The Communication Profile in Young Adults With Autism

by

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ABSTRACT

Autism spectrum disorders (ASD) are characterized by impairments in social-communication, and restricted, repetitive and stereotypical patterns of behavior, interests, and activities. There is a paucity of research about the adult population as the vast majority of research into ASD has focused on children and adolescents. As impairments in social-communication are integral to ASD speech-language pathologists (SLP) have a pivotal role to play in the assessment and intervention of adults with ASD in an effort to optimize their independence and productive participation. This study focuses on the communicative profile of adults with ASD who are considered high-functioning (i.e. those without intellectual disability; HFASD).

Impairments in social communication, also known as pragmatics, are defining criteria for ASD. Although specific pragmatic problems have been noted in adults with HFASD, the full extent of their pragmatic difficulty remains undocumented, largely because there are few comprehensive assessment tools. Difficulties with syntax and vocabulary also have been reported, but since findings are mixed, it is not clear whether young adults with HFASD have difficulties in these language domains. In addition, our standardized test instruments may not be sufficiently sensitive to detect subtle difficulties with sophisticated syntax. If so, in conversation, adults with HFASD might exhibit problems in vocabulary and grammar that influence listeners' impressions, but that would not be detected by a standardized test.

The objectives of this study were to determine, in comparison to a control group, whether subtle communication impairments of young adults with HFASD would be detected by formal language assessments and/or language sample analysis. The language sample was derived from a simulated employment interview. Performance on the Communication Checklist-Adult (CC-A) and the Nonliteral Language and Pragmatic Judgment subtests from the Communication Assessment of Spoken Language (CASL) was expected to reveal deficits in pragmatic skill, while difficulties in syntax or vocabulary on the Test of Adolescent and Adult Language – 4 (TOAL-4) were not expected. Language sample analysis was expected to reveal subtle differences in language that were not revealed on the conventional assessments.

Twenty adults with ASD were compared to 20 controls. Groups did not significantly differ on sex, nonverbal abilities and educational level. A standardized test battery was administered and a simulated job interview with a professional recruitment consultant was conducted to generate a language sample. Transcripts of the language samples were used to generate indices of pragmatics (Pragmatic Rating Scale, PRS), vocabulary (e.g., lexical diversity, lexical sophistication and word errors), and syntax (e.g. mean length of utterance and subordination index).

Pragmatics: On the CASL, the average standard score of participants with HFASD was significantly lower than the mean standard score of the controls. Even so, the mean subtest standard scores for the HFASD group

were still within normal limits. Scores on the CC-A though, clearly indicated impairment. Results from the language sample, using the PRS also indicated impairment in the HFASD in comparison to the control group. Language sample analysis also revealed that the average length of the interviews was longer for the HFASD group than the controls and included more within- and between- utterance pauses.

Syntax and Vocabulary: On the TOAL-4, adults with HFASD had significantly more difficulty with the Sentence Combining subtest than controls although the mean score for the HFASD group was within normal limits. No differences were found on the TOAL-4 for vocabulary, but the language sample revealed that the group with HFASD made a higher proportion of word level errors than controls.

For these adults with HFASD, most standard scores on the traditional standardized language tests were within normal limits but language sample analysis and the informant measure identified pragmatic language impairments, social dysfunction, and vocabulary problems. Our findings revealed subtle differences in communicative quality that may have a negative impact on conversational partners. These results may help explain why adults with HFASD sometimes fail to advance beyond a job interview, despite being well-qualified.

This thesis is an original work by Wendy Mitchell. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Getting to Work: The impact of impaired communication on employment prospects for young adults with Autism Spectrum Disorder", No. Pro00035414, December 14, 2012.

DEDICATION

To Mom and Dad for sharing this little gem:

"Thank God every morning when you get up that you have something to do which must be done, whether you like it or not. Being forced to work, and forced to do your best, will breed in you temperance, self-control, diligence, strength of will, content and a hundred other virtues which the idle never know." Charles Kingsley

And to Chester and Ben …

who listened without judgment and took me for much needed walks

and to my siblings, Lisa Morrison, Shelley Smith, and friends Wendy and Les De La Mare, Michele Burns, Peggy and Bill Martinook, and the folks at the Refuge who provided me shelter from the storm.

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Table of Contents

CHAPTER 1

Introduction

Autism spectrum disorders (ASD) are characterized by impairments in social–communication, and by restricted, repetitive and stereotypical patterns of behavior, interests, and activities (American Psychiatric Association, 2013). ASD is referred to as a spectrum of disorders because the diagnosis encompasses a wide range of skills and abilities (Mailick Seltzer et al., 2003). The vast majority of research into ASD has focused on children and adolescents (Moxon & Gates, 2001; National Professional Development Center on Autism Spectrum Disorders, 2010) but ASD is a lifelong condition. The paucity of research in the adult population (Barnhill, 2007; Hurlbutt & Chalmers, 2004) is of concern because many children with an ASD diagnosis are now approaching adulthood (Shattuck et al. 2012) and will require services. In addition, many adults are reported to be seeking an ASD diagnosis to potentially access services, to request accommodations at work or school and for peace of mind (Fombonne, 2012; Murphy, Beecham, Craig & Ecker, 2011; Stoddart, Burke & King, 2012). With a prevalence rate of approximately 1% in both children and adults (Brugha et al., 2011), there will also be some adults whose ASD has been undetected (Baron-Cohen, et al., 2009; Mandell et al., 2012). For example, ASD may be the more appropriate diagnosis for as many as 10% of residential psychiatric patients (Mandell et al. 2012).

Because the number of adults with ASD is growing rapidly, advocates and service providers have turned their attention to how best to identify and support them (Interagency Autism Coordinating Committee - IACC, 2011) and research focused on their needs has been identified as a priority (Autism Speaks, 2009). Identifying these needs is complicated by the diversity seen in ASD. As with children, the needs of adults with ASD vary widely because their range of skills and abilities is broad. For example, one adult may be nonverbal, have limited responses to social overtures and present with

repetitive motor mannerisms, whereas another adult may be verbally fluent, yet socially isolated, and insist that certain daily routines be followed precisely. Frequently, the first profile is associated with depressed cognitive abilities and is typically identified during the early years whereas the second profile is associated with individuals whose cognitive abilities fall within or above the normal range and whose ASD may not be detected until much later. The service needs for the first adult would need to be life-long and address housing, employment and community integration. One-on-one assistance with meal planning, housekeeping, self-care are likely to be required. Supported employment commensurate with developmental level and assistance with engaging in community activities including transportation and access to recreational activities would also be necessary. On the other hand, very little is known about the service needs of adults whose cognitive and verbal skills are relatively preserved (Barnard, Harvey, Potter & Prior, 2001, Gerhardt & Lainer, 2011, Shattuck, Wagner, Narendorf, Sterzing & Hensley, 2011). Hence, this population has been consistently underserved (Fombonne, 2012).

Narrowing the focus to individuals with ASD who do not have an intellectual impairment (i.e., IQ's $\geq$ 70) allows a more meaningful examination of outcomes than trying to address the range of abilities across the entire spectrum. Traditionally, this segment of the population has been diagnosed with Pervasive Developmental Disorder Not-otherwise Specified (PDD-NOS), high functioning autism (HFA), or Asperger's syndrome (AS; Baron- Cohen, 2000). The label PDD-NOS was used to capture individuals who did not meet the full criteria for autism but who nevertheless displayed social and communicative impairments and repetitive/routine behaviors (Paul, Orlovski, Marcinko & Volkmar, 2009). The term high functioning autism (HFA) was frequently used to refer to those who met criteria for autism, with cognitive scores within the average range but whose early language development was delayed. The diagnosis of Asperger's syndrome (AS) was given to those who met the criteria for autism, with age-

appropriate cognitive skills where there was no history of delay in early language development (Baron-Cohen, 2000). The differentiation of HFA and AS has long been controversial (Volkmar, Lord, Bailey, Schultz & Klin, 2004) and many researchers argue that HFA and AS cannot be differentiated reliably (National Research Council, 2001; Noterdaeme, Wriedt & Hohne, 2010; Schopler, 1997; Tager Flusberg, Joseph & Folstein, 2001). Consequently, the new criteria for ASD in *the Diagnostic and Statistical Manual of Mental Disorders - 5th Edition* (DSM-5; American Psychiatric Association, 2013) have collapsed diagnostic subtypes, including autism, AS, and Pervasive Developmental Disorder – Not Otherwise Specified, into a single category, 'Autism Spectrum Disorder' to increase sensitivity and specificity regarding the diagnosis of autism (Wilson et al., 2013). As HFA and AS are no longer distinguished from one another they will subsequently be referred to as HFASD. For this paper HFASD will refer to those who meet criteria for ASD with typical cognitive abilities regardless of early language development.

To truly address research and clinical priorities for adults with HFASD, it is important to understand how they function in society. There are a handful of research studies that have reported on long-term functional outcomes in individuals with HFASD (Cederlund, Hagberg, Billstedt, Gillberg & Gillberg, 2008; Engstrom, Ekstrom & Emilsson, 2003; Hofvander et al., 2009; Howlin, Goode, Hutton & Rutter, 2004; Marriage, Wolverton & Marriage, 2009; Taylor & Seltzer, 2010; Whitehouse, Watt, Line & Bishop; 2009b). Overall, their outcomes tend to be more positive than those who present with an accompanying cognitive disability but attainments in many areas are surprisingly low (Cedurlund et al., 2008; Engstrom et al., 2003; Howlin et al., 2004) and many function below the potential implied by their intellectual skill (Hofvander et al., 2009; Marriage et al., 2009; Taylor & Seltzer, 2010). For example, the majority of adults with HFASD fail to achieve employment or complete vocational training, live independently, or have any sustained friendships or relationships (Cederlund et al., 2008; Whitehouse et al.,

2009b).

At least two of the frequently mentioned long-term outcomes, the ability to achieve and maintain employment and the ability to sustain friendships and relationships, are influenced by an individual's communicative competence (Howlin, 1997 & 2003; Kapp, Gantman & Laugeson, 2011; Landa 2000; Mawhood & Howlin, 1999). In relation to employment, qualitative (Bolman, 2008, Griffith, Totsika, Nash & Hastings, 2011; Hendricks, 2010, Hurlbutt & Chalmers, 2002 & 2004) and anecdotal reports (Grandin & Scariano, 1986; McDonald, 1998; Romoser, 2000) have indicated that communication impairments are perceived as one of the barriers to employment for adults with HFASD. This is not surprising because in the typically developing population, communication abilities have been found to play a key role in a successful job interview (Einhorn, 1981;Louw, Derwing & Abbott, 2010; Patron, Siltanen, Hosman & Langenderfer, 2002; Ugbah & Majors, 1992) and communication is the number one skill most valued by employers in the job market (National Association of Colleges and Employers Job Outlook, 2007).

The ability to establish friendships and relationships is also influenced by conversational abilities (Parker & Gottman, 1989; Kapp et al., 2011). The ability to effectively engage and maintain conversations is a particularly challenging skill for individuals with HFASD (Adams, Green, Gilchrist & Cox, 2002; Capps, Kehres & Sigman, 1998; Paul et al., 2009) and may result in few or strained peer relations (Baron-Cohen & Wheelwright, 2003; Russell, 2007), difficulties resolving conflicts or negotiating (Olswang, Coggins & Timler, 2001) and limited social participation and exclusion from social groups (Adams, 2001) even though individuals with HFASD desire friendships with peers (Daniel & Billingsley, 2010; Humphrey & Symes, 2010)

Given the current landscape, where there is an increasing demand for assessment and intervention for adults with HFASD (Stoddart et al., 2012), it is imperative to consider the potential influence that communication may have on functional life skills like gaining and maintaining employment and

establishing friendships and relationships. First it is important to identify the communicative profile of adults with HFASD and then it will be important to establish how these characteristic behaviours affect important skills for living a full and meaningful life. This study aims to take the first step in this process by evaluating the communicative profile of adults with HFASD through the use of a battery of formal assessment and detailed analysis of an ecologically valid language sample.

Communication in HFASD

Various aspects of communication, including phonology, syntax, semantics and pragmatics, have been investigated in the population with HFASD, although the vast majority of this work has been conducted with children and adolescents (Bailey, 2012; Piven & Rabins, 2011). Overall, the consensus has been that even though individuals with HFASD may be delayed in their communication development, there are no specific autism-linked deficits in language syntax (i.e. grammar, language structure) or semantics (i.e. meaning), but that pragmatics of communication (i.e. the ability to use language appropriately in social situations) is universally impaired (Tager-Flusberg, Paul & Lord, 2005). Even so, most of the studies on syntax and semantics focused on early-developing and rudimentary skills (Volden & Lord, 1991). More recently though, there have been suggestions that when detailed analysis of language is done, specific errors in more subtle and sophisticated, later-developing syntax may be found (Eigisti, Bennetto, Dadlani, 2007). In adolescents with HFASD, Volden and Lord (1991) found syntactic errors that were dissimilar in pattern to those exhibited by adolescents with intellectual delay. More recently, others have also found evidence of syntactic difficulty in some adults with HFASD compared to appropriately matched controls (Lewis, Woodyatt & Murdoch, 2007b; Whitehouse, Line, Watt & Bishop et al., 2009a). In addition, impaired use and understanding of vocabulary have also been reported (Lewis et al., 2007b; Whitehouse et al., 2009a; Howlin, 2003; Rumsey & Hamburger, 1988). Thus, syntactic and vocabulary problems have been reported in

addition to dysfunctional pragmatics. Even though the notion that language continues to develop into adulthood is slowly gaining acceptance (Nippold, 1993; 2009; Nippold, Hesketh, Duthie & Mansfield, 2005; Nippold, Mansfield, Billow & Tomblin, 2008; Nippold, Mansfield & Burrows, 2007), we still have few formal, standardized tools that can be used to evaluate language competence in adults. This is particularly concerning as access to supports and interventions are frequently based on performance on the more traditional language assessments (Lewis et al., 2007b).

While the few available adult studies (Barnes & Baron-Cohen, 2012; Colle, Baron-Cohen, Wheelwright, van der Lely, 2008; Jolliffe & Baron-Cohen, 2000; Howlin, 2003; Lake, Humpreys & Cardy, 2011; Lewis et al., 2007a, 2007b; McCabe, Hillier & Shapiro, 2013; Paul et al., 2005; Rumsey & Hamburger, 1988; Seung, 2007; Shriberg et al., 2001; Slocombe et al., 2013; Whitehouse et al., 2009a) have found preliminary evidence of impairment across domains, none of them have compared adults with ASD to typical adults using both a comprehensive battery of language measures and a detailed language sample analysis.

The objective of this study is to investigate the nature of differences in the language profile between adults with HFASD and matched controls, using a battery of standardized test measures accompanied by detailed language analysis. Establishing which skills are characteristic of adults with HFASD is a crucial first step toward understanding the impact of impaired communication on a functional skill such as employment. Without knowing exactly what kind of communication strengths and weaknesses they display, we are unable determine how their communication might interfere with success on the job and thus unable to counsel employers and co-workers about the types of communication impairment they should expect.

CHAPTER 2

Review of the Literature

The aim of this review is to summarize the current state of the science regarding the language profile in adults with HFASD and to identify gaps in the evidence. This is particularly important because it is often assumed that language skills in the HFASD population are at or above age level, (Aarons & Gittens, 1992; Church, Alisanski & Amanullah, 2000; Jordan & Powell, 1995). This perception is based on the performance of some intellectually able children and adolescents on standardized language tests that is within normal limits. As this review will demonstrate, the evidence derived from standardized test performances is mixed with regard to the integrity of language skills in people with HFASD, across the age spectrum. As a consequence, the usefulness of traditional standardized language assessments will be examined to determine whether they provide adequate and appropriate assessment of language in adults with HFASD.

Language is commonly divided into three components: form, content and use (Bloom & Lahey, 1978). Form refers to the structure of language and consists of phonology (production of speech sounds), morphology (smallest grammatical unit that contains meaning, for example, suffixes and prefixes) and syntax (how words are arranged in sentences). Content refers the meaning of language and includes vocabulary, the meanings of words, and relationships between words. Language use focuses on the functionality of language and is typically referred to as pragmatics. Language continues to develop in the areas of syntax, vocabulary and pragmatics in adulthood although the change is subtle when compared to the rapid language acquisition that occurs during early childhood (Nippold, 2007).

A systematic and comprehensive search of the literature was undertaken to identify research that focused on evaluating the oral communication skills of adults with HFASD. Databases including Medline, Eric, PsycInfo, Embase, Cinahl, ComDisDome and Scopus were searched using the following key words: Asperger syndrome (AS), pervasive

developmental disorder, Autism Spectrum Disorder (ASD), autistic disorder and/or any derivations of these terms. Articles in any of the above areas were examined if they used descriptive terms related to oral communication such as the following: language, pragmatic, linguistic, semantic, verbal, communication, speech, comprehension, impairment, characteristics, abilities, skills, fluency, disorder and competence. The search was restricted to studies that focused on adults (19 – 44 years), studies that were printed in English and studies that were published from January 1, 2000 and beyond. Articles prior to 2000 were excluded because only those published since then would include adults who had been designated as HFASD between 1981 and 1996. Prior to 1980 the designation of HFASD was rare (Engstrom et al., 2003). Every article selected for review was also examined for citations, both forward and backward, in an effort to find additional articles that met inclusion criteria. Articles identified through backward searches that were published prior to 2000 were included if they included adults with HFASD.

Literature Review Findings

This systematic search of the literature resulted in only 14 articles that specifically targeted the communication profile in adults with HFASD. As previously mentioned, most of the research in ASD has concentrated on early warning signs, early diagnosis, and the design of early intensive interventions for preschoolers, children and adolescents (Bailey, 2012; Piven & Rabins, 2011). Because the pediatric literature regarding HFASD is more comprehensive, brief summary statements regarding the communicative profile for children with HFASD are provided in an effort to link what is known about communication in the pediatric population to the communicative profile in adults. In general, the limited literature on communication skills of adults with HFASD, suggests that their profile is similar to the profile of children and adolescents with HFASD. Pragmatic skills are impaired and syntactic and semantic abilities may or may not be intact (Barnes & Baron-Cohen, 2012; Colle et al., 2008; Jolliffe & Baron-Cohen, 2000; Howlin, 2003; Lake et al., 2010; Lewis et al., 2007a, 2007b; McCabe et al., 2013; Paul et al., 2005;

Rumsey & Hamburger, 1988; Seung, 2007; Shriberg et al., 2001; Slocombe et al., 2013; Whitehouse et al., 2009a). Table 1 lists relevant characteristics of the studies that were reviewed and Table 2 provides details regarding the language measures used. The sub-domain of phonology has been rarely examined and a full examination of it was beyond the scope of this paper. Therefore, it will not be considered further. The literature regarding the other components of language is summarized below.

Table 1: Studies Identified from the Literature Review

	Author	Language Focus	Sample size: HFASD/Controls	HFASD Sample Divided? (AS, HFA/ ASD)	Age years: M (SD) HFASD	Age years: M (SD) Controls
1.	Barnes & Baron-Cohen (2012)	Pragmatics	28 /28	No	30.29 (7.78) No range reported	30.21 (8.79) No range reported
2.	Colle et al. (2008)	Syntax	12 /12	Yes 10AS 2 HFA	27.5(11.8) No range reported	27.2 (11.23) No range reported
3.	Howlin (2003)	Vocabulary	76/0	Yes 42 AS 34 HFA	Greater than 18 yrs	N/A
4.	Jolliffe & Baron-Cohen (2000)	Pragmatics	34 /17	Yes 17 AS 17 HFA	AS: 27.77 (7.84) Range: 18-49 Autism: 30.71 (7.84) Range: 19-46	30.00 (9.12) Range: 18 -49
5.	Lake et al. (2010)	Syntax	13 /13	No	27 Range: 19 – 35	Reported age-matched
6.	Lewis et al. (2007a)	Syntax Vocabulary Pragmatics	17 / 13	Yes 13 AS 4 HFA/ASD	34.8 (12.2) Range:18 – 67/	34.7 (13.6) Range: 18 - 65
7.	Lewis et al. (2007b)	Syntax Vocabulary Pragmatics	17 / 13	Yes 13 AS 4 HFA/ASD	34.8 (12.2) Range:18-67/	34.7 (13.6) Range:18 -65
8.	McCabe et al. (2013)	Syntax Pragmatics	16 / 18	Yes 9 AS 7 ASD	20.7(SD 2.8)/ No range reported	21.3 (SD 2.4) No range reported
9.	Paul et al. (2005)	Pragmatics	30 / 0	Yes 15 AS 15 HFA	AS 20.7 HFA 21.6 Range 10-49	N/A
10.	Rumsey & Hamburger (1988)	Syntax Vocabulary Pragmatics	10 /10	No	26 (SD 7) Range 18-39	28 (SD 5) Range 19-36
11.	Seung (2007)	Syntax Vocabulary Pragmatics	20 /0	Yes 10 AS 10 HFA	Range 11-49	N/A

	Author	Language Focus	Sample size: HFASD/Controls	HFASD Sample Divided? (AS, HFA/ ASD)	Age years: M (SD) HFASD	Age years: M (SD) Controls
12.	Shriberg et al. (2001)	Pragmatics	30 /53 Audio archive	15 AS 15 HFA	AS 20.7 HFA 21.6 Range 10-49	26.4 (SD 12.7)
13.	Slocombe et al. (2013)	Syntax Vocabulary Pragmatics	17/17	No	26.41 (SD 9.08) Range 18-51/	22.25 (SD 2.7) Range 19-28
14.	Whitehouse et al. (2009a)	Syntax Vocabulary Pragmatics	11/12	No	21.9 (SD 4.0) Range 16–28/	21.6 (SD 3.2) Range 18-28

Table 2: Language Focus and Measures

	Author	Language Focus	Assessments/ Language tasks	Scores Reported
1.	Barnes & Baron-Cohen (21012)	Pragmatics	Written narrative	Novel coding scheme focused on gist of narrative. Evaluated setting, character, conflict & resolution (0,1,2).
2.	Colle et al. (2008)	Syntax	Narrative retelling of 'Frog where are you?'	Novel coding scheme: (Length & episodes, Reference Analysis, Temporal Relations, Mental State Expressions)
3.	Howlin (2003)	Vocabulary	British Picture Vocabulary Scale Expressive One Word Picture Vocabulary Test	Age equivalent (AE), for those scoring beyond AE a randomized AE was assigned then subsequently rated language level : (0: Above ceiling,1: 15 yr to ceiling, 2: 12 – 14.9 yrs, 3: 10 – 11.9 yrs, 4: 8 – 9.9 yrs, 5: < 8 yrs)
4.	Jolliffe & Baron-Cohen (2000)	Pragmatics	1 Global Integration Task: (coherently organize narratives) 2 Global Inference Task (response to questions)	Novel scoring schemes 1 Accuracy of rearranging sentences (0: Inaccurate, 1: Accurate) and response time 2 Accuracy of response to questions (0: Inaccurate, 1: Accurate)
5.	Lake et al. (2010)	Syntax	Spontaneous language sample re: general interests & hobbies	Length of utterances Duration of silent & filled pauses
6.	Lewis et al. (2007a)	Syntax Vocabulary Pragmatics	Test of Language Competence – Expanded Edition	Standard test scores were converted to z-scores
7.	Lewis et al. (2007b)	Syntax Vocabulary Pragmatics	Western Aphasia Battery (WAB), Right Hemisphere Language Battery	Standard test scores
8.	McCabe et al. (2013)	Syntax Pragmatics	Personal narrative	Novel scoring schemes: High point analysis: (Topic maintenance, event sequencing, informativeness). Pragmatic referencing, conjunctive cohesion & dysfluencies
9.	Paul et al. (2005)	Pragmatics	Video-taped Structured interview samples	Prosody-Voice Screening Profile: (Judgments on Phrasing, Rate, Stress, Loudness, Pitch, Voice quality, Resonance)
10.	Rumsey & Hamburger (1988)	Syntax Vocabulary Pragmatics	Neurosensory Centre Comprehensive Examination for Aphasia, Boston Naming Test	Standard test scores
11.	Seung (2007)	Syntax Vocabulary Pragmatics	1 Test of Language Competence (TLC), 2 Narrative re: Video, 3 Question & Answer (Q&A) re: video	1 Composite score & Subtest Scores, 2 Ambiguous Pronoun Use, Lexical Productivity (# of different words & total # of words produced) 3 Number of verb tense mismatch during Q & A

	Author	Language Focus	Assessments/ Language tasks	Scores Reported
12.	Shriberg et al. (2001)	Pragmatics	Video-taped interview samples	Speech /fluency errors during conversational speech
13.	Slocombe et al. (2013)	Syntax Vocabulary Pragmatics	1 Syntactic Alignment Task 2 Lexical & Frame of Reference Alignment Task	1 Percentage of syntactic alignment 2 Percentage of lexical alignment & egocentric frame of reference
14.	Whitehouse et al. (2009)	Syntax Vocabulary Pragmatics	1 Goldman Fristoe Test of Articulation 2 British Picture Vocabulary Scale 3 Test for Reception of Grammar 4 Expression, Reception & Recall Narrative Instrument 5 York Adult Assessment 6 Communication Checklist -Adult	1 Raw error total 2 Raw scores 3 Standard scores 4 Standard scores 5 Percentage correct

Syntax.

Syntax refers to "the rule system governing the use of grammatical structures of language" (Silverman & Miller, 2006, p.37). In children with HFASD, there has been a long-standing consensus that syntax is not specifically impaired (Bartak, Rutter & Cox, 1975; Cantwell, Baker & Rutter, 1978; Pierce & Bartolucci, 1977; Rutter, 1970; Tager-Flusberg et al., 1990). Nevertheless, some children with HFASD exhibit syntactic impairment that is more significant than one would predict considering their cognitive functioning (Condouris, Meyer & Tager-Flusberg, 2003; Kjelgaard & Tager-Flusberg, 2001; Landa & Goldberg, 2005; Mc Gregor et al, 2011; Roberts, Rice & Tager-Flusberg, 2004). This is particularly true when more complex syntactic tasks are administered such as formulating a sentence incorporating a key word. There is also some evidence, albeit from studies with small sample sizes (Eigsti et al., 2007 in children; Volden & Lord, 1991 in adolescents) for disordered versus delayed syntactic development.

Studies using standardized language measures.

As mentioned above, tasks requiring more complex syntax are needed to evaluate competence in adults. Four of the 14 studies examined syntax used subtests of standardized tests to evaluate skills in sentence construction. Rumsey & Hamburger (1988) found no significant mean differences between groups of ten adults with HFASD and ten matched controls on a subtest from the Neurosensory Center Comprehensive Examination for Aphasia (Spreen & Benton, 1977) that required participants to construct sentences (Rumsey & Hamburger, 1988). However this assessment was designed for patients with aphasia and those without aphasia tend to obtain ceiling scores (Spreen & Risser, 2003). Thus a non-significant finding between the controls and the HFASD groups on this measure is likely more reflective of the assessment's limitations than a valid measure of syntactic abilities.

Using the Oral-Expression: Recreating Sentences subtest from the Test of Language Competence (TLC; Wiig & Secord, 1985) or the more recent

Test of Language Competence - Expanded (TLC-E, 1989, Wiig & Secord, 1989), Shriberg et al. (2001) and Seung (2007) found that adults with HFASD obtained scores within normal limits. This subtest involves creating sentences using targeted words (e.g., sit, painted, because) in relation to a context (e.g., in the park). Neither Shriberg nor Seung recruited a control group; participant's scores were compared to the test norms. Both samples were beyond the age limits targeted by the test and performance at ceiling may have resulted in nonsignificant differences. Using the same measure, Lewis et al. (2007a) found significantly weaker average raw scores in adults with HFASD than in a matched control group. Lewis' findings are consistent with Minshew, Goldstein and Siegel (1995) who also found impaired sentence formulation abilities on this subtest in adolescents with HFASD (mean age 17 years) when compared to test norms and matched controls.

Of the 14 studies reviewed, only one evaluated comprehension of syntax in addition to syntactic expression. Whitehouse et al., (2009a) found that a group of 11 adults with HFASD performed similarly on a test of receptive syntax (selecting a picture to match a spoken sentence) to 12 typical adults and 26 controls with language disability, all matched on nonverbal cognitive skill. Also, there was no significant group difference on the average length of utterance calculated from a story-retelling task. However, the lack of significant group differences may be due to the task. Although a story-retelling task is considered a more subtle assessment of syntactic skill than a sentence construction subtest (Paul, 2007), it may not elicit complex syntax from adults and thus may not be a sufficiently sensitive measure. Adults are more likely to use complex syntax when the task is challenging and they are knowledgeable, interested, and motivated to participate (Nippold, 2010).

Overall, consistent group differences in syntax between adults with HFASD and controls have not been reported when standardized test instruments have been administered. As in the pediatric literature, closer inspection of the data provides evidence of a possible subgroup that have

syntactic impairments. Lewis and colleagues (2007a) conducted a cluster analyses that revealed a distinct subgroup whose average performance was in excess of three standard deviations below the mean obtained by the controls, on the Oral Expression: Recreating Sentences subtest of the TLC-E (Wiig & Secord, 1989). In Seung (2007), inspection of the data also provides evidence of a HFASD subgroup with syntactic impairment. Of the 18 males classified as HFA or AS, 38% had a score on the Oral Expressions: Recreating Sentences subtest that was at least 1.5 standard deviations below the test norms.

It is also important to exercise caution in interpreting these nonsignificant syntactic findings as evidence of syntactic competence. The standardized assessments may underestimate impairment because individuals with HFASD tend to perform better on structured tasks in controlled environments than on less structured tasks in less artificial situations (Gerber, 2003). The ability to generalize these findings to the population in HFASD is also limited as the majority of studies had small sample sizes and in four of the studies (Lewis et al., 2007 a & b; Shriberg et al., 2001; Seung, 2007), samples included age ranges in excess of 40 years. Also, as mentioned above, the spread of scores in the Seung study (2007) tended to cluster at the extremes, either at ceiling or well below the normal range.

Studies using language samples.

Instead of judging syntactic skill from isolated responses to structured stimuli, a language sample provides an opportunity to evaluate syntax in spontaneous communicative contexts, thus providing a more ecologically valid assessment of productive syntax (Paul, 2007). Five studies (Colle et al., 2008; Lake et al., 2011; McCabe et al., 2013; Seung, 2007, Whitehouse et al., 2009a) utilized transcripts of language samples to evaluate syntactic abilities. Language samples were generated from a variety of conversational and narrative tasks; from discussing preferred hobbies / interests (Lake et al., 2011), to retelling the story from a children's wordless picture book

(Colle et al., 2008; Whitehouse et al., 2009a), to generating a narrative after watching a brief video (Seung, 2007), to sharing a personal narrative regarding an event (McCabe et al., 2013). These studies transcribed samples verbatim, separated the speech into utterances, and then evaluated syntactic abilities using a variety of metrics.

In typical adults, three syntactic indices have been used to capture the use of more advanced syntax (Berman & Verhoevenm, 2002; Nippold et al., 2005; Nippold et al., 2007, Scott, 1988; Scott & Windsor, 2000; Verhoevenm et al., 2002). They are mean length of utterance (MLU), clausal density and use of nominal/relative clauses. Nominal clauses express an attitude, belief or feeling introduced by the main clause and relative clauses further describe the subject or object of a sentence (Nippold, 2010). Examples of nominal and relative clauses are provided in Appendix A. Only one of these indices, MLU, has been examined previously in adults with HFASD.

MLU is calculated by taking the total number of words and dividing by the total number of utterances. An utterance is typically defined as a main clause and any accompanying dependent clauses. MLU has been found to be an important marker of later syntactic development (Berman & Verhoevenm, 2002; Scott & Windsor, 2000) and steadily increases into early adulthood (20 – 29 years; Nippold et al, 2007). A larger MLU suggests more complex syntax because expansions at the phrase and clause levels add words (Scott & Windsor, 2000). In a language sample where participants discussed their hobbies and interests, Lake et al., (2010) reported that the MLU for the control group was 9.1 versus 5.7 for the group with HFASD. Nippold (2007) suggests that typical adults average 9 or more words per utterance during conversational discourse (Nippold, 2007), so the adults with HFASD in this study were using considerably shorter sentences than matched controls and than what would be expected for adults generally. However, on the standardized story-retelling task from the ERRNI (Bishop, 2004), Whitehouse et al. (2009a) failed to find significant differences regarding MLU between adults with HFASD and matched controls. It's possible that the more artificial

task of retelling a story allowed the Whitehouse et al., (2009a) participants to perform as well as the participants in the ERRNI standardization sample in comparison to the spontaneous conversation in the Lake et al. (2010) study.

The second metric is clausal density, which refers to the average number of clauses per utterance. Clausal density includes both independent and dependent clauses, and is calculated by dividing the total number of clauses by the total number of utterances per sample. An independent clause refers to a complete sentence that contains a main verb and is autonomous. For example, 'I *like* my job' is considered an independent clause with *like* as the main verb. In contrast, a dependent clause must be attached to a main clause and does not make sense on its own. For instance, 'when I am working on my computer' is not a sentence until it is combined with a main clause like 'I close my office door, when I am working on the computer.' Clausal density increases during adolescence (Scott, 1988) and in the early adult years (Nippold et al., 2005). Higher clausal densities (greater than or equal to 1.3) indicate more efficient expression of ideas (Paul, 2007). For example, instead of "I went to California. I saw a movie" one can say "When I went to California, I saw a movie". None of the reviewed studies with adults with HFASD specifically reported on clausal density.

Although none of the studies reported on clausal density per se, Colle et al. (2008) reported on the mean number of sentences that contained subordinate clauses. There were no significant group differences between adults with HFASD and matched controls on the number of sentences containing subordinate clauses in their story-telling task. However, the elicitation context, telling the story from a child's wordless picture book, may have been too juvenile to elicit the use of more complex syntax (Nippold, 2010). When participants related a personal experience (McCabe et al., 2013), significant differences were found regarding the use of subordinate conjunctions, the grammatical component often used to introduce subordinate clauses. In McCabe et al. (2013), control participants, on average, used a higher proportion of conjunctions to introduce clauses than

adults with HFASD (Control $\underline{M}$= 0.52; HFASD $\underline{M}$=0.28; [t(32) = -4.056, p< .001]) thus displaying a greater number and more sophisticated use of dependent clauses. The final index, which examines the use of nominal and relative clauses, was not investigated in any of the 14 studies that were reviewed.

In summary, there is conflicting evidence about syntactic complexity from the studies that utilized language samples. Lake et al., (2010) found that adults with HFASD used shorter utterances than controls while Whitehouse et al. (2009a) did not find significant differences compared to test norms, although differing results may well be explained by differences between the tasks. Using more subtle measurements such as the use of conjunctions, McCabe et al., (2013) suggest that the HFASD group appear to be less efficient at generating personal narratives. Research that evaluates the three syntactic indices that are noted to improve from adolescence into adulthood is clearly needed. Furthermore, studies that employ sampling tasks that elicit more complex syntax, such as expository (explaining how to do something) and persuasive (arguing a controversial point of view) discourse are required to develop a better understanding of syntactic abilities and possible differences in adults with HFASD. These types of discourse tasks are more reflective of the demands faced by adults in higher education and in the work environment and more likely to elicit complex syntax (Nippold, 2010). The current research evaluated two of these indices (MLU and clausal density) using a conversational/expository sampling task that is more reflective of an adult interaction.

Semantics.

Semantics involves "the rule system governing how words are used" (Silverman & Miller, 2006, p.37). All of the studies on adults with HFASD examined semantic skills via participant vocabulary. Vocabulary has been identified as a relative strength in the child and adolescent populations with ASD (Boucher, 1988; Eigsti et al., 2007; Fein et al., 1996; Tager-Flusberg, 1991) and Minshew and colleagues (1993) found that the basic vocabulary

abilities of adolescents with HFASD were comparable to test norms. However, a history of neologisms (invented words) is documented in HFASD (Miller & Ozonoff, 2000; Noterdaeme, Wriedt & Hohne, 2010, Volden & Lord, 1991). Invented words (e.g., bloosers for bruises) may indicate deviant versus delayed language development (Volden & Lord, 1991). Although rare, children and adolescents with HFASD have been found to use peculiar words (Volden, 2002) and neologisms (Volden & Lord, 1991). Volden and Lord (1991) also suggested that words might appear to be "unusual" or "peculiar" if there was a discrepancy between the word's level of sophistication and the nature of a specific task. For example, if a speaker referred to washing dishes as "eliminating the detritus of a meal", use of "detritus" in that context is likely to be judged peculiar.

Studies using standardized measures.

In the literature on adults with HFASD, vocabulary has been investigated using single-word receptive and expressive vocabulary tests. Four adult studies found impaired receptive vocabulary in adults with HFASD (Howlin, 2003; Lewis et al., 2007b; Rumsey & Hamburger, 1988; Whitehouse et al., 2009a). Adults with HFASD were less able, when compared to test norms (Howlin, 2003) and when compared to unaffected controls matched on nonverbal IQ (Whitehouse et al., 2009a), to identify single vocabulary items from a selection of four pictures. In terms of expressive vocabulary, adults with HFASD were also less able to generate a key word in relation to a picture when compared to test norms (Howlin, 2003) and to unaffected controls matched on nonverbal IQ (Lewis et al., 2007b) or full scale IQ (Rumsey & Hamburger, 1988). Rumsey and Hamburger (1988) also noted "peculiar word choices" in a few participants with HFASD although examples were not provided. Although all of these studies identified vocabulary impairment in adults with HFASD, these results need to be interpreted with caution as the limitations previously mentioned in the syntactic domain (i.e., broad age ranges in the participant groups, participants beyond age of test norms), also apply to these studies regarding vocabulary.

Studies using language samples.

Language samples could also be used to evaluate vocabulary. In comparison to children and adolescents, adults have more extensive vocabularies and are more proficient in their use (Nippold, 2007). One easily calculated measure used to describe advanced vocabulary development is lexical diversity (Johansson, 2008). Lexical diversity refers to the speaker's use of many different words. Measures such as Type-Token Ratio (TTR; Templin, 1957) and number of different words (NDW) have been used to assess lexical diversity. TTR is calculated by dividing the number of different words by the total number of words. A TTR close to 1.0 indicates a varied vocabulary; whereas a TTR close to 0 suggests a limited, repetitive vocabulary (Kemper & Sumner, 2001). The NDW index counts the number of different word roots in a language sample (Scott, 2008). For both diversity measures, the length of the sample needs to be controlled in order to interpret the data. TTR decreases with increasing sample size due to the frequent use of closed class words, such as articles, which negatively influence the ratio whereas NDW increases with increasing length of sample (Scott, 2008).

In order to capture the possible use of unusually sophisticated vocabulary, online word frequency text profilers, such as, the Vocabprofiler (www.lextutor.ca), can be used. The text analyzer identifies word choices in conversation that are, or that are not, found in the 2000 most frequent word family lists and the academic word list (550 words that are frequent in academic texts across subjects; Laufer & Nation, 1995) in spoken English (Heatley, Nation & Coxhead, 2002).

Very few studies were found that evaluated language samples of adults with HFASD in terms of the above measures, perhaps because vocabulary has always been considered an area of relative strength in children with HFASD. Seung (2007) reported that the number of different words (NDW) and the total number of words (TNW) were similar for individuals with HFA and AS. Unfortunately without knowing the number of utterances and with no

control group the findings fail to provide evidence for or against intact vocabulary in adults with HFASD. The current research investigated whether or not indices of vocabulary differed between adults with HFASD and controls using TTR as a measure of lexical diversity, and using a text analyzer to assess the use of sophisticated vocabulary.

Studies using an informant questionnaire (phonology, semantics and syntax).

Only one study (Whitehouse et al., 2009a) administered a checklist, the Communication Checklist – Adult (CC-A; Whitehouse & Bishop, 2009), where phonology, semantics and syntactic abilities were combined and could not be teased apart. The CC-A is a newly devised informant questionnaire that measures structural language abilities, pragmatic skills, and social relations and interests. On the CC-A, adults with HFASD (n=11) had significantly worse structural language than typical controls (n=12; Whitehouse et al., 2009a). This is a significant finding as the CC-A provides information regarding a person's use of language from an informant's perspective derived from daily interactions with the participant. These findings are in contrast to the formal language assessments administered that evaluated knowledge of language structures and failed to detect any differences (Whitehouse, et al., 2009a).

Pragmatics.

In the research literature the term pragmatics is often used interchangeably with social communication as pragmatic abilities are deemed the key component in social communicative interactions (Adams, 2005). However, social communication also includes social interaction, social cognition, and language processing, in addition to pragmatic abilities (McTear & Conti-Ramsden, 1991). For this study the term pragmatics does not refer to this broader definition but is focused on language development that involves "learning the rules for tailoring language forms and expression of meaning to fit the social demands of the linguistic and nonlinguistic context" (Landa, 2000, p.128). Pragmatic language skills encompass a wide array of skills that have been organized into various domains for clinical purposes

22

(Adams, 2002; Paul, 2010; Prutting & Kirchner, 1987). Whichever model is selected they commonly target 'why we talk', also referred to as communicative functions or speech acts (Adams, 2002; Paul, 2010; Prutting & Kirchner, 1987). Individuals use language for a variety of different purposes, for example to greet, to comment, to protest, to request and to narrate/share a personal experience. The ability to form and to respond to communicative acts becomes more sophisticated over time. For example, a request for a drink may be communicated in a variety of ways: by pointing at the desired item, by using the word 'juice', by using more polite forms (e.g. 'May I have some juice please?'), or by using more subtle nonliteral requests (e.g. 'My throat's dry.' or 'It sure would be nice to wet my whistle.').

The second area commonly addressed is the ability to adjust language according to the listener or situation (Paul 2010, Prutting & Kirchner, 1987). For example, a speaker simplifies language when engaging with a child versus an adult or talks quietly to a colleague while they are attending a presentation than in the staff room at lunch. The third area of pragmatics involves the often unstated, but learned, rules of conversations (Paul, 2007) including how to initiate and sustain a conversation, how to remain on topic and how to repair breakdowns during discourse (Adams, 2002; Paul, 2010; Prutting & Kirchner, 1987). The fourth domain is presupposition or manner of communication. This requires the speaker to consider what the listener needs to know and what the listener already knows. Thus a speaker needs to provide orderly and relevant responses, be informative, and use cohesive devices (e.g., pronouns) so as not to be redundant (Adams, 2002; Paul, 2010; Prutting & Kirchner, 1987). A final domain encompasses paralinguistic aspects of language (Paul, 2010; Prutting & Kirchner, 1987). This includes vocal intensity, vocal quality, prosody (appropriate rhythm and intonation) and fluency.

Recently, Russell and Grizzle (2008) reported on the pragmatic language competencies that were evaluated in 24 existing pragmatic language assessments, observational checklists, and informant

questionnaires. The standardized assessments reviewed by Russell and Grizzle (2008) tended to focus on the assessment of specific communicative functions, specifically requests and greetings, as well as on skill in generating narratives and on later developing pragmatic skills such as understanding nonliteral language (e.g., idioms/figures of speech, humor, and sarcasm). Checklists based on observing the child in an interaction and informant questionnaires also tended to focus on specific communicative functions, such as greeting, requesting, persuading, but also captured a) conversational management (e.g., topic maintenance, turn-taking, conversational repair), b) register variation (e.g., politeness, slang and figurative language use), and c) presupposition/manner of communication. During interactive samples, speech characteristics (e.g., tone of voice/prosody) and fluency were also commonly evaluated (Russell & Grizzle, 2008).

As previously mentioned, impairments in pragmatics are viewed as universal in ASD (Landa 2000; Paul, et al., 2009; Tager-Flusberg et al., 2005; Young, Diehl, Morris, Hyman & Bennetto, 2005) but satisfactory assessment of pragmatics has always been problematic. Pragmatic skills are influenced by culture, vary according to context or situation and may be influenced by individual style (Adams, 2002). This variability, coupled with the broad array of skills encompassed by the term "pragmatic skills", make testing this skill in a traditional standardized test format challenging. The few standardized assessments that do exist also fail to adequately capture the range of pragmatic deficits that characterize the individual with HFASD (Bishop, 1998). For example, one standardized assessment may evaluate an individual's ability to detect humor where another standardized assessment may capture an individual's ability to understand figurative language (Russell & Grizzle, 2007). These assessments provide useful information regarding one or more specific pragmatic skills but provide limited information regarding a person's ability to converse in various contexts with different communication partners. In addition, performance on these standardized measures may not generalize to pragmatic skill use in interactive situations

(Volden, Coolican, Garon, White & Bryson, 2009). Traditional assessments also compare a person's performance on a single occasion to a normative sample. This is problematic because it's unlikely that the performance on that one occasion is representative of an individual's pragmatic abilities in all contexts and with all communicative partners (Adams, 2002).

Pragmatic abilities in ASD have been studied for several decades and child and adolescent studies have found that individuals with HFASD exhibit a vast range of specific pragmatic difficulties when compared to matched controls. For example, they appear to be overly literal in their language comprehension (Baron-Cohen, 1997, Happe, 1993; Happe, 1996), are less able to infer meaning from context (Loukusa & Moilanen, 2009) and have difficulty interpreting narrative humor (Ozonoff & Miller, 1996). Young children with ASD rely more on requests and protests to initiate social contact, a pattern that is not seen in typically developing children (Wetherby & Prutting, 1984). They also communicate at a significantly lower rate than typically developing children (Shumway & Wetherby, 2009). In relation to discourse management they have difficulty initiating and maintaining conversations with others (Loveland, Landry, Hughes, Hall & McEvoy, 1988). They tend to switch topics abruptly (Adams, 2002; Eales, 1993; Tager-Flusberg & Anderson, 1991), to drift or stray from the topic (de Villiers et al., 2007; Paul, et al., 2009), and often fail to respond to questions or comments (Capps et al., 1998). Their ability to vary register has also been found to be impaired as they are less capable at altering speaking styles than controls (Volden, Magill-Evans, Goulden, & Clarke, 2007) and they often fail to use slang expressions that are typically used by their peers (Adreon & Durocher, 2007). Finally with regards to presupposition/manner of communication they are less attentive to listener's needs (Fine, Bartolucci, Szatmari & Ginsberg, 1994), tend to provide either too much or too little detail during conversational interactions (Volden, 2002), use utterances that do not relate to the topic of the previous utterance (Hale & Tager-Flusberg, 2005) and use odd utterances that disrupt the flow of conversation (Volden 2002).

Although the adult literature is not nearly as comprehensive regarding the variety of pragmatic impairments in adults with HFASD, 12 studies in our review reported on pragmatic language skills and 11 of them identified impairment regarding pragmatic skills in adults with HFASD. The results from standardized language assessments that evaluated comprehension of pragmatic competencies will be discussed first. This will be followed by a review of pragmatic language abilities assessed using language samples. The section will conclude with results from a published checklist that evaluates pragmatic language competencies more broadly.

Studies using standardized language measures.

Four studies (Lewis et al., 2007a & b; Seung, 2007; Shriberg et al., 2001) used norm-referenced assessments to report on pragmatic abilities in adults with HFASD. As previously discussed, standardized assessments are of limited utility, but three studies (Lewis et al., 2007a; Seung, 2007; Shriberg et al., 2001) reported on the understanding of nonliteral language in adults with HFASD. Each administered the Figurative Language subtest from the TLC or TLC-E (Wiig & Secord, 1985; TLC-E; Wiig & Secord, 1989). This subtest requires the participant to interpret an utterance like 'She sure casts a spell over me' in relation to a situation (e.g., boys talking about a girl at a dance). Mean subtest standard scores for the HFASD group were within normal limits ($\underline{M}$=8.5, SD= 3.87; Seung, 2007; $\underline{M}$= 7.75, SD= 3.9; Shriberg et al., 2001). These results should be interpreted with caution as neither study had a control group, the adults with HFASD were older than the age limits covered by test norms and ceiling effects may have masked impairments. When average raw scores for adults with HFASD ($\underline{M}$=24, SD=10) were compared to matched controls ($\underline{M}$=33, SD=4), Lewis et al. (2007a) found significantly weaker (t=-3.274, p= 0.002) performance in the adults with HFASD compared to controls. In a subsequent study, Lewis and colleagues (2007b) further investigated the pragmatic profile of adults with HFASD by administering the Right Hemisphere Language Battery (Bryan, 1989). The authors indicated that although this test was designed for adults

with right hemisphere brain damage it is one of the few adult instruments available that evaluates understanding of humor. The HFASD group (M=46.88, SD=12.79) was significantly less skilled (*t*=-6.30, *p*=0.004) at appreciating humor compared to the matched controls (M=52.15, SD=4.06). Similar results were reported by Martin and McDonald (2004), who noted that adults with HFASD misinterpreted significantly more ironic jokes than matched controls.

Studies using language samples.

Although language samples provide opportunities to investigate communicative functions, conversational management, register variation and presupposition/manner of communication, the studies on adults with HFASD focused only on skills in two of these pragmatic domains: conversational management and presupposition/manner of communication.

Conversational management: Responsiveness.

One aspect of conversational management is responsiveness or how attentive a speaker is to their conversational partner. Adults with HFASD were found to be less responsive than controls during conversational exchanges. Lake et al. (2010) indicated that even when frequent prompts were provided to sustain the interaction, adults with HFASD (n=13) responded to questions 84.5% of the time compared with a 99% response rate in the control group. Seung (2007) also noted that in conversation, when a query combined 'what' and 'why', participants with HFASD would more frequently respond to the 'what', and neglect the 'why', portion of the question.

Responsiveness was also measured by the frequency of 'ums' and 'uhs' interjected during a conversational exchange. Lake et al., (2010) found that adults with HFASD produced significantly fewer interjections (M=1.7) but more silent pauses (M=4.0) compared to the 13 unaffected controls (M=5.0 and 0.0, respectively). The majority (68%) of silent pauses occurred at the beginning of utterances for the adults with HFASD and at essentially the same rate as 'ums' or 'uhs' in the control group (Lake et al., 2010). The

authors suggested that using silent pauses rather than interjections makes it challenging for the listener to discern who is holding the conversational floor and whether or not the conversational partner should speak. This confusion between speakers may ultimately result in a communication breakdown.

Recently, Slocombe and colleagues (Slocombe et al., 2013) investigated conversational responsiveness in dyads, by evaluating linguistic alignment during structured tasks. Linguistic alignment refers to "the process by which interlocutors converge with their conversational partner on a number of different linguistic levels" (Slocombe et al., 2013, pp. 1424). The authors investigated linguistic alignment at semantic, syntactic, and referential levels. Seventeen adults with HFASD were compared to 17 controls. No significant differences between the groups were found between adults with HFASD and controls in any condition. Contrary to Lake et al. (2010) and Seung (2007), results from this study suggested that adults with HFASD were attending to the communicative partner in goal-directed interactions (Slocombe et al., 2013). However this was a highly structured task in comparison to the dynamic conversations in the other studies. The nonsignificant mean differences may reflect the ability of adults with HFASD to perform better on structured tasks in controlled environments than on less structured tasks in more natural situations (Gerber, 2003).

Conversational management: Breakdown and repair.

Another aspect of conversational management is conversational repair or how a speaker handles a breakdown in conversation with their communication partner. Lake et al. (2010) investigated conversational repairs and found that the HFASD group (n=13) rarely revised their speech (M rank= 2.7 per hundred words) in comparison to the control group (M rank= 3.8 per hundred words; $U(25)=129$, $z= 2.28$, $p=.02$). The adults with HFASD were less likely to clarify their utterances. Unfortunately, it wasn't clear how many of the utterances in the language sample actually needed to be revised. Thus, further investigation is necessary to determine if adults with HFASD just make fewer errors, if they don't detect their errors or, as the

authors suggested, they are conscious of their formulation problems but are unlikely to revise or clarify because they are unaware of the influence their errors may have on a conversational partner.

Presupposition/manner of communication.

The second pragmatic domain that was investigated using language samples was presupposition/manner of communication. Skills in this domain include using cohesive devices (e.g. "**Bill** is whiz when it comes to computers. **He** is able to fix any problem." The pronoun '**he'** is a cohesive device that links the two sentences together), giving orderly and relevant details, and being appropriately informative (Paul, 2005). Narratives (e.g., generating a story from a wordless picture book, retelling a story after hearing a model and providing a description of a personal event) are often chosen as an assessment vehicle rather than conversation because narratives require the speaker to recall a sequence of events and share them in a coherent fashion with a listener.

Presupposition/manner of communication: Cohesive devices.

The use of cohesive devices is used as an index of whether or not narratives produced by adults with HFASD are more confusing than narratives produced by adult controls. Take the following example, "Suzy and Jane went to the dog show. She was particularly fond of the Golden Retrievers." The reference 'she' is considered an ambiguous cohesive device because the listener cannot discern whether 'she' refers to Suzy or Jane. Using ambiguous cohesive devices can lead to confusion for the listener and ultimately to communication breakdowns. Adults with HFASD had significantly more ambiguous pronominal references in comparison to the control group whether the task was generating a personal narrative (McCabe et al., 2013) or retelling a story task (Colle et al., 2013). Seung (2007), whose participants retold a story from a video clip, also noted ambiguous pronoun usage in adults with HFA and AS. Adults with HFASD were also reported to use more nominal phrases (e.g., 'The boy …') versus personal

pronouns (e.g., 'He …'; Colle et al., 2013) suggesting that they were less adept at shifting from using proper nouns to pronouns.

Presupposition/manner of communication: Orderliness/relevance.

Another aspect of presupposition/manner of communication is the use of orderly and relevant responses or monologues. Regardless of the coding system used in analysis, adults with HFASD produced poorer quality narratives than controls (Barnes & Baron-Cohen, 2012; McCabe et al., 2013). Adults with HFASD included fewer "big picture" story elements in story retelling tasks (Barnes & Baron-Cohen, 2012) and their personal narratives lacked complexity (McCabe et al., 2013). In fact, the personal narratives from adults with HFASD were similar in quality to the narratives produced by preschool children with the majority of adults with HFASD producing only logical/causal sequences of events as opposed to stories that included a series of events, an apex and conclusion/resolution (McCabe et al., 2013).

Presupposition/manner of communication: Informativeness.

The overall informativeness of narratives was also examined. McCabe et al., (2013) reported that the personal narratives of the adults with HFASD contained either too many irrelevant details or grossly lacked sufficient detail. Similar impairments have been reported in the pediatric population (Capps et al., 1998; Hale & Tager-Flusberg, 2005; Paul et al., 2009; Volden, 2002).

Speech Characteristics and Fluency.

The final pragmatic domain evaluated in the adult literature was prosody, defined as the appropriate intonation and rhythm of a speaker, and fluency. Shriberg et al., (2001) used the Prosody-Voice Screening Profile (Shriberg, Kwiatkowski & Rasmussen, 1990) to document the prosody-voice profile in a sample of 30 individuals with HFASD (Mean Age= 21.15, SD: 10.85) and compared these profiles to an archived database of speakers with typical speech development. They found that the speech of 30 adults with HFASD was notably louder, more nasal, at a higher pitch and lacked "pragmatic stress" compared to the control sample. Pragmatic stress refers to how emphasis can influence the interpretation a listener gives to an

utterance. For example, an angry speaker is likely to emphasize key words ('**I'm** leaving **now. I** am **going** to **ride** my **bike**!') while the happy/excited speaker may emphasize the same words in a different way ('I'm leaving **now** I am going to ride my **bike**!'). In this example, the sentence structure remains the same but the pragmatic prosody provides the listener with additional cues to interpret the speaker's intended meaning. Failure to provide appropriate pragmatic stress suggests that adults with HFASD may fail to provide listeners with enough information to clarify their intentions.

The speech of the participants with HFASD was also less fluent containing on average fewer fluent utterances (~75%) in comparison to the control group (86.3%). The most common disfluency reported was sound/ syllable repetitions (e.g., ba ba ba ball). Other studies with adults with HFASD (Lake et al., 2010; McCabe et al., 2013) also noted an increased rate of disfluency and rates of repetitions. Although the magnitude of these differences was small, Paul et al. (2009) found that some unusual prosodic characteristics, such as nasality and lack of pragmatic stress, negatively influenced social/communication ratings as measured by a standardized semi-structured caregiver interview. These two studies suggest that unusual speech/prosody characteristics are present in at least some adults with HFASD and may negatively influence their social/communication interactions with others.

Studies using an informant questionnaire.

Thus far the pragmatic language skills in the adults with HFASD have been evaluated using either traditional standardized tests or language samples. Only one study (Whitehouse et al., 2009a) used an alternative assessment, a pragmatic checklist, to evaluate pragmatic language abilities in this population. Pragmatic checklists are appealing because they are quick and easy to administer in comparison to conducting traditional assessments or analyzing language samples. They also provide information about pragmatic skills or deficits that occur infrequently, but are nonetheless salient. Thus, a pragmatic checklist captures pragmatic behaviours that may

be missed on formal language assessments or that are challenging to sample (Adams, 2002). Currently, the Children's Communication Checklist -2 (CCC-2; Bishop, 2003) is considered the 'gold standard' for this type of checklist as it has normative data and reports high sensitivity (.89) and specificity (.97) for identifying children with autistic and social pragmatic impairment (Bishop, 2006). It also probes the broadest range of pragmatic behaviours in comparison to other pragmatic checklists (Russell & Grizzle, 2008). The CCC-2 and the upward extension, the Communication Checklist –Adult (CC-A; Whitehouse & Bishop, 2009) measure pragmatic language ability broadly, considering how a person converses in various contexts with a variety of communication partners. Whitehouse et al. (2009a) found that adults with HFASD (n=11) had significantly worse pragmatic performance on the Pragmatic Language Composite of the CC-A than typical controls (n=12).

Overall, regardless of the method used to examine pragmatic language, all but one of the studies (Slocombe et al., 2013) found that adults with HFASD presented with pragmatic impairments. The pragmatic task utilized in the study conducted by Slocombe et al. (2013) was highly structured. The nonsignificant mean differences reported there may reflect the ability of adults with HFASD to perform better on structured tasks in controlled environments than on less structured tasks in more natural situations (Gerber, 2003). Findings from the remaining studies indicated that adults with HFASD were less skilled at interpreting nonliteral language. They exhibited less sophisticated conversational management and their narratives lacked complexity and were confusing in comparison to controls. Concerns regarding speech characteristics and fluency were also noted in comparison to controls and negatively influenced their social/communication interactions with others. These findings are not surprising given that pragmatics of communication is universally impaired in HFASD (Tager-Flusberg et al., 2005).

Summarizing the literature across the domains of syntax, semantics and pragmatics, those studies that utilized standardized assessments (Howlin,

2003; Lewis et al., 2007a & 2007b; Paul et al., 2009; Rumsey & Hamburger, 1988; Seung, 2007; Shriberg et al., 2001 & Whitehouse et al., 2009) found significant communication impairment in adults with HFASD across language domains. Others (Lewis et al., 2007a; Seung, 2007) found evidence of a subgroup that has also been noted in the pediatric HFASD literature. More widespread communicative impairment is consistent with the results of Eigsti et al. (2007), Condouris et al., (2003) Landa and Goldberg (2005), and McGregor et al., (2011) all who found evidence of more impairment on syntax and vocabulary than would have been expected given participants' typical cognitive level. This raises the possibility that there may be a subgroup of adults with HFASD that have subtle impairments in communication domains other than pragmatics. Clearly further research is needed with larger samples to be able to investigate more closely the heterogeneity that exists within HFASD.

Six of the 14 studies identified in the literature review elicited language samples in an effort to evaluate language in more natural contexts (Barnes & Baron-Cohen, 2012; Colle et al., 2008; Lake et al., 2013; McCabe et al., 2013; Seung, 2007; Shriberg et al., 2001). Unfortunately, none of them investigated vocabulary abilities in comparison to controls, but they did confirm pragmatic impairments and they identified possible impairments in syntax. Finding syntactic impairments was surprising because the activities that generated the language samples might have been considered too juvenile to engage adults (e.g., generating a story from a child's wordless picture book) or to challenge their syntactic skills.

Methods for language analysis in adults are still relatively undeveloped and sampling context/genre needs to be carefully considered as it can influence syntactic complexity (Nippold, 2010). For example, conversations are the least formal and least demanding syntactically in comparison to expository discourse or persuasive discourse. The latter two forms should elicit the most complex language, because the speaker is primarily responsible for successful communication and the level of conceptualization

required is more sophisticated. Because the tasks used in the studies that were available for review were not particularly complex or challenging it is possible that as the demands increase that the syntactic impairments in adults with HFASD will also increase in comparison to matched controls.

Overall, this literature review found only 14 articles that focused on the communication profile in adults with HFASD. As expected, the evidence suggests that adults with HFASD have pragmatic impairments. Although the findings have been somewhat mixed, the literature also suggests that at least some adults with HFASD have impairments in vocabulary and syntax. This profile is similar to profiles of children with Specific Language Impairment (SLI; Kjelgaard & Tager-Flusberg, 2001; Roberts, Rice & Tager-Flusberg, 2004). SLI refers to a disorder "in which children perform below age expectations on language measures despite having adequate cognitive and sensory skills for typical development" (Rice, Warren & Betz, 2005, p.11).

Since the identification and support of adults with HFASD is now a research priority (The Interagency Autism Coordinating Committee - IACC, 2011), it's important to determine the range of communicative impairments that are characteristic of adults with HFASD, using measures that are sensitive enough to identify even subtle impairments. Unfortunately, until recently, language development was believed to be complete by late adolescence. As a consequence, typical adult language development has rarely been studied and there are very few instruments that have been designed to assess language in adults. Nonetheless, the study reported here aims to describe a comprehensive profile of the communication of high-functioning adults with ASD in comparison to a matched control group using a comprehensive battery of standardized assessments as well as a detailed language sample from a simulated job interview. This will provide the first detailed profile of linguistic and communicative skills for adults with HFA.

Assessment in the Adult Population – A Comprehensive Process

Investigators who wished to examine adult language in HFASD have used the only standardized tools available those that are designed for neurologically impaired populations such as adults with aphasia following a stroke or those with traumatic brain injury (Lewis et al., 2007b; Rumsey & Hamburger, 1988). It is not clear that instruments designed to assess the neurologically damaged language system are valid for evaluating developmentally disabled language skills (Hegde & Pomaville, 2012). The situation is so dire that using assessments designed for children has even been recommended (Stoddart et al., 2012), but they may also be inappropriate because their norms frequently fail to extend beyond early adulthood (i.e., 18 – 21 years of age).

Research for adults with HFASD has dealt with this issue in a variety of ways. Forced to use formal assessments that were standardized on a younger population, Howlin (2003) opted to report results using age equivalents, while Lewis et al., (2007b,) and Whitehouse et al., (2009a) opted to report results using raw scores. Others reported standard scores based on the oldest age band (Lewis et al., 2007a, Seung 2007 & Shriberg et al., 2001). Although some studies (Seung, 2007; Shriberg, et al., 2001; Whitehouse et al., 2009a) have reported no differences between adults with HFASD and controls it is possible that ceiling effects may have masked true differences (Howlin, 2003). It is also possible that the tests of advanced language are not sensitive enough to overcome the powerful cognitive strategies intellectually able adults draw upon in the structured testing environment (Paul, 2005). Individuals with HFASD also perform better on structured tasks in controlled environments than on less structured tasks in less artificial situations (Gerber, 2003).

Standardized tests: vocabulary and syntax.

There is an urgent demand for assessment tools that evaluate later developing, complex language skills that more specifically measure this population's needs. The *Test of Adolescent and Adult Language-4 (TOAL-4,*

Hammill, Brown, Larsen & Wiederholt, 2007) may address some of these limitations. Vocabulary, syntax and graphology (i.e., conventions governing handwriting) are assessed by the TOAL-4. This assessment has test norms based on a sample of 1,671 adults between 19 and 24 years 11 months of age thus extending language norms beyond 21 years. The manual also indicates that special care was taken to avoid ceiling effects in the design of the subtests. Vocabulary abilities are measured with the Word Opposites (i.e., generate an antonym), Word Similarities (i.e., generate a synonym) and Spoken Analogies (i.e., complete an analogy) subtests. These subtests are more sophisticated measures of vocabulary than the single word-naming tasks that commonly have been used to evaluate expressive vocabulary (Larson & McKinley, 2007). The Sentence Combining (i.e., combine two sentences into a single sentence) and the Word Derivations subtests assess syntactic abilities. In the Word Derivations subtest the respondent is given a key word (e.g., laugh) and listens to two sentences. In the second sentence the final word is missing (e.g., 'The play was funny. The audience broke out _____'). The respondent is required to use a derivation of the key word to complete the second sentence (e.g., 'laughing'). Hammill and colleagues (2007) claim that these syntactic subtests are more reflective of language use than the syntactic subtests on previous editions of the TOAL. Reviews conducted in the Mental Measurements Yearbook (Langlois, 2010; Vetter, 2010) suggest that the TOAL-4 is a reliable and valid instrument. The test – retest reliability exceeded 0.80 on all subtests, inter-rater reliability exceeded 0.80 and results from the TOAL-4 are highly correlated (0.80) with measures of verbal cognition (Hammill et al., 2007). However, a shortcoming of the TOAL-4 is that it fails to address pragmatic language abilities.

Standardized tests: pragmatics.

Although the evaluation of pragmatic language skills using formal assessments is challenging, a more recent assessment, the *Comprehensive Assessment of Spoken Language* (Carrow-Woolfolk, 1999), has been recommended as a possible assessment for individuals with HFASD (Paul,

2005). For adults, two subtests from the CASL, Pragmatic Judgment and Nonliteral Language measure elements of pragmatic language. The Pragmatic Judgment subtest requires a respondent to generate an answer that is appropriate to the situation (e.g., 'Suppose the telephone rings. You pick it up. What do you say?'). This subtest addresses 10 of Russell and Grizzle's (2008) 17 pragmatic domains, more than any other of the standardized measures evaluated. The Nonliteral Language subtest requires a respondent to explain nonliteral meaning (e.g. 'When 5-year old Jimmy started pulling his sister's hair, Dad said, "Jim you're not a puppy anymore." What did he mean?'). Together these two subtests evaluate a broad range of pragmatic skills, including basic competencies required to participate in an interaction (e.g., rituals/ greetings/ good byes), the ability to sustain a brief interaction (e.g., conversational turns and maintenance), and the ability to extend discourse (e.g., nonliteral language and negotiations/ directions/ instructions) (Russell & Grizzle, 2008). Children and adolescents with HFASD had impaired performance on the Pragmatic Judgment subtest (Reichow, Salamack, Paul, Volkmar & Klin, 2008) so it may be a useful component of a comprehensive assessment for individuals with HFASD.

Although the subtests from the CASL address a range of pragmatic skills, an informant questionnaire has the potential to capture communication behaviors that may occur infrequently but are nonetheless salient and may be missed by traditional language assessments (Bishop, 2003*). The Communication Checklist – Adult (CC-A, Whitehouse & Bishop, 2009),* measures pragmatic language abilities. As previously mentioned the CC-A measures the broadest number of pragmatic abilities in comparison to other pragmatic checklists (Russell & Grizzle, 2008) and is the only checklist that includes norms for adults.

Language sampling: Sampling context.

Obtaining a language sample provides an opportunity to determine how an individual integrates the various domains of language in an ecologically valid context, in contrast to that provided by the standardized language test

environment (Hammett Price, Hendricks & Cook, 2010; Landa, 2000; Nippold, 2010). Additionally, language samples provide a more discriminating measure of language skills than most standardized language measures (Bishop, 2003; Klin, Sparrow, Marans, Carter & Volkmar, 2000) because true productive syntax is elicited when an individual generates a message in a dynamic interactional context rather than in the predictable structure of a testing environment (Landa, 2000; Paul, 2005). Given the limited number of formal language assessments for adults and the limitation listed above, it is important that assessments in HFASD include evaluations of real life interactions in order to evaluate communication skills in more naturalistic contexts (Bartlett, Armstrong & Roberts, 2005; Mawhood, Howlin & Rutter, 2000). However, careful consideration needs to be given to the sampling context as vocabulary, syntax and pragmatic language vary widely depending on the genre. As previously mentioned, conversational discourse is more informal and communicatively less demanding than expository discourse (Nippold, 2010). For adults, expository and persuasive samples are the most effective at eliciting later-developing syntactic markers. They also reflect real life communication demands (Nippold, 2007; Scott, 2010). In addition, competence with these discourse genres is important for "personal satisfaction, social success, school achievement, and effective communication in the workplace" (Nippold, 2010, pp.305).

Recently Nippold and colleagues (Nippold et al., 2007) elicited expository discourse in a sample of children, adolescents and adults, using a peer conflict resolution (PCR) task The PCR task consisted of two scenarios concerning conflicts between young people, one occurring in a school setting and the other occurring in a work setting. After listening to the scenarios participants retold the situation and answered a brief series of questions about the nature of the problem, how it should be handled, and what the consequences of that strategy might be. The interpretation of the conflict engaged the participants in expository discourse, as the responses to the questions required explanations and opinions (McFadden, 1991).

Syntactic indices.

Measures of syntactic complexity (i.e., mean length of utterances and clausal density as previously defined) were larger in the adult group in comparison to the adolescent and child groups (Nippold, et al., 2007). A larger mean length of utterance and a higher subordination index suggest more complex syntax because expansions at the phrase and clause levels add words (Nippold, 2007, Scott & Windsor, 2000). It appears that the PCR task is useful for eliciting complex syntax and Nippold et al. (2007) have begun to establish a normative database that could be used when assessing adults, including those with HFASD.

Vocabulary.

When evaluating language samples the most commonly used vocabulary measure is lexical diversity (Scott, 2010). However, language samples may also be evaluated using an online word frequency text profiler that indicates whether or not a person's word choices are amongst the most common 2000 word families and the academic English word list in spoken English (Heatley, Nation & Coxhead, 2002). A language sample where the vocabulary is limited to the most common word lists may suggest that the speaker has a less sophisticated vocabulary. Because speakers with HFASD are also sometimes characterized as using uncommon words (Volden & Lord, 1991; Wing, 1981) exploratory investigations regarding word choices may be useful in an effort to distinguish common from rare word choices in speakers with HFASD compared to a control group.

Pragmatics.

A number of studies (Adams et al., 2002; deVilliers et al., 2007; Hale & Tager-Flusberg, 2005; Paul et al., 2009; Landa et al., 1992) have devised indices to capture pragmatic skills in conversational samples from individuals with ASD. One of the indices, The Pragmatic Rating Scale (PRS; Landa et al., 1992), is recommended as a profile to document pragmatic impairment (Paul, 2005). The PRS was originally devised as a tool to evaluate social communication deficits in family members of individuals with HFASD.

Originally the PRS consisted of 19 unusual pragmatic behaviours, derived from observations of relatives of autistic probands, clinical reports and theoretical accounts (Landa et al., 1992). These items are listed in Appendix B. Landa et al (1992) identified significantly more pragmatic dysfunction in parents of children with an ASD diagnosis than in parents with children without an ASD diagnosis.

Recently, Paul et al., (2009) reasoned that if the PRS was able to identify subtle pragmatic impairments, like those in parents of children with ASD, then it could be used to capture subtle pragmatic impairments in those with HFASD. Their study evaluated the conversational behaviors of 29 HFASD adolescents and 26 unaffected peers matched on age and gender using a modified PRS (Paul et al., 2009; Appendix B).

Of the 18 pragmatic items evaluated on the modified PRS, Paul et al., (2009) found adolescents in the HFASD group had significantly more difficultly effectively managing conversations compared to controls. On average, the HFASD group exhibited more utterances where the content was asynchronous with the topic or where a shift in topic was unannounced, as well as displayed more frequent preoccupations with a particular topic. The HFASD group also had difficulty balancing conversational exchanges in that they were less responsive to examiner cues and their conversations had less reciprocal to-and-fro exchange than matched controls. Finally the HFASD group had difficulty providing the appropriate amount and types of information as they provided irrelevant/inappropriate details significantly more than the control group. Given its usefulness in documenting pragmatic impairment in adolescents, the PRS (Paul et al., 2009) also might be useful in documenting social-communication impairments in adults with HFASD.

In summary, a comprehensive assessment of adults with HFASD should include formal assessments of which the TOAL-4 (Hammill et al., 2007) and CASL (Carrow-Woolfolk, 1999) may be useful. The TOAL-4 provides extended norms up to 24 years 11 months and the vocabulary and syntactic subtests were carefully designed to avoid ceiling effects (Hammill et al., 2007). The

CASL compliments the TOAL-4 as it evaluates pragmatic language abilities and samples the broadest number of pragmatic domains when the Pragmatic Language and Nonliteral Language subtests are administered in comparison to other assessments (Russell & Grizzle, 2008). Supplementing the formal assessments with an informant questionnaire such as the CC-A and a language sample derived from a task that is challenging for adults would also be helpful.

The CC-A captures infrequent communication behaviors that are difficult to assess in structured assessments and during language sampling tasks, such as "gets confused when a word is used with a different meaning from usual", "others have fun at his or her expense" and "talks about fictitious events as if they were real". A language sample derived from a task that is challenging and age appropriate for adults would also enhance the comprehensive assessment. An ecologically valid situation, such as a simulated employment interview, conducted by a trained recruitment consultant provides an appropriate sampling context for young adults. Young adults experience employment interviews as they enter the work force and an employment interview requires that the interviewee engage in a reciprocal conversation that requires the interviewee to quickly formulate thoughtful responses.

A detailed language sample analysis derived from a simulated employment interview offers the opportunity to identify subtle language impairments that may be missed by traditional language assessments. This more challenging speaking task may reveal weaknesses in the use of complex syntax and literate vocabulary (Nippold, 2010). The communication profile derived from this type of inclusive assessment may be useful in establishing a more comprehensive understanding of the communication profile in adults with HFASD.

Summary and Key Evidence Gaps

Although adults with ASD are acknowledged as underserved (Eack et al, 2013), the evidence for what supports and services are needed is weak

(Howlin, 2012). In order to meet the needs of adults with HFASD, it is important to first establish a more comprehensive understanding of the communication profile of adults with HFASD. Although specific pragmatic problems have been noted in adults with HFASD (Barnes & Baron-Cohen, 2012; Colle et al.; 2013; Lake et al., 2010; Lewis et al., 2007 a & b; McCabe et al., 2013; Paul et al., 2009; Shriberg et al., 2001; Seung, 2007; Whitehouse et al., 2009a;), the full extent of their pragmatic difficulty remains undocumented, largely because there are few comprehensive assessment tools (Adams, 2002; Paul, 2007). Difficulties with syntax (Lake et al., 2011; Lewis et al. 2007a; McCabe et al., 2013) and vocabulary (Howlin, 2003; Lewis et al., 2007b; Rumsey & Hamburger, 1988; Whitehouse et al. 2009) also have been reported, but since findings are mixed, it is not clear whether young adults with HFASD have difficulties with these other language domains. In addition, our standardized test instruments may not be sufficiently sensitive to detect subtle difficulties with sophisticated syntax or literate vocabulary in adults with HFASD (Paul, 2005; Worth & Reynolds, 2008). If so, in conversation, young adults with HFASD might exhibit problems in vocabulary and grammar that may influence listeners' impressions, but that would not be detected by a standardized test. Because communicative skill has a profound effect on a person's ability to function as a productive participant in the community, it is important to determine communicative needs in this population to better address service needs.

Research Questions

In the proposed study, these gaps will be investigated by addressing the following questions:

1. Do the language skills of adults with HFASD and control participants matched on nonverbal IQ, educational level and sex differ on a comprehensive battery of standardized assessments (i.e., TOAL-4, CASL and CC-A) that target syntax, vocabulary and pragmatic language abilities? It is expected that adults with HFASD will perform more poorly than matched controls on

pragmatic skills, as indexed by subtests of the CC-A and CASL, but that syntax or vocabulary as measured by the TOAL-4 will not be significantly different between groups.

2. Do the language skills of adults with HFASD and control participants matched on nonverbal IQ, educational level and gender differ on indices of syntax, vocabulary and pragmatics obtained from detailed language sample analysis? It is predicted that detailed language sample analysis will reveal poorer performance in participants with HFASD across all language domains.

CHAPTER 3

Method

Participants

Twenty adults with HFASD and 20 unaffected controls were recruited from the greater Edmonton and Calgary areas by the primary investigator. Individuals with HFASD were recruited through local autism societies, service providers and post-secondary educational institutes. Controls were recruited primarily through post-secondary educational institutions. Recruitment methods included the use of flyers, electronic bulletins, and personal communication. All participants were between 18-30 years of age, English was their primary language, and performance IQ (PIQ) score, derived from the Block Design and Matrix Reasoning subtests on the Wechsler Abbreviated Scale of Intelligence – Revised (WASI- R; Wechsler, 1999) or the Wechsler Abbreviated Scale of Intelligence – 2 (WASI-2; Wechsler, 2011), was 70 or greater. Exclusion criteria for both groups included current or prior diagnosis of psychosis, past or present alcohol or drug abuse, and hearing impairment.

For adults diagnosed with HFASD, verbal report of a formal clinical diagnosis of ASD was required. In order to ensure that the diagnosis was currently appropriate, the Autism Diagnostic Observations Schedule (ADOS-2; Lord, Rutter, DiLavore & Risi, 2003) was administered. Only those whose diagnosis had been confirmed by the ADOS-2 were included in the study. Adults in the control group were administered the Autism-Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001), a 50-item self-report questionnaire to affirm that they did not possess an excess of features associated with the autism phenotype. No participants in the control group exceeded the cutoff of 32 on the AQ.

The participants with HFASD were recruited first and in total 24 individuals with HFASD were recruited. Four participants were deemed ineligible because they did not meet inclusion criteria. Two had scores below 70 on the WASI-2 and 2 had scores that did not meet diagnostic threshold on the ADOS despite having a reported diagnosis of ASD. All of the controls that

spontaneously volunteered met the inclusion criteria. Near the end of the recruitment process, specific participants were sought via personal communication to match the participants with HFASD as closely as possible (e.g., young adult female who had completed high school). The target sample size (n=25) was not met as it was challenging to find adults with HFASD even though a stipend was offered and recruitment efforts included various locations within two major cities.

General Procedure

For those with HFASD two sessions were required, whereas for the controls only one session was required. Each session for adults with HFASD lasted approximately 90 minutes and the session for the controls was approximately 2 hours. All of the participants from the Edmonton area (n = 35) were seen in the Pragmatics Language Lab at the University of Alberta and those from Calgary (n=5) were seen in a private office. The administration of all tasks occurred in a quiet space and assessments were completed according to their standardized protocols. The principal investigator completed all of the assessments, following the same sequence with each participant. The IQ and ASD diagnostic measures (WASI and ADOS/ AQ) were administered first, followed by language measures; i.e., subtests from the TOAL-4, (Hammill et al., 2007) and the CASL (Carrow-Woolfolk, 1999).

Upon completion of the assessments the participants were given a brief break prior to the simulated employment interview with the recruitment consultant. This allowed for arrangement of the recording equipment. The I-Phone 4 was selected as the audio recording device because it was nonintrusive when placed on the table and the recordings obtained from the device are of high quality. Video recordings, for back up purposes, were recorded using a JVC HD Memory Camera that was positioned at a distance from the interview table. Both the digital video and audio samples were downloaded onto a password protected computer.

The simulated employment interview with the recruitment consultant required 7 – 10 minutes to complete. The recruitment consultant followed the interview protocol (Appendix C), which consisted of "getting to know you" questions and a peer conflict resolution (PCR) task involving a work situation. The interview questions were designed in collaboration with the professional recruitment consultant who conducted the interviews. Interview questions were not job specific but were more general in nature in order to be appropriate for all participants. The interview included questions such as, "Please tell me about your work experience and education." and "What do you think are your greatest strengths?" A situation describing a peer conflict in a fast food restaurant (Nippold et al., 2007) was also integrated into the interview. Following Nippold's protocol, the interviewer read a brief scenario to the participant that the participant then retold to the examiner. The examiner would repeat the story if requested. This was followed by six questions related to the scenario that required the participant to identify the problem, to describe how it might be handled and to discuss the implications of handling the situation as proposed. If the participant's responses were incomplete or unclear the interviewer was instructed to probe further or reframe the questions to prompt a response from the participant. The recruitment consultant was also instructed to offer encouragement on occasion by providing positive comments following the interviewee's responses.

The CC-A informant questionnaire (Whitehouse & Bishop, 2009) was the final component of the research protocol. Participants were asked to select an informant who knew them well and share with them printed instructions on how to complete the 70-item questionnaire. Family members (a spouse, sibling or parent) completed the questionnaires for both groups. As previously mentioned the questionnaire requires the informant to rate behaviours using a 4-point scale. The questionnaire was completed remotely using a secure internet format or in person using a paper and pencil format.

Instruments

   Wechsler Abbreviated Scale of Intelligence – Revised (WASI- R; Wechsler, 1999) and Wechsler Abbreviated Scale of Intelligence – 2 (WASI-2; Wechsler, 2011). All participants were administered the nonverbal subtests (Matrix Reasoning and Block Design) from the WASI-R (Wechsler, 1999) or the WASI-2; (Wechsler, 2011). These are well-researched instruments; reliability coefficients for performance IQ range from 0.87 to 0.93. In addition, good convergent validity for the nonverbal subtests was reported, with correlation co-efficients ranging from 0.70 to 0.87 with a full-scale cognitive measure (Garland, 2005). Correlations of this magnitude represent a large effect size (r>.50, Cohen, 1988).

Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore & Risi, 2000). The ADOS was administered to participants with ASD to confirm the diagnosis. The ADOS is a semi-structured assessment consisting of various activities that facilitate the observation of behaviors related to autism. Separate scores regarding communication and social competence are reported. Module 4 of the ADOS was designed for verbal adolescents or adults and was administered by a research reliable examiner (inter-rater agreement with the administration and scoring practices of skilled examiners at or above 80%) in approximately 35 to 40 minutes. Module 4 of the ADOS has good reliability (raters obtained substantial agreement on classification, domain scores and item scores) and also good general criterion-related validity (Bastiaansen et al., 2011).

   Autism-Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). The AQ is a 50-item self-report questionnaire that was administered to controls to affirm that members of the control group did not possess an excess of features associated with the autism phenotype. The AQ has been shown to discriminate effectively between those individuals who presented with HFASD and those who did not (Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001, Bishop et al., 2004; Woodbury-Smith, Robinson, Wheelwright & Baron-Cohen, 2005). Good convergent validity was

established with the Social Responsiveness Scale (Constantino & Gruber, 2005) with a correlation coefficient of .64 (*p*<.01). Correlations of this magnitude represent a large effect size (r>.50, Cohen, 1988).

Test of Adolescent and Adult Language-4 (TOAL-4, Hammill, Brown, Larsen & Wiederholt, 2007). Syntax and vocabulary abilities were determined using selected subtests from the TOAL-4. The participants' vocabulary abilities were measured with the Word Opposites, Word Similarities and Spoken Analogies subtests. Sentence Combining and the Word Derivations subtests assessed syntactic abilities. As previously mentioned the TOAL-4 normative sample is between 19 and 24 years, 11 months of age and special care was taken during its development to avoid ceiling and floor effects. The average subtest scaled score is 10 with a standard deviation of three however; a subtest scaled score of 6 or 7 is considered below average (Hammill et al., 2007). The TOAL was designed to be useful in evaluating how language proficiency influences productive employment (Hammill et al., 2007). Test – retest reliability exceeds 0.8 on all subtests, inter-rater reliability exceeds 0.8 and results from the TOAL-4 are highly correlated (0.8) with measures of verbal cognition.

Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999). Pragmatic abilities were measured using the Pragmatic Judgment and Nonliteral Language subtests from the CASL. The subtest standard score average is 100 with a standard deviation of 15. The CASL is a well-standardized assessment with internal reliability for the subtests ranging from 0.64 -0.94 (Hayward, Stewart, Phillips, Norris, & Lovell, 2008). Test norms extend to 21 years 11 months. The criterion-related validity with the Oral and Written Language Scales (OWLS; Carrow-Woolfolk, 1995), another comprehensive language assessment with test norms that extend to 21 years 11 months, was strong (0.80).

Communication Checklist – Adult (CC-A; Whitehouse & Bishop, 2009). Pragmatic abilities were also evaluated using the CC-A, an informant questionnaire. Informants who know the participant well supply information

about structural language (i.e., grammar, vocabulary, speech production), pragmatic skills and social engagement. The Social Engagement scale contains items evaluating nonverbal social communication such as failing to look at others while conversing or standing too close to others in a conversation. The informant rates behaviours (e.g., It's difficult to stop him/her from talking) on a 4-point frequency scale (0= less than once a week; 1= at least once a week, but not every day; 2= once or twice a day; 3= several times a day or always). Scaled scores are provided for the three composites. A scaled score of 6 or less falls just below the 10th percentile and suggests abnormality. If two or more scaled scores are at or below 6, communicative difficulties that influence everyday life are inferred (Whitehouse & Bishop, 2009). As previously mentioned, the CC-A is one of the few assessments that measures pragmatic language abilities and includes norms for adults. The CC-A demonstrates high reliability (> .9) and sufficient sensitivity identifying adults with communication disorders, as over 90% of adults with a communication disorder had a Total Raw Score below the 20th percentile on the CC-A (Whitehouse & Bishop, 2009).

Preparation of Data for Analysis: Transcription of Interviews

Three master's-level students in the Communication Sciences and Disorders program at the University of Alberta, who were unaware of diagnostic group status, transcribed and coded the 40 interviews using the Systematic Analysis of Language Transcripts (SALT; Miller & Chapman, 2010) software.

The interviews, including the PCR task, were transcribed verbatim from audio recordings following the conventions outlined in the SALT manual (Miller & Chapman, 2010). Transcripts were segmented into Communication units (C-units). A C-unit consists of an independent clause and attached or embedded clauses or phrases (see Appendix A for definition and exceptions). In addition to segmenting the interview into C-units, a number of codes and grammatical markings were inserted into the transcript for further analysis. A

sample transcript is included in Appendix D that illustrates these codes for both the participant (P) and the interviewer (I). Codes included the following:

a) Insertion of timing markers (in minutes:seconds): The beginning and end of recording , as well as the time point when the recruitment consultant introduced and finished the PCR task .

b) Pauses between utterances with the same speaker (in seconds) (e.g., :03) and between utterances of different speakers (e.g., :05).

c) Overlapping speech between the speakers: This is captured with angle brackets (<>). For example: I: It's not <important>. P: <Yeah>.

d) Mazes that included filled pauses, false starts, repetitions, omissions (an asterisk symbol* is used to code partial words or omitted words) and reformulations were bound in parentheses. For example, "(I kind of uh) sometimes I (wo*) won't say what needs to be said." Anything in parentheses is excluded from the analysis.

e) Word-level errors [EW]: Word errors consisted of words that were either nonsensical or in error given the sentence context (e.g. using 'per' instead of 'for'), subject-verb agreement errors or verb tense errors. The following illustrates how a word-level error was coded: I am on [EW:in] my first year.

h) Utterance-level errors [EU]: These consisted of utterances that had multiple errors that resulted in a nonsensical sentence (e.g., "But from one to six, (I is is my) in (well) a field or a building."). A code of [EU] placed at the end of the utterance was used to indicate an utterance-level error.

Students were trained in transcription and coding using the tutorials available on the SALT website (http://www.saltsoftware.com). Prior to beginning transcription and coding of the interviews included in this study, students transcribed and coded, with a minimum of 80% inter-rater agreement, a sample interview. In order to ensure accuracy of student transcription and coding, a linguistics student, trained as a SALT

transcriptionist by the creators of SALT, and an expert in the field (a Speech Language Pathologist with more than 25 years of experience) reviewed all of the transcripts. Prior to completing the transcriptions the linguistics student and the expert SLP established agreement with one another by coding a language sample. Initial agreement between the two exceeded 95%. Any differences regarding C-unit divisions or student codes were resolved through discussion. Both individuals reviewed all of the transcripts completed by the students at the University of Alberta and their consensus transcripts were used for the analyses reported here.

Dependent Measures and Scoring
Formal standardized assessments.

The primary investigator scored the participants' assessment protocols from the TOAL-4 and the CASL according to scoring procedures described in each of the manuals. The scoring software provided with the CC-A was used to generate composite scores for the informant measure.

Indices derived from the language sample.
Syntax.
1. Mean Length of Utterance (MLU):

The SALT software provides a number of reports. The Standard Measures report includes the total number of utterances and total number of words for each sample. The report also automatically calculates the mean length of utterance by dividing the total number of words by the total number of utterances per sample.

2. Subordination Index (SI):
Subordination index (SI) codes were manually inserted at the end of each C-unit. For every C-unit the independent clause (IC) and any dependent clauses (DC) are counted. For example, SI2 is attached to the following communication unit:

"If I start something (DC), I always like to finish it (IC) [SI2]."

After subordination codes are inserted into the transcript the SALT program automatically calculates SI, a measure of clausal density. Within a transcript the program identifies the SI codes and divides these by the total number of utterances.

Semantics.

For the vocabulary measures a text analyzer, the Vocabprofiler (www.lextutor.ca) was used. The vocabulary sampled was limited to the PCR task in order to control for differences in participants' background knowledge and experience. To prepare the transcripts for the Vocabprofiler, the primary investigator edited each participant's PCR task by removing the interviewer's utterances and any participant mazes. The transcripts were then entered into the Vocabprofiler which then generated the following measures.

1. Lexical Diversity:

Lexical diversity was measured by calculating a Type Token ratio (TTR; Templin 1957). The text analyzer automatically calculated the TTR by dividing the number of different words in the sample by the total number of words.

2. Lexical Sophistication:

Exploratory investigations regarding word frequency were conducted in an effort to distinguish ordinary words from rare word choices. The Vocabprofiler identifies low and high frequency vocabulary used by speakers or writers. From a sample of text, the Vocabprofiler identifies words that are not contained within the most frequent 2000 word families or the academic English word list (550 words that are frequent in academic texts across subjects; Laufer & Nation, 1995). The text analyzer identified the number of rare words, those not included in the word lists, and total number of words in the PCR task. The percentage of uncommon words was then calculated manually by dividing the number of rare words by the total number of words.

Pragmatics.

The Pragmatic Rating Scale (PRS; Landa, 1992; Paul et al., 2009) was used to evaluate pragmatic behaviours on the entire language sample, that is, the simulated interview plus the PCR. Three research assistants, master's-level students in the Communication Sciences and Disorders Program at the University of Alberta, were trained to score the PRS using language samples from individuals with and without a diagnosis of HFASD who were not eligible to participate in the study.

Training procedure and alterations to PRS protocol.

During training, disagreements regarding coding were discussed and the protocol used by Paul et al., (2009) was altered as follows:

1. Paul et al., (2009) could only establish inter-rater reliability by dividing the sample into three-minute intervals. Rather than artificially dividing this sample into three-minute intervals, codes were assigned after each interview question and then upon completion of the entire PCR task, when natural breaks occurred.

2. Operational definitions for "Scripted Stereotyped Sentences or Discourse" and "Awkward Expression of Ideas" were collapsed together as in the original PRS (Landa et al., 1992) because consensus on individual operational definitions was not reached.

3. The Paul et al., (2009) 3-point rating scale (0=behaviour occurring almost never, 1= occurring sometimes, 2= almost always) was modified as follows: 0= behaviour did not occur, 1= behaviour occurred on one occasion, 2= behaviour occurred on two or more occasions.

Appendix E includes examples of the pragmatic behaviours that were coded using the revised operational definitions and 3-point rating scale. At the completion of training inter-rater agreement was in excess of 80% across all possible pairs of the three raters. This was based on the following formula:{Number of agreements / (Number of agreements + number of disagreements)} x 100.

Pragmatic coding of participant interviews using the PRS.

Each participant's audio interview, supplemented by the transcription, was then scored by two of the three trained research assistants who were blind to participant group membership. Inter-rater reliability for codes and rating scores on the PRS were calculated on 20% of the sample interviews using the formula: Number of agreements / (Number of agreements + number of disagreements) x 100. Reliability exceeded 85%. The two research assistants discussed differences regarding coding and agreed on a final PRS rating after reviewing the transcript and audio file together. The scores (i.e., 0, 1, or 2) assigned for each pragmatic behaviour were summed across the 6 opportunities with the exception of "Inappropriate / Absent Greeting". This pragmatic behaviour was only scored on one occasion at the beginning of the interview. The maximum number of points that could be obtained was 206 (See Appendix F for an example of the Pragmatic Rating Scale Score form).

Analytic Approach

The test scores from the assessments and the indices derived from the language sample were analyzed first by using multivariate analysis of variance (MANOVA), followed by univariate analyses of variance to identify if significant differences existed between the adults with HFASD and controls (ANOVA; Finn, 1974; Haase & Ellis, 1987; Hummel & Sligo, 1971). MANOVA identifies group differences that may be due either to a single dependent variable or to a combination of two or more dependent variables. However, the linear combinations are often not interpretable, as was the case in this study. Thus MANOVA is first conducted to control for Type I error (i.e., the risk of rejecting the null hypothesis when it is in fact true; Pallant, 2007). Follow-up ANOVAs were conducted to determine which, if any, of the dependent variables in the set of dependent variables from the MANOVA reached significance. Hummel and Sligo (1971) determined that adopting this procedure would result in a family-wise error rate for the set of independent ANOVAs close to the nominal alpha level ($\alpha = .05$).

There are a number of assumptions associated with MANOVA that include a) independence of subjects, b) multivariate normality, c) homoscedasticity, and d) linearity. In the current study, the participants were independent of one another and all data were collected from each participant independently. MANOVA is robust to violations of multivariate normality when there are at least 20 in each cell (Stevens, 2009; Pallant, 2007). For homescedasticity, the variance and covariance matrices for all dependent variables across groups need to be considered equal. MANOVA is again robust to violations of homescedasticity when sample sizes are equal (Salkind, 2003), which was the case in the present study. Linearity between dependent variables for each MANOVA was inspected using scatter plots and all were found to be linear.

Where possible, the MANOVA/ANOVA analyses were conducted with alpha set at .05 (Tables 6-9). For the standardized tests given directly to the participants, that is the TOAL-4 and the CASL, the dependent variables were syntax, semantics and pragmatics. For the standardized informant measure, the CC-A, the dependent variables were structural language and pragmatic abilities. Finally, for the indices derived from the language sample, the set of dependent variables were syntax (mean length of communication unit, clausal density and proportion of utterance level errors), semantics (Type Token Ratio, proportion of rare words and proportion or word errors) and pragmatics (raw score on Pragmatic Rating Scale). In each case the independent variable was diagnostic group. Productivity measures, considered a subcategory of pragmatics, were also derived from the interview and PCR task. For productivity, the dependent variables were length of the interview, number of pauses (either within or between utterances) and total number of utterances. Since there were only two groups of participants, follow-up multiple-comparison tests were not needed.

CHAPTER 4
Results

Preliminary Analysis

As shown in Table 3, groups did not significantly differ on sex, PIQ and educational level. An independent samples t-test confirmed that the PIQ was not significantly different (t [38.00] = 0.71, p = 0.94) between groups. To determine whether educational levels were equivalent, a Fisher's Exact Test was conducted, revealing no significant group difference (p = 0.72). The groups were significantly different in terms of average chronological age (t [28.85] = -2.240, p=.03). Participants with HFASD were on average older (M= 22.55, SD= 3.71) than the controls (M= 20.45, SD= 1.96). This age difference was not regarded as a confounding factor because adults with HFASD tend to achieve milestones (e.g., employment, independence, academic competence) later than typical adults (Marriage et al., 2009).

Table 3: Description of Participants

	HFASD	Control
Sample Size	N= 20	N =20
Sex	14 male; 6 female	14 male, 6 female
Performance IQ	M =110.05 SD =15.32[1]	M =109.75 SD =11.13[1]
	Range: 84 - 123	Range: 70 - 128
Educational Level:		
High school completed	30% (n = 6)[2]	30% (n = 6)[2]
Some college or university completed	65% (n=13)[2]	55% (n=11)[2]
Completed college or university degree	5% (n = 1)[2]	15% (n = 3)[2]
Age (in years)	M = 22.55 SD =3.71[3]	M =20.45 SD =1.96[3]
	Range: 18 – 30 years	Range: 18 – 24 years
ADOS 2	M= 9.15 SD: 2.254	N/A
	Range: 7 – 15	
AQ	N/A	M=13.75 SD = 6.488
		Range: 2- 26

[1] p = 0.94
[2] p = 0.72
[3] p = 0.03

Two of the language assessments used in the research protocol, the TOAL-4 (Hammill et al., 2007) and the CASL (Carrow-Woolfolk, 1999), did not have age norms that encompassed the age range of the sample. The use of standard scores from the oldest normative band versus other types of scores such as raw scores or *z*-scores was considered appropriate if the raw scores from those beyond the age range were comparable to those in the oldest normative band. Reporting of standard scores as opposed to raw or *z*-scores is easier to interpret and allows a tentative comparison of the performance of the HFASD group to test norms in addition to the control group.

As previously mentioned, syntax and vocabulary abilities were determined using selected subtests from the TOAL-4 (Hammill et al., 2007). Five participants, all with HFASD, were older than 25 years, which was beyond the test's age norms of 19 through 24 years 11 months of age. However, normative data showed that raw scores plateaued at the upper age levels and it was anticipated that those beyond the age norms would perform the same as those in the highest age band. To test this assumption a series of five independent *t*-tests using raw scores from participants (n=9; 1 with HFASD and 8 controls) between 24 years to 24 years, 11 months and those beyond the age range, (n=5) was conducted. To reduce the possibility of a Type II error, a 0.20 level of significance was selected. As shown in Table 4, no significant differences were found between the groups and therefore, standard scores in the highest age band were assigned for participants beyond the age range.

Table 4: Average raw scores of TOAL-4 subtests

TOAL-4 Subtests	Participants (n=5) Beyond 24 years 11 months		Participants (n=9) between 24 and 24:11 year		*t*	Significance ($a \leq 0.20$)
	M	SD	M	SD		
Word Opposites	27.00	4.35	25.78	1.64	-0.60	0.57
Spoken Analogies	19.60	4.97	18.00	3.87	-0.67	0.52
Word Similarities	21.60	10.59	19.22	4.66	-0.60	0.57
Word Derivations	27.00	4.36	25.78	1.64	-0.71	0.49
Sentence Combining	17.00	4.30	18.56	2.88	0.82	0.43

The Pragmatic Judgment and Nonliteral Language subtests from the CASL (Carrow-Woolfolk, 1999) were used to evaluate pragmatic language abilities in all of the participants. However, the highest age band for which norms for the CASL are available is 21 years through 21 years and 11 months. Seventeen participants, 10 with HFASD and 7 controls, were beyond the age norms of the CASL. Like the TOAL-4, the normative data revealed raw scores on the CASL that plateaued at the upper age levels and it was anticipated that adults beyond the age norms would perform the same as the adults in the highest age band. To test this assumption, two *t*-tests (one for each subtest) using raw scores from those within the highest normative age range (n=5; three with HFASD and two controls) and those beyond the age range (n = 17; 10 with HFASD and seven controls) were conducted. To reduce the possibility of a Type II error, a 0.20 level of significance was selected. As shown in Table 5, no significant differences were found between the two age groups and therefore, the standard scores from the highest age band were reported for both the HFASD and control participants who were older than 21 years and 11 months.

Table 5: Average raw scores of CASL subtests

CASL Subtests	Participants (n=17) ≥ 22 years of age		Participants (n=5) 21 years to 21 years, 11 months		*T*	Significance (*a* ≤ 0.20)
	M	SD	M	SD		
Pragmatic Judgment	62.12	3.85	59.40	6.02	1.22	0.68
Nonliteral Language	39.47	7.69	41.00	4.30	-0.42	0.24

Primary Analysis

The primary analysis was conducted to answer the following research questions:

1. Do the language skills of adults with HFASD and control participants matched on nonverbal IQ, educational level and sex differ on a comprehensive battery of standardized assessments (i.e., TOAL-4, CASL and CC-A) that target syntax, vocabulary and pragmatic language abilities? It is expected that adults with HFASD will perform more poorly than matched controls on pragmatic skills, as indexed by subtests of the CC-A and CASL, but that syntax or vocabulary as measured by the TOAL-4 will not be significantly different between groups.

2. Do the language skills of adults with HFASD and control participants matched on nonverbal IQ, educational level and gender differ on indices of syntax, vocabulary and pragmatics obtained from detailed language sample analysis? It is predicted that detailed language sample analysis will reveal poorer performance in participants with HFASD across all language domains.

Formal assessment measures.

First, the average standard scores from the assessments that targeted syntactic, semantic and pragmatic language ability were evaluated to determine if performance on these measures was impaired in adults with HFASD compared to a group of matched controls. Standard scores were used in the analyses for all participants, including those beyond the normative age range, as the preliminary analysis found no significant differences between the raw scores obtained by those beyond the test norms for the TOAL-4 and the CASL when compared to those within the highest age band. The original hypothesis was that formal test scores were not likely to result in impaired performance in the HFASD group when compared to controls with the exception of the tests that evaluated pragmatic language abilities. The results are divided according to each communication domain (e.g., syntactic, semantic and pragmatic). Because the sample size was relatively small, once the primary analysis was conducted, subsequent analyses were descriptive rather than statistical to avoid over-interpretation of the data.

Syntactic measures.

A one-way MANOVA with group membership (HFASD, controls) as the independent variable and standard scores from the syntactic subtests from the TOAL-4 (Word Derivations and Sentence Combining; Hammill et al., 2007) as the dependent variables was conducted. A statistically significant difference was found between the HFASD group and the control participants on combined syntactic variables, (Wilks' Lambda = 0.85, F (2, 37) = 3.23, *p* = 0.04). Following Hummel and Sligo (1971), a one-way ANOVA was conducted for each of the two dependent variables (Word Derivations and Sentence Combining) as a follow-up test to the MANOVA. Average standard scores on the Sentence Combining subtest were significantly different (F [1, 38] = 6.50, *p* =.02, d=.81), as shown in Table 6. On average, adults with HFASD had significantly more difficulty integrating several short sentences into a single grammatically correct sentence. According to Pallant (2007), these differences represent a large effect size (d ≥ .8). No significant

differences between the groups were found on the other syntactic subtest, Word Derivations, where participants were required to attach derivational affixes to root words.

*Table 6: S*tandard Scores on Syntactic and Semantic Subtest Assessments from TOAL-4

TOAL-4	HFASD	Controls	ANOVAs	
	M (SD)	M (SD)	$F_{(1.38)}$	p
	Range	Range		
Syntactic Subtest Standard Scores				
Sentence Combining	7.1 (2.31)	8.7 (1.75)	6.50	.02
	2 - 12	5 - 12		
Word Derivations	8.9 (2.53)	9.5 (1.91)	0.72	.40
	5 - 14	6 - 13		
Semantic Subtest Standard Scores				
Word Opposites	10.1 (3.03)	10.5 (1.85)	N/A	
	4 - 15	7 - 13		
Spoken Analogies	8.2 (3.99)	9.3 (2.77)	N/A	
	2 - 15	6 - 15		
Word Similarities	9.1 (3.30)	9.7 (2.64)	N/A	
	2 - 15	3 - 16		

N/A: Not applicable: A follow-up ANOVA was not conducted as the MANOVA was not significantly different between the groups.

Semantic measures.

Group membership (HFASD or controls) was the independent variable and semantic subtests' standard scores from the TOAL-4 (Word Opposites, Spoken Analogies, and Word Similarities; Hammill et al., 2007) were the dependent variables in a one-way MANOVA. The mean scores of the HFASD group and the control participants on combined semantic variables were not significantly different (Wilks' Lambda = 0.97, F (3, 36) = 3.73, *p* =.77). As predicted, results summarized in Table 6 indicate that there were no significant differences between the mean scores for adults with HFASD and

the controls on any of the vocabulary subtest measures. Both the controls and adults with HFASD had mean subtest scores within the normal range (8 – 12). These findings support the original hypothesis that adults with HFASD perform as well as the control group on standardized measures of vocabulary.

Nevertheless, closer inspection regarding the performance of individuals in the HFASD group on the TOAL-4 (Hammill et al., 2007) is warranted as there are some individuals with HFASD that present with more impaired performance on measures of both syntax and semantics than their cognitive development would suggest (Smith Gabig, 2011). The cutoff for SLI using test norms is arbitrary (Tomblin, McGregor & Bean; 2011) but recently SLI in adults was affirmed using the scores derived from subtests on the TOAL-3 (Hammill, Brown, Larsen & Wiederholt, 1994). Following the criteria for SLI in adulthood used by Poll, Betz and Miller (2010) 30% of the individuals with HFASD (n=6) whose PIQ was within or above the normal range (PIQ ranged from 92 to 121) met this criterion on the TOAL-4. No individuals in the control group had this profile.

Pragmatic measures.

Diagnostic group (HFASD and controls) was the independent variable and the pragmatic subtests' standard scores from the CASL (Pragmatic Language and Nonliteral Language) were the dependent variables in a MANOVA. There was a statistically significant difference between the HFASD group and the control participants on combined pragmatic variables (Wilks' Lambda = 0.47, F (2, 37) = 20.62, p < .01). Follow-up one-way ANOVAs were conducted for each of the pragmatic subtests and significant group differences and a large effect (d=.8 or greater; Pallant, 2007) were revealed on both Nonliteral Language (F [1, 38] = 23.20, p <.01, d=1.52) and Pragmatic Judgment (F [1, 38] = 27.62, p <.01, d=1.66). As shown in Table 7, the adults with HFASD scored, on average, significantly lower than the control group. Despite large group differences, average scores for the participants with HFASD were within normal limits (85-90). Four HFASD

participants exhibited subtest standard scores that were 78 or lower on the Nonliteral Language subtest (i.e., at least 1.5 standard deviations below the normative mean of 100, or in the moderately impaired range; Bishop & Edmundson, 1987). Three participants were below these same criteria for the Pragmatic Judgment subtest. Only one participant had a score of 73 on both subtests, which suggests moderate impairment on both subtests. None of the participants in the control group had subtest standard scores on either subtest that were 1.5 standard deviations below the mean of 100.

Table 7: Standard Scores on Pragmatic Subtest Assessments from CASL

CASL Subtests	HFASD	Controls	ANOVAs	
	M (SD)	M (SD)	$F_{(1.38)}$	p
	Range	Range		
Pragmatic Subtest Standard Scores				
Nonliteral Language	86 (15.71)	105 (9.09)	23.20	< .01
	45 - 114	85 - 123		
Pragmatic Judgment	85 (7.39)	99 (9.72)	27.62	< .01
	71 - 100	80 - 114		

Informant measure.

To analyze the CC-A (Whitehouse & Bishop, 2009), a separate multivariate analysis of variance was conducted with diagnostic group (HFASD vs. controls) as the independent variable and with the Structural Language Composite and Pragmatic Skills Composite scores as the dependent variables. A separate analysis of variance was required as the CC-A is a questionnaire that gathers information from an informant rather than directly from the child. The Structural Language Composite includes various aspects of language including speech, syntax, vocabulary and cohesion whereas the Pragmatic Skills Composite includes aspects of social language such as *missing the point of humor, including overly precise details while*

talking, and *ignoring conversational overtures*. The third subscale, Social Engagement, was not included in the MANOVA as the items are related to social interaction rather than communication per se. Examples of Social Engagement items that are not specifically communicative are *using eye contact, appearing anxious in the company of others* and *showing concern when others are upset*. Although the Social Engagement Composite was not included in the MANOVA, the mean and standard deviation for each group are shown in the table to demonstrate that the CC-A identified social communication difficulties (two or more subscale scores of 6 or less) that will influence everyday life (Whitehouse & Bishop, 2009). Furthermore, two or more composite scores below five is a pattern rarely seen in the normative sample (less than 5%; Whitehouse & Bishop, 2009).

The results from the one-way MANOVA revealed a statistically significant group difference, with Wilks' Lambda = 0.54, $F (2, 37) = 16.11$, $p < .01$. Following Hummel and Sligo (1971), a one-way ANOVA was conducted for each dependent variable as a follow-up test to the MANOVA (Table 8). There were significant group differences on both the Structural Language Composite ($F [1, 38] = 136.90$, $p < 0.01$, d=1.06) and the Pragmatic Skills Composite ($F [1, 38] = 291.60$, $p <0.01$, d= 1.82) the magnitude of the differences was large (d > .08; Pallant, 2007).

Table 8: Composite Standard Scores on the CC-A

CC-A	HFASD	Controls	ANOVAs	
	M (SD)	M (SD)	$F_{(1.38)}$	p
	Range	Range		
Structural Language Composite	7.15 (3.68)	10.85 (3.27)	136.90	< .01
	2 - 14	4 – 14		
Pragmatic Skills Composite	4.45 (2.21)	9.85 (3.57)	291.60	< .01
	0 - 9	0 – 14		
Social Language Composite	2.20 (2.56)	10.50 (2.89)	N/A	N/A
	6 - 15	0 – 7		

N/A: Not applicable: Social Language Composite not included in MANOVA.

The average score of adults with HFASD on the Structural Language Composite was significantly lower than that of the controls, which suggests they have weaker grammatical, vocabulary and/or speech production abilities. Nevertheless, the average score (M=7.15) for the HFASD group was above the 10th percentile, which is a commonly used cut-off level for identifying abnormality (Whitehouse & Bishop, 2008). However, nine adults with HFASD had scores on this composite that were below the 10th percentile on this composite compared to two controls.

To explore the types of structural language errors reported for the HFASD group and controls, Fisher's exact probability tests were conducted. For each item, groups were compared on the number of participants where the item was endorsed by the informant. Significant differences were found on the following items:

1. *Gets the sequence of events muddled up when trying to tell a story or describe a recent event*; e.g. if describing film might talk about the end before the beginning. This item was endorsed for 55% of the adults with HFASD and not endorsed for any of the matched controls (p = .0001).

2. *Takes in just 1-2 words in a sentence, and so misinterprets what has been said*; e.g. if someone says 'I want to go skating next week', s/he may think they've been skating, or want to go now. This item was endorsed for 25% of the adults with HFASD and not endorsed for any of the matched controls (p = .0471).

3. *Makes false starts, and appears to search for the right words*: e.g. might say do you- do you- do you want to go- want to go to the cinema. This item was endorsed for 40% of the adults with HFASD compared to 5% for the matched controls (p =.0197).

Items related to basic grammar (e.g., *mixing up 'he' and 'she'*), speech impediments (e.g., *mispronounces words*) and vocabulary (e.g., *mixing up words with similar meaning such as saying 'screwdriver' for 'hammer'*), which are suggestive of individuals with SLI, were rarely endorsed as impaired in the HFASD group.

For the Pragmatic Skills composite the average score of adults with HFASD was 4.45. In the normative group a composite score of less than 5 was rarely noted and is indicative of a problem of "clinical significance" (p.12, Whitehouse & Bishop, 2009). A Fisher's exact probability test was conducted comparing the number of participants in each group where the Pragmatic Composite was below the normal range (composite score $\leq$6). Eighty percent of the adults with HFASD had a Pragmatic Abilities composite below the normal range compared to 5% for the matched controls (p = .0001).

To explore the types of pragmatic language errors reported for the HFASD group and controls, Fisher's exact tests were conducted comparing the number of participants where the item was endorsed in comparison to the number of participants where the item was not endorsed. Significant group differences were found on the following items:

1. *S/he interrupts people at inappropriate times*. This item was endorsed for 75% of the adults with HFASD compared to 30% for the matched controls (p = .0104).

2. *Says things that may appear too formal for a given situation*. So, for instance, after eating a nice meal, s/he may be heard to say, 'that meal was a culinary delight'. This item was endorsed for 75% of the adults with HFASD compared to 5% for the matched controls (p = .0001).

3. *Gets confused when a word is used with a different meaning from usual*; *e.g. might fail to understand if an unfriendly person was described as 'cold' (e.g., would assume they were shivering).* This item was endorsed for 65% of the adults with HFASD compared to 10% for the matched controls (p = .0008).

4. *Talks about lists of things s/he has memorized; e.g. the names of the capitals of the world or the performance of a sporting team.* This item was endorsed for 65% of the adults with HFASD compared to 10% for the matched controls (p = .0008).

5. *Moves the conversation to a favourite topic, even if others don't seem interested in it.* This item was endorsed for 80% of the adults with HFASD compared to 5% for the matched controls (p = .0001).

6. *Ignores conversational overtures from others; e.g. if asked, 'what are you doing?' Does not look up and just continues working.* This item was endorsed for 75% of the adults with HFASD compared to 25% for the matched controls (p = .0038).

7. *Hurts or upsets other people without meaning to; e.g. s/he may say 'blunt' things that offend people*. This item was endorsed for 70% of the adults with HFASD compared to 20% for the matched controls (p = .0036).

8. *It's difficult to stop him/her from talking*. This item was endorsed for 55% of the adults with HFASD compared to 20% for the matched controls (p = .0484).

9. *Tends to bore people. For instance, s/he may talk about facts that appear obvious, or talk about an event or a joke for too long.* This

item was endorsed for 75% of the adults with HFASD compared to 15% for the matched controls (p = .0003).

10. *Includes over-precise information (e.g. exact date or time) in his/her talk; e.g. when asked 'when did you go on holiday?' may say '13th July 1995' rather than 'in the summer'.* This item was endorsed for 60% of the adults with HFASD and not endorsed for any of the matched controls (p = .0001).

11. *Asks questions even though s/he has been given the answer.* This item was endorsed for 55% of the adults with HFASD compared to 15% for the matched controls (p = .0187).

12. *Shows unusual interest in things or activities that most people would find unremarkable, such as types of electric socket, washing machines, types of apples.* This item was endorsed for 55% of the adults with HFASD compared to 10% for the matched controls (p = .0012).

13. *Uses unusual words even when chatting informally. Talks like an academic professor in inappropriate social setting.* This item was endorsed for 75% of the adults with HFASD compared to 5% for the matched controls (p = .0001).

Summary of results from standard measures and the informant questionnaire.

Participants' performance on the standardized language tests (i.e. TOAL and CASL subtests) was compared to scores derived from the informant questionnaire (CC-A) to determine if both instruments identified the same adults with HFASD as having structural language impairments. Two of the three participants identified as having language impairment on the TOAL-4 were also identified as having structural language difficulties on the CC-A. The third participant's Structural Language Composite score on the CC-A was just above cutoff. Seven additional HFASD participants were identified as having structural language impairments on the CC-A, although their performance on most subtests of the TOAL-4 was within 1.5 standard

deviations from the norm. The remaining 10 participants were not identified as having structural language difficulties on the CC-A nor the TOAL-4. With regard to pragmatic language, (1) all the participants (n=6) who were identified with pragmatic impairments on the CASL subtests (-1.5 standard deviation below the norm) were also identified on the CC-A. (2) Ten participants who were not identified as having pragmatic impairment on the CASL subtests were identified as pragmatically impaired on the CC-A. (3) Four participants were not identified as having pragmatic impairment on either measure. Overall, the CC-A appears to be more sensitive to both structural language and pragmatic communication problems.

The language sample.

Indices derived from language sample analysis.

As with the formal assessments, to control for an inflated Type 1 error, a separate multivariate analysis of variance (MANOVA) was conducted with each of the communication indices derived from the language sample where possible. It was hypothesized that there would be significant differences between the HFASD group and controls on all of these indices. The HFASD group was expected to use less complex syntax, to use odd words more frequently, and have more pragmatic impairments than the matched controls.

Syntactic Indices.

To examine the effects of group (HFASD and controls) on syntactic indices, a MANOVA was conducted with the average mean length of utterance (MLU) and the clausal density index as the dependent variables. These dependent measures were based on the entire language sample. The MLU (number of total words/ total number of C-units per sample) and subordination index (total number of clauses/ total number of C-units per sample) were generated using the SALT program. Results are shown in Table 9. Results from the MANOVA revealed that there were no significant differences between adults with HFASD and matched controls on the combined syntactic indices (F (2, 37) = 0.007, *p*= 0.99). An inspection of the

mean scores for each index did not support the original hypothesis that adults with HFASD would perform more poorly than the control group on syntactic indices derived from the language sample.

Table 9: Indices of Syntactic Complexity and Vocabulary

	HFASD	Controls	ANOVAs	
	$\underline{M}$ (SD)	$\underline{M}$ (SD)		
	Range	Range		
			$F_{(1,38)}$	p
Syntactic Indices				
Mean length of utterance	10.90 (2.39)	10.97 (1.89)	N/A	
	6.09 – 16.17	7.59 – 14.32		
Subordination Index	1.60 (0.18)	1.60 (0.19)	N/A	
	1.13 – 1.97	1.28 – 2.12		
Semantic Indices				
Type Token Ratio (PCR only)	0.41 (0.079)	0.41 (0.072)	0.003	0.96
	0.22 – 0.57	0.30 – 0.42		
Proportion of Rare Words (PCR only)	4.85 (3.92)	3.20 (3.12)	2.17	0.15
	0 – 9	0 - 18		
Proportion of Word Errors	0.65 (0.63)	0.21 (0.16)	9.04	0.01
	0 – 2.63	0 – 0.58		

N/A: Not applicable: A follow-up ANOVA was not conducted as the MANOVA was not significantly different between the groups.

Semantic indices.

Results regarding the vocabulary measures derived from the language sample are also reported in Table 9. Group was the independent variable and the measures of lexical diversity (type-token ratio; TTR), the proportion of rare words, and the proportion of word level errors were the dependent variables in a MANOVA. The first two indices were restricted to the PCR task

to eliminate the potential influence of experience and educational background on vocabulary. Because TTR is influenced by the length of the sample (TTR decreases with longer samples; Scott & Windsor, 2000), an independent samples *t*-test on the mean number of words per sample was conducted with group membership (HFASD, controls) as the independent variable in order to determine whether the entire PCR task could be used versus truncating the samples at an arbitrary number of words. No significant group differences were noted (t (38)= -0.64 p = .52, d = .20) in the average number of words in the PCR task between the adults with HFASD ($\underline{M}$= 369.55, SD = 248.37) and the controls ($\underline{M}$= 329.15, SD = 131.96). As the effect size was small (d$\leq$ .02; Cohen, 1988) and there were no significant differences in the mean total number of words in the PCR task between groups, the whole PCR task was used in subsequent statistical analyses. The third vocabulary index was a proportion based on the number of word errors to the total number of words in the entire sample.

A one-way MANOVA was conducted and revealed significant group differences (Wilks' Lambda = 0.74, F (3, 36) = 4.21, *p* = 0.01) regarding average performance on the vocabulary indices. Again, following Hummel and Sligo (1971), a one-way ANOVA was conducted for each dependent variable as a follow-up test to the MANOVA. The results in Table 9 suggest that the average proportion of words in error (F [1, 38] = 9.0, *p* =0.01, d = -0.96) was significantly different between the groups. On average, adults with HFASD made a significantly higher proportion of word errors than did the matched control group. Table 10 provides some word error examples drawn from the language samples of adults with HFASD:

Table 10: Word Error Examples from the Language Samples of Adults with HFASD

Word Error:	In context:
'per' instead of 'for'	"Well again Peter might feel a little disappointed but as **per** Mike he might feel a little bit bad because he wasn't willing to help out."
'unflexible' instead of 'inflexible'	"Because it would mean that Jane is unflexible in what she wants to do and doesn't want to compromise as well …"
'ethnic' instead of 'ethical'	"I am still a very hard ethnic worker."

Although the frequency of rare words was not significantly different between the groups, a list of rare words as generated by the text analyzer for both groups is shown in Table 10. Several of these words were used by two or more participants, but more were used by only one individual. Adults with HFASD generated 67% of the rare words used by a single person. They are written in bold in the table.

Table 11: Unique and Shared Rare Words Generated during the PCR Task

Unique Rare Words*		Shared Rare Words	
Accordingly	Relative	Shift	Desirable
Manual	Continuing	Working	Initially
Stressed	Potentially	Given	Further
Favorably	**Comparative**	Dilemma	
Hinder	**Economics**	Exception	
Externally	**Equally**	Flexibility/	
Factual	**Output**	Flexible	
Neglecting	**Productive**	Efficient	
Superior	**Reciprocated**	Joint	
Gratification	**Weight**	Short	
Resolve	**Logically**	Part	
Mutual	Strengthens	Switching	
Scenario	**Consensus**	Assigned	
Allotted	**Ground**	Joint	
Respect	**Per**	Ideal	
		Expected	

* Bolded words in table are rare words produced only by adults with HFASD

Pragmatic indices.

Pragmatic rating scale.

The primary focus of analysis for the PRS was to explore the differences between the HFASD and control participants regarding pragmatic behaviours in the simulated employment interview and PCR task. An independent samples *t*-test was conducted to determine if the HFASD group and the controls differed significantly ($\alpha = 0.05$) on the total raw score that was obtained from the 18 pragmatic behaviours. A higher raw score on the PRS is indicative of more impairment. Results indicated that there was a significant difference regarding the average raw score obtained for the HFASD group (M= 19.40, SD= 10.05) and the controls (M=8.40, SD= 4.29; *t* (25.69) = -4.50, *p* <.01, *d*= 1.42).

Following Paul et al., (2008) investigations into the differences between the adults with HFASD and the matched controls regarding the 17 PRS items (Atypical Greeting was discarded as this was only recorded on one occasion for each participant) were conducted using independent sample t-tests on the average raw scores for each item (Table 11). A Bonferroni correction was used, so that a *p* value of .05 was divided among the 17 comparisons, resulting in a *p* level of .003 to reach significance. Using this criterion, significant differences on the following items were found between the adults with HFASD and the controls:

Table 12: *Significant PRS Items*

Comparison of PRS:	*t*	α ≤ .003
Irrelevant / inappropriate detail	-3.20	.003
Out of sync content / unannounced topic shifts	-3.58	.001
Awkward Expression	-3.31	.002
Candid	-1.60	.119
Direct /Blunt	-1.73	.093
Formal	-1.53	.133
Informal	-1.20	.239
Overly Talkative	-1.95	.059
Confusing Account	-2.68	.011
Topic Preoccupations / Perseveration	-1.32	.194
To and Fro Exchange	-1.45	.154
Terse	-0.41	.682
Odd Humor	-0.74	.466
Insufficient Information	-1.75	.089
No Reference to Pronouns	1.00	.324
Inadequate Clarification	-1.45	.154
Vague Speech / Language	-0.45	.655

On average, the adults with HFASD provided irrelevant or inappropriate details, they shifted topics unexpectedly or their content was out of sync with the topic of discussion, and the expression of their ideas was considered significantly more awkward in comparison to the controls. The following examples illustrate each of these pragmatic impairments:

Table 13: *Pragmatic Impairment Examples from the Language Samples of Adults with HFASD*

PRS Items:	Examples of Errors
Irrelevant / inappropriate detail	In response to work experience:
	'I worked at the Mayfair Golf and Country Club in the locker room. Locker Room Attendant was my position. I shined shoes for a living. And it was pretty good. ***The thing about the Mayfair is that they have really, really good food.'***
	"I have worked at a pet store. I am not gonna do that again. That was on the whole a bad experience. Even though I stated there for 2 ½ years. ***Just to them animals are stock, like you bring them in put them on a shelf and then if they sell great and if they don't, yeah."***
Out of sync content / unannounced topic shifts	In response to what is your greatest strength:
	"My singing I think definitely. My teacher was ecstatic about my skill. I already had raw talent and thanks to her I refined it to the point where I really enjoy myself. ***And some of my favourite music in Pink Floyd. I am a sucker for classic rock."***
Awkward Expression	In response to what work environment you would work best within:
	"I want to **expand upon myself** which is why I would like to get into a job where I have to interact with people more."
	In response to the PCR task:
	"Because sometimes **you have got to play hard ball** with some people because there are actually some people out there who **wouldn't waste the time kicking you to the ground**."

Response length and fluency.

As previously mentioned, the interview script (Appendix C) covered "getting to know you" questions and a situation describing a peer conflict in a fast food restaurant (Nippold et al., 2007). A separate multivariate analysis of variance was conducted with diagnostic groups (HFASD vs. controls) as

the independent variable and response length and fluency measures as the dependent variables. Speech characteristics and fluency measures included 1) length of the interviews in minutes, 2) the proportion of pauses, including both within and between utterance pauses, and 3) total number of utterances. Using an alpha level of .05, MANOVA confirmed significant group differences (Wilks' Lambda = 0.77, F (3, 36) = 3.59, p = .02). Because the MANOVA was significant, a one-way ANOVA was conducted for each dependent variable as a follow-up test to the MANOVA (Hummel & Sligo, 1971). The results in Table 12 suggest that both the average length of interviews (F [1, 38] = 8.45, p = 0.006, d=-.92) and average proportion of pauses (F [1,38] = 6.19, p =.02, d=-.79) were significantly different between the groups, and a large effect size was found (Pallant, 2007).

Table 14: Response Length and Fluency Measures

	HFASD				Controls			
	M	SD	Median	Range	M	SD	Median	Range
Interview Length (in minutes)	11:31[1]	4:22	9:51	7:08 to 24:23	8:13[1]	2:34	7:21	5:31 to 15:23
Number of utterances	88.40	36.66	80.00	46 - 168	74.85	32.74	67.50	41- 179
Number of Pauses	5.00[2]	6.32	3.00	0-22	1.35[2]	1.79	1	0-7

[1] p = 0.006
[2] p = 0.02

Retelling of the PCR Task.

For the PCR task, half of the participants from each group recalled relevant details of the scenario (see Appendix C for scoring details). In each group, 10 participants recalled the gist of the scenario although a single important detail was missing. The detail that was missing was not the same in each case but, for example, participants in both groups frequently forgot to explicitly mention the setting (i.e., fast-food restaurant) although it could

be inferred from other details provided during the story retelling (e.g., Mike works on the grill). The absence of any detail did not negatively influence the participants' responses to the questions. Two participants, both from the HFASD group, requested that the story be retold indicating that they had forgotten the details of the story. After the recruitment consultant repeated the scenario one participant recalled every detail and the other participant the gist of the scenario.

Table 15 provides a concise summary of the findings generated from the study in relation to the research questions. First it identifies if the language skills of adults with HFASD and control participants that were matched on nonverbal IQ, educational level and sex differed on standardized assessments (i.e., TOAL-4, CASL and CC-A) that targeted syntax, vocabulary and pragmatic language abilities. It also summarizes whether or not the language skills of adults with HFASD and control participants differed on indices of syntax, vocabulary and pragmatics obtained from detailed language sample analysis.

Table 15: *Summary of Findings*

Structural Language Measures:		**Significant Group Difference**
Semantic	TOAL-4: Word Opposites: subtest standard score	No
	TOAL-4: Word Similarities: subtest standard score	No
	TOAL-4: Spoken Analogies: subtest standard score	No
Syntax	TOAL-4: Sentence Combining: subtest standard score	Yes
	TOAL-4: Word Derivations: subtest standard score	No
Pragmatic	CASL: Non-literal Language: subtest standard score	Yes
	CASL: Pragmatic Judgment: subtest standard score	Yes
Informant Measure	CC-A: Language Structure: subscale score	Yes
	CC-A: Pragmatic Skills: subscale score	Yes
Language Sample Indices:		
Semantic	TTR (PCR only)	No
	Proportion of Rare Words (PCR only)	No
	Proportion of Word Errors	Yes
Syntax	Mean Length of Utterance:	No
	Subordination Index:	No
Pragmatic	Raw Score Pragmatic Rating Scale (PRS)	Yes
	Interview Length	Yes
	Number of Utterances	No
	Number of Pauses	Yes

CHAPTER 5

Discussion

Even though communication impairment is a core feature of ASD, very few studies have documented the communicative profile in adults with HFASD. Pragmatic impairment is viewed as universal but a review of the literature found that most of the research had been designed to only investigate specific pragmatic impairments. For example, adults with HFASD were found to be less skilled at interpreting nonliteral language (Lewis et al., 2007a & b), and less responsive to their conversational partners (Lake et al., 2010; Seung, 2007). Our review found that very few studies described the scope of pragmatic problems in adults with HFASD and as a result, the full extent of their pragmatic difficulties remained undocumented. In large part, this is due to the lack of comprehensive assessment tools for the pragmatic communicative domain (Adams, 2002; Paul, 2007). In other communicative domains such as syntax some adults with HFASD appeared to have difficulties compared to appropriately matched controls (Lewis, et al., 2007, Whitehouse et al., 2009a). In addition, impaired use and understanding of vocabulary had also been reported (Lewis et al., 2007; Whitehouse et al., 2009a; Howlin, 2003; Rumsey & Hamburger, 1988). Because most of the previous studies of adult communication in HFASD included participants across a broad age range and in some cases, with uncertain diagnoses, it remained unclear whether young adults with HFASD had difficulties with syntax and vocabulary in addition to pragmatics. This study filled this gap by administering a battery of standardized tests, including two newer measures of pragmatic skill and one newer measure of syntax and semantics, to a sample of young adults with HFASD who were relatively close in age and who were rigorously diagnosed using one of the accepted "gold standard" instruments, the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2003).

A comprehensive evaluation of communicative status has also been hampered because no study has previously analyzed language samples of

adults with HFASD across vocabulary, syntactic and pragmatic domains. One concern in assessment is that our standardized test instruments may not be sufficiently sensitive to detect subtle difficulties with more sophisticated syntax. If so, young adults with HFASD might exhibit difficulties in vocabulary and grammar, but the scores on standardized tests would not identify them. Although language samples provide a more subtle assessment of language skill than standardized measures (Bishop, 2003) they are more labour-, and thus resource-, intensive, so clinicians do not always choose to pursue them unless it is necessary. This study was the first to evaluate the communicative profile in adults with HFASD by administering a comprehensive battery of standardized language tests as well as analyzing a language sample in detail.

Another gap in the research on adults with HFASD is the functional impact of dysfunctional communication abilities. Because communication impairments are commonly believed to negatively influence real world skills such as achieving employment and sustaining friendships and relationships (Howlin, 1997 & 2003; Kapp, Gantman & Laugeson, 2011, Landa, 2000; Mawhood & Howlin, 1999), it seems important to determine whether communicative difficulties in the population with HFASD have a negative impact on their ability to participate in their communities. This study was the first to obtain a language sample from a simulated employment interview, gathering information about how adults with HFASD use or struggle to use language in a life-like adult context compared to controls matched on gender, performance IQ and educational level.

The noteworthy findings from this study were the following: 1) As expected, standardized tools did not identify communicative impairment that were in the range of clinical significance, but language sample analysis and an informant measure identified pragmatic language dysfunction, 2) the language sample revealed that vocabulary errors were more prevalent in adults with HFASD than controls during the simulated employment interview, but unexpectedly, that 3) there were no group differences in syntactic

abilities, based on analysis of the language samples. What follows is a discussion regarding the implications of each of these findings.

First, both language sample analysis and the informant measure revealed pragmatic impairments in adults with HFASD whereas the traditional, standardized subtest measures that targeted pragmatic language did not reveal impairment. The Pragmatic Rating Scale (PRS; Landa et al., 1992) identified significantly more pragmatic anomalies in adults with HFASD than matched controls. The significantly higher scores for young adults with HFASD on the PRS are consistent with two other studies that used the PRS with HFASD adolescents (Lam & Yeung, 2012; Paul et al., 2009).

In the current study the deficits seen in conversational skills of young adults with HFASD in comparison to the control group were *Out of Sync Content/ Unannounced Topic Shifts* and *Awkward Expression of Ideas*. Providing *Irrelevant/Inappropriate Detail* approached significance. These behaviours were also noted as being more prevalent in adolescents with HFASD (Lam & Yeung 2012; Paul et al., 2009). The current study identified fewer inappropriate pragmatic behaviours as measured by the PRS in adults with HFASD than were noted in previously reported studies of adolescents with HFASD (Lam & Yeung, 2012; Paul et al. 2009). One plausible explanation is that both of the adolescent studies collected lengthier samples derived from contexts that were less structured and more conversational in nature. Their sampling contexts provided opportunities for the participants not only to respond to questions but to initiate topics of conversation. In the current study, the recruitment consultant controlled the conversational interaction and opportunities for the participants to initiate topics of discussions were not provided or encouraged. In addition, the simulated employment interview may have included limited opportunities to sample some of the other behaviours. For example, during an interview there would be fewer opportunities to interject humour and a formal speaking style would be considered more appropriate given the context. Longitudinal research studies, sampling pragmatic skills in a variety of contexts over time, would

allow more definitive conclusions regarding changes in pragmatic language abilities from adolescence through adulthood.

Notably, as Paul et al. (2009) found in adolescents with HFASD, adults with HFASD did not consistently use dysfunctional pragmatic behaviours while speaking. Paul and colleagues indicated that the population used a relatively small quantity of atypical conversational behaviour while engaged in communicative interactions. In fact, for two of the three areas where there were significant or nearly significant differences between the groups (*Out of Sync Content/ Unannounced Topic Shifts* and *Irrelevant/Inappropriate Detail*), the average percentage of occurrence was 9%, and 6% respectively. Future research should evaluate if even these relatively small proportions of aberrant pragmatic behaviour in adolescents and adults are sufficient to influence how individuals with HFASD are perceived.

The third area, the maximum percentage of possible points for *Awkward Expression of Ideas* occurred on an average of 53% in the group with HFASD and on an average of 25% for the control group. This pragmatic behaviour, operationally defined as the inappropriate use of words/figures of speech and/or seemingly stereotypic use of a phrase, was coded at least once in all of the interviews with the adults with HFASD and for 17 of the 20 controls. This high percentage of *Awkward Expression of Ideas* codes may reflect the demanding sampling context where participants needed to quickly generate thoughtful responses to interview questions. Although the average percentage of possible points for this aberrant behaviour was high it is not dissimilar to the maximum percentage of possible points for an inappropriate pragmatic behaviour (42%) reported in the adolescent study (Paul et al., 2009). Overall, the current study provides additional evidence regarding the utility of the PRS as a means of documenting pragmatic impairment in individuals diagnosed with HFASD. The use of the PRS to document deficits in communicative interactions in individuals with HFASD has also been extended from adolescents to include young adults with HFASD.

Another noteworthy pragmatic finding generated from the language sample analysis was performance on response length and fluency measures. The HFASD group had significantly longer interviews and also had an increased number of pauses during the interview than the controls. These findings are consistent with the literature, which suggests that individuals with HFASD may be verbose (Adams et al., 2002; Shriberg et al., 2001) and that they tend to have more reformulations and silent pauses during conversational speech (Lake, et al., 2011; Paul et al., 2009; Shriberg et al., 2001). Both appear to be contributing factors to the increased length of their interviews in comparison to the controls. An important consideration and a future direction for research is determining the functional impact that increased length and pauses may have on a conversational partner in everyday life. In a job interview, for example, the research suggests that unusually long pauses and/or extended ramblings characterize unsuccessful interviews (Einhorn, 1981).

Pragmatic impairment was also identified in our sample using the CC-A (Whitehouse & Bishop, 2009), the informant measure. The mean Pragmatic Skills composite score for the HFASD group was two standard deviations below the norm, which is "indicative of a problem of clinical significance" (p.12, Whitehouse & Bishop, 2009). There are 21 questions on the CC-A that focus on pragmatic skills. Thirteen of the questions align with nine of the behaviours sampled on the PRS (*Overly Direct/Blunt, Inappropriately Formal, Overly Talkative, Irrelevant/Inappropriate Detail, Confusing Accounts, Topic Preoccupation/Perseveration, Unresponsive to Examiner Cues, Insufficient Background Information, Awkward Expression of Ideas*). The Pragmatic Skills Composite also has another eight questions that target pragmatic behaviours that may not be as easily assessed from a language sample such as *understanding nonliteral information*, *engagement style* (e.g., *talks to people too readily*), and *how other people relate to the individual being assessed* (e.g., *people have fun at his/her expense*). These items provide additional

information on how a person engages in conversational interactions with a variety of communication partners.

This study is one of the first to report on findings from the CC-A in a sample of adults with HFASD. The CC-A effectively discriminated the adults with HFASD from the controls. Sixteen of the participants with HFASD in comparison to one control were identified as having two composite scores below six, which suggests that communication difficulties will influence everyday life. The findings from this study are consistent with the findings from the companion assessments for children, the Children's Communication Checklist (CCC; Bishop, 1998) and the revised edition, the Children's Communication Checklist -2 US Edition (CCC-2; Bishop, 2006). The CCC/CCC-2 has been shown to be useful to measure communication (Norbury, Nash, Baird & Bishop, 2004) and pragmatic language impairment in children with ASD in clinical and research settings (Geurts, Verte, Oosterlaan, 2004; Volden & Philips, 2010). The CC-A, like its predecessor the CCC/CCC-2, captures the kinds of communicative difficulties that may influence a person's ability to succeed in day-to-day interactions in their community.

The PRS and the CC-A both identified significant pragmatic impairment in the adults with HFASD compared to the controls. These findings are contrary to the findings from the pragmatic subtests on the CASL where adults with HFASD scored toward the lower end of the normal range, (i.e., within one SD of the mean). This suggests that the PRS and the CC-A are better suited to identifying pragmatic impairment in adults with HFASD than more traditional assessments. Volden and Philips (2010) also found that the CCC-2 was better at identifying pragmatic impairment in children with HFASD than performance on a more traditional pragmatic assessment like the CASL.

On the other hand, Reichow et al (2008) argue that when pragmatic subtest scores are a standard deviation below performance on measures of more formal aspects of language (e.g., vocabulary, syntax), there a need for communication intervention, so perhaps scores on pragmatic subtests need

to be interpreted relative to the scores achieved on other domains of language. If this perspective is applied to the current study, adults with HFASD scored, on average, in the mid-80s on the CASL subtests of Pragmatic Judgement and NonLiteral Language, but received mean scores closer to the population mean of 100 on subtests of the TOAL that measured syntax and semantics. Clinically the subtests from the CASL may be helpful as part of a comprehensive assessment providing support for communication services for young adults with HFASD if scores on these subtests fall at least a standard deviation (Reichow et al., 2008) below performance on structural language subtests. Clinical, documentation could emphasize the discrepancy between these subtests and performance on more formal aspects of language that are typically within the average range to demonstrate a need for intervention that targets pragmatic language (Reichow et al., 2008).

With regard to vocabulary, no deficits were noted regarding performance on standardized tests of vocabulary between the adults with HFASD and controls. The language sample analysis however, revealed that the adults with HFASD had a significantly higher proportion of word usage errors than the control group. Close inspection of the language samples was required as word errors were intricately linked to context. For example, in the PCR task a participant is discussing the need to repay a favour to a co-worker but the participant mistakenly uses the word 'feeling' rather than 'favour' in the sentence, "Maybe the feeling can be reciprocated later."

Only one other study (Perkins, Dobbinson, Boucher, Bol & Bloom, 2006) was found that considered vocabulary usage errors in conversational samples of adults with ASD. Numerous vocabulary usage errors were noted for the seven adult participants who ranged in age from 19 to 33 years of age. Unfortunately, all of the participants had an intellectual disability so direct comparisons between the two studies are inappropriate. The increased frequency of word errors noted in the current study is consistent with Volden and Lord's (1991) finding of higher numbers of word errors in adolescents with HFASD compared to controls. These types of word errors would not be

identified on traditional tests of vocabulary but are detected in language samples where vocabulary selection in a given context appears odd or overly precise (Tager-Flusberg et al., 2005). Given the limited literature on vocabulary derived from language samples in adults with HFASD these findings need to be replicated in larger samples to draw any definitive conclusions. Furthermore the potential influence of odd or unusual words in context could be explored to determine if the use of odd or overly precise words negatively influences interactions with a conversational partner.

The lack of significant difference between the adults with HFASD and controls on the syntactic indices derived from the language sample was unexpected. The anticipated outcome was that detailed language sample analysis should reveal subtle syntactic errors that were not evident on more traditional assessments. The syntactic indices were 1) mean length of utterance (MLU) and 2) subordination index (SI). The examples shown in Table 13 can be used to illustrate a possible reason why no differences were found between adults with HFASD and controls on MLU and the SI.

Table 16: Utterance Examples

Adults with HFASD: Employment Interview

I think that even if I were to go out briefly for the lunch hour or whatever outside, I don't know that would make much of a difference to some of the issues I have yet to work my way through.

I want a work environment that challenges me in what I find to be most difficult because I feel since I'm somewhat withdrawn.

Controls: Employment Interview

I think because I 'm fairly young and I've gotten to the point that I'm at, that's not very common.

Or if it's a coworker and we're at the same level, I'll talk to the manager and maybe see if we can diffuse it that way, maybe before taking it out in a more aggressive fashion, which I really don't feel is necessary.

Adults with HFASD: PCR Task

But if he explains to his friend that his arm is sore and that he's going to have a difficult time doing the garbage maybe he can switch out for the grill later so that his arm doesn't get so sore.

I think Mike should switch with him because if Peter's having a tough time lifting heavy loads with a sore arm, probably if he ended up doing it he would probably end up hurting himself more.

Controls: PCR Task

It would be worth asking her how she injured herself, what kind of injury it is, if Kathy would be willing to switch with her some other time when her arm is better.

I think, a good thing for Mike to do would be to empathize with him and say, "You know what, you have a hurt arm I guess."

In both MLU and clausal density, all of these examples are equivalent; they are complex sentences that have a main clause and 4 subordinate clauses. On inspection the utterances derived from individuals with HFASD seem more awkwardly constructed in comparison to the control group. However a procedure was not established to remove awkward sentences from the MLU and SI calculations. If some way could be found to quantify awkwardly constructed utterances this may negatively influence MLU and SI results for the HFASD group. In future perhaps these could be removed by blind coders.

When the MLU and SI from this study were compared to the literature it was surprising to find that the means for the HFASD adults (MLU $\underline{M}$= 10.90, SI $\underline{M}$=1.60) and the controls (MLU $\underline{M}$= 10.96, SI M=1.60) were less than those reported for typical adults aged 17 years (MLU $\underline{M}$ 11.84, SI $\underline{M}$ = 1.76) and 25 years (MLU $\underline{M}$= 14.04, SI $\underline{M}$ = 1.97) who completed a similar expository task (Nippold et al., 2007). In the Nippold study, the 20 participants per age band completed the same fast-food restaurant PCR task as participants in the current study, in addition to a second PCR task regarding a science fair. Although the MLU and SI increased from the 17-year old group to the 25-year old group these were not significant differences.

One possibility for the lower MLU and SI in the current study is that answering the interview questions may not have demanded utterances that were as syntactically complex as responses in the PCR task. When MLU was calculated for the PCR task separately from the employment-related questions, the MLU increased for both groups (Adults with HFASD, $\underline{M}$=11.72. SI $\underline{M}$=1.69); Controls, $\underline{M}$= 11.63, SI $\underline{M}$=1.69) to be in line with those reported for typical adults by Nippold et al. (2007). This finding highlights the influence of sampling context on language sample results. Future research that focuses more explicitly on expository (explaining how to do something) versus persuasive (arguing a controversial point of view) discourse may advance the field and develop a better understanding of syntactic abilities and potential differences in adults with HFASD.

Limitations

Limitations in the current study included limitations inherent in standardized measures as well as some that were specific to the language sampling context and analysis. In summary, the comprehensive assessment of adults with HFASD revealed similar pragmatic problems in adults with HFASD to those previously found in the adolescent population. Both the CC-A and the PRS identified pragmatic impairment in adults with HFASD. The pragmatic subtests from the CASL were less informative although they may be useful clinically if scores on the pragmatic subtests are substantially below performance on structural language subtests. These results are in keeping with other studies with adults with HFASD (Lewis et al., 2007a&b, Whitehouse et al., 2009b) and were expected given that impairments in the appropriate, social and functional use of language are viewed as universal in ASD (Landa 2000; Paul, et al., 2009; Tager-Flusberg, Paul & Lord, 2005; Young et al., 2005). As for vocabulary, the impairments documented in other studies (Howlin, 2003; Lewis 2007b & Rumsey & Hamburger, 1988; Whitehouse et al., 2009a) were not found in the current study which aligns more closely with the child/adolescent findings that vocabulary abilities in individuals with HFASD are a relative strength (Boucher, 1988; Eigsti et al., 2007; Fein et al., 1996; Minshew et al., 1993, Tager-Flusberg, 1991). The occasional use of peculiar or odd words in conversational contexts persists into adulthood. Finally, syntactic impairment was noted on one of the standardized measures for adults with HFASD but was not found when the participants used their language to converse with the recruitment consultant. This finding was unexpected and may reflect limitations of the simulated employment interview and/or the indices used to evaluate syntax. New analytic tools that can evaluate even more subtle syntactic impairments have recently come to light that will be used in future analyses. Grammatical errors may be identified using the text analyzer Grammarly (www.grammarly.com), a comprehensive editing tool that searches for proper use of more than 250 advanced grammar rules.

Limitations of the simulated employment interview include the participants' awareness that the interview with the recruitment consultant was not an actual interview and that there was no specific job available at the end. Thus, they may not have given their best performance to impress the interviewer. Nonetheless, the simulated employment interview was made as real as possible with the use of a professional recruitment consultant using questions drawn from the vocational literature and designed in close cooperation with the consultant. In addition, the inclusion of the PCR task logically fit with the employment questions and was not outside the realm of possibility in an interview situation. This standardized context is a step in the direction of collecting data in an ecologically valid situation.

Another limitation was the relatively small sample size. Efforts were made to recruit a larger sample size by targeting two major cities and also various locations (e.g., physician's offices, post-secondary institutions, specific autism groups serving young adults with HFASD) within each city. A stipend was also offered to attract participants. Despite the relatively small sample size this study was larger than all of the studies reviewed that utilized a control group except for one (Barnes & Baron-Cohen, 2012).

Why do these communication impairments persist in adults with HFASD?

The Theory of Mind (ToM) model offers a plausible explanation regarding persisting impairments in communication in adults with HFASD (Baron-Cohen, S., Leslie, & Frith, 1985). This theory proposes that pragmatic impairments are the result of a specific social cognitive mechanism (Volkmar, 2004) and that individuals with HFASD lack the ability to infer other people's mental states in order to predict and explain human behavior (Baron-Cohen, Leslie & Frith, 1985). If so, for example, the language an adult with HFASD opts to use in a social context, would fail to take into account the knowledge, expectations and beliefs of the conversational partner. The ability to tailor one's language to meet the listener's needs; considering what the listener expects, needs to know or might be interested in, requires an individual to put themselves in the other person's shoes. According to this theory

individuals with autism fail to do this because they have impaired abilities in ToM (Tager-Flusberg, 1999). Over the years this model has been modified as researchers have demonstrated that some individuals with HFASD are able to pass both first and second order false belief tests (e.g., I think, she thinks; Rajendran & Mitchell, 2007). Thus the ToM model cannot independently explain the persistent communication difficulties found in adults with HFASD.

Alternatively, it is possible that impaired executive functions (EF) underlie the pragmatic impairments seen in HFASD (Happe, 1999). The EF model suggests that the array of pragmatic deficits associated with autism is due to affected, frontally mediated, executive cognitive structures (Pennington & Ozonoff, 1996). The affected cognitive structures inhibit an individual's ability to control actions in novel contexts. For example, Bishop and Norbury (2005) suggest that executive functions such as planning and generating ideas are pertinent to pragmatic language abilities such as, comprehending multiple meaning words, interpreting ambiguous phrases, and understanding non-literal language. Additionally, perseverative topic use is frequently observed in HFASD and may be explained by a difficulty in shifting to a new topic, another executive function skill area impaired in ASD (Ambery, Russell, Perry, Morris & Murphy, 2006; Lopez, Lincoln, Ozonoff & Lai, 2005; South, Ozonoff & McMahon, 2007). Although it can be argued that impaired abilities on executive function tasks can explain many of the pragmatic challenges associated with HFASD, the strength of the research is compromised as impaired performance on executive function tasks are not unique to HFASD, nor are difficulties on executive function tasks universal to individuals with HFASD (Kenworthy, Yerys, Gutermuth & Wallace, 2008; Rajendran & Mitchell, 2007).

A third possibility is that early language impairments have a long-term cascading effect on the social communicative impairments seen in adults with HFASD. Research from adults with SLI, suggests that social communication impairments are evident in adults who were diagnosed with SLI during childhood (Clegg, Hollis & Rutter, 1999; Rutter & Mawhood, 1991; Conti-

Ramsden, Mok, Pickles & Durkin, 2013). This is true even when the preexisting language impairments are not detected in adulthood using standardized language assessments (Durkin & Conti-Ramsden, 2007). On this view, the social communication challenges may be the result of earlier impairments in communication that made it challenging for individuals with SLI to relate to others (Brinton & Fujiki, 1993), leading to frustration and distress (Brinton & Fujiki, 2010). These experiences in turn negatively influenced social communication interactions with peers throughout the lifespan (St. Clair, Pickles, Durkin & Conti-Ramsden, 2011). It is possible that the persistent social communication impairments in adults with HFASD are similar to those in adults with SLI – early structural language impairments have negatively influenced the development of pragmatic language abilities and have persisted into adulthood with or without evidence of persisting language impairments. Longitudinal studies or documentation regarding early language development is required to affirm this likelihood of this explanation.

Any one of or a combination of the aforementioned possibilities may offer a reasonable explanation for the social communicative impairments in an adult with HFASD. No conclusive research exists to date regarding which explanation or combined explanation best fits with the communicative profile of adults with HFASD. Future research should endeavor to conduct longitudinal research that link origins of social communication impairment with social cognition, executive functioning and early structural language abilities to determine the influence of each of these variables on the communication profile in adults with HFASD.

Summary and Conclusions

In summary, the current study focused exclusively on communication impairment in young adults with HFASD in comparison to a control group who were not significantly different regarding performance IQ, educational level and gender. The findings from this study have added to a limited body of literature regarding the communication profile of young adults with HFASD by investigating performance not only on more traditional assessment

measures but also by analyzing a language sample derived from an ecologically valid communicative interaction with a recruitment consultant.

From a clinical perspective, since the identification and support of adults with HFASD is now a research priority (The Interagency Autism Coordinating Committee - IACC, 2011), it's important to determine the range of communicative impairments that are characteristic of adults with HFASD, using measures that are sensitive enough to identify even subtle impairments. Results from this study suggest that supplementing the formal assessments with an informant questionnaire such as the CC-A and a language sample derived from a task that is challenging for adults would also be helpful. The CC-A captured infrequent communication behaviors that are difficult to assess in structured assessments and during language sampling tasks such as "gets confused when a word is used with a different meaning from usual", "others have fun at his or her expense" and "talks about fictitious events as if they were real". A detailed language sample analysis offered the opportunity to identify subtle language impairments such as word errors that were missed by the traditional language assessments. The communication profile derived from this type of inclusive assessment may be useful in establishing a more comprehensive understanding of the communication profile in adults with HFASD.

What remains to be determined, however, is the functional impact of these communicative impairments. As previously mentioned, one direction for future research, and the next priority for the author of this study, is to have naïve listeners rate the communicative quality of language samples derived from contexts that are meaningful to adults. The use of naïve raters in evaluating communicative quality is both a reliable (Allard & Williams, 2008; Black & Hazen, 1990; DeThorne & Watkins, 2001; Gertner et al., 1994; Hazen & Black, 1989; Newman & McGregor, 2006; Place & Becker, 1991) and valid (Stevens, 1975) approach that can be used to investigate the influence of communication impairments and whether or not it negatively influences the lives of individuals with HFASD, by presenting a barrier to full

participation in the community. This type of research will move the field beyond delineating impairment and address critical issues related to functional impact and improving the quality of life for adults with HFASD.

APPENDICES

Appendix A: Language Transcription Definitions

Language Transcription: (from Scott 1988 referenced in Newman & McGregor & Nippold 2005)

T-unit: An independent clause (IC) and any dependent clause (DC) or nonclausal structures that are attached to it or embedded within it (Hunt, 1970). For example, *Bill bought a new bike* [IC] *before he went to Europe* [DC]. as opposed to the following: *Bill went to France and then he went to Italy* which is two T-units. Whenever a subordinating conjunction (and, but or so) initiates an independent clause it is considered to be a new T-unit.

C-unit: identical to a T-unit but includes responses that lack an independent clause when answering a question (Loban, 1976). For example, *Did Jack drive? Yes*. The response '*yes*' is 1 C-unit.

Fragment: an utterance that lacks a main verb or a subject – therefore not an independent clause (Crews, 1977). Doesn't answer a question. For example, '*going down the road', 'the other day', '2 weeks later'*

Syntax

Definitions and Examples of Clauses:

The following definitions and examples of clauses are from Nippold and colleagues (2005, p.1061):

Independent (Main) Clause

An independent clause contains a subject and a main verb and makes a complete statement (Crews, 1977). For example, the following are both independent clauses: ''Mother rode her bicycle to work today,'' and ''It started to rain late last night.''

Dependent (Subordinate) Clauses

A dependent clause contains a subject and a main verb but does not make a complete statement; therefore, it cannot stand alone. There are three main types of dependent clauses: relative, adverbial, and nominal (Crews, 1977; Quirk & Greenbaum, 1973):

1**. *A relative clause*** (i.e., adjective clause) acts like an adjective and modifies the noun that precedes it: For example, *The cat **that was sleeping on the couch** was content*

2. ***An adverbial clause*** acts like an adverb and modifies a verb. It often describes a condition or cause and begins with a subordinate conjunction: for example, ***Unless we can reach Los Angeles by eight o'clock***, *we'll miss*

the concert.

3. **A nominal clause** is a noun-like element that can serve as either the subject of a sentence (e.g., **Whatever she told you about the wedding** *was a great exaggeration*) or its object (e.g*.,I told her* **what she needed to hear**). Nominal clauses often begin with wh-words: For example, *I never know* **where I should park,**; *My desire to become a nurse is* **why I study so hard** ; *Checkmate is* **when your opponent's king cannot escape**.

Examples from pilot data:

1. "I think *(main verb)* someone who *(relative clause)* lets me go try to solve problems *(nonfinite verb)* on my own and lets me have a little individual work, but who *(relative clause)* also will step in if *(adverbial clause)* I'm going completely off track and offers his guidance."
2. "Well in order to maintain *(nonfinite verb)* a good relationship with your coworker, you want *(main verb)* to try *(nonfinite verb)* to help *(nonfinite verb)* him out if *(adverbial clause)* you can."

Appendix B: Behavior Categories for Pragmatic Rating Scale (PRS)

Original PRS (Landa et al., 1992)	Modified PRS (Paul et al., 2009)
Atypical Greeting	**Inappropriate / Absent Greeting**
Overly Candid	**Strikingly Candid**
Overly Direct or Blunt	**Overly Direct or Blunt**
Overly Formal or Informal	**Inappropriately Formal**
	Inappropriately Informal
Overly Talkative	**Overly talkative**
Overly Detailed: Provides **minute details** about an event or tells technical aspects when asked a general question and also fails to substitute articles or relative clauses to reference old information.	**Irrelevant / Inappropriate detail:** Provides **minute details** about an event or tells technical aspects when asked a general question.
	Failure to Reference Pronouns / Terminology: Fails to substitute definite articles and relative clauses to reference old information**.**
Out of Synchrony Communicative Behavior: Elaborates on insignificant aspects of interviewer's statements rather than on main point; tangential responses; frequent and obvious misinterpretation of interviewer's statements or queries	**Out of sync content / unannounced topic shifts** Elaborates on insignificant aspects of interviewer's statements rather than on main point; tangential responses; frequent and obvious misinterpretation of interviewer's statements or queries. **Abruptly changes topic** without using typical social markers that signal the change or indicate the relevance of the off-topic information (e.g. 'This is off the subject but . . . ' or 'That reminds me of the time when ...'.
Abrupt Topic Change: Abruptly changes topic without using typical social markers that signal the change or indicate the relevance of the off-topic information (e.g. 'This is off the subject but . . . ' or 'That reminds me of the time when ...'.	
Confusing Accounts	**Confusing Accounts**
Topic Preoccupations	**Topic Preoccupation/ Perseveration**
Little Conversational To and Fro	**Little Reciprocal To-and-Fro Exchange:**
Terse	**Terse**
Odd Humor	**Odd Humor**
Insufficient Background Information	**Insufficient Background Information**
Inadequate Clarification	**Inadequate Clarification**
Vague	**Vague**
Awkward Expression of Ideas: Semantically inappropriate use of words /	**Scripted, stereotyped sentences or discourse**

figures of speech. Frequent seemingly stereotypic use of a phrase during an interview even when it does make sense in the context.	**Awkward Expression of Ideas**
Inappropriate Topics: Initiates topics that are wholly unrelated to a structured task, such as bringing out photographs of a vacation during cognitive testing	**N/A**
Indirect: Overly subtle in expression of opinions or instructions with the result that the intended connotation or desired action is unclear.	**N/A**
N/A	**Unresponsive to Examiner's Cues**
N/A	**Indistinct Speech / Mispronunciations**
N/A	**Rate of Speech is Too Rapid / Slow**
N/A	**Unusual Timing of Responses/ Reformulations**
N/A	**Unusual Rhythm of Speech such as Stuttering**
N/A	**Physical Distance**
N/A	**Gestures**
N/A	**Facial Expressions**
N/A	**Gaze**

All of the Modified PRS items were used in the current study with the following exceptions:

1. *Scripted, stereotyped sentences / discourse* and *Awkward Expression of Ideas* were combined as in the original PRS (Landa et al., 1992) because reliability regarding the two items could not be achieved during training.

2. *Unresponsive to Examiner's Cues* was eliminated, as this would likely be influenced by nonverbal as well as verbal cues and this study only reviewed audio, not video, files.

3. The remaining speech items *(Indistinct Speech / Mispronunciations, Rate of Speech is Too Rapid/Slow, Unusual Timing of*

Response/Reformulations and Unusual Rhythm of Speech such as stuttering) were excluded in an effort to focus on pragmatic behaviors.

4. The remaining paralinguistic items (*Physical Distance, Gestures, Facial Expression and Gaze*) were disregarded as this study reviewed audio files only.

Good afternoon (good morning), thank you for coming in to meet with me today. How are you?

Before I get into the questions, I just want to let you know the process. I will be asking a series of questions so that I can get to know you better. If you need me to repeat or clarify any of the questions please ask. Thank you and let's get started.

1. *Please tell me about your experience and education.*

2. *What do you consider to be your greatest strength? And something that you need to improve upon? (Have you done anything to help you improve in that area?)*

3. *What are you most proud of in terms of your accomplishments? (from school or work or extra curricular)*

4. *Please describe the work environment that you would work the best within. **OR** Tell us about your best supervisor? What qualities made them a good supervisor?*

5. *What do you do to handle frustrations (stress) in the workplace? (What do you do outside of work to relax?)*

Peer Conflict Resolution Task (Nippold et al., 2007)

To introduce the task, the interviewer read the following statement aloud to the participant (adapted from Selman et al., 1986, p. 459):

People are always running into problems with others at school, at work, and at home. Everyone has to work out ways to solve these problems. I am going to read you a story that illustrates this type of problem. I would like you to listen carefully and be ready to tell the story back to me, in your own words. Then I will ask you some questions about the story. I want to know what you think about the issue and how it should be handled.

Story B: " The Fast-Food Restaurant "

Mike and Peter (Jane and Kathy) work at a fast-food restaurant together. It is Mike's (Jane's) turn to work on the grill, which he (she) really likes to do, and it is Peter's (Kathy's) turn to do the garbage. Peter (Kathy) says his (her) arm is sore and asks Mike (Jane) to switch jobs with him (her), but Mike (Jane) doesn't want to lose his (her) chance on the grill.

Critical Story Elements:

1. Characters – 2 people Mike and Peter (Jane and Kathy) -
2. Setting - Work together / at a fast-food restaurant
3. Job task– Mike (Jane) on the grill
4. Job task - Peter (Kathy) has garbage duty
5. Problem – Peter (Kathy) has a sore arm
6. Request – Peter (Kathy) ask Mike (Jane) to switch positions
7. Dilemma – Mike (Jane) doesn't want to lose his (her) chance on the grill

$iClient, Examiner

+ Language: English

+ Participant ID: P3

+ Gender: M

+

+ DOE: 2/28/2012

+ CA: 24;10

+ Context: Con

+ Examiner: RC

+ Transcriber: LC

+ Checker: AEM

+ [EW]: error at word level

+ [EU]: error at utterance level

+ [EO]: error overgeneralization

- 0:54

C (Um) well, I have[EW:had] (a) an eccentric interest in (use/ed to be) gecko/s [SI-1].

C But (uh) I have change/ed now to orchid/s [SI-1].

E Hmm.

C And (I uh) just last night and the night before, I was set/ing up (uh) two (uh) tank/s of plant/s from (uh) South_America, Peru, Columbia and (s* uh) Ecuador [SI-1].

C (And then uh) and then I *will be importing some frog/s from a friend of mine (um) for about a thousand dollar/s for the frog/s [SI-0].

C And I *am gonna sell (them uh) the one/s that I don't wanna keep [SI-1].

E Wow.

C And so, yeah [SI-X].

C That/'s kind of where my interest/s are right now [SI-2].

C (Um) I have work/ed at (:02 uh) several different kind/s of restaurant/s, (uh) usually in the kitchen [SI-1].

C (Um :03) I work/ed (at a) at the XX Mayfair_Golf_and_Country_Club in the (uh) locker_room [SI-X].

C Locker_room attendant (was) was my position [SI-1].

C I shine/ed shoe/s for a living [SI-1].

C And (it was) it was pretty good [SI-1].

C (Um) and (the) the thing about the Mayfair is that they have really, really good food [SI-2].

C Like wow [SI-X].

C (Um) and then <(uh)> [SI-X]^

E <That/'s good>.

C What[EW:where] else (did I) have I work/ed [SI-1]?

C I/'ve work/ed at a pet_store [SI-1].

C (Um) *I *am not gonna do that again [SI-0].

C That was, (uh on) on the whole, a bad experience [SI-1].

C Even though I stay/ed there for two_and_a_half year/s [SI-1].

C (Um) just to them, (it/'s) animal/s are stock [SI-1].

C (It/'s not you know you buy them or) like you bring them in [SI-1].

C (You) you put them on a shelf [SI-1].

C And then if they sell, great [SI-1].

C If they don't [SI-X]>

; :03

C Yeah [SI-X].

E OK.

E Let's not (get) <go there>.

C <(Uh)> [SI-X]>

E What about your education?

E So <XX> for education?

C (<Um> uh) education [SI-X].

C Well, I have a general_science degree, biology and chemistry [SI-1].

E Mm.

C (Um I/'ve) I had some practical live experience [SI-1].

C I/'ve been in a quality analysis pharmaceutical lab [SI-1].

C (Um) I was do/ing several research project/s [SI-1].

C (O*) one I engineer/ed (e*) e_coli to produce (uh) Butanol [SI-X].

C (Which was uh) we won (our) in our track (for) in the competition [SI-1].

C But (uh) it was/n't a particularly valuable industrial project because (uh) e_coli, (take/3s um) like it grow/3s fast for a microbe [SI-2].

C But (you can/'t really) it/'s not easy to work with for that purpose [SI-1].

C And the fuel chosen does/n't burn very fast (so or) or hot or <explosively> [SI-1].

E <Hmm>.

C So (you can/'t really use it in) like you can/'t use it pure (uh compa*) compared to diesel [SI-1].

C So (the) the better project that we end/ed up doing a couple *of year/s later was (uh) engineer/ing Neurospora_crassa, a bread mold [SI-2].

C It/'s multi_cellular [SI-1].

C You can strain it from the media which is a heck of a lot easier than e_coli [SI-2].

C And (um we made it we) we were try/ing to make it (uh) over express fatty acid/s and then (a s* uh) replace the cell/s with ethanol and esterify the fatty acid/s in the same step with heat, ethanol and potassium_hydroxide [SI-X].

C And then (um yeah you get b*) you get biodiesel from it [SI-1].

C And (it/'s) it/'s a very good fuel [SI-1].

C (It it uh is solid at lower temperature/s or no) it/'s liquid at lower temperature/s [SI-1].

C So (uh ((you know)) even) even our Canadian winter/s could use this as a viable fuel [SI-1].

E Hmm.

C (Um) and (the big thing) the big advantage, (that it) other than (the) those thing/s that I/'ve mention/ed, is that (it uh :04) it does/n't take a food source from a third world country [SI-3].

C It take/3s agricultural waste that no one value/3s anyway [SI-2].

C (Um) so right there (it/'s) it/'s a vast improvement [SI-1].

C (Um al*) alternative/s would have been to use algae (and) in waste water treatment plant/s and that sort of stuff which (i*) might be a good idea [SI-2].

C I don't know [SI-1].

C <(Um)> [SI-X]^

E <Hmm>.

E Sound/3s very interesting.

C Other than that, I/'ve work/ed in a genetics (uh) memory lab (uh) maintain/ing fruit_fly (uh) culture/s (uh) at the university here [SI-1].

C (Um) and then (I) another project that I had was, (to um uh) we were try/ing to determine the structure of blue pigment in panther_chameleon/s [SI-2].

C (Um) I was out to prove that it was/n't collagen raised like (uh) scientist/s had thought [SI-3].

C (Um) blue_light bounce/3s off of it [SI-1].

C And we see it as blue [SI-1].

C All the other color/s go in and is[EW:are] absorb/ed by the melanin underneath [SI-1].

C (Uh) I did/n't think that was the case because there/'s[EW:there_are] relate/ed animal/s (uh) of the same species, just different population/s [SI-3].

C They have different pigment/s [SI-1].

C (So it would and) but they have (identical color or %blah different c*) *a different color, identical pattern [SI-1].

C And (uh) so (it would) XX would say that it can/'t be two different system/s XX in the same pattern [SI-X].

C It has to be the same system just add/ing one step to make it blue [SI-1].

E Mm.

C And (the) we prove/ed it was/n't collagen [SI-2].

C But (uh) the best we could get was (uh) a mass spec [SI-2].

C And that indicate/ed that it was (a uh ((what was the metal))) cobalt metal complex, kind of like hemoglobin [SI-2].

E Hmm.

C (Um) but (the) the problem was that it/'s not soluble in anything other than formic_acid or (tia*) trifluopric_acid [SI-2].

C (Um) and those are very nasty substance/s to work with [SI-1].

C You can/'t manipulate them enzymatically (or) or chemically (uh) or (uh) study them spectroscopically or use/ing the other method/s [SI-1].

C So (it uh) it (kinda hit) was a dead end after that [SI-1].

E Oh.

C I could/n't confirm the result/s [SI-1].

C So, (um) <yeah> [SI-X].

E <Hmm>.

E Very interesting.

E <OK, so>^

C <That/'s my> experience [SI-1].

E OK.

E So, I/'m gonna move us along <then>.

C <Sure>.

E And (uh) what do you consider to be your greatest strength?

C (Uh :06 I think uh :06 it/'s I) I/'m good at a couple *of thing/s [SI-1].

C (Um :02 {clears throat}) well, I guess I/'m analytical [SI-2].

C (Um) I/'m creative in using certain media [SI-2].

C (Um) I/'m :02 academic [SI-1].

C (Uh) [SI-X]>

: :02

E Those are all good thing/s.

C Yeah [SI-X].

E OK.

E (Uh) so what is something that you need to improve upon?

E And (how have you done or) what have you done to improve on it?

C (Um) well (a* I have/n't uh) I did/n't really know myself very well [SI-1].

C (Uh) so (I was) I was wander/ing aimlessly as far as my career go/3s [SI-1].

C (Um I) I/'m six year/s in [SI-1].

C And (I don't have a plan or) I did/n't have a plan [SI-1].

C (A* uh my) I quit my education after *my degree [SI-1].

C (Um) so I was just kind of take/ing random class/s at that point and just try/ing to figure

out what to do [SI-1].

C (Um) lab science/s are great [SI-1].

C But it does/n't pay [SI-1].

C So what I like, there are no job/s in [SI-2].

C And even the job/s that are *available don't pay that well [SI-2].

C And they/'re not (sig* uh) stable [SI-1].

C They/'re susceptible to fluctuation/s in grant/s [SI-1].

E Hmm.

E <Mhm>.

C <(Um)> or, (you know i* did) the research, is it viable [SI-1]?

C (You know) if it/'s not then, <you know> there <go/3s> the job [SI-3].

E <Mhm>.

E <Yeah>.

E Yeah.

C (Uh) instead I/'m go/ing to go for medical, laboratory technology which use/3s a lot of science/s [SI-2].

C But it pay/3s a heck of a lot better [SI-1].

C And (it/'s) it/'s guarantee/ed because our population is still aging [SI-2].

C (Uh) and (we have) a very large proportion of our population is <older> [SI-1].

E <Mhm>.

C So [SI-X]>

E So (you you/'re) you/'re improve/ing on the fact that you know what you/'re gonna to do?

C Yeah [SI-X].

C <(Uh)> there/'s that [SI-1].

E <OK>.

E OK.

E Great.

E (Um) so what are you most proud of in term/s of your accomplishment/s?

109

C (Um :09 uh :06) probably just grow/ing the plant/s and (ha* you know) hatch/ing baby gecko/s and stuff [SI-0].

C (It/'s just) I don't know [SI-1].

C That/'s what make/3s me happy <(um)> *and proud [SI-1].

E <OK>.

C I suppose just (my) my knowledge of those area/s [SI-1].

E Hmm.

E That sound/3s good.

E OK.

E Can you please describe the work environment that you would work best within?

C (Um) quiet (uh) *and dimly lit [SI-0].

C (Um I) I/'m fairly certain that I have (uh) Irlen_Syndrome [SI-2].

C So fluorescent light/s, (uh) over time, (um) especially (if I/'m do/ing) if I/'m read/ing, it[EW:they] just exhaust/3s[EW:exhaust] me [SI-2].

E <Mm>.

C <(Uh)> other than that (um) not a lot of traffic [SI-0].

C (Uh) certain personality type/s, like (uh um) assertive people, (they don't) I don't really get along with them [SI-1].

C (Um there ha*) there/'s always one in every place I work that (uh) I can/'t get along with [SI-3].

C (Um) [SI-X]>

: :03

E What about a supervisor?

E (You were) did <you> describe your <supervisor>?

C <(Uh)> <a supervisor> that recognize/3s that I/'m a reservoir of knowledge [SI-2].

C And (not you know :03) they don't try to tell me how thing/s are [SI-2].

C They ask me [SI-1].

E <Mm>.

C <That would> be (uh) appreciated (of) by me (um) especially on thing/s that I know about [SI-2].

C Like if you know that this is my area of expertise, don't try to tell me how thing/s are [SI-

3].

E OK.

C (Um) so yeah [SI-X].

C (That/'s) that/'s one thing that drive/3s me nut/s (o* on the few time/s that I/'ve had) like at the pet_store for instance [SI-2].

C (Um) [SI-X]>

: :02

E OK.

C <Yeah> [SI-X].

E <Good>.

E So, how do you handle frustration/s in the workplace?

C (Uh) it depend/3s on what the frustration is [SI-2].

C (Uh) like (if :02) there have been time/s where I/'ve try/ed to go to boss/s [SI-2].

C Or (I/'ve I) I usually try to go to the person that I have a problem with to begin with [SI-2].

C Like if it/'s a coworker, I/'ll go directly to them and try and resolve it [SI-2].

C (Uh) that has mixed result/s [SI-1].

C (Uh) if that does/n't work, sometime/s I go to my boss/s [SI-2].

C But generally, that does/n't work either [SI-1].

C (Um) [SI-X]>

: :04

E What if (it/'s just) like work is stress/ing you out?

E How do you handle those kind/s of stress/s?

C I quit [SI-1].

E OK.

C Yeah [SI-X].

C Or (uh) [SI-X]>

E Do you do anything outside of work to relax?

C (Um) I play video game/s, although not very often anymore [SI-1].

C (I/'m more consume/ed m*) my time is consume/ed by[EW:with] (uh) growing plant/s and that sort of stuff, (um) *and buy/ing and trade/ing animal/s (um) and plant/s [SI-1].

111

E OK.

C Yeah [SI-X].

E Sound/s good.

C Play/ing with my cat [SI-0].

E OK.

E (Uh) so, people are always run/ing into problem/s with other/s, (uh) at school, at work and at home.

E And, you/'ve indicate/ed that a little bit.

E So everyone has to work out a way>

E Sorry.

E I/'m go/ing to start that over again.

E Everyone has to work out way/s to solve these problem/s.

E I/'m go/ing to read you a story that illustrate/3s this type of problem.

- 12:47

= E explains directions and read story and questions

- 13:29

C (Um) Mike and Peter work at a fast food restaurant together [SI-1].

C It/'s Mike/z turn at the grill [SI-1].

C And Peter, (is) his arm is sore [SI-1].

C And he does/n't wanna do the garbage [SI-1].

C But (uh) he ask/3s Mike to switch job/s with him [SI-1].

C Mike does/n't want to lose his chance on the grill [SI-1].

E OK.

E Great.

E So now (um) I have a few question/s.

E What is the main problem?

: :03

C (Um :02 someone want/3s or) someone else want/3s someone else to (uh) do something for them [SI-1].

C And they don't want to [SI-1].

C <So> [SI-X]^

E <OK>.

E And why is that a problem?

C (Um :09 uh) the guy can suck it up and use his other arm [SI-1].

= E and C laugh

E Well that/'s>

E (Uh) no.

E So (th*) there/'s a conflict between the two of them.

E And why is that a problem?

C (Um :02) why is that a problem [SI-1]?

C Because they want different thing/s [SI-1].

E OK.

E And what is a good way for Mike to deal with Peter?

: :03

C Tell him to go take the garbage out with his other arm [SI-1].

= C laughs

C Or, you know [SI-1].

E With his other arm.

E OK.

C Yeah [SI-X].

C Or just say, "well, then you/'re take/ing out the garbage for the next two day/s" [SI-2].

E OK.

E And why is that a good way for Mike to deal with Peter?

C Because he still (you know) get/3s his time on the (uh) grill [SI-1].

C And (um :04) Peter (you know) does/n't have to take out the garbage that day with his bad arm [SI-1].

C I guess [SI-1].

C Either way [SI-X].

C You <know> [SI-1].

E <OK>.

E And what do you think will happen if Mike does that?

: :04

C (Uh :08) I don't know [SI-1].

C It depend/3s on (what Peter say/3s or) what Peter think/3s [SI-2].

E OK.

E And how do you think they both will feel if Mike does that?

: :03

C (Um) well, Mike will be like, "I lost my chance to grill today" [SI-2].

C (Um) Peter will be like, "my arm does/n't hurt as much" [SI-2].

C Yeah [SI-X].

E OK.

15:48

Operational Definitions are based on Landa et al., (1992) and examples are provided. The examples provided illustrate frequency codes [1 (behavior occurred on one occasion) or 2 (behavior occurred on two or more occasions)] for the pragmatic items (italics are used to identify the pragmatic behaviour coded followed by superscripts indicating the cumulative count that would then result in a code of a 1 or a 2):

a) **Inappropriate/Absent Greeting:** Fails to greet or acknowledge the examiner's greeting (e.g. makes insulting remarks about the interviewer's presence rather than welcoming remarks):
For example *no greeting response[1]* when the recruitment consultant introduces herself and then when the recruitment consultant proceeds to ask the participant's name and the *participant fails to respond and does not share his or her name[2]*. [PRS Score =2]

b) **Strikingly Candid:** Expresses very personal information or makes highly critical, evaluative comments about people or situations:
In response to the PCR task the participant says, "Peter is an ass *for pretending that his arm is sore[1].*" [PRS Score =1]

c) **Overly Direct or Blunt:** Overly blunt or straightforward in expression of opinions or instructions:
Using the statement above where the participant says, "Peter is an *ass[1]* for pretending that his arm is sore." [PRS Score =1]

d) **Inappropriately Formal:** Uses extremely precise articulation; uncommon multisyllabic words in conversation where more common words would suffice:
After the interviewer introduces herself using her first name the participant responds with "Nice to meet you I am *Mr. Martinook[1]* and I would like to *impress upon you[2]* how *delighted[3]* I am to meet with you today." [PRS Score =2]

e) **Inappropriately Informal:** Profanity; overly familiar terms or slang when referring to professionals:
After being asked about work experience the participant says, "My jobs have all been *super crappy[1]*, *like super nasty[2]*." [PRS

Score =2]

f) **Insufficient Background Information**: Fails to indicate clearly the specific noun phrase to which a pronoun refers; uses technical jargon that a lay person would not understand; discusses events or people without providing the background information necessary for the interviewer to understand the account:
When asked about proudest accomplishments and the participant says, "I was the *AAA*[1] winner and spent some time with *Ricky Dunget*[2]." (No previous utterances clarify the meaning of AAA or identify Ricky Dunget). [PRS Score =2]

g) **Topic Preoccupation/ Perseveration:** Brings up previously discussed topics without being prompted to do so by the interviewer. Discussion of previous topic is redundant:

h) **Overly talkative:** Difficult to interrupt; talks too long despite being given cues (e.g. interviewer trying to interject) to relinquish conversational turn.
In response to a question *the recruitment consultant is heard trying to interject* and the *participant ignores the interjection and carries on talking*[1] [PRS Score =1]

i) **Irrelevant / Inappropriate detail:** Provides minute details about an event or tells technical aspects when asked a general question.
When asked to share about educational experience the participant's response begins with *providing the name of their elementary school*[1] and *the address of their elementary school*[2]. [PRS Score =2]

j) **Out of sync content / unannounced topic shifts**: Elaborates on insignificant aspects of interviewer's statements rather than on main point; tangential responses; frequent and obvious misinterpretation of interviewer's statements or queries. Abruptly changes topic without using typical social markers that signal the change or indicate the relevance of the off-topic information (e.g. 'This is off the subject but . . . ' or 'That reminds me of the time when ...'):
After being asked about their strengths and weaknesses the participant says, "*Chocolate cherry ice cream is my absolute favorite*[1]." [PRS Score =1]

k) Confusing Accounts: Disorganized presentation of information; inappropriate use or absence of cohesive devices that indicate how current information is related to previous discourse:
For example, if the participant said, "*Given the work environment, managers are people and there is an opening time and closing time and it's been rather challenging but it's thanks to the manager[1]."* [PRS Score =1]

l) Little Reciprocal To-and-Fro Exchange: Interrupts or fails to expand or acknowledge the interviewer's chit-chat statements:
If the participant was nonresponsive to the recruitment consultant's comment regarding the weather. [PRS Score =1]

m) Terse: Rarely speaks unless presented with a query; short, unelaborated responses:
When asked about work history the participant says, "*McDonalds[1]."* When probed further regarding responsibilities at McDonalds the participant says, "*I did cash[2]."* [PRS Score = 2]

n) Odd Humor: Fails to signal humorous statements or to indicate the humorous nature of message when humor clearly not detected by interviewer:
In response to a preferred supervisor the participant says, "I used to work at Starbucks and the manager there made me *froth at the mouth[1]."* [PRS Score =1]

o) Failure to Reference Pronouns/Terminology: Fails to substitute definite articles and relative clauses to reference old information (i.e. continues to use fully specified noun phrases even after the reference has been clearly established):
When asked about the best supervisor the participant says, "Mr Lau was great as a supervisor. *Mr. Lau[1]* was great at supporting you when you had questions. *Mr Lau[2]* also liked to challenge you by giving you big projects to work on. I thought *Mr. Lau[3]* was great. [PRS Score =2]

p) Inadequate Clarification: Fails to revise a message sufficiently to clear up confusion resulting from the original message.
If the recruitment consultant made a query regarding something the participant said and the participant failed to respond as in:
Recruitment Consultant: "Sorry I missed that." Participant *does*

> *not repeat / rephrase previous utterance*[1] and continues to speak regarding places of work.

q) Vague Speech and Language Behaviors: Accounts are general or global and only peripherally address the inquiry. Multiple requests must be made to obtain basic details. Despite adequate quantity of verbal output, little content is expressed: When asked about their best supervisor the participant says, "Someone who is nice *I guess*[1]. Someone who is *kind of*[2] lenient with *stuff*[3]." [PRS Score =2] Coders were particularly sensitive to words such as 'kind of', 'sort of', 'I guess' given that this was a simulated employment interview and not a casual conversation with a friend.

r) Awkward Expression of Ideas: Semantically inappropriate use of words / figures of speech. Frequent seemingly stereotypic use of a phrase during an interview even when it makes sense in the context:
When the recruitment consultant comments that it sounds like the participant worked really hard to finish school and the participant says, "*You hit the nail on the head*[1]." [PRS Score =1]

It was also possible for different elements of a response to be coded in more than one location. For example, the participant who provides copious details regarding their elementary school and location and then talks about their junior high school and senior high school in a similar fashion in response to the question, "Tell me about your educational experience?" would be coded under Irrelevant / Inappropriate Detail (e.g. addresses and names of schools) and also under Overly Talkative due to the verbosity of the response.

Coding for Inadequate Clarification and Inappropriate / Absent Greeting were modified from Paul et al (2009). Opportunities for Inadequate Clarification may not have occurred during the interview and thus a code of 'No Opportunity' (NO) was used if the interviewer did not ask the participant to clarify any responses. When the raw scores were calculated a 'NO' code was treated as a '0'. The Inappropriate / Absent Greeting was only coded during the introduction / first question and was not coded during the

remainder of the interview. A maximum score of 206 could be obtained, with the higher score more indicative of pragmatic impairment.

Appendix F: Pragmatic Rating Scale Score Form

0 = did not occur 1 = occurred on 1 occasion 2 = occurred on 2 or more occasions **NO**= no opportunity		Intro & Q1	Q2	Q3	Q4	Q5	PCR	**TOTAL**
1	Inappropriate / absent greeting		N/A	N/A	N/A	N/A	N/A	/2
2	Strikingly candid							/12
3	Overly direct or blunt							/12
4	Inappropriately formal							/12
5	Inappropriately informal							/12
6	Overly talkative							/12
7	Irrelevant / inappropriate detail							/12
8	Out of sync content / unannounced topic shifts							/12
9	Confusing accounts							/12
10	Topic preoccupation / perseveration							/12
11	Little reciprocal to-and-fro exchange							/12
12	Terse							/12
13	Odd Humor							/12
14	Insufficient background info							/12
15	Failure to reference pronouns/terminology							/12
16	Inadequate clarification*							/12
17	Vague Speech and Language Behaviors							/12
18	Awkward Expression of Ideas							/12
	TOTAL:	/36	/34	/34	/34	/34	/34	/206

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