of everyday life social interactions (Barnes, 2012).

1.3.3 Empathising-Systemising: The Extreme Male Brain Theory

The *Empathising-Systemising (ES) theory* of autism (Baron-Cohen, 2002) extended the Theory of Mind hypothesis to include more of a focus on the role of empathy within Theory of Mind. This theory highlights early observations of the condition and supports the conceptualisation of ASD as a distinct cognitive profile with strengths rather than as a disorder characterised by deficits. A related theory is the Extreme Male Brain theory, which extends the ES theory of autism to help explain why ASDs are at least four times more common in males than females (Baron-Cohen, 2002, 2010). This theory suggests that the conditions are also characterised by behaviours and cognitive patterns that, in the typically developed population, are more common in males. These include preferences for rule-based, structured, factual information and less propensity towards emotion-driven interpretations of situations. It argues that ASDs are best defined in terms of a superior systemising and neglected empathising profile (Baron-Cohen, 2002).

Baron-Cohen (2002) describes empathising as the ability to identify another person's emotions and link them to their thoughts, using Theory of Mind, and then to respond to these with an appropriate emotion. It enables a person to care for others and be cared for by others. Systemising is defined as the drive to consider the rules governing a system and to consider the variables associated with it. It therefore enables a person to predict the behaviour of a system in order to eliminate uncertainty and elicit control (Baron-Cohen, 2002). Baron-Cohen argues that males systemise more naturally, and therefore have a greater propensity towards understanding the inanimate world, than females, who have more of a natural affinity towards empathising and have a greater propensity towards understanding the social world. He argues that this "male brain" profile is apparent in an extreme form within individuals with ASDs and that the gender differences in empathising and systemising observed within the typically developed population are reduced in people with ASDs.

Research exploring empathising and systemising skills among people with and without ASDs has provided support for this theory. On Theory of Mind tests, girls who are typically developing perform better than boys, and children with ASD perform worse than typically developing boys (Happe, 1995). This finding has been replicated in the 'Reading the Mind in the Eyes' Test, a more complex tasks exploring the practical ability to "read" emotional states from people's eyes (Baron-Cohen et al., 2001). Fabio, Oliva and Murdaca (2011) found that children with ASD took significantly longer than children who were typically developing to correctly select emotional stimuli than to select systematic stimuli. While this provides further support for an increased difficulty in interpreting emotions in others, it is important to note that in this study the generalisability of the findings is somewhat limited by the groups being poorly matched and the ASD group including children with learning disabilities, as well as children without.

1.3.4 Summary

The cognitive theories of ASD help to understand the complexities in presentation by grouping difficulties into separate but interacting domains (Rajendran & Mitchell, 2007). An information processing style of weak central coherence and executive dysfunction may help to explain key features such as a strength for details, enjoyment of repetitive tasks, and difficulty tolerating changes in routine or rules (Frith & Happé, 1994; Ozonoff et al., 1991). The social impairments seen in ASDs may be linked to an overarching Theory of Mind deficit which makes understanding the subtleties of social interactions confusing (Baron-Cohen et al., 1985). Difficulties in empathising, and a superiority in understanding rule-governed systems associated with ASDs may be the result of a processing style reflective of an Extreme Male Brain profile (Baron-Cohen, 2002). ASDs are complex and non-uniform. Considering the core cognitive profiles may help to focus attention on both the strengths and difficulties associated with the condition so that individuals might achieve the best possible quality of life though enhancing those strengths and supporting the difficulties.

1.4 High Functioning Autism and Asperger Syndrome Distinction

The complexities in the conceptualisation of ASDs are exacerbated when the similarities and differences between the clinical presentations of HFA and AS are further considered. In adulthood, HFA and AS have been argued to share similar characteristics (Frith, 1991; Howlin, 2003). Both conditions present with the triad of impairments, with hyper- or hypo- sensitivity in one or more sensory modalities (Leekam, Nieto, Libby, Wing & Gould, 2007), difficulties with comprehending what other people think (Frith et al., 1999), and difficulties interpreting complex emotions (Golan et al., 2006). It is this similarity in aspects of clinical presentation that has influenced the DSM-5 (APA, 2013) decision to remove AS as a distinct diagnostic subgroup despite possibly important differences emerging between HFA and AS both in neuroanatomy (Yu, Cheung, Chua, & McAlonan, 2011) and

cognitive profile (Planche & Lemonnier, 2010). The picture is further complicated by the limited number of studies directly comparing AS to HFA (Wing et al., 2011). In this section an exploration of evidence supporting the similarities of the conditions, and highlighting the differences, will be considered.

1.4.1 Neuroanatomy and Neurobiology

Yu and colleagues (2011) conducted a meta-analysis of magnetic resonance imaging (MRI) studies of people with AS compared to people with HFA and used voxel-based morphometry to create a whole brain representation of the differences. They observed significant areas of difference in grey matter volume between the groups and distinct distribution patterns. However, Pina-Camacho and colleagues (2013) systematically reviewed structural MRI data and suggested a less clear distinction. Despite this, the authors concluded that, on the grounds of the available evidence, it is too soon to remove different presentations of ASD from within diagnostic manuals as fundamental differences may exist.

Cortical inhibition linked to GABAergic function, a potential area of dysfunction in people with ASDs (Coghlan et al., 2012), has also been shown to be significantly reduced in people with HFA compared to those with AS and people who are typically developing (Enticott, Rinehart, Tonge, Bradshaw & Fitzgerald, 2010). GABAergic function is the primary inhibitory system in the brain and altered GABAergic function is linked to anxiety as well as an information-processing style which favours sameness and detail (Coghlan et al., 2012). This suggests that people with HFA may experience greater difficulty with changes to routine and an increased need for structure and sameness than people with AS.

1.4.2 Cognitive Profile

In terms of non-ASD specific cognition, there is mixed evidence as to whether HFA and AS have distinct profiles. There is an emerging body of research that suggests that AS and HFA may be distinguished by the level of intellectual ability and subtest profile as

measured by the Wechsler Scales of Intelligence (Kanai et al., 2012; Spek, Schatorjé, Scholte, & van Berckelaer-Onnes 2009). In general, children with HFA have an intelligence profile characterised by superior performance IQ (PIQ) compared to verbal IQ (VIQ) whereas the reverse is observed in children with AS (Planche & Lemonnier, 2012). An overall superiority on intelligence tasks has also been observed among AS (Kanai et al., 2012).

Planche and Lemonnier (2012) explored the cognitive profiles of 15 children with HFA compared to 15 children with AS using the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) and a developmental neuropsychology assessment (the NEPSY). Alongside a general PIQ>VIQ pattern in children with HFA compared to a VIQ>PIQ pattern in children with AS, the authors observed significant performance differences. Children with HFA performed worse than children with AS and typically developing children on tasks linked to language and comprehension. This is perhaps unsurprising given the differences in language acquisition between the groups and the impact of a different early language development trajectory on social communication (Kaland, 2011).

1.4.3 Autistic Profile

Comparisons between people with HFA and people with AS on traits associated with ASDs typically used diagnostic tools or the triad of impairments to explore differences. Few studies have explored the mechanisms and skills that might underlie the profile differences or what the implications of any differences might be on day to day life. Walker et al. (2004) compared different presentations of ASD on the ADI-R (Lord et al., 1994), a gold standard diagnostic tool, between children with PDD-NOS, AS and Autism. The three presentations were compared using analysis of variance (ANOVA). Individual statistical differences between AS and autism alone were not reported by the authors as they compared presentation across all conditions. A significant difference was observed between all three groups on the ADI-R. Children with AS were shown to have higher levels of functioning than children with

PDD-NOS and Autism whereas children with PDD-NOS were shown to have less autistic symptoms, as measured by the ADI-R, than children with AS and Autism. Although unable to be directly compared, mean differences between the AS and the Autism group on some sections of the ADI-R are suggestive of diagnostic differences between the groups.

In adulthood, there is evidence for differences in communication between people with AS and people with HFA. Spek and colleagues (2009) compared verbal fluency, a skill linked to social skills and executive function with implications for communicative skills. They explored this in 31 adults with HFA, 31 adults with AS, and a comparison group of 30 adults who were typically developing using a number of linguistic tasks. All three groups were matched for age and intelligence. The HFA group was shown to be impaired across all tasks compared to the TD group, whereas the AS group was only impaired on a semantic task, where participants were required to name as many professions as they could within one minute; the only task in the battery of tests which linked to aspects of social, everyday life by focusing on professions. People with HFA were shown to have greater executive dysfunction than the AS group when both were compared to adults without an ASD. Adults with HFA and with AS showed greater difficulties on the 'professions' verbal fluency which the authors suggest highlights a social difficulty, although this conclusion may be exceeding the methodology of the research.

Social impairments are pronounced in both HFA and AS (Adolphs, Sears & Piven, 2001). Although few studies have explored social cognition differences between HFA and AS, it is differences in this feature which may be the most important reason for keeping a distinct AS diagnosis (Pina-Camacho et al., 2013). The majority of existing studies have explored differences in childhood populations and so the implications in later life are not as well understood (Kaland, 2011). Ozonoff and colleagues (1991) observed children with AS to outperform children with HFA on first order false belief tasks. Peterson and Paynter (2010)

have also demonstrated Theory of Mind to be significantly impaired in children with HFA aged 5-12 years compared to children with AS in the same age range highlighting a difference in this skill between conditions.

Ghaziuddin (2008) explored social presentation in 39 children with HFA compared to 58 children with AS and reported significantly different social profiles between the groups. Seventy-nine percent of children with AS were rated as being "active but odd" according to Wing and Gould's (1979) social impairment profiles, whereas 82% of children with autism were identified as falling under the "aloof and passive" category. The findings demonstrate significantly different social profiles in children with HFA compared to children with AS.

In adulthood, people with AS have been shown to have a more active social impairment, measured by Wing and Gould's (1979) social trait grouping, compared to a passive profile in people with HFA (Ghaziuddin, 2010). The author argues that this might make the presence of co-morbid mental health difficulties such as depression more common among people with AS (Ghaziuddin, 2010). Schalock (2004) highlighted the importance of social functioning, social participation, social inclusion and interpersonal relationships on quality of life. These areas are encompassed in the social interaction component of the triad of impairments (Wing & Gould, 1979), and well established to be difficult for people with ASDs. How these difficulties affect the day to day life of people with HFA compared to people with AS has yet to be explored.

1.5 Summary and Research Aims

In summary, the research to date portrays ASDs as complex conditions, with equally complex aetiology, making the conceptualisation of it as either a single developmental disorder, or a group of discrete but overlapping clinical presentations, difficult (Kaland, 2011; Planche & Lemonnier, 2012; Wing et al., 2011). ASDs are characterised by difficulties across social interaction and social communication as well as impaired imagination leading to

restricted and stereotyped behaviours and a low tolerance of change or uncertainty (Wing & Gould, 1979). These traits present with a range of severity and individual idiosyncrasies and the profile is not uniform. Interpreting emotions and attributing thoughts to others is difficult for people with ASDs but a superiority in rule-based tasks and understanding systems is a strength of the condition. Theories such as WCC (Frith & Happé, 1994), ED (Ozonoff et al., 1991), Theory of Mind (Baron-Cohen et al., 1985), and the Extreme Male Brain Theory of autism (Baron-Cohen, 2002) may help to explain this profile.

Although it is well established that ASDs have a partly genetic basis, the exact causes are still unknown and it is likely that many complex interacting factors are involved, including genetic, biological and environmental (Coghlan et al., 2012). An understanding of the genetic basis of ASDs is emerging, with chromosomal abnormalities and point-mutations across the whole genome thought to influence development of ASDs (Abrahams et al., 2008; Lai et al., 2011). Biologically, GABAergic function may be linked to the expression of certain behavioural traits that are associated with ASDs (Coghlan et al., 2012) and in-utero hormonal changes may also play a role in increasing the susceptibility of developing the condition (Auyueng et al., 2010; Baron-Cohen et al, 2014).

Given the number of contributing aetiological factors, variation in presentation, and the number of theories that have been proposed to help understand ASDs, it is unsurprising that achieving an all-encompassing conceptualisation of the condition is complicated. The removal of ASD subtypes within the DSM-5 has reignited the early conceptualisation debate and within this, AS and its difference or similarity to HFA is now arguably at the centre.

Emerging differences in the neuroanatomy of HFA compared to AS have been reported (Yu et al., 2011) however further research is needed to clarify this picture. Explorations into differences in the presentation of the conditions are increasing and there is emerging evidence to suggest that the conditions differ in intellectual profiles, with people

with AS showing a superiority in verbal IQ and people with HFA in performance IQ (Spek et al., 2009). Furthermore, differences may exist in the presentation of some of the core features of ASD including communication and Theory of Mind abilities (Paynter & Peterson, 2010). Despite this, the information remains contradictory and inconclusive. Furthermore, the majority of research focuses on children and adolescents with ASDs meaning understanding the impact that any differences may have in later life has not been achieved (Kaland., 2011).

Amidst this drive to understand the specific presentations and seek a clearer understanding of ASDs, there is a need for research exploring how characteristics associated with the conditions may affect the day to day experiences of the people affected. It is well established that social experiences and activities are closely linked to overall quality of life (Mansell, Elliot, Beadle-Brown, Asham & Macdonald, 2002; Schalock, 2004; Tobin et al., 2013), and that impairments in social interaction and social communication are core features of ASDs. Understanding whether differences exist in social-emotional functioning between people with HFA and people with AS may therefore help to understand a key feature of ASDs and add to the debate as to whether there is a clinical need for the presentations to be conceptualised as discrete from one another. By investigating whether adults with AS and adults with HFA perceive and experience social interactions differently a focus can be given to enabling better tailored support to people with the conditions and their families. To date, there are no studies exploring perceived social and emotional experiences of adults with AS compared to adults with HFA.

In order to investigate these issues the current research involved two studies. Study 1 explored differences between adults with HFA and adults with AS in the ability to empathise and the ability to accurately interpret complex emotions in others. The ability to empathise is a difficult skill for people with ASDs and is central to social interactions and communication (Baron-Cohen, 2002). By exploring self-reported empathy skills in people with HFA,

compared to people with AS, an understanding of the presentation of one of the core features of ASDs may be achieved. The ability to understand complex emotions in others, associated with effective reciprocal social interactions and communication, is another trait that is well established as being difficult for people with ASDs but it is unclear as to whether differences in this ability exist between adults with HFA and adults with AS. Measuring performance on a test of this skill that has a "correct" answer, will enable for a comparison to be made between the aforementioned self-report empathy perception and actual skill in reading emotions, which heavily influences the ability to empathise.

Study 2 involved exploring social and emotional experiences in day to day life. Exploring perceived experiences of day to day social interactions and interpersonal relationships will help to enhance the understanding of whether there is a clinical need for the presentations to be conceptualised as discrete. It will also be useful in considering whether different types of support are needed for people with HFA and people with AS in order to help them achieve the best possible quality of life. Finally, as sex differences may play a role in the way ASD presents and so influence experiences of social and emotional interactions, the study intended to explore this difference.

1.6 Research Questions

This research is exploratory in nature but makes hypotheses about expected outcomes based on the information available from previous research. The research questions and related hypotheses for each study are presented below.

Study 1

1. *Do differences exist between adults with HFA and AS in their perception of their ability to empathise?*

It was hypothesised that the AS group will report fewer difficulties on empathy quotient.

2. Do differences exist between adults with HFA and AS in the ability to "read" complex emotions in others?

It was hypothesised that adults with AS will perform significantly better on this advanced practical test of theory of mind.

Study 2

3. Do differences in day to day social and emotional functioning exist between adults with HFA and AS?

It was hypothesised that adults with HFA will experience greater social difficulties than adults with AS.

Sex Differences

Both Studies will seek to also answer the following research question:

4. Do these features present differently between women and men with HFA and AS?

It was hypothesised that that sex differences observed among people without an ASD will not be observed within people with HFA or AS.

Chapter Two

Methodology

This research made use of a large existing dataset collected by the Autism Research Centre (ARC), University of Cambridge, to answer two of the research questions; whether differences exist between people with HFA and AS in their perceived ability to empathise and ability to interpret complex emotions. Participants were also newly recruited through the ARC so that the third research question, whether differences exist between the conditions in everyday life social and emotional functioning, could be answered. This chapter will first present the methodology for Study 1, which uses the ARC dataset, and then Study 2, which details the methodology for the newly recruited participants for the social and emotional functioning questionnaire (SEF-Q).

2.1 Study 1

2.1.1 Design

This study was exploratory in nature however hypotheses were made based on indications from previous studies. A 2 (Diagnosis: HFA or AS) x 2 (Sex: Male or Female) between subjects design was used to explore perceptions of the ability to empathise, using the Empathy Quotient (EQ; Appendix A i), and the ability to correctly interpret emotions, using the 'Reading the Mind in the Eyes' Test (Eyes Test; see Appendix A ii for an example). These variables were explored first between participants with HFA compared to participants with AS and then between males and females within each group.

2.1.2 Participants

This sample was composed of adults, aged 18 years or over, with a diagnosis of either HFA (a diagnosis of Autism without the presence of an intellectual disability) or AS who had registered through the ARC. Participants had all consented to their questionnaire responses

being used by external researchers working in collaboration with the ARC, and had completed the target questionnaires (EQ and Eyes Test) for this research.

2.1.2.1 Inclusion Criteria. The primary inclusion criterion was a diagnosis of either HFA or AS. Diagnostic information was gathered through the initial screening questionnaire completed when a participant registers with the ARC. This includes information regarding diagnosis received and diagnostic method, including how and where the diagnosis was received. A further inclusion criterion was the capacity to give informed consent also evidenced by the initial screening questionnaire.

2.1.2.2 Exclusion Criteria. Exclusion criterion was the presence of an intellectual disability. The distinction between high and low functioning autism is made based on an IQ of over 70 in HFA or an IQ of under 70 in LFA. This exclusion criterion was therefore essential in achieving diagnostic validity for this ASD subtype. The ARC's initial screening questionnaire requests information about any diagnosed specific, or generalised, intellectual disability and so this was able to be assessed from participants basic information. In order to standardise the sample, scores on Raven's Progressive Matrices, a non-verbal measure of intelligence, were used to match groups. This also enabled IQ, and therefore HFA, to be further confirmed.

2.1.2.3 Clinical Grouping. The ARC's initial screening questionnaire requests self-report information regarding diagnosis, diagnostic measure, and diagnosing professional. This report of an official diagnosis was accepted as valid. Self-report of medical diagnosis have been demonstrated as reliable across a range of conditions (Mulleners et al., 2001; Simpson et al., 2004). Crucially, self-report of official diagnoses has been shown to be particularly accurate, with agreement as high as 98%, in the ASD population (Auyeung, Allison, Wheelwright & Baron-Cohen, 2012; Daniels et al., 2012). Participants who did not report receiving a diagnosis of AS or HFA through a recognised medical or research

organisation or by a recognised professional, or who were unable to provide information about the diagnostic assessment used, were excluded in order to further the reliability of the self-reported diagnosis. HFA is a descriptive rather than discrete diagnosis although, as discussed, some standardised diagnostic tools, for example the DISCO (Wing et al., 2002), do include it as a diagnostic category. In order to ensure participants were not missed from the dataset, participants who had listed HFA or ASD as their diagnosis were included in the sample provided that they did not also have an intellectual disability (identified as IQ<70) and that the aforementioned confirmation of diagnostic method was available in their initial screening questionnaire.

2.1.2.4 Sample Size. A power calculation using G*Power software version 3.1.3 (Faul, Erdfelder, Buchner, & Lang, 2009) was conducted in order to determine required sample size for this ARC dataset comparison (see Appendix B). To achieve a sample size calculation which was appropriate for the data, a-priori independent means t-tests were selected as the test statistic. Effect size was calculated from Paynter and Peterson's (2010) study exploring theory of mind difference between children with AS compared to children with HFA. Theory of Mind underpins the social difficulties associated with ASDs and is linked to both difficulties with empathising and interpreting other people's emotions. Differences observed in this skill can therefore be used to estimate differences within the current study. Furthermore, this study had well matched groups and transparency of descriptive statistics. Means and Standard Deviations were taken from this study and an effect size of .78 was determined using G*Power (Faul et al., 2009) and used for this estimation of sample size. Power was set at 80% according to Cohen's (1988) desired statistical power, based on Type I and Type II error risk, at the 0.05 level. Total sample size was calculated as 42, meaning the group sizes for this exploration required a minimum of 21 people with HFA and 21 people with AS.

2.1.2.5 Participant Demographics. Forty-three adults with HFA and 43 adults with AS were selected for this comparison of features of ASD. Participants were matched on a case by case basis for age and IQ, measured by Raven's Progressive Matrices (Ravens et al., 1997), and groups were matched for sex distribution (see Table 1).

Table 1

*ARC Dataset participant demographics**

	N	***M* Age (*SD*)**	***M* IQ (*SD*)**	***N* Male**	***N* Female**
HFA	43	39.09 (13.05)	18.91 (1.74)	20	23
AS	43	37.95 (12.52)	18.91 (1.74)	20	23
TOTAL	86			40	46

**M*= mean, *SD*= Standard Deviation

2.1.3 Ethical Considerations

Analysis of the existing ARC dataset by collaborating researchers has standing ethical approval granted by The University of Cambridge to the ARC (ethical approval ref: 2010.56 from Cambridge Psychology Ethics Committee). Ethical approval for the lead researcher to access parts of the dataset appropriate for this research was sought, and given favourable opinion, by the University of East Anglia Faculty of Medicine and Health Sciences Research Ethics Committee (see Appendix C).

All participants who register with the ARC to volunteer online are first presented with information which explains that their anonymous responses to the online battery of tests may be used by both internal and external collaborating researchers. Participants are required to indicate whether they consent to this before they are able to access the online questionnaires. This ensures informed consent is achieved. All responses are automatically coded to ensure anonymity in responses and participant confidentiality. Only the ARC Database Manager has access to participant identifiable information linked to these codes. This ensures participants'

information and responses can be removed from the database should they request this while ensuring anonymity to researchers.

2.1.4 Assessment Measures

Participants who volunteer with the ARC are invited to complete a battery of questionnaires and tests with the explicit purpose that the anonymised results of these tests will be made available to both internal and external researchers for analysis. The full list of ARC research questionnaires can be found in Table 2. From this list The Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004) and The 'Reading the Mind in the Eyes' Test (Eyes Test; Baron-Cohen et al., 2001) were used in the exploratory design of this study.

2.1.4.1 Raven's Progressive Matrices. As described within the participant demographics, Raven's Progressive Matrices (RPM; Raven, Raven & Court, 1997) were used to match participants on intelligence and ensure that any group differences could not be attributed to IQ. Raven's Progressive Matrices is a non-verbal measure of general intelligence which is widely used in research due to its robust psychometric properties (Schweizer, Goldhammer, Rauch & Moosbrugger, 2007).

2.1.4.2 The Empathy Quotient. The Empathy Quotient (Baron-Cohen & Wheelwright, 2004) is a 60 item self-report questionnaire that is designed to measure how easily a person can pick up on other people's feelings and how strongly they are affected by other people's feelings (Appendix A i). This enables empathy to be explored as a social function by measuring empathy both in terms of cognition and affect (Baron-Cohen & Wheelwright, 2004). Each participant is required to respond to items such as "I often find it difficult to judge if something is rude or polite" or "I can tell if someone is masking their true emotion" by selecting one of four options; 'strongly agree', 'slightly agree', 'slightly disagree' or 'strongly disagree'. The EQ has been shown through confirmatory factor analysis to have reliability of .93 (Allison, Baron-Cohen, Wheelwright, Stone & Muncer,

2011) which means that it is effective in measuring empathy as it is currently conceptualised. Test-retest reliability of the EQ is also high, at $r = .835$ ($n = 25$, $p = 0.0001$; Lawrence, Shaw, Barker, Baron-Cohen & David, 2004), suggesting that it is effective in producing a constant interpretation of empathy in individuals and, ultimately, in ensuring it is a robust measure.

2.1.4.3 The 'Reading the Mind in the Eyes' Test. The 'Reading the Mind in the Eyes' Test: Revised Edition (Eyes Test; Baron-Cohen et al., 2001a) is a 36 item advanced test of Theory of Mind and social sensitivity. It measures a participant's ability to determine complex emotional states from limited information and without a context, and is a practical measure of empathy. The test requires a participant to look at a picture of a person's eyes and select one of four presented descriptive words that best describes what the person in the picture is feeling (see Appendix A ii). Vallente and colleagues' meta-analysis (2012) demonstrated that the Eyes Test has good internal consistency at .70 using Cronbach's alpha (Dehning et al., 2012) and .77 using Guttman's split-half method (Serafin & Surian, 2004). This is important in ensuring that a test measures the factors it is designed to and therefore increases the validity of findings.

Test-retest reliability for the Eyes Test has also been shown to be acceptable at .65 using the interclass correlation coefficient (Vallente et al., 2012) which, as with The EQ, is important for ensuring that scores on the test are robust and constant over time. Furthermore, The Eyes Test has been shown to demonstrate diagnostic sensitivity between people who are typically developed and people with either HFA or AS (Baron-Cohen et al., 2001). This is important as it indicates that the test measures some of core features of ASD and therefore any differences between HFA and AS observed in this area may be cautiously considered in terms of their diagnostic profiles.

Table 2

ARC online measures available to adult volunteers

Measure	Description
AQ	The Autism Spectrum Quotient: A questionnaire to measure autistic traits.
EQ	The Empathy Quotient: A questionnaire to measure empathy.
SQ	The Systemising Quotient: A questionnaire to measure the drive to systemise.
Gender Questionnaire	A questionnaire about gender identity.
Hormone Questionnaire	A questionnaire about steroid hormone related medical history.
The Ravens Matrices Test	A timed test as a non-verbal index of IQ.
The Mental Rotation Test	A timed test measuring the ability to manipulate spatial information. It requires participants to mentally rotate representations of two and three dimensional objects.
The Embedded Figures Test	A timed test measuring visual search and analysis ability. Participants are shown a target shape and are asked to find it in a larger complex design in which it is embedded.
The Reading the Mind in the Eyes Test	A timed test that measures 'theory of mind' ability. Participants are asked to choose from a set of mental state terms and match them to pictures of people's eyes.
The Karolinska Directed Emotional Faces Test (KDEF)	A timed test that measures emotion recognition. Participants are shown a series of photographs of peoples' faces and asked to choose from a list of mental state terms how best describes what the person is feeling in the picture.
GoNoGoTest	A timed test that measures the executive function of sustained attention and response control. Participants are asked to press buttons in response to pictures as quickly as possible, sometimes being required not to make a response.
Maths Test	A test measuring mathematical ability.
SPQ	The Sensory Perception Questionnaire: A questionnaire to measure sensory sensitivity.
Female Health and Development Questionnaire	A questionnaire about health and growth related to hormones, in females.
Male Health and Development Questionnaire	A questionnaire about health and growth related to hormones, in males.
Handedness Inventory	The Edinburgh Handedness Inventory, to establish dominance/laterality.

2.1.5 Procedure

The ARC advertises online research opportunities on its main website, through information posters and leaflets at the centre itself, and in journal articles. All perspective participants are directed to www.autismresearchcentre.net as part of the current database procedure. They are required to register before being given access to information about the

nature of the questionnaires available online, and how their information and responses will be used. It is made clear that all responses are anonymous and that these responses may be used by both internal and external collaborating researchers for analysis. Participants are also informed that they may be contacted for future research and are required to indicate their understanding of this and to give consent accordingly, or opt out.

Once registered, participants complete an initial screening questionnaire. The questionnaire explores basic descriptive information such as age, sex, educational attainments, and employment status. Mandatory fields also include diagnosis, diagnostic method, and comorbid conditions, while general screening questions assess specific research study inclusion and exclusion criteria, for example medication. Participants then navigate to, and select tasks from, the online test battery and complete as many or as few as desired. Each task is preceded by the appropriate instructions and participants are able to log in and out of the database as often as they desired to reduce the demands placed on them.

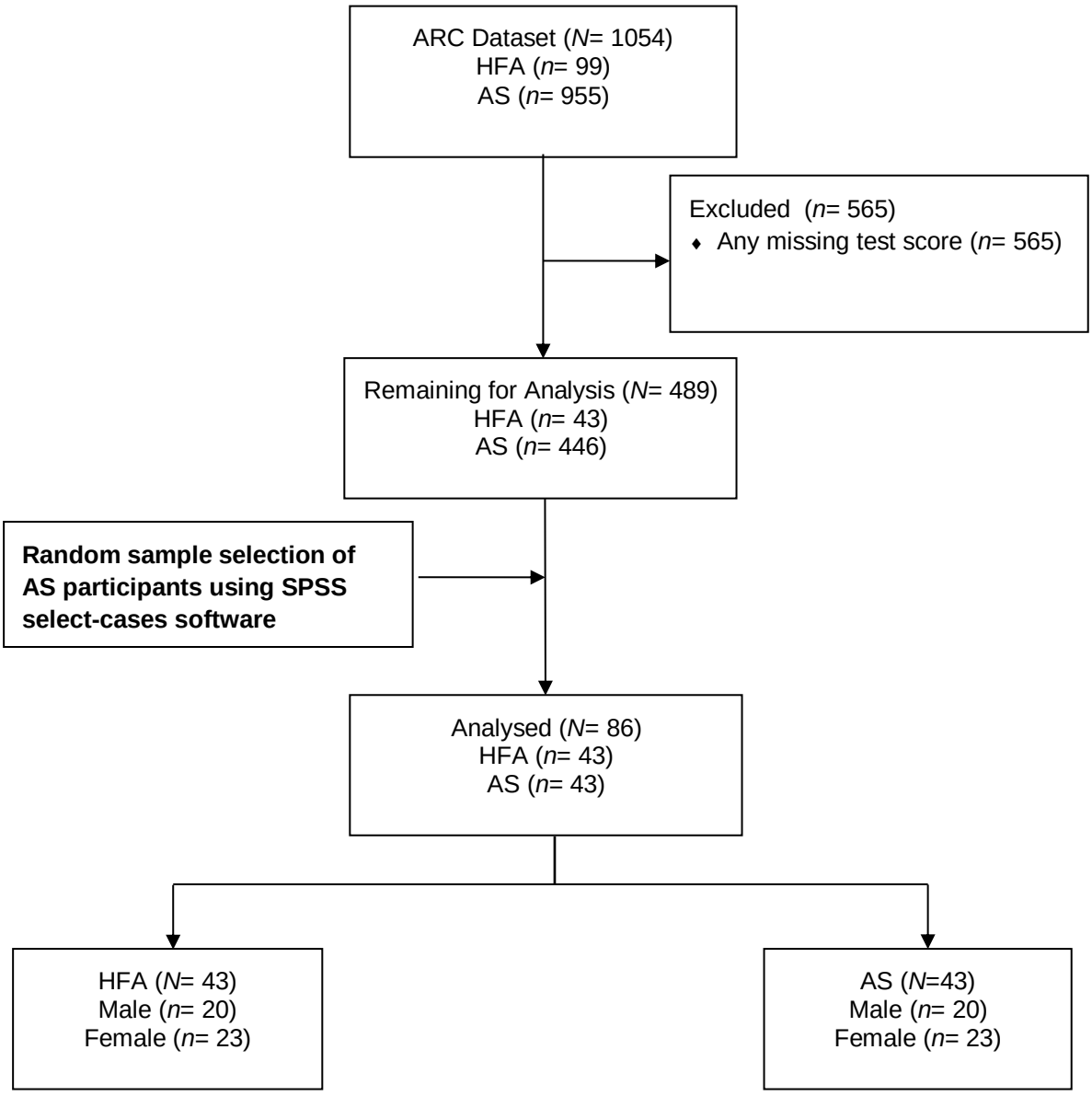
In order to access parts of the database for Study 1, the lead researcher sought local ethical approval for the research in accordance with the ethical approval requirements of the ARC granted by Cambridge Psychology Ethics Committee (ethical approval number 2010.56) which is guided by the British Psychological Society, the Medical Research Council, and the Royal College of Physicians. Once the study was given favourable approval by the University of East Anglia Faculty of Medicine and Health Research Ethics Committee, the database manager produced an anonymised spreadsheet including the results of participants with a diagnosis of HFA or AS, aged 18 years or over, who had completed either the EQ, Eyes Test or RPM.

This dataset was transferred to the lead researcher in a password protected document. The dataset was manually searched to ensure that required demographic information; gender, age, diagnosis and Ravens Progressive Matrices were available, as well as the EQ and the

Eyes Test being complete. Participants with missing data were excluded. This reduced the full dataset from 99 individuals with HFA and 955 individuals with AS to 43 individuals with HFA and 446 individuals with AS (Figure 1). For comparative purposes, a random sample selection, controlling for a reasonably equal sex split, of 43 participants from the AS group was made using SPSS (SPSS Inc.) select cases function.

Figure 1

CONSORT Diagram of Study 1 Participant Inclusion



2.1.6 Data Analysis

Prior to the comparative analyses, the data were tested using a Kolmogrov-Smirnov analysis. This determined whether parametric assumptions were met in order to inform the statistical analyses. As the data were not normally distributed (Appendix D), a Mann-Whitney U sum of ranks test was used to explore between-group differences in performance on the EQ and Eyes Test. Sex differences were explored separately using the Mann-Whitney U test. A supplementary analysis using logistic regression was also conducted, using variables that significantly differed between the two groups, in order to explore whether these variables predicted clinical group. Although the data were not normally distributed, this does not violate the assumptions which need to be met for logistic regression to be used, which are linearity, independence of errors, and non multicollinearity of data (Field, 2013), and so was an appropriate statistical test to use.

2.2 Study 2

Study 2 aimed to explore differences in day to day social and emotional functioning in adults with HFA compared to adults with AS. The results of this new comparison could then be considered in the context the findings from Study 1.

2.2.1 Design

A 2 (Diagnosis: HFA or AS) x 2 (Sex: Male or Female) between subjects design was also used to explore the results of the Social-Emotional Functioning Questionnaire (SEF-Q). Between subject comparisons were undertaken to investigate differences in day to day social and emotional functioning, across three subscales of the SEF-Q, between people with HFA and people with AS and between males and females.

2.2.2 Participants

The SEF-Q sample was composed of adults, aged 18 years or over, with either HFA or AS, who had previously participated in a battery of tests for the ARC and who had

consented to being contacted with regards to participating in other studies. Inclusion and exclusion criteria, as well as diagnostic grouping remained largely the same as with the ARC dataset comparison however are summarised in this section before sample size and participant demographics are presented.

2.2.2.1 Inclusion Criteria. As with Study 1, the primary inclusion criterion is a diagnosis of either ASD with no intellectual impairment (HFA) or AS. Recruitment emails were only sent to volunteers with the ARC who met this criteria and this information was confirmed through initial screening questions at the start of the SEF-Q.

2.2.2.2 Exclusion Criteria. Exclusion criteria included self-assessed diagnosis or unclear diagnostic information. Self-reported global learning disability was also an exclusion criterion.

2.2.2.3 Clinical Grouping. Clinical grouping, and rationale, was the same for Study 1 and Study 2. The participation invite email was only sent to registered volunteers with the ARC who had confirmed their diagnosis as either HFA or AS.

2.2.2.4 Sample Size. Social and emotional functioning is also plausibly linked to theory of mind through the impact this has on the ability to empathise with others, and interpret complex emotions, which affects reciprocal relationships. Give this, the effect size calculation for Study 1 was deemed appropriate for Study 2. Methodological design also remained the same and so the previously calculated sample size of 21 adults with HFA and 21 adults with AS was accepted for this study.

2.2.2.5 Participant Demographics. 25 adults with HFA and 25 adults with AS were included in this exploration of day to day social and emotional functioning (see Table 3). Again, participants were matched for age and sex distribution within groups.

Table 3

SEF-Q participant demographics

	N	***M** Age (SD)**	***N* Male**	***N* Female**
HFA	25	47.00 (11.70)	14	11
AS	25	42.28 (13.20)	12	13
TOTAL	50		26	24

**M*= mean, *SD*= Standard Deviation

2.2.3 Ethical Considerations

The SEF-Q exploration was detailed in the existing ethical application which was given a favourable opinion by the University of East Anglia Faculty of Medicine and Health Sciences Research Ethics Committee. Only participants who had consented via the ARC to receive information about future studies were sent a participation invitation email. This recruitment email (Appendix E i) contained brief information about the study, the lead researcher's contact details, and hyperlinks to the study's Participant Information Sheet (Appendix E ii) and then to the online SEF-Q. The Participant Information Sheet provided comprehensive details regarding the specifics of the study and ensured that participants had a clear sense of the purpose of the research, what would be required of them should they wish to participate, and how their information would be used. Contact details for the lead researcher were provided on all documentation. This provided participants with an opportunity to clarify any points and ensured that consent would be informed.

The SEF-Q questionnaire was hosted by the website Survey Monkey. Survey Monkey offers easy online access to questionnaires for participants, with no participant registration required, as well as password protected access to completed questionnaires. This helped to ensure the confidentiality of participant responses. Furthermore, Survey Monkey offers the option to remove Internet Protocol Address (IPA) numbers, a computer's unique identification which details location and registered users, from completed questionnaires.

This option was enabled for the SEF-Q responses aiding the anonymity or responses. Finally, Survey Monkey encrypts responses as they are submitted to avoid the possibility of personal information being accessible to hacker software. This was therefore a secure, confidential and anonymity-protected platform to use.

Due to the online format, participants were required to give some personal information so that their survey could be found should they wish to withdraw at a later stage. To reduce the risk of this information meaning a participant could be identified, full initials and dates of birth were collected, instead of participants' names. This was adequately anonymous, without risking possible overlap between participants, whilst ensuring specific questionnaires could be located should a participant wish to withdraw from the study or should a questionnaire need to be followed up. Once completed, questionnaires were downloaded from the Survey Monkey website and stored in a password protected .zip file on the lead researcher's computer ahead of analysis.

No deception was used in the recruitment or testing of participants. Possible distress caused to participants was considered and detailed in the University of East Anglia Faculty of Medicine and Health Sciences research ethics application. Questions regarding managing feelings of annoyance were considered and it was decided that a protocol be put in place should a participant make a disclosure which indicated that they or someone else was or could be in harm. If this happened, a conversation would be had with research supervisors to consider the content and possible further action. If this was deemed necessary, the full initials and date of birth would be sent to the ARC database who could identify the participant so that they could be contacted and encouraged to speak to their GP about managing difficulties. In this instance confidentiality would be broken.

This research adhered to the requirements of the Data Protection Act (1998). Any physical data were stored securely in a locked cabinet and data stored electronically was

password protected and transferred only using an encrypted memory stick. Once the research has been completed, the data will be stored according to University of East Anglia and University of Cambridge guidelines.

2.2.4 Assessment Measures

2.2.4.1 The Social and Emotional Functioning Questionnaire (SEF-Q). The assessment measure used for this part of the research was an adapted version of the Social and Emotional Functioning Interview (Rutter et al., 1988). The Social and Emotional Functioning Interview (SEF-I) is a 53 item semi-structured interview designed to assess perceived experiences of everyday social and emotional difficulties. The interview was developed in line with the ADI and ADOS, by the same authors. There is some overlap between questions on the SEF-I, the ADI, and the ADOS, however, the SEF-I was developed in order to specifically explore some of the more subtle social difficulties associated with ASDs rather than broader diagnostic presentations (Rutter et al., 1988).

The SEF-I explores functioning in seven domains (see Table 4) and each is either scored based on concepts of social structures, for example rated on the level of understanding about the concept of friendship, or based on intensity and emotional quality of social experiences, for example rating level of annoyance with others. Responses are rated from 0 (accurate concept, appropriate intensity, and appropriate emotional quality) to 3 (abnormal concept, intensity or emotional quality) with higher rates of 7, 8 or 9 for exceptional responses such as failing to answer a question due to reporting having no friendships. The SEF-I items have been shown to have weighted kappa coefficients ranging from 0.49 to 1.00 which indicate a range from moderate agreement to almost perfect agreement with the domain they were designed to measure (Mawhood, 1995).

One of the strengths of the SEF-I is its versatility in terms of being used both as a complete measure, and for specific questions or subscale domains to be used in isolation.

Each item is scored independently and offers an interpretable result in itself (Mawhood, 1995). As the research questions sought to explore whether differences or similarities between people with HFA and AS led to different everyday life social experiences, only the 'Interpersonal Difficulties', 'Friendships and Social Relationships', and 'Self-Image' subscales were considered (see Table 4 for subscale questions and themes). These areas seek to understand the participant's perception of others and of their relationships and will therefore provide an insight into practical social skill differences without placing too great of a demand on participants, as the full SEF-I in its entirety takes several hours to complete. In order to further reduce the demands placed on participants and enhance recruitment, the interview was adapted into an online questionnaire (SEF-Q; See Appendix E iii) with permission granted for the adaptations (Appendix E iv) from the two lead authors; Professor Catherine Lord (Cornell University) and Professor Sir Michael Rutter (Institute of Psychiatry).

Table 4

SEF-I Subscales, Themes, and Individual Items

	SEF-I	
Subscale	**Themes**	**Questions**
Interpersonal-Difficulties	Annoyance, Managing emotions, Interactions with others	1. Social problems at work/college/centre 2. Perception of causes of problems 3. Reasons for annoyance 4. Display of annoyance (outside home) 5. Display of annoyance (at home) 6. Perception of others annoyance 7. Understanding of others annoyance
Friendships and Social Relationships	Quality and perceptions of friendships, Social fulfilment	1. Acquaintances 2. Social relationships at work/college/centre 3. Friends 4. Quality of friendships 5. Concept of friendship 6. Loneliness 7. Teasing 8. Bullying
Self-Image	Considering the self in relation to social experiences and future desires	1. Attempts to Improve Social Competence 2. Wishes for future

2.2.5 Procedure

Participants from the ARC database who had previously consented to receive information regarding future participation were contacted for recruitment to this part of the study. Participants who had registered with the ARC as having either HFA, ASD providing they had specified that they did not have a learning disability, and AS were sent an automated email from the ARC Database Manager to ensure their anonymity. This email (Appendix E i) contained an ARC standardised invite script, approved through their ethical application, which informed the recipient that a new research participation opportunity was available and reiterated how to opt out should they wish to. It also contained a brief summary of the research, inclusion and exclusion criteria, and hyperlinks to the participant information sheet and online questionnaire.

Once directed to the SEF-Q Survey Monkey homepage, participants were first required to complete a consent form. Participants were required to initial to indicate that they had read and understood the participant information sheet, that they understood they were under no obligation to take part, that they could withdraw from the study or from the ARC database at any time, and that all identifying information would be stored securely and all questionnaires anonymised.

The first page of the questionnaire was designed to collect demographic information about the participant including diagnosis, diagnostic method, age at diagnosis, date of birth, and sex. Participants were also required to enter their full initials so that their questionnaire could be identified should they wish to withdraw from the research at any stage. This part of the SEF-Q was mandatory and participants could not access the main questionnaire without completing it. Participants then had to answer a series of questions such as "How easy do you find it to get along with people?" Responses were either selected from a list of multiple choices, with choice answers mirroring the scoring codes of the SEF-I, or free text answer boxes. Once completed, participants were required to click "submit" at which point they were presented with an on-screen message from the lead researcher as follows:

> *"Thank you for taking the time to complete this questionnaire. This study hopes to gain an insight into some of the differences and similarities between High Functioning Autism and Asperger's Syndrome by exploring everyday life experiences of people with those conditions. If you have any questions about this study or would like a summary of the main findings please contact the lead researcher on c.skelly@uea.ac.uk"*

The survey was designed to send an automated email to the lead researcher whenever a questionnaire had been submitted. All information was then downloaded and saved in an encrypted .zip file. Responses were deleted from the Survey Monkey's password protected

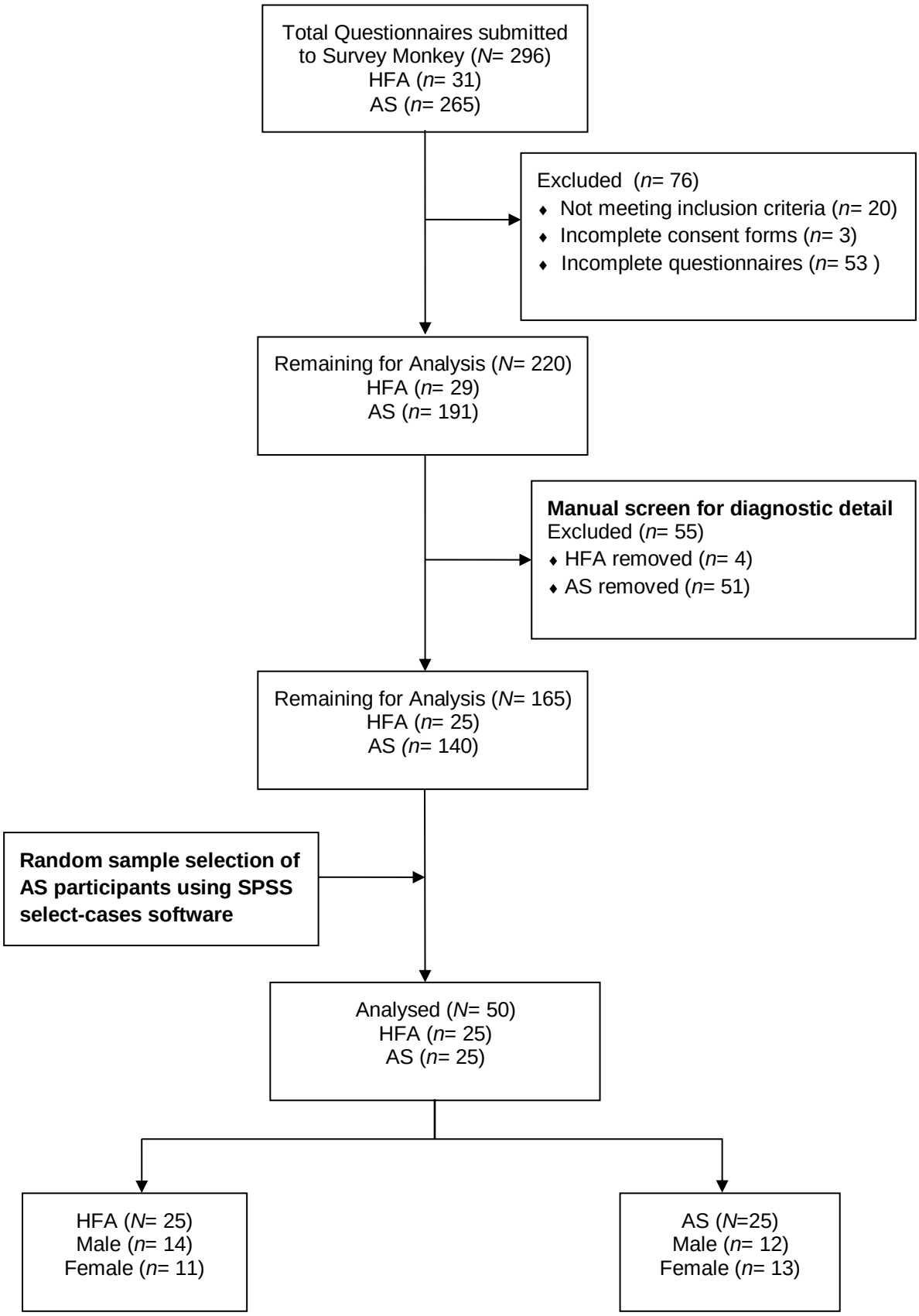
response storage folder. Questionnaires were printed for analysis and the demographic information and consent forms, which contained information including diagnosis, date of birth, and participant initials, and so could potentially identify the participant, were stored separately from the SEF-Q responses. This also meant that the SEF-Qs were scored blind as the information regarding diagnostic group had been removed from the response pages. This method ensured that scoring was not biased towards any ideas held by the lead researcher.

Significantly more adults with AS (*N*= 265) completed the SEF-Q than adults with HFA (*N* =31), which mirrored the ARC dataset proportions. Submitted questionnaires were first manually screened for completeness of responses and exclusion criteria. Following this, participants who had not provided detailed information about diagnosis, either diagnosing professional, service or diagnostic method, were removed. This left 25 adults with HFA and 140 adults with AS (see Figure 2). From the 140 adults with AS who completed the SEF-Q a random sample selection of 25 participants was selected using SPSS software (SPSS Inc.). This was done by entering all participants ID codes into SPSS and using the 'select cases' function of the software to produce a random sample of the required number. Questionnaires were scored according to the SEF-I coding system.

After completing the thesis resulting from this research, all data will be stored confidentially and securely for 5 years at an archiving company used by the University of East Anglia Medical School, after which it will be destroyed. No individual participant, or their answers, will be identifiable within these results.

Figure 2

CONSORT Diagram of Study 2 Participant Inclusion



2.2.6 Data Analysis

Parametric assumptions of the data were explored using Kolmogrov-Smirnov analysis of normal distribution in order to determine the appropriate analysis for the between group comparisons. As the data were not normally distributed (Appendix F), Mann-Whitney U tests were used to explore difference between scores across the three subscales of the SEF-Q. Mann-Whitney U were also used to explore sex differences. As with Study 1, supplementary analyses, using variables shown to be significantly different from one another, were further explored using a logistic regression. This aimed to determine whether experiences of everyday life vary enough between groups to be predictive of clinical group.

2.3 Summary

The methodology for the research questions of this thesis was split into two studies in order to make use of a large dataset already in existence at the ARC and reduce demands on participants. The methodological design and analysis was matched across Study 1 and Study 2. Study 1 explored differences in some of the core features of the autistic profile, the perceived ability to empathise with others and the ability to understand complex emotional expressions, in an established sample of adults with either HFA (n = 43) or AS (n = 43) matched for age, sex, and IQ. The EQ and Eyes Test, which are both appropriately reliable and valid measures, were used to answer these research questions. The results of this comparison were analysed using Mann-Whitney U, the non-parametric equivalent of an independent samples t-test, and logistic regressions. Twenty-five participants with HFA and 25 participants with AS, matched for age and sex, were newly recruited, through the ARC, for Study 2. This study sought to answer the research question of whether differences exist in day to day social and emotional functioning. Three subscales of the SEF-I, a reliable and ASD-specific measure, consisting of ‘Interpersonal Difficulties’, ‘Friendships and Social Relationships’, and ‘Self-Image’ were formatted into an online questionnaire (SEF-Q) and

used to explore this. These data were also not normally distributed and so were also analysed using Mann-Whitney U tests and logistic regressions. Sex differences were explored in both studies, again, using Mann-Whitney U tests.

Chapter Three

Results

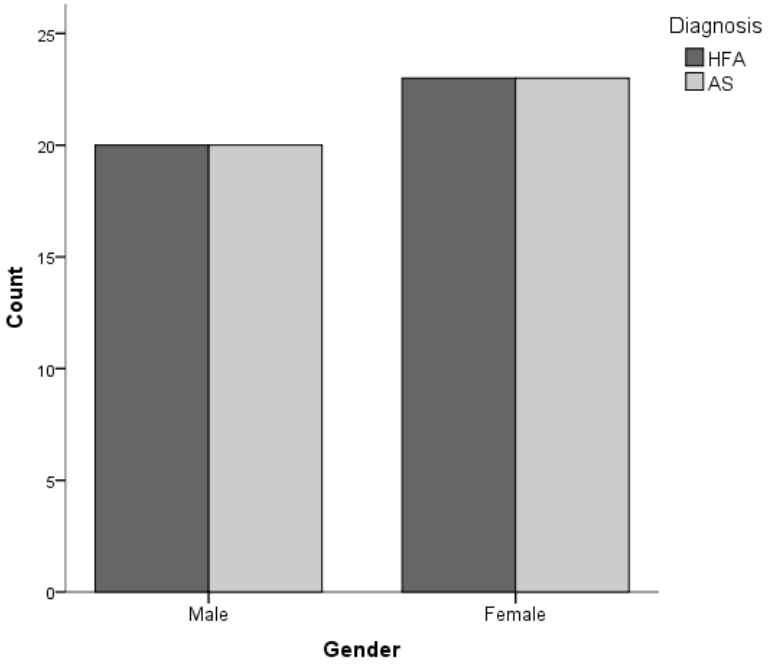
This chapter presents the results of the research. The results from Study 1, the exploration of the existing dataset at the ARC, are presented first followed by the results from Study 2, the newly recruited SEF-Q comparison. In each section the statistical tests employed are described ahead of the results being discussed.

3.1 Study 1 Results

3.1.1 Descriptive Statistics

Mann-Whitney U tests were used to explore differences in means of key demographic information between adults with HFA and adults with AS (Table 5). There was no significant difference in age between the HFA group (M = 39.09, SD = 13.053) and the AS group (M = 37.95, SD =12.524), z = -.039, p=.969. Furthermore there was no significant difference in IQ, as measured by Raven's Progressive Matrices (Raven et al., 1997), between the HFA group (M = 18.91, SD = 1.743) and the AS group (M = 18.91, SD = 1.743), z = -.056, p = .955, and on a case by case comparison the groups were equal. Gender frequencies were explored within each group and shown to be matched (Figure 3).

Figure 3
Sex distribution per group for study 1



3.1.2 Exploratory Analyses

As the data were not normally distributed, parametric assumptions could not be fulfilled, and Mann-Whitney U tests were used. Mann-Whitney U is a non-parametric equivalent of an independent samples t-test, used to compare the means of two groups on the same task (See Table 5). It ranks scores according to frequency and explores the difference between groups on these ranked scores.

Table 5

*Means and Medians ofStudy 1 comparisons**

	HFA (*n* = 43)			**AS (*n* = 43)**		
		Male (*n*=20)	**Female (*n*=23)**		**Male(*n*=20)**	**Female(*n*=23)**
Mean Age (SD)	39.09 (13.05)	44.85 (12.15)	34.09 (11.90)	38.56 (11.92)	41.25 (11.68)	36.22 (11.89)
Mean RPM* (SD)	18.91 (1.74)	19.50 (0.69)	18.39 (2.20)	18.91 (1.73)	18.90 (1.37)	18.91 (2.04)
Measures	**Mean (SD)**					
EQ	16.91 (10.22)	15.65 (8.91)	18.00 (11.33)	17.98 (8.86)	17.75 (10.14)	18.17 (7.81)
Eyes Test	20.09 (7.66)	19.35 (8.78)	20.74 (6.67)	23.53 (7.00)	24.35 (6.72)	22.83 (7.31)
	Median (Ranges)					
EQ	14.00 (4-50)	12.00 (4-41)	17.00 (5-50)	16.00 (5-41)	22.50 (5-41)	21.55 (6-38)
Eyes Test	22.00 (1-30)	21.00 (1-30)	23.00 (7-30)	25.00 (1-33)	25.50 (9-33)	25.00 (1-32)

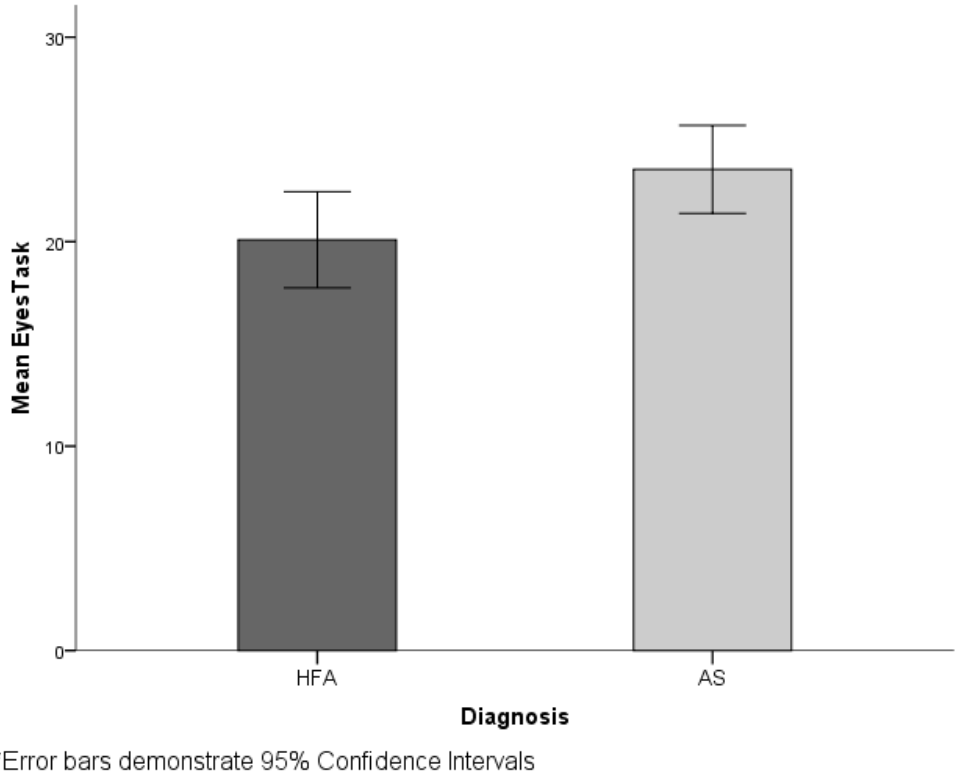
***** *RPM = Raven's Progressive Matrices, EQ = Empathy Quotient, Eyes Test = Reading the Mind in the Eyes Test*

3.1.2.1. Research Question 1: ***Do differences exist between adults with HFA and AS in their perception of their ability to empathise?*** No significant difference was found between adults with HFA and adults with AS in how they perceive their abilities to empathise with others, as measured by the EQ, z = -.926, p = .335.

3.1.2.2 Research Question 2: ***Do differences exist between adults with HFA and AS in the ability to "read" complex emotions in others?*** The objective ability to accurately interpret complex emotional states from expressions in the eyes was explored between groups using the Eyes Test. A significant difference between AS and HFA was observed, z = -2.367, p = .018. As depicted in Figure 4, adults with AS were significantly better at correctly interpreting complex emotions than adults with HFA. Cohen's d was calculated using group means and standard deviations and the effect size of this difference was shown to be d = 0.47 indicating a moderate effect.

Figure 4

Mean scores on Eyes Test for adults with HFA and AS*



*Error bars demonstrate 95% Confidence Intervals

3.1.2.3 Sex Differences. There was no significant difference in performance on the EQ between adult men and women with HFA, z = -.610, p = .542. There was also no significant difference in performance between on the EQ between men with AS and women with AS, z = -.403, p = .687. Similarly, no significant difference was observed between men with HFA and women with HFA in performance on the Eyes Test, z = -.403, p = .687. This result was also replicated within the AS population, with no significant observed between men with AS and women with AS in performance on the Eyes Test, z = -.817, p = .414.

3.1.3 Supplementary Analysis: Diagnosis

A significant difference was found between scores on the Eyes Test between adults with HFA and adults with AS. In order to explore the extent to which scores on the Eyes Test could predict clinical group, and so consider its effectiveness as a sub-grouping tool, a binary logistic regression was carried out. The Model Chi-Square indicated that performance on the Eyes Test could significantly predict group membership, $\chi 2$ (1) = 4.728, p = .030, with 59.3% of cases accurately predicted. The observed odds ratio, *Exp(B)* = 1.068, 95% CI [1.004, 1.137] indicated that a one point increase in the score on the Eyes Test was associated with an 1.068 increase in the odds of being diagnosed with AS.

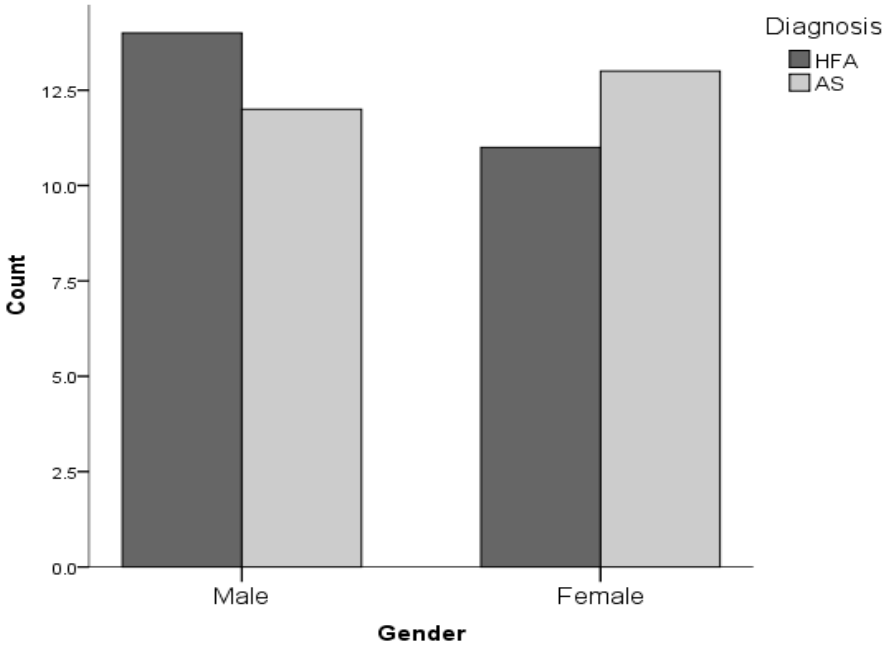
3.2 Study 2 Results

3.2.1 Descriptive Statistics

Mann-Whitney U tests were again used to explore differences in means of key demographic information between adults with HFA and adults with AS. There was no significant difference in age between the HFA group (M = 47.00, SD = 11.70) and the AS group (M = 42.28, SD =13.196), z = -1.340, p = .180, or in gender distribution (Figure 5)

Figure 5

Sex distribution per group for study 2



3.2.2 Data Transformation

As discussed, the Mann-Whitney U test ranks the data for each task and calculates the total sum of ranks for each group in order to establish whether there are differences between the groups. Given this design, it interprets scores of 0 as indicating no data. Within the SEF-Q a score of 0 is obtained if no problems are reported for a question and therefore there was a possibility of the Mann-Whitney U test excluding data in its rankings and so not providing an accurate analysis. The results from the SEF-Q were manually searched for scores of zero. As scores of zero were obtained for some questions, and to avoid these results being excluded when the Mann-Whitney U test was run, the questionnaire results were transformed by adding one to each score point. This enabled the same distribution and difference in scores to be explored while ensuring the full sample was ranked by the Mann-Whitney test.

3.2.3 Experimental Analyses

3.2.3.1 Research Question 1: ***Do differences in day to day social and emotional functioning exist between people with HFA and people with AS?*** Mann-Whitney U tests,

utilising the transformed data set, were used to explore the difference between ranked scores of adults with HFA compared to adults with AS on the Interpersonal Difficulties, Friendships and Social Relationships, and Self-Image subscales of the SEF-Q (See Table 6). No significant difference was found in Interpersonal Difficulties between adults with HFA and adults with AS, $z = -1.360$, $p = .174$. Similarly, no significant difference was found in Friendships and Social Relationships between adults with HFA and adults with AS, $z = -1.100$, $p = .271$. A significant difference was, however, observed between groups on Self-Image (see Figure 6). Adults with HFA were shown to have significantly poorer self-image, as measured by the SEF-Q, than adults with AS, $z = -3.743$, $p < .001$. Group means and standard deviations were used to calculate Cohen's d and a large effect was observed ($d = 1.20$).

Table 6

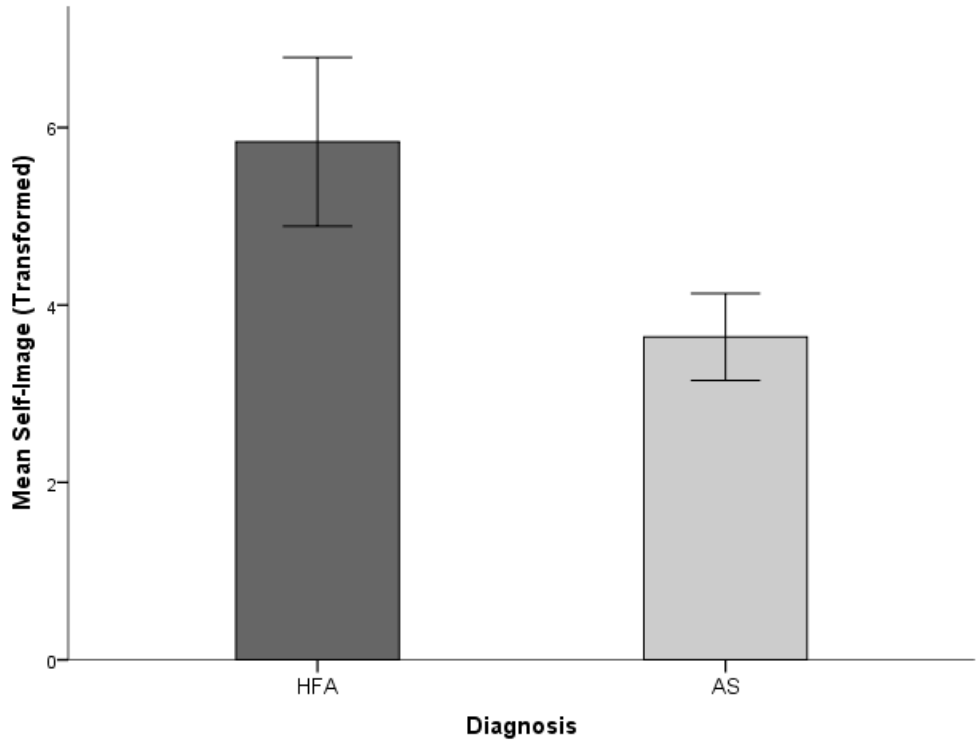
*Means and Medians of Study 2 comparisons**

	HFA (*n* =25)			**AS (*n* =25)**		
		Male(*n*=14)	**Female(*n*=11)**		**Male(*n*=12)**	**Female(*n*=13)**
Mean Age (SD)	47.00 (11.70)	49.79 (10.06)	43.45 (13.13)	42.28 (13.20)	48.00 (11.26)	37.00 (13.01)
SEF-Q	**Mean (SD)**					
SEF-Q ID*	22.92 (7.23)	20.21 (6.81)	26.36 (6.49)	20.16 (6.63)	20.33 (6.01)	20.00 (7.41)
SEF-Q FSR	22.28 (7.49)	22.79 (8.64)	21.64 (6.07)	20.04 (7.20)	22.08 (8.14)	18.15 (5.91)
SEF-Q SI	5.84 (2.30)	6.50 (2.62)	5.00 (1.55)	3.64 (1.86)	3.83 (1.12)	3.46 (1.27)
	Median (Ranges)					
SEF-Q ID	23.00 (9-39)	20.50 (9-31)	24.00 (18-39)	19.00 (11-31)	19.50 (11-31)	17.00 (11-30)
SEF-Q FSR	21.00 (13-42)	21.00 (13-42)	20.00 (16-38)	20.00 (10-38)	21.00 (12-38)	18.00 (10-31)
SEF-Q SI	5.00 (3-10)	6.00 (3-10)	5.00 (3-9)	4.00 (2-6)	4.00 (2-5)	3.00 (2-6)

***** *SEF-Q ID = Interpersonal Difficulties, SEF-Q FSR = Friendships and Social Relationships, SEF-Q SI = Self Image*

Figure 6

Mean scores on Self-Image for adults with HFA and AS*



*Error bars demonstrate 95% Confidence Intervals

3.2.3.2 Sex Differences. Mann-Whitney U tests were also used to explore whether men and women from within each diagnostic group scored differently. There was a narrowly non-significant difference between men and women with HFA in self-reported 'Interpersonal Difficulties', with women reporting greater difficulties, z = -1.948, p = .051. No significant difference was observed between men with AS and women with AS on the 'Interpersonal Difficulties' subscale, z = -.436, p = .663.

Mann-Whitney U tests were used to explore differences between men and women with either HFA or AS on the 'Friendships and Social Relationships' and 'Self-Image' subscales. There was no significant difference on the 'Friendships and Social Relationships' subscale reported by men with HFA compared to women with HFA, z = .000, p = 1.000.

This was also the case for men with AS (*M* rank = 15.17) compared to women with AS, *z* = -1.421, *p* = .155.

No significant difference was observed in 'Self-Image' between men with HFA compared to women with HFA, *z* = -1.597, *p* = .110. This was also observed within the AS group, with no significant difference reported in 'Self-Image' between men with AS compared to women with AS, *z* = -.896, *p* = .370.

3.2.4 Supplementary Analysis

3.2.4.1 Diagnosis. A significant difference was found between scores on the 'Self-Image' subscale of the SEF-Q between adults with HFA and adults with AS. In order to explore the extent to which scores on the Self-Image subscale could predict clinical group membership and so consider its effectiveness as a possible grouping tool, a binary linear regression was also carried out. The Model Chi-Square indicated that clinical group could be significantly predicted by Self-Image (χ^2 (1) = 17.750, *p* <.001) with an accuracy of 72%. The odds ratio, *Exp(B)* = .410, 95% CI [.229, 737], indicated that for a single point increase in score on the measure of self-image, participants were 2.437 times more likely to have HFA.

3.2.4.2 Individual Item Exploration. The Self-Image subscale was comprised of two questions. The first explored attempts to improve social skills and the second explored hopes and plans for the future. Mann-Whitney U tests were conducted on each question in order to explore differences between adults with HFA compared to adults with AS on these questions and so understand whether both or only one question contributed to the overall subscale difference. A significant difference was observed between groups on both questions. Adults with HFA reported significantly greater difficulty in appropriately adapting social skills than adults with AS, *z* = -2.136, *p* = .033. Adults with HFA also displayed a significantly greater

inability to think about realistic hopes for the future and consider plans for these than adults with AS, $z = -3.415$, $p = .001$.

Chapter Four

Discussion

This chapter discusses the research undertaken and begins with an overview of the findings in line with the research questions and hypotheses. The implications of the findings from a theoretical and clinical perspective are then presented, including a consideration of how well the results support or contradict existing research. An evaluation as to how the study contributes to the debate surrounding the conceptualisation of High Functioning Autism (HFA) and Asperger Syndrome (AS) is then considered. The chapter concludes with a critical analysis of the research that reviews its strengths and limitations as well as future research directions.

4.1 Overview of Findings

4.1.1 Study 1

4.1.1.1 Research Question 1. In a group of adults, aged 18 years old and over, matched for age, gender and IQ, no significant difference was observed in the perceived ability to empathise between people with HFA and people with AS, as measured by the Empathy Quotient (EQ). This contradicted the hypothesis that adults with AS would report greater ability to empathise with others than adults with HFA.

4.1.1.2 Research Question 2. In the same groups of adults, a significant difference was found in the ability to correctly interpret complex emotions. Adults with AS were shown to be significantly better than adults with HFA at correctly interpreting complex emotions, as measured by The Reading the Mind in the Eyes Test (Eyes Test). This result supported the study's hypothesis. The observed difference in scores was shown to have a moderate effect size This means that clinical presentation has a moderate impact on how able an individual with ASD is to correctly interpret mental states from facial expressions. This difference in scores was also shown to be strong enough to be predictive of clinical group, , albeit with a

modest predictive accuracy of 59.3%. The significance of this is important as it suggests that the Eyes Test has some sensitivity to distinguishing between clinical presentations. It is, however, important to note that the predictive accuracy is small as, by chance alone, a model would be expected to accurately predict 50% of cases.

4.1.2 Study 2

4.1.2.1 Research Question 1. In a separate group of adults with ASDs, aged 18 years old and over, matched for age and gender, no significant difference was observed in self-reported 'Interpersonal Difficulties' between adults with HFA and adults with AS, as measured by the SEF-Q. Similarly, no significant difference was found in the reported quality of 'Friendships and Social Relationships' in adults with HFA compared to adults with AS. Both these findings contradicted the hypothesis that adults with HFA would experience greater social difficulties.

On the 'Self-Image' subscale of the SEF-Q however, and in support of the study's hypothesis, a significant difference was observed between adults with HFA compared to adults with AS. Adults with HFA reported significantly greater difficulties associated with 'Self-Image' than adults. This difference in 'Self-Image' was shown to have a large effect size which suggests that clinical presentation explains a large amount of the variation in 'Self-Image' as conceptualised within the SEF-Q. 'Self-Image' predicted group membership, with 72% accuracy. This model indicated that an individual is 2.44 times more likely to have AS than HFA if they have a low score, indicating fewer difficulties, on the 'Self-Image' subscale. A further analysis of the 'Self-Image' subscale of the SEF-Q showed that both hopes and plans for the future, as well as the adaptation of social skills, were significantly more challenging for people with HFA compared to people with AS.

4.1.3 Sex Differences across Studies

No significant differences in the perceived ability to empathise, measured by the EQ, were observed between men and women with HFA or between men and women with AS. Similarly, no significant differences were observed between men and women, with either HFA or AS, in the ability to correctly interpret mental states in other people, as measured by the Eyes Test.

On the SEF-Q, no significant differences were reported by men compared to women with either HFA or AS in reported 'Friendships and Social Relationships' or 'Self-Image'. On the 'Interpersonal Difficulties' subscale, no significant differences were reported by men compared to women with AS. Among adults with HFA however, reported 'Interpersonal Difficulties' were narrowly non-significantly different between women and men, indicating that women with HFA tend to report greater 'Interpersonal Difficulties' than men with HFA.

4.2 Discussion of Findings

This research aimed to enhance an understanding of the subtleties of the clinical presentations of HFA and AS and to contribute to the debate as to whether distinct conceptualisations within ASD are clinically useful. It sought to consider the most helpful way of conceptualising the presentations from a clinical and theoretical perspective by focusing on the experiences of individuals with either condition. The theoretical and clinical implications of the findings are considered here, before a position on the conceptualisation of the HFA/AS distinction conditions is taken.

4.2.1 Theoretical Implications

The overall poor performance observed among participants with both HFA and AS on the EQ and Eyes Test is consistent with previous research (Barnes, 2012; Baron-Cohen & Wheelwright, 2004; Fabio et al., 2011; Peterson & Paynter, 2010). These findings support the

two theories underpinning this research; The Theory of Mind deficit (Baron-Cohen et al., 1985) and Extreme Male Brain Theory (Baron-Cohen, 2002) of autism.

4.2.1.1 Theory of Mind. Theory of mind, a skill that is impaired in ASDs, is the ability to understand what you or other people want, think, feel, or believe (Premack & Woodruff, 1978). It is the ability to understand that other people may hold beliefs that are different from yours and to consider what these may be by evaluating their position in a given situation (Baron-Cohen et al., 1985). Theory of mind therefore requires the ability to empathise with a person's experiences (Baron-Cohen et al., 1985) and can be measured by the self-report EQ (Baron-Cohen & Wheelwright, 2004). In their original construct of the measure, Baron-Cohen and Wheelwright (2004) demonstrated that 81.1% of adults with HFA and AS scored 30 or below on the EQ compared to just 12.2% in typically developed populations. In the present study, 88% of adults (76/86) with HFA and AS scored less than 30 providing support for the high proportion of individuals with empathy difficulties within ASDs.

Within Study 1, no significant difference was observed between adults with HFA and adults with AS in the perceived ability to empathise, the conditions are therefore not distinguishable by this phenotype. The ability to empathise with others is supported as being a unifying feature of autism spectrum conditions in adults. A childhood comparison of theory of mind skills in HFA compared to AS, however, showed that children with HFA are comparatively impaired on this skill (Peterson & Paynter, 2010). While the present study uses a broader exploration of the ability to empathise than the false-belief tasks used by Peterson and Paynter (2010), the findings suggest a difference in this skill between child and adult populations.

There are a number of hypotheses as to why this difference between children and adults might exist. Some research suggests that the cognitive and behavioural phenotypes

associated with ASDs are more pronounced in childhood than in adulthood (Howlin, Goode, Hutton & Rutter, 2004). This might be reflective of a period of accelerated brain growth in children with ASDs, underpinning the development of a larger total brain volume compared to children who develop typically, which then stabilises with age (Courchesne, Campbell & Solso, 2011). It might be that empathy is a skill that is more affected during this period of development. Children with AS, whose language development follows a typical trajectory, may have a greater intellectual or linguistic ability, which enhances Theory of Mind skills, compared to children with HFA who have a language delay and associated comprehension difficulties. It could therefore be hypothesised that the lack of difference in this skill in adulthood is reflective of the narrowing of the developmental gap experienced among children.

An alternative hypothesis is linked to the theoretical construct of Theory of Mind, which suggests that it is, in itself, a *developmental skill,* and so not stable over time. While some children with ASDs never develop sufficient theory of mind to be able to accurately assess what others may be feeling, many people with ASDs do achieve these skills, particularly in more contextual or explicit settings (Torralva et al., 2012). It may be that theory of mind, rather than being more impaired in HFA compared to AS in childhood, develops more slowly in HFA and causes the observed difference between child and adult populations. Longitudinal studies are needed to test this hypothesis. If this is the case, however, then children with HFA specifically may benefit from increased support around developing this skill so they may be supported to better understand social and emotional interactions.

The Eyes Test is a practical, non-contextual, measure of theory of mind. It measures social intelligence through the ability to ‘mind-read’ (Whitten, 1991) from expressions and, while the skills required to do this overlap with empathy, the measure is reflective of a

practical ability. Previous research has consistently demonstrated that people on the autistic spectrum find it significantly more difficult to understand emotional states in others than people who are typically developed (Baron-Cohen et al., 2001).. Baron-Cohen et al. (2001) demonstrated mean scores on the EQ, where a higher score indicates a superior performance, to be 30.9 in IQ-matched typically developed adults (N = 14) compared to adults with ASDs (N = 15), where a mean score of 21.9 was observed. The findings of this research also support this deficit within ASDs as a mean score of 20.09 observed among adults with HFA and of 23.53 among adults with AS.

A significant difference was found between adults with HFA and adults with AS in their ability to correctly interpret emotional states from photographs of eye region expressions, measured by the Eyes Test. Non-contextual, practical, theory of mind skills were therefore observed to be significantly more impaired in adults with HFA compared to adults with AS. This has not previously been compared between the two groups and this study provides the first evidence for a difference in this profile.

The difference in this skill has implications for functioning in social situations as the results suggest that adults with HFA may find it more difficult to understand the emotional states of others in everyday situations. Social learning and social cognition theories highlight the importance of emotion in social interactions and in facilitating social learning (Truer & Van Wissen, 2013). Facial expression mimicry during social interactions has also been shown to enhance social coordination and improve quality of relationships (Hess & Bourgeois, 2010). As adults with HFA were shown to be less able to correctly interpret emotional states in others than adults with AS, it is likely social interactions are more challenging for people with HFA. The results from the SEF-Q further support this theory. Social and Emotional functioning difficulties were observed across all areas of the SEF-Q in adults with HFA and AS. Theory of mind enables a person to interpret and predict other people's behaviours as

well as to understand the intentions behind their actions (Baron-Cohen, 2001). It is likely that the universal difficulties in social experiences are in part linked to Theory of Mind difficulties.

4.2.1.2 Empathising-Systemising: The Extreme Male Brain Theory. The Extreme Male Brain Theory (Baron-Cohen, 2002) extends the Empathising-Systemising theory of autism, which suggests that strengths associated with ASDs are linked to an enhanced systemising profile, while difficulties are associated with impaired empathy (Baron-Cohen, 2008). Within the typically developed population, there is a clear sex difference between empathising and systemising; males have weaker skills in empathising and greater skills in systemising, while females have the opposite profile. This theory proposes that ASDs are associated with an extreme presentation of this male profile without the typical sexual dimorphism. The results of this research replicate findings from previous research and provide further support for the Extreme Male Brain Theory of autism.

The poor performance observed across the EQ and the Eyes Test exemplify ASDs as conditions associated with the delays and difficulties in the ability to empathise as expected by the Extreme Male Brain model. With regards to sexual dimorphism, no significant differences were observed between men and women, with either HFA or AS, on any of the measures used in this research. Within typically developed populations women perform significantly better than men on the Eyes Test, t (48)= -4.8, p = .0001, a trend which does not exist in ASD populations (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). This is also the case on the EQ, t (196) = 3.4, $p < .0001$, (Baron-Cohen & Wheelwright, 2004). The lack of sex difference on the EQ and the Eyes Test among adults with ASDs replicates recent research exploring behavioural differences between men and women with ASDs (Lai et al., 2011; Wheelwright et al., 2006). To the knowledge of the author, however, this is the first time that this sex similarity has been observed on these measures in discrete HFA and AS

groups. This finding across groups indicates that the Extreme Male Brain Theory's proposed empathising<systemising profile, without sexual dimorphism among people with ASDs, presents itself in a similar was across in adults with HFA and adults with AS. This suggests that the difference between groups relates to a fundamental difference in skill, as the observed difference on the Eyes Test between adults with HFA and adults with AS is not influenced by sex profile differences. One potential explanation for this could be that differences in early development trajectories between the groups leads to differences in the capacity for social learning of emotional inferences, which accounts for this difference in adulthood.

A lack of sex difference was again observed across the three subscales of the SEF-Q. This also suggests that the differences observed may be attributed to differences between HFA and AS rather than being influenced by sex differences. This provides further support for the Extreme Male Brain Theory of autism by showing that both men and women with either HFA or AS have similar social experiences. However, a previous exploration of behavioural differences between men and woman with ASDs found that women demonstrate significantly less social interaction and communication impairments through the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1989) than men (Lai et al., 2011). It may be that both groups perceive similar social and emotional experiences, as suggested by the present research, but that there are observable differences in these domains between men and women. While the Extreme Male Brain Theory of autism is therefore well supported, it may be important for this area to be explored further in order to clarify whether some sex differences need to be considered when supporting people with ASDs.

4.2.2 Clinical Implications

The results of this research appear to support existing theories of ASD and enhance the understanding of how well they explain different clinical presentations. The results,

however, raise a number of questions about the clinical presentation of ASDs and about what the most useful, and clinically helpful, way of conceptualising HFA and AS is.

4.2.2.1 The Social Impairment. Of particular interest to clinical work with people with HFA or AS is the discrepancy between results on the EQ compared to the Eyes Test. The EQ measures a person's perception of their ability to empathise and the Eyes Test is an advanced practical test of the same skill. The difference observed in practical empathy skills and lack of observed difference in perceived ability to empathise suggests that insight into difficulties does not reflect actual performance. This has implications for how proactive people with HFA might be in seeking support. Adults with HFA, who have greater difficulty interpreting complex emotions and so may need increased support, may be less likely to seek out support due to poor insight. A lack of social support may limit the ability for appropriate social-learning and so further enhance social difficulties for adults with HFA in particular (Truer & van Wissen, 2013). The sex of the individual may also contribute to this effect. The lack of significant difference in 'Interpersonal Difficulties' and problems associated with 'Friendships and Social Relationships' and 'Self-Image' across men and women, when considered in comparison to previous research suggesting observable social-communication difficulties between the groups, might suggest that men with HFA have the least developed perception of their difficulties. This group specifically may benefit from increased social support and more proactive recruitment to support groups.

As well as there being no significant sex differences between men and women, no significant difference was observed between adults with HFA and AS on the 'Interpersonal Difficulties' and 'Friendships and Social Relationships' subscales of the SEF-Q. While this finding contradicts the hypothesis that adults with HFA would report greater difficulties, the findings still reflect that the overall difficulties in these areas experienced by both people with HFA and AS.

The ‘Friendships and Social Relationships’ subscale of the SEF-Q explores the quality of, and perceptions about, relationships across eight domains including ‘Acquaintances’, ‘Social Relationships at Work/College/Centre’, ‘Friends’, ‘Quality of Friendships’, ‘Concept of Friendship’, ‘Loneliness’, ‘Teasing’, and ‘Bullying’. The lack of observed differences between groups on this subscale is of interest given that children with HFA and AS have been shown to have significantly different social characteristics (Ghaziuddin, 2008). Ghaziuddin’s (2008) study of the social presentations of 39 children with HFA and 58 children with AS demonstrated significantly different social profiles in children with HFA, typically characterised as “aloof and passive”, compared to children with AS, typically characterised as “active but odd”. If these differences are accepted as valid, it appears that the impact is not sufficient enough to alter adult experiences of ‘Friendships and Social Relationships’ between the groups, or impact on the aforementioned ‘Interpersonal Difficulties’. The contrast with findings within child populations does however raise questions about the development of the social impairments associated with ASDs and changes in presentation with age.

Adults with AS and HFA appear to share a perception of difficulties in these aspects of everyday interactions associated with ‘Interpersonal Difficulties’ and ‘Friendships and Social Relationships’. The agreement in these subscales is perhaps unsurprising given the overlap between the areas being measured, yet the consistency is important in strengthening the confidence in the findings. The shared experiences among people with HFA and people with AS has implications for training groups which seek to teach social skills with the explicit aim of enhancing relationships with others (Cappadocia & Weiss, 2011). In their review of these social groups, Cappadocia and Weiss (2011) highlight a tendency towards combined HFA and AS participant groups. The lack of difference in reported experiences of social difficulties, observed in the present study, supports the continued use of this format.

4.2.2.2 Adaptive Behaviours. Significant differences were observed between adults with HFA and AS with challenges associated with 'Self-Image', as measured by the SEF-Q. This difference has important clinical implications. The 'Self-Image' subscale of the SEF-Q is comprised of two questions, the first exploring the ability to reflect on, and appropriately adapt and modify, social behaviour. The second explores perceptions, hopes and realistic plans for the future. The subscale therefore conceptualises self-image as the ability to think about the self, both in relation to others and in relation to the outside world, to use this information to inform social behaviours and make realistic plans based on social, relational, or personal goals. Adults with AS were significantly more able to adapt social behaviours according to feedback from peers or trial and error social learning. This is a vital skill in the development of social intelligence (Tobin et al., 2013). The reduced capacity to develop this skill among adults with HFA may lead to social difficulties being repeated across interactions, meaning any social challenges persist, causing social relationships to be less rewarding, and ultimately impacting on quality of life (Schalock, 2004).

This is of particular interest from a diagnostic viewpoint as the ability for social adaptation was a distinguishing feature between AS and autism as conceptualised in the DSM-IV. In terms of the impact of this difference, Chiang and Wineman's (2014) literature review explored factors associated with quality of life in people with ASDs. Of the 16 studies reviewed, the majority reported reduced quality of life in individuals with an ASD. Of the four papers exploring quality of life in adults, the authors identified that the most consistent predictors of self-reported good quality of life was engagement in a range of leisure activities and management of behavioural problems which disrupt social relationships. The observed difference in reported ability to adapt and modify social on the SEF-Q might therefore also suggest that differences exist between the groups on perceived quality of life. If this is the case, it is important that people with ASDs are further supported in developing an

understanding of adaptive social behaviours. Baron-Cohen (2008) highlights the importance of utilising strengths within the ASD profile, such as a drive for rule-based systems, in order to increase the capacity for social learning.

It is also important to consider that the SEF-Q conceptualisation of Self-Image, adaptive behaviours and future planning, may also reflect the broader cognitive faculty of executive functioning which, as previously discussed, includes the ability to develop, adapt, and maintain problem-solving strategies in order to achieve future goals. Further support for this hypothesis comes from the fact that, although people with HFA were shown to show significantly more difficulties than people with AS, low scores were observed across both groups, which is consistent with the Executive Dysfunction theory of autism (Memari et al., 2013). In addition to this, the effect sizes observed from this comparison, Cohen's d =1.20, reflect previous studies exploring executive functioning in ASDs compared to control groups which have highlighted large effect sizes ranging from d= 0.62 - 2.07 depending on task (Panerai et al., 2014; Pennington & Ozonoff, 1996). Less clear distinctions have been found on executive function tasks between adults with AS and adults with HFA however (Ozonoff, South, & Miller, 2000) and so it is possible that while the Self Image subscale maps on to executive functioning, it is not entirely explained by it and so the importance of the social aspect of the questions should be highlighted.

4.2.2.3 Sex Differences. The lack of sex differences across tasks clearly supports the Extreme Male Brain Theory of autism. Despite this, it is important that the clinical implications of the near-significant difference on the 'Interpersonal Difficulties' subscale of the SEF-Q are considered further. This finding is not unusual as the research into sex differences within ASDs to date is contradictory. Some results indicate marked differences in autistic features between men and women whereas others demonstrate greater similarities (Lai et al., 2011; Lai et al., 2013, Rivet & Matson, 2011).

In this study, the results from the SEF-Q suggest some possible differences in social experiences between men and women with HFA but fail to reach statistical significance. A near significant difference (p = .051*)* with women reporting grater 'Interpersonal Difficulties' than men, was observed. This sex difference was not observed between men and women with AS on the same subscale. As current ASD diagnostic measures use observed or reported behaviours, both historical and current (APA, 2013; ICD-10, 2010; Lord et al., 1994; Lord et al., 2000;), it is important that the categories of behaviours included in these reflect possible variations in presentation. If differences exist on behaviours associated with managing social difficulties between men and women with ASDs, it may be that a consideration of sex differences within the diagnostic criteria is important.

Differences between the sexes in the way ASD presents and in the way difficulties are perceived have implications on both the accuracy of diagnosis and on access to appropriate support. The results of this exploration are open to interpretation due to borderline non-significance, however, further research exploring this area is clearly necessary. Within this, explorations to confirm the presence or absence of a sex difference on interpersonal relationships would be useful.

4.2.3 HFA and AS Conceptualisation

The results of this research highlight the complexity of the argument as to whether AS should remain a distinct diagnostic option within manuals. Furthermore, as each measure used in this research has a language component, a key difference in early development between AS and HFA, and groups were matched in Study 1 using Raven's Progressive Matrices (Raven et al., 1997), which is a non-verbal measure of intelligence, it is important to note that verbal intelligence may have led to a general AS superiority. Despite this, important similarities and differences between AS and HFA have been observed in this study which can be considered in light of the conceptualisation of the conditions. Although there are

contradictory findings of studies designed to investigate differences between the conditions, the consensus is that it may be too soon to definitively say whether the conditions are distinct, and what the most beneficial way of conceptualising these presentations is (Kaland, 2011; Pina-Camacho et al., 2013; Planche & Lemonnier, 2012; Spek et al., 2009).

The significant difference observed between adults with HFA and adults with AS on the Eyes Test is of particular significance to the debate as to whether the conditions should be conceptualised as different presentations of the same condition, or as separate conditions with overlapping features. The Eyes Test has known neuroanatomical correlates including the dorsolateral prefrontal cortex, the left medial frontal cortex, the superior temporal gyrus, and parts of the amygdala (Richell et al., 2002). If differences exist between adults with HFA and adults with AS on this task, it may reflect underlying neuroanatomical or neuro-functional differences between the conditions. This area of exploration is in its infancy (McAlonan et al., 2008; Yu et al., 2011) and more studies exploring functional and structural differences between HFA and AS neuroanatomy may help to explain differences in the presentation of the conditions. Based on the results of this study, combined with the neuroanatomical correlates of the Eyes Test, one hypothesis is that HFA and AS may differ in the neurological areas that underpin the ability to interpret emotional states. This may mean that differences in abilities between the conditions are more canalised, i.e. that they are fundamental characteristics of the populations which are not altered by individual variations, and may explain why the results of the Eyes Test were shown to be predictive of clinical group.

The differences observed in this study also have important implications for clinical practice. People with HFA may need more social support than adults with AS, due to a greater difficulty in interpreting emotional states in others. People with HFA were also observed to experience increased social and emotional difficulties associated with ‘Self-Image’ which includes adaptive behaviour and realistic planning for the future. This is of

interest as within the DSM-IV, AS differs from ASD on language development and the presence of “age appropriate self-help skills, adaptive behaviour (other than social interaction) and curiosity about the environment” (APA, 2000), with AS having greater capacity for the later. In the present study, adults with AS were shown to have significantly greater capacity to adapt social behaviours appropriately through social learning compared to adults with HFA. This significant difference on the ‘social adaptation of behaviours’ question within the ‘Self-Image’ subscale of the SEF-Q supports the validity of the original DSM-IV conceptualisation of AS and reflects a key difference between the AS and HFA. As with the Eyes Test, the predictive accuracy and large effect size observed for the ‘Self-Image’ results suggest that these experiences and abilities are fundamentally different between groups.

HFA appears to be associated with more impaired social and emotional functioning than AS, particularly in the ability to appropriately adapt social behaviours, and in the ability to understand complex emotions in others. Both these factors may be linked to quality of life. This suggests a possible need for clinical presentations of ASDs to remain independently conceptualised within diagnostic manuals and suggests a need for HFA to be included within this. The subtleties of the abilities associated with AS and areas of increased challenges within HFA can therefore be highlighted and understood by professionals supporting people with either condition.

4.2.4 Summary

The results of this research raise a number of questions about the conceptualisation of HFA and AS as well as the role of sex in the presentation of ASDs. The observed difference in the ability to interpret complex emotions between adults with HFA and adults with AS may reflect a fundamental social skill difference between the groups. Furthermore, this difference in performance on the Eyes Test may be reflective of underlying neuroanatomical or neuro-functional differences. The majority of comparisons did not identify profile

differences between males and females. This supports the Extreme Male Brain theory of autism (Baron-Cohen, 2002). However, a near-significant difference was observed in 'Interpersonal Difficulties' and the current research being undertaken by Lai and colleagues (2011; 2013) on sex differences across ASD presentations may help to clarify whether sex needs to be considered within the diagnostic criteria of ASDs. Finally, prominent clinical implications can be drawn from the analyses. Individuals with HFA and AS appear to differ in skills and experiences that are central to social intelligence, social adaptations and functioning, and ultimately quality of life. Given this, there may be a clinical need for discrete presentations of ASDs to be considered within diagnostic manuals.

4.3 Critical Analysis

A compressive critical analysis of the strengths and weaknesses of the research is considered within this section. The analysis seeks to provide an account of the reliability and validity of the findings based on the study's design and methodology as well as to consider the value of the research as a whole.

4.3.1 Strengths of the Research

Very few studies have directly compared social and emotional functioning between adults with HFA and adults with AS and the novelty of this exploration is a strength of this thesis. To date, the majority of studies which have directly compared differences across the social impairment associated with ASDs have used diagnostic tools such as the ADI-R (Lord et al., 1994) or diagnostic features such as the triad of impairments and social subgrouping profiles (Wing & Gould, 1979) to do so. While this thesis research also explored differences in the social impairment associated with ASDs, it did so by considering the abilities and perceived abilities of adults with either condition and exploring the everyday social and emotional experiences of adults with HFA and adults with AS. This allowed for a more

practical consideration of the differences between groups and places perceived experiences at the centre of the conclusions which could be drawn.

One strength of this study lies in the utilisation of existing data. Within certain fields, particularly neuroimaging research, there is a drive towards making raw data and datasets available to collaborating or external researchers so that different hypotheses and areas of interest may be explored while demands placed on participants are reduced (Keator et al., 2013). Through the Autism Research Centre (ARC) volunteers contribute their time to complete questionnaires and measures on the online volunteer platform and it is important that their contribution is valued and fully made use of. Two of the research questions were able to be answered through the use of this existing data. This research was therefore able to take advantage of this resource and hence reduce the demands placed on newly recruited participants.

In terms of methodology, the reliability of the results is enhanced by well-matched participant groups. Participants in Study 1, the ARC dataset analysis, were matched for age, IQ and gender split. The IQ match is particularly important in this study as the Eyes Test has a language component with participants being required to select a correct word to depict an expression. Given the impaired ability to correctly name emotional states observed within the HFA group, the reliability of the findings are improved by the removal of general intelligence as a confounding variable. Participants in Study 2, the SEF-Q exploration, were also matched for age and sex. Participants were required to indicate whether they had ever received a diagnosis of a specific or global learning disability, however, as discussed within the limitations of the study, IQ information was not available. The fact that the groups were matched for age is important due to the nature of the research questions. Social experiences are well established to fluctuate throughout life (Lang, Wagner & Neyer, 2009) and the comparative age groups ensured the exploration of social and emotional experiences was

reliable. A further strength was that the sample size was sufficient for good statistical power in the analysis (Cohen, 1988).

The study used measures with good psychometric properties which enhance both the validity and reliability of the findings. The EQ and Eyes Test have undergone substantial reliability tests and have been shown to have excellent properties (Allison et al., 2011; Dehning et al., 2012). Although there is less psychometric information available for the SEF-Q, the measure has also been shown to have good reliability (Mawhood, 1995). Furthermore, as it was developed by the authors of both the ADOS and the ADI-R, the gold-standard ASD diagnostic tools, its properties overlap with these measures suggesting clear clinical relevance. The SEF-I was designed as a supplementary analysis tool for the subtleties of social difficulties specifically experienced by people with ASDs (Rutter et al., 1988). As such, it is one of the most tailored social functioning tools for this population. By scoring the SEF-Q without diagnostic information, the results were protected against any preconceptions the lead researcher may have had, which again enhances the validity of the findings.

Finally, the research is clinically and currently relevant. The DSM-5 (APA, 2013) no longer includes AS a distinct diagnosis. This significant change to the conceptualisation of the presentations of ASDs has meant there is an increased need for studies exploring the similarities and differences between AS and HFA to consider what conceptualisation is most clinically useful from the perspective of the individuals with ASDs. By exploring differences between the conditions which have an impact on everyday life, this research has sought to be beneficial to the people affected, within this current context.

4.3.2 Limitations of the Research

Despite these strengths, the study has a number of important limitations which need to be considered. The most prominent limitation is in the lack of diagnostic sub-group validation within both Study 1 and Study 2 participants. Most participants registered with the ARC have

done so having taken part in in-person testing for other research projects being conducted at the centre. As such a number of participants in the database have received confirmatory diagnosis through participation in studies where the ADOS (Lord et al., 2001), ADI-R (Lord et al., 1994), or DSM-IV diagnostic criteria were used and language delay information would have contributed to the confirmatory diagnosis. Other participants registered through the database only provide a self-reported official diagnosis that was conducted elsewhere. In order to reduce the chance that participants incorrectly reported a diagnosis, only participants who had been able to provide information with regards to either diagnostic tool or the place where they received their diagnosis (for example a specific NHS service or as part of an identifiable research project) were included. Although the reliability of the findings may have been enhanced by participants having their diagnosis confirmed with a recognised tool, and the lack of this is a limitation of the research, self-report of official diagnosis within the ASD populations has been shown to be highly reliable (Auyeung et al., 2012; Daniels et al., 2012).

A further limitation within participant grouping was the inability to match the Study 2 participants on IQ. It is possible that IQ, even within the normal range, may impact on social functioning (McQuade, Murray-Close, Shoulberg & Hoza, 2013) and may have been a confounding variable in the analysis. The presence of an intellectual disability, which would contradict a diagnosis of HFA, was listed as an exclusion criterion on the recruitment email and a screening question on the SEF-Q confirmed the lack of an intellectual disability. However, being able to control for the impact of IQ on social and emotional functioning or being able to confirm that the groups were matched on IQ would have enhanced the methodology. The interpretations of the results would also have been more reliable if differences were able to be attributed to diagnostic group alone rather than possible intellectual differences. Despite this however, all participants would have had to be able to use a computer, accessed the online ARC database, registered as wanting information

regarding further research, received the recruitment emails, read and understood the instructions for participation, accessed the SEF-Q, and read, understood and responded to the questions. Being able to cope with the complexities of this procedure may therefore provide further confidence that the participants did not have an intellectual disability. It is also important to consider that the method of recruitment, through an online research platform, may lead to a selection bias towards higher functioning individuals within these populations.

A disadvantage of utilising existing data for some of the research question comparisons was that a repeated measured design could not be used for the SEF-Q. Conducting all measures with the same participants would have enabled an exploration of how profile differences impacted on social and emotional functioning within the same groups of participants. This would have been an improved methodological design by enabling direct associations to be considered. With regards to the interpretations of the findings, it is important to note that the non-significant results may be underpowered as the study's sample size was based on a large effect-size. The moderate to large effect sizes observed within the significant results, however, indicates good statistical power.

4.4 Future Research Directions

Whilst seeking to enhance the understanding of the similarities or differences between HFA and AS, the research has highlighted a number of areas for future consideration. Most noticeably, the research suggests that it may be too soon to confidently decide how to conceptualise the conditions, and indicates the continued need for studies comparing HFA and AS. One of the limitations of the study was the lack of objective confirmation of diagnostic grouping; large scale studies with well-matched and validated groups will be an asset to this field. This is especially important as a limitation of the research area as a whole is the lack of comparative studies with adult populations. Autism Spectrum Disorders are developmental and presentations may fluctuate with age. Within this, differences between

Theory of Mind skills across child and adult populations may offer interesting perspectives on the development of skills which link to social experiences and quality of life. Given this, it is important that studies with both child and adult samples are conducted, as well as longitudinal research to confidently explore the development of cognitive, behavioural, social, and neurobiological differences between the conditions.

The results demonstrate similarities between the sexes in the profile exploration using the EQ and Eyes Test, which supports the Extreme Male Brain theory of autism (Baron-Cohen, 2002). While the autistic profile appears to outweigh the expected gender difference in these measures, it was less clear whether perceptions of 'Interpersonal Difficulties' may differ between men and women. An emerging body of research (Lai et al., 2011; Lai et al., 2013; Rivett & Matson, 2011) suggests differences do exist in presentation between men and women with ASDs in some areas. This finding suggests that it may be important to consider the impact of differences in day to day experiences between men and women. It is unclear whether the diagnostic criteria for ASDs need to be different for men and women, however. Given the hypothesised under diagnosis of women with ASD (Lai et al., 2011), studies exploring gender differences among people with ASDs, across a range of areas, are needed.

Very few studies have explored neuroanatomical differences between HFA and AS (McAlonan et al., 2008). Studies to date suggest a distinct difference in pattern of grey matter volume in each diagnostic group (Yu et al., 2011). Differences observed in performance on the Eyes Test may represent underlying differences in neuroanatomy or function between the groups. Research dedicated to exploring neurobiological differences between the groups may help towards understanding variation in the capacity for certain cognitive tasks and so provide a greater insight into pervasive challenges faced by people with either condition. This would also contribute to the wider debate as to whether they should be conceptualised as separate conditions with similar presentations, or as the same condition.

The increased impairment in the ability to interpret emotional states of others among adults with HFA has implication for social difficulties and the development of close social relationships (Hess & Bourgeois, 2010). In addition, the lack of observed difference on the EQ may indicate that insight into social difficulties is difficult for adults with HFA. Larger scale studies, with validated diagnostic groups, confirming these findings are important given the implications on social functioning and associated quality of life (Schalock, 2004). If differences are consistently observed in this ability between the groups, it may be that social skills training groups need an additional focus on helping people with HFA to manage this difficulty.

Of particular clinical interest is the difference between adults with AS and adults with HFA in perception of challenges associated with 'Self-Image'. The results indicate that adults with AS are significantly more able to adapt social behaviours and plan for the future. This has implications for the level and nature of lifespan support needed for people with HFA compared to those with AS. Research furthering our understanding of social adaptation and future difficulties may help clarify whether a different supportive approach is needed for people with HFA compared to those with AS and if so, whether the conditions should be conceptualised as distinct so that access to this support is made easier. This finding is also of interest in light of previous conceptualisations of AS in comparison to Autism. Within the DSM-IV (APA, 2000), AS differed form autism in the former having a greater capacity for adaptive behaviour. The finding of this research suggests that this may indeed be an important distinction. Finally, it is important that future studies match for verbal intelligence (VIQ) to ensure that the impact of language differences between the groups can be explored.

4.5 Conclusion

This research sought to enhance the limited understanding of the subtleties in presentation between adults with HFA and adults with AS in light of the DSM-5 removal of

AS as a distinct diagnosis. It aimed to add to the debate surrounding how the conditions should be conceptualised and to specifically consider differences in social-emotional skills and functioning in everyday life.

Despite a number of potential limitations surrounding group membership and particularly the validity of self-reported diagnosis, the results provide a novel and contextually relevant insight into ASDs. In order to answer the two research questions of Study 1, whether differences exist between people with HFA and those with AS in the perception of their ability to empathise, and whether differences exist in the ability to read complex emotions in others, the design made use of part of a large dataset in existence at the ARC. Between the 43 adults with HFA and the 43 adults with AS no significant difference was reported in the perceived ability to empathise with others. A significant difference was, however, observed in the ability to correctly interpret complex emotions, which adults with HFA found significantly more difficult. In line with the Extreme Male Brain theory of autism (Baron-Cohen, 2002) no gender differences were observed within groups. These finding suggest the groups do not differ in terms of how they view aspects of their social abilities, but that differences in actual ability do exist.

Experiences of social and emotional functioning were compared within a newly recruited sample of 25 adults with HFA and 25 adults with AS. Reports of challenges associated with 'Interpersonal Difficulties', and 'Friendships and Social Relationships' did not differ between groups. In contrast, challenges associated with 'Self-Image', linked to social adaptation and future planning, were shown to be significantly more difficult for adults with HFA compared to adults with AS. No significant differences in experience were observed between men and women, however, the near-significance of the result for the 'Interpersonal Difficulties' subscale among adults with HFA suggests that this area may require further exploration.

The main comparisons indicate differences between the conditions do exist, and the clinical implications of these results highlight a possible need for discrete presentations to be conceptualised within diagnostic manuals. Adults with AS are more able to interpret complex emotions and face fewer social and emotional challenges in certain areas than adults with HFA. This may imply a greater need for social support among adults with HFA. Furthermore, differences observed in the capacity for social adaptation may support the DSM-IV conceptualisation of differences between the conditions. Despite this, some aspects of social and emotional experiences do not differ between adults with HFA and AS and from a clinical perspective, this finding supports combined social skills groups. The potential clinical advantages and disadvantages of a broader ASD diagnostic group need to be further addressed.

This study concludes that HFA and AS differ in aspects that may have important implications for the everyday life of individuals with these conditions. There is currently insufficient evidence to support either the removal or maintenance of AS a separate condition within diagnostic manuals but the research suggests that discrete presentation categories, including HFA, may be useful in tailoring appropriate support. The limitations of this study should be addressed in future research, and studies exploring lifespan comparisons of AS and HFA across cognitive, behavioural, social, and neurobiological domains are needed.

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Appendices

Appendix A – Study 1 Measures

Appendix A i: Empathy Quotient (Baron-Cohen & Wheelwright, 2004)

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Appendix A ii: The 'Reading the Mind in the Eyes' Test (Baron-Cohen et al., 2001)

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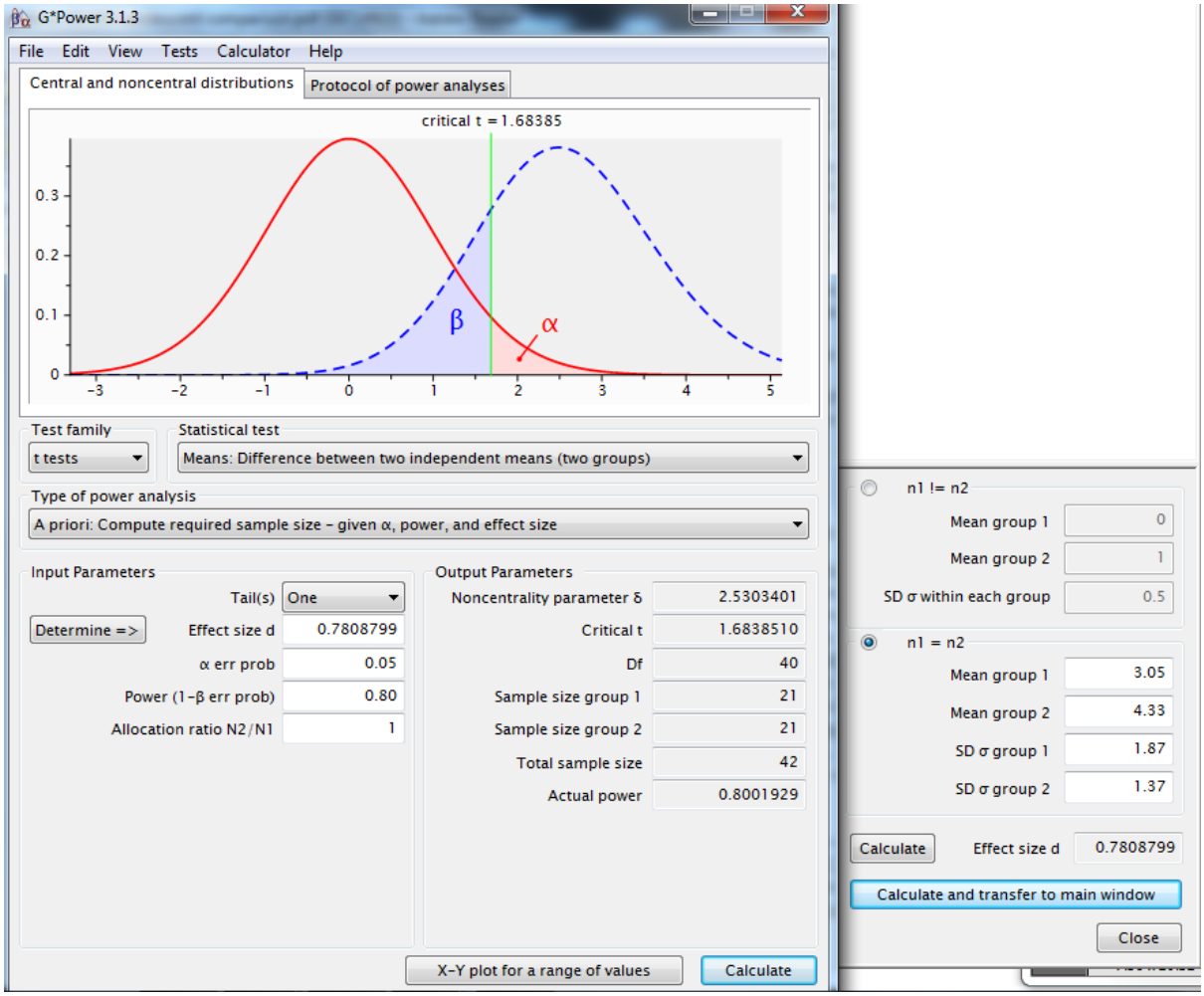
Appendix B – Power Calculation

Power Calculation conducted using G*Power (Faul et al., 2009)



Appendix C – University of East Anglia Ethical Approval Documentation.

Faculty of Medicine and Health Sciences Research Ethics Committee

University of East Anglia

Charlotte Skelly
Doctoral Programme in Clinical Psychology
Medical School
University of East Anglia
Norwich
NR4 7TJ

Research & Enterprise Services
West Office (Science Building)
University of East Anglia
Norwich Research Park
Norwich, NR4 7TJ

Telephone: +44 (0) 1603 591720
Email: fmh.ethics@uea.ac.uk

Web: www.uea.ac.uk/researchandenterprise

21st August 2013

Dear Charlotte,

Project Title: Exploring the social, emotional and autistic profiles of adults with High Functioning Autism and Asperger's Syndrome; Do differences exist between the conditions?
Reference: 2012/2013 - 63

The amendments to your above proposal have been considered by the Chair of the Faculty Research Ethics Committee and we can confirm that your proposal has been approved.

As a condition of this approval, the Chair has asked that you confirm that you will adhere to the lone worker policy.

Please could you ensure that any further amendments to either the protocol or documents submitted are notified to us in advance and also that any adverse events which occur during your project are reported to the Committee. Please could you also arrange to send us a report once your project is completed.

The Committee would like to wish you good luck with your project.

Yours sincerely,

Yvonne Kirkham
Project Officer

Appendix D – Parametric Assumption Testing for Study 1

A Kolmogrov-Smirnov test, with lilliefors significance correction, was conducted in order to determine whether the results for the main comparisons, Empathy Quotient (EQ) and Reading the Mind in the Eyes Test (Eyes Test), were normally distributed (see Figures 1 and 2). The results indicated a significant deviation from the normality curve for the results of the EQ for adults with HFA, $D(43) = .153$, $p = .008$, and adults with AS, $D(43) = .154$, $p = .012$, which were both shown to be positive skewed. This demonstrated that the data were not normally distributed and therefore parametric assumptions could not be satisfied. This was also the case for the results of the Eyes Test for both people with HFA, $D(43) = .137$, $p = .042$, and those with AS, $D(43) = .144$, $p = .025$. The results of this measure were negatively skewed and therefore not normally distributed.

Figure 1*: Positively skewed Empathy Quotient score distribution by diagnosis*

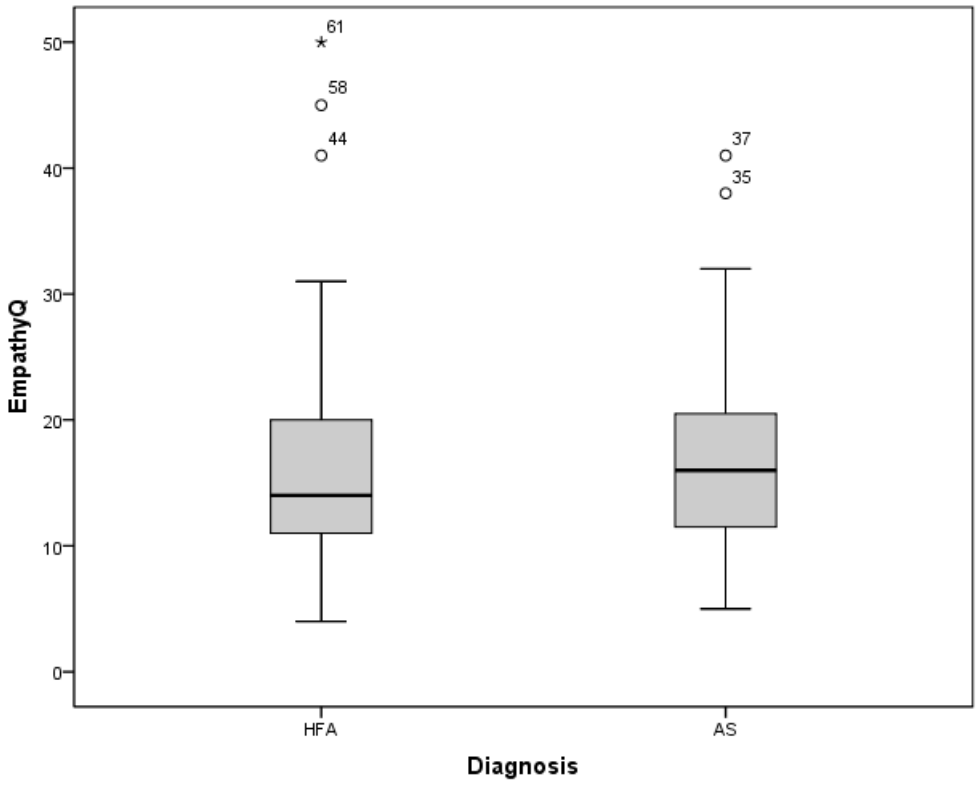
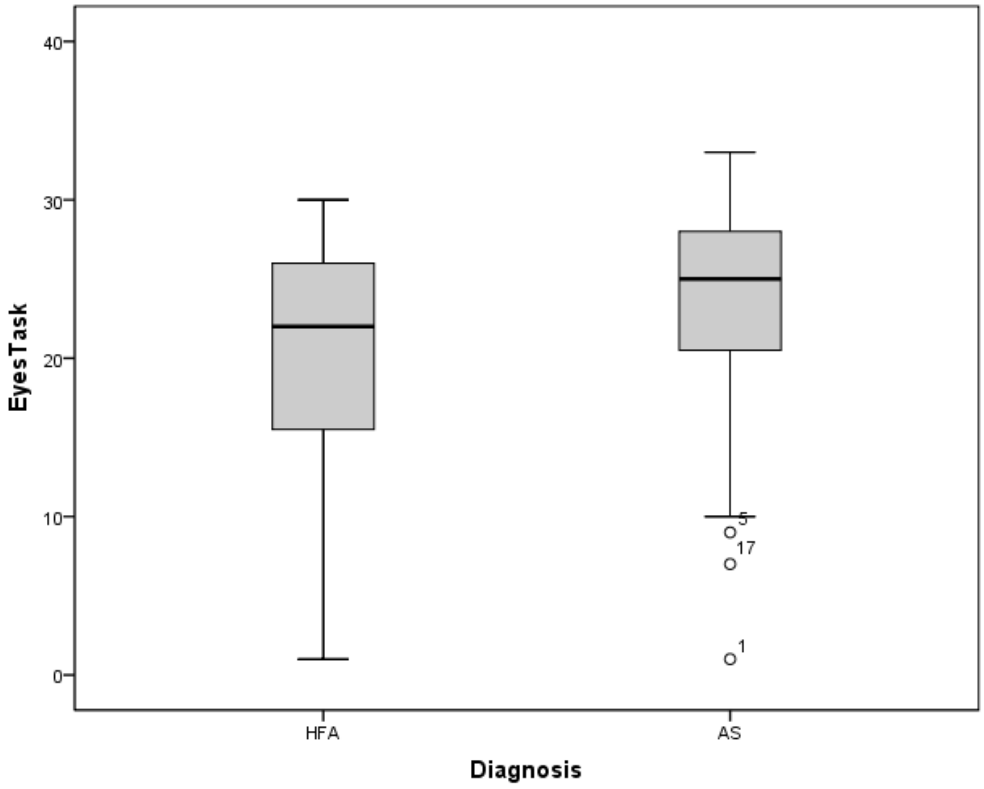


Figure 2 *Negatively skedded Eyes Test score distribution by diagnosis*



Appendix E – Study 2 Resources

Appendix E i: Participant Recruitment Email

The University of East Anglia and Autism Research Centre, University of Cambridge are collaborating to conduct a piece of research exploring profile differences between people with Autism and people with Asperger's Syndrome.

We are looking for adult volunteers to complete a short online questionnaire about your day to day experiences so that we can get a better understanding of how any differences might be affecting everyday life. The questionnaire should take approximately 10-20 minutes and to take part you must:

- be aged 18+
- have a diagnosis of either Autism or Asperger's Syndrome
- not have a learning disability

For more information, please follow the link below or contact the lead researcher, Charlotte Skelly at c.skelly@uea.ac.uk or call 07769483417:
http://autismresearchcentre.net/docs/CSKELLY_ParticipantInformation.pdf

To complete the questionnaire, please click on the link below and follow the instructions:

https://www.surveymonkey.com/s/REDACTED

Thank you!

Appendix E ii: Participant Information Sheet

Participant Information Sheet

Exploring the social, emotional and autistic profiles of adults with High Functioning Autism and Asperger's Syndrome; Do differences exist between the conditions?

We would like to invite you to take part in our research study. Before you decide whether you want to, we would like you to understand why the research is being done and what taking part would involve.

What is the purpose of the study?

The purpose of this study is to investigate what differences might exist between High Functioning Autism and Asperger's Syndrome. The study is looking at both performance differences in some of the strengths and difficulties associated with High Functioning Autism and Asperger's Syndrome as well as differences in everyday life experiences.

It will use anonymous questionnaires that you and other participants may have already completed via the Autism Research Centre (ARC), University of Cambridge, website as well as new information collected from this questionnaire.

This study is primarily being conducted for educational purposes. It is a thesis research project to fulfil the academic requirements for the University of East Anglia Doctoral Programme in Clinical Psychology.

Why have I been invited?

You have been invited to take part because you have previously registered as a research volunteer at the ARC, and have agreed to be contacted with information about other projects which might be of interest to you.

In order to take part, you must have a diagnosis of either High Functioning Autism or Asperger's Syndrome.

Do I have to take part?

There is no obligation for you to take part in this study and it is up to you to decide to do so. If you read through this information sheet and agree to be involved, we will ask you to complete a consent form before participating. You are free to withdraw at any time both from this study and the ARC database without giving a reason.

What will happen to me if I take part?

If you would like to take part, you can simply follow the hyperlink at the end of the recruitment email which directed you to this page. This will direct you to an online questionnaire. First, you will be asked to indicate that you have read this information sheet and that you agree to take part in the study by completing the questionnaire.

After this, you will need to answer a few basic questions about yourself. This is so that your answers can be put into the right "group" for example male or female. It also means that, should you wish to withdraw from the study at any time, your questionnaire can be identified. Once you have answered these background information questions you can click to the next page, which begins the main "Social Experiences" questionnaire. This is a series of questions with either multiple choice answers or comment boxes where you can write your thoughts.

There are no right or wrong answers as the questions are about your day to day experiences and how easy or difficult you find certain tasks.

When you have answered all of the questions, you will be given the contact details of the lead researcher (which can also be found at the bottom of this document) so that you can get in touch if you have any questions. The whole questionnaire should take between 10 and 20 minutes to complete.

Will my taking part in this study be kept confidential?

Once you have completed the questionnaire, the lead researcher will automatically be notified. Your completed survey can only be accessed by the lead research and this is password protected. Your survey will be stored securely using encrypted memory sticks, password-protected documents and within locked filing cabinets if printed in line with University of East Anglia ethical approval. Questionnaires completed via the ARC website are automatically anonymised at point of completion and managed by Paula Smith, ARC Database Manager, in line with University of Cambridge ethical approval.

After completing the study, your data will be stored confidentially and securely for 5 years at an archiving company used by the University of East Anglia Medical School, after which it will be destroyed. No individual participant or their answers will be identifiable within these results.

The exception to this would be if, during the questionnaire, information is disclosed which would cause concern for your welfare or the welfare of others. At this time, the research team would meet to confidentially discuss the nature of the information disclosed. If it is decided that further action needs to be taken you would be withdrawn from the project and your data would not be used as confidentiality would need to be broken so that the appropriate people can be contacted to follow this up with you.

How will I be able to withdraw from the study?

You are free to withdraw from both this project and the ARC database at any time. To do so, please email the primary researcher or Paula Smith (research@cambridgepsychology.com), with "Remove Me" in the subject line. You do not need to provide a reason for this decision.

Who has reviewed the study?

All research is looked at by an independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and given a favourable

opinion by the University of East Anglia Faculty of Medicine and Health Sciences Research Ethics Committee.

Further information and contact details

If you would like further information about this research or if you have concern about any aspect of this study, please contact the primary researcher Charlotte Skelly on *07769483417* or at the email address c.skelly@uea.ac.uk. If you have any further questions you can contact the research supervisor Pete Langdon at the email address P.Langdon@uea.ac.uk. For information regarding the ARC database please contact Paula Smith at the email address: research@cambridgepsychology.com

Should you wish to discuss the research or your experience with someone independent please contact the Clinical Psychology Doctorate Research Lead, Dr Sian Coker at the email address: sian.coker@uea.ac.uk

Appendix E iii: Social and Emotional Functioning Questionnaire

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Appendix E iv: Permission for SEF-I adaptation

From: Azis-Clauson, Camilla [camilla.azis@kcl.ac.uk]
Sent: 25 November 2013 13:59
To: Charlotte Skelly (MED)
Subject: RE: [from web site] Social Emotional Functioning Interview

Dear Ms Skelly

Yes, I, too, give my consent as per your email below.

Best wishes
Michael

Professor Sir Michael Rutter
PO 80 SGDP Centre,
Institute of Psychiatry
De Crespigny Park
Denmark Hill
London SE5 8AF
UK.

From: Charlotte Skelly (MED)
Sent: 23 November 2013 12:32
To: TO: Michael L Rutter
Subject: [from web site] Social Emotional Functioning Interview

Dear Professor Rutter,

I hope you don't mind me contacting you. My name is Charlotte Skelly and I am a Trainee Clinical Psychologist at the University of East Anglia. I am currently conducting my thesis research as part of the doctorate which focuses on exploring differences and similarities between High Functioning Autism and Asperger's Syndrome.

As part of the study, I am using your Social Emotional Functioning Interview (SEF) to consider the impact of any profile differences on day to day life within each population. I am emailing to request your permission to either email participants the SEF (with scoring codes removed) or format it as an online survey so that participants can complete it without having the additional demands of having to meet a stranger face to face? This would just be formatted as the SEF questions written out with space for responses, and some prompts, below.

I have also written to Professor Lord, who has given her consent to this but suggested that I contact you as well given the measure was very much a joint effort. The research will only be running from now until September 2014 and will close following submission of my thesis at which time I will assume your permission, if given, as having expired.

I would be really grateful if you could let me know either way and thank you for your time.
Yours sincerely,

Charlotte Skelly

From: Catherine Lord, Ph.D.
Sent: 23 November 2013 02:18
To: Charlotte Skelly (MED)
Subject: Re: Social Emotional Functioning Interview

Hi Christine,

It is fine with me if you do this but the SEF isn't really mine. It was a joint effort with professor Rutter and two students at the institute of psychiatry. You should ask professor Rutter for permission. If you don 't hear back from him in a reasonable amount of time. I'd assume it's fine.

Good luck,

Cathy

On Nov 22, 2013, at 3:48 AM, "Charlotte Skelly (MED)" wrote:

Dear Professor Lord,

I hope you don't mind me contacting you. My name is Charlotte Skelly and I am a Trainee Clinical Psychologist at the University of East Anglia, United Kingdom. I am currently conducting my thesis research as part of the doctorate which focuses on exploring differences and similarities between High Functioning Autism and Asperger's Syndrome.

As part of the study, I am using your Social Emotional Functioning Interview (SEF) to consider the impact of any profile differences on day to day life within each population. I am emailing to request your permission to either email participants the SEF (with scoring codes removed) or format it as an online survey so that participants can complete it without having the additional demands of having to meet a stranger face to face? I would be very happy to send you a copy of the form I intend to email out if you would like to approve the final version but it would just be the SEF questions written out with space for responses, and some prompts, below.

The research will only be running from now until September 2014 and will close following submission of my thesis at which time I will assume your permission, if given, as having expired.

I would be really grateful if you could let me know either way and thank you for your time.

Yours sincerely,

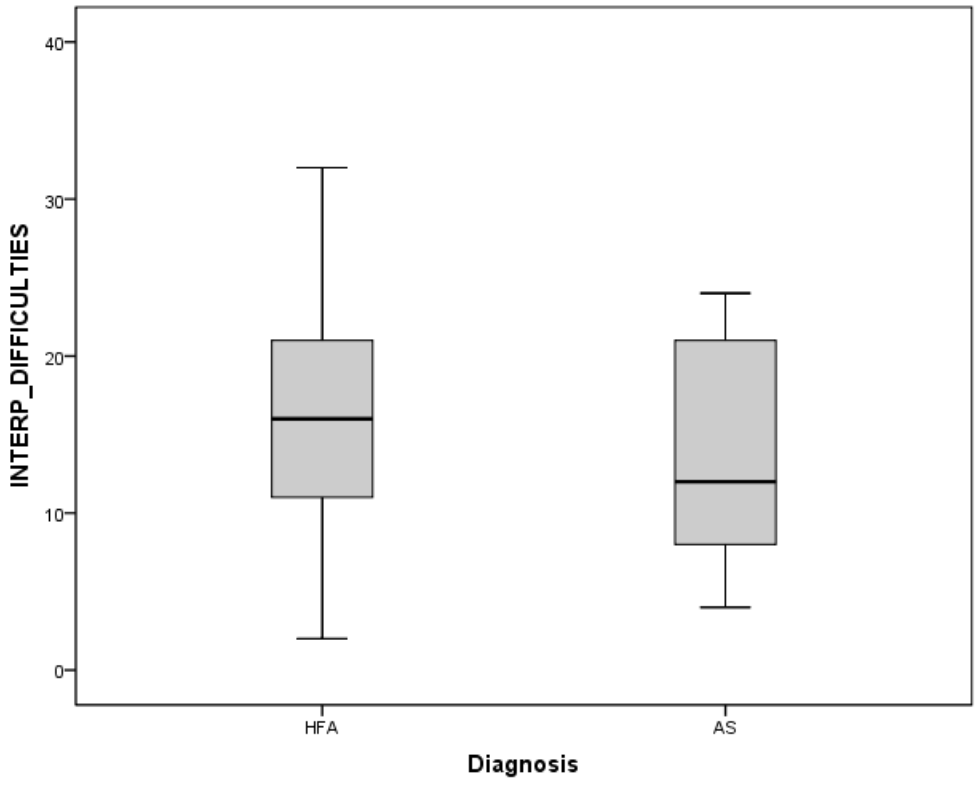
Charlotte Skelly

Charlotte Skelly
Trainee Clinical Psychologist
University of East Anglia

Appendix F – Parametric Assumption Testing for Study 2

A Kolmogrov-Smirnov test, with lilliefors significance correction, was also conducted in order to determine whether the results for the main subscale comparisons, Interpersonal Difficulties, Friendships and Social Relationships, and Self-Image, were normally distributed. The data for the Interpersonal Difficulties subscale were normally distributed (see Figure 4), as evidenced by the lack of significant deviation from the normally curve observed by the Kolmogrov-Smirnov test, for both the HFA group, D (25) = .085, p = .200, and the AS group, D (25) = .162, p = .091.

Figure 4 *Normally-distributed Interpersonal Difficulties score distribution by diagnosis*



The data for the Friendships and Social Relationships as well as the Self-Image subscales however both displayed a significant deviation from the normality curve indicating that the data were not normally distributed for neither the HFA nor the AS group (see Figures 5 and 6). The distribution of the Friendships and Social Relationships subscale data were shown to be positively skewed for adults with HFA, D(25) = .182, p = .033, and adults with

AS, $D(25) = .207$, $p = .007$. This was also the case for the results of the Self-Image subscale for both people with HFA, $D(25) = .242$, $p = .001$, and those with AS, $D(25) = .185$, $p = .027$. The results of this measure were also positively skewed and therefore not normally distributed.

Figure 5 *Positively skewed Friendships & Social Relationships score distribution by diagnosis*

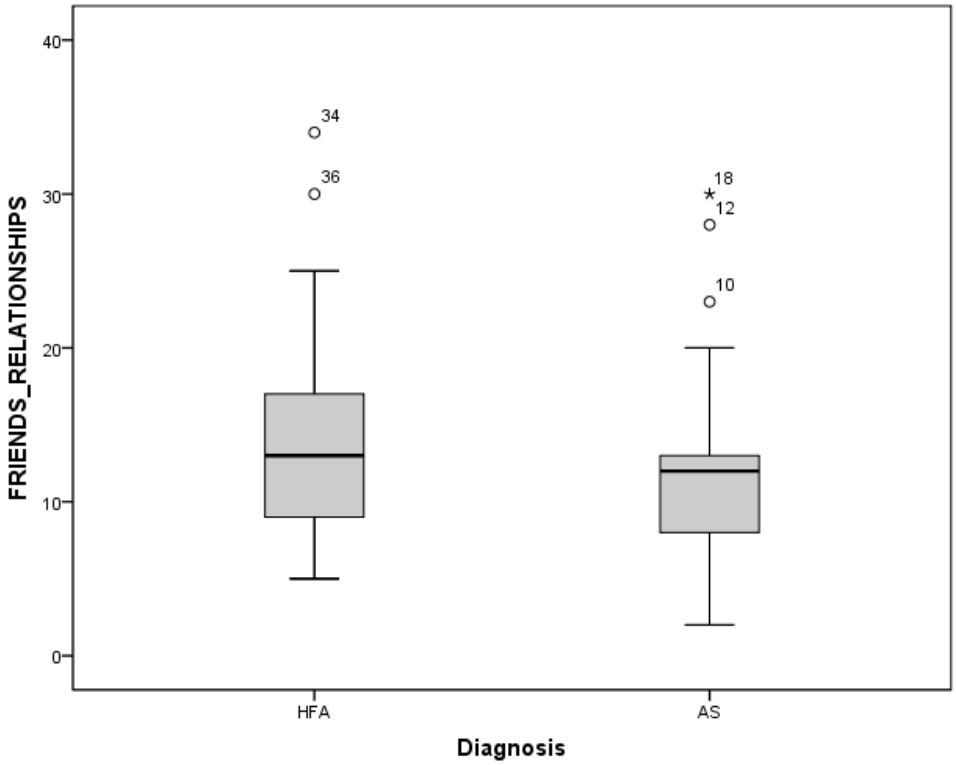


Figure 6 *Positively skewed Self-Image score distribution by diagnosis*