Indicators of Linguistic Processing Constraints in the Narratives of Individuals with High-Functioning Autism

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INDICATORS OF LINGUISTIC PROCESSING CONSTRAINTS IN THE
NARRATIVES OF INDIVIDUALS WITH HIGH-FUNCTIONING AUTISM

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By
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ABSTRACT

INDICATORS OF LINGUISTIC PROCESSING CONSTRAINTS IN THE
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Thesis supervised by Diane L. Williams, Ph.D.

A current model of autism proposes that it is a disorder of information processing. The purpose of this study was to compare the language production of adults with high-functioning autism (HFA) to that of age and Verbal IQ-matched controls with respect to speech disruptions and formulaic expressions, features which indicate linguistic processing challenges. Standard language measures and language samples from the ADOS Telling a Story from a Book and Create a Story tasks were collected and analyzed. No between-group measures were found to be statistically significant. However, 10 of 16 individuals with HFA exhibited speech disruptions consistent with clinically “tangled” speech. A number of the individuals with HFA used idiosyncratic versions of formulaic expressions consistent with an underlying difference in language acquisition. The findings suggest that some individuals with HFA may have greater difficulty with
linguistic processing than others consistent with proposals from previous research on language subgroups in autism.
DEDICATION

I dedicate my thesis to my mentor, Dr. Williams. Dr. Williams provided me with multiple opportunities to advance my knowledge and research skills during my time at Duquesne. I am thankful for the time, patience, and support she afforded me while completing this project.
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Background

Introduction

According to the *Diagnostic and Statistical Manual Fourth Edition* of the American Psychiatric Association (DSM-IV; APA, 2000), there are three major criteria or symptoms which must be present to support a diagnosis of autism. The first criterion is restricted, repetitive, and stereotyped patterns of behaviors, interests, and activities. The second symptom is a qualitative impairment in social interaction. Third, and perhaps the most variable criterion, is a qualitative impairment in communication. The nature of the communication disorder associated with autism continues to be the most investigated diagnostic measure. This is particularly because the level of language use varies greatly among affected individuals. Moreover, the communication patterns are central to our understanding of the disorder. For example, some individuals with autism have no functional communication and others have adequate linguistic knowledge but impairment in using functional communication in conversation or other discourse tasks. Individuals with “high-functioning autism” (HFA) have overall intelligence quotients of 80 or above and have fluent verbal skills. However, even these individuals have significant challenges with language production.

The language production of individuals with HFA has been described as “unique,” “stereotypical,” and “idiosyncratic” according to Volden and Lord (1991). This type of language is so characteristic of autism that it is one of the diagnostic criteria included in the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 2001), the current accepted research instrument for diagnosing individuals with autism. Examiners are trained to observe for the idiosyncratic and stereotypical behavior. This type of
language is thought to be the result of an overuse of formulaic or prefabricated expressions (Lord, Rutter, DiLavore, & Risi, 2002). Included in this formulaic use of language is an excessive borrowing of phrases and sentences from television or other forms of media and the frequent use of idiomatic phrases. This overuse of formulaic expressions (FEs) in the language of individuals with HFA is thought to be indicative of differences in the way the population learns language. In some verbal children with autism, multiword utterances may appear early and function as single units resulting in an appearance of advanced syntactic development (Prizant & Wetherby, 1993). Perhaps FEs are being learned as larger, intact units of language.

Prizant (1983) suggested that, “the [formulaic] language patterns of the autistic persons…may reflect the inability to segment others’ utterances and realize their internal structure” (p. 303). Due to specific linguistic deficits, individuals with autism often rely on "borrowed" utterances from others in order to express their needs and intentions. More importantly, the internal structure (i.e., semantic-syntactic relationships) of utterances may not be analyzed or fully comprehended. Therefore, parsing language into its meaningful units (i.e., plurals, possessives, gerunds) presents such difficulty for these individuals that comprehension and production are ultimately compromised.

Barry Prizant’s ideas regarding language production in verbal individuals with autism are resonant with Alison Wray’s (2002), a well-known researcher who has completed extensive research concerning formulaic expressions, contention that formulaic sequences are a result of a particular kind of processing, which by-passes the processes of assembling words out of morphemes, phrases out of words, and sentences out of phrases. Neurotypical individuals employ this type of processing whenever there is
a need to reduce a processing load, such as occurs when there are time constraints or other reasons to convey a large amount of information succinctly. For example, the retrieval of one big “word,” (e.g., minding his own business) the formulaic expression (FE), does not require the construction of a message’s constituent parts, greatly reducing the associated processing demands. The language production difficulties associated with the neurodevelopmental disorder of autism may result from constraints related to a reduced information processing capacity.

**Information Processing Model of Autism**

When information is perceived by the brain, the brain responds by managing, organizing, attaching meaning, and creating new knowledge. This brain function is referred to as information processing. Information processing may be simple or complex depending upon the type of information to be processed and the conditions under which the processing occurs. Information processing may be complex because of the amount of information which must be processed, limited time constraints during which the processing must occur, the lack of an inherent structure in the information to be processed, and/or a need to integrate the information with previously learned information or new contextual information. A model based on a series of neuropsychological studies which examined behavior across the cognitive domains (i.e., language, memory, and perception), conceives of autism as a disorder of complex information processing (Minshew, Goldstein, Muenz, & Payton, 1992; Minshew, Goldstein, & Siegel, 1997; Williams, Goldstein, & Minshew, 2006). According to this model, the behaviors associated with autism are the result of underlying neurobiological constraints which make it difficult for individuals with autism to handle large amounts of information with
no explicit structure, information that must be integrated, or information that must be processed under a time constraint. “Complex” is defined according to the individual’s general skill level and the circumstances under which the processing must occur. In autism, simple information processing is intact but complex information across the language, memory, and perception cognitive domains is impaired.

The complex information processing model not only broadens the conceptualization of autism beyond the diagnostic triad; it also facilitates the integration of findings across cognitive and neurobiologic methodologies. The results of functional magnetic resonance imaging (fMRI) studies have provided support for the complex information processing model of autism which suggests that the brain with autism cannot manage multiple tasks because of a lower capacity to process information (Just, Cherkassky, Keller, & Minshew, 2004; Harris et. el., 2006; Wang, Lee, Sigman, and Dapretto, 2006). The reduced capacity causes deficits of higher-order abilities across cognitive and perceptual-motor domains. More specifically, an integration of the neuropsychological and neurofunctional results presents autism as a complex information processing disorder that is the result of underconnectivity of within and between neural systems or brain regions. The underconnectivity between key components of a cognitive processing network ultimately affects integrative processing (Minshew, Williams, & McFadden, 2008).

As stated, the domains most severely impacted in autism are those with the highest demands for integration of information such as language. According to the complex information processing and underconnectivity models of autism, skills that require more localized processing and smaller information processing networks will be
relatively intact in autism (i.e., vocabulary Kjelgaard & Tager-Flusberg, 1999; Tsai & Beisler, 1984); whereas, skills that require integrative processing and the use of more complex information processing networks (particularly the recruitment of frontal and posterior areas and within and between the language areas of the brain) will be more affected according to Just et. al (2004). Therefore, one would predict that individuals with autism would not have difficulty with all of semantic processing, but would have difficulty with semantic processing that requires integrative processing, for example, multiple meaning words and figurative language. In fact, individuals with autism were found to have more difficulty comprehending terms related to emotional states (Tager Flusberg and Sullivan, 1995; Hobson and Lee, 1989) and abstract terms (Frith and Snowling, 1983) compared to concrete words.

Information processing impairments can result in problems with decoding of spoken language with resultant difficulty with the production of spoken language. Although the means of receiving language is unimpaired in autism (resulting in normal tests of hearing and perception), the way the brain with autism analyzes auditory language for storage is impaired (Scott-Van Zeeland, McNealy, Wang, Sigman, & Bookheimer 2010). Individuals with autism are thought to store units in chunks, or formulaic language. When they retrieve that language, the same units are used in chunks. When the processing load becomes too demanding, another characteristic, echolalia or the use of spoken language without a clear referent is also evident. An excess use of echolalia and FEs may be an indicator of pronounced difficulty with the integration of complex language.
Formulaic Language

FEs are verbalizations which appear to be stored and retrieved as a single word as opposed to constructed following the rules of syntax. They include: idioms (e.g., a blessing in disguise) and collocations (e.g., I’ll give you a call). Formulaic expressions often contain lexical items with nonliteral or nonstandard meanings (i.e., “break a leg”) and have emotional implications. Van Lancker Sidtis and Rallon (2004) explain that a definitive feature of formulaic utterances is a predetermined word selection and pattern as well as a stereotyped intonation or placement of stress. Wray (2002) proposes that formulaic language occurs whenever the linguistic processing load becomes too great and a reduction in complexity is needed. For individuals with autism, use of FEs may be rooted in the difficulty with complex information processing. Processing difficulties lead to the inability to organize and integrate language (Minshew et. al., 1997). The demands of a social context and time constraints may result in the use of routines of language that have been practiced repeatedly which may not always fit the context.

Linguistic Processing.

Most typically developing children begin their language acquisition by using gestalt, or whole forms but quickly change over to an analytic form. Therefore, gestalt language learning is learning in chunks rather than the tiny component sounds and specific meaning of each individual sound or even word. The use of these gestalt forms, or FEs, are not only instrumental to a child's participation in social interaction, but they also help to provide children with a foundation and framework for developing more complex communication skills.
Wray (2000) describes the two purposes for formulaic language. First, it is a means for ensuring physical and social survival (i.e., facilitating fluency by making pauses shorter and less frequent), and, second, it serves as a way to avoid processing overload. Formulaic expressions (FEs) allow a speaker to express a more complex thoughts with the use of a few, culturally shared idiomatic expressions or to reduce the formulation load by using tightly entrained words and ideas. Language development of children with autism may indicate an excessive reliance on FEs. Evidence includes multiword utterances that appear early and function as single units, syntactic development that appears more sophisticated than it is, a high frequency of echolalia, and segmentation and recombination of unanalyzed chunks (Prizant & Wetherby, 1993). The difficulty with capturing this phenomenon is a lack of a universal definition of a formulaic expression and robust and effective method for classifying FEs.

**Formulaic language and second language learners.**

Gestalt style and gestalt forms in language acquisition have been studied with second-language (L2) acquisition. Studies with this population support the supposition that the two purposes for using FEs are to reduce processing load and to meet the fluency demands of social interaction. For example, Boers, Eyckmans, Stengers & Demecheleer (2006) investigated the nature of formulaic language in L2 learners comprised of 32 students of modern languages, majoring in English, at a college for translation and interpreting in Brussels, Belgium, 19 to 22 years of age. Two groups of individuals underwent 22 hours of teaching that was comprised of extensive reading material and listening tasks. The studies’ groups were taught to appreciate the structure and relationship of a word’s parts, or language flexibility. Conversely, the control groups’
attention was focused on the traditional method of the distinction between grammar rules and lists of individual words. The two groups’ oral proficiency was measured by two blind judges who counted the number of FEs produced during interviews. Results showed that the experimental group used more FEs and were deemed more orally proficient than the control group. The findings suggest that the experimental students’ awareness of formulaic sequences was raised sufficiently for them to recognize usable chunks in a new text and then recycle them into conversation.

Fillmore (1979) conducted a longitudinal study on second-language acquisition of five Spanish-speaking children learning English who approached the task through a number of "social strategies" and "cognitive strategies." She defined a major social strategy consisted of a child attempting to participate in social discourse by producing formulaic utterances. By doing so, the child was able to use "the language long before he knows anything about its structure and before he/she can create any sentences in the language himself" (p. 211). It was noted that utterances were often used in somewhat appropriate contexts because they were associated with particular activities or routines. Fillmore added that "the strategy of acquiring formulaic speech is central to the learning of language" (p. 212). This is because a child’s analytic knowledge of language is fueled by his/her general cognitive development, in particular the prioritization of learning about the world.

Building upon Fillmore’s observations about formulaic language, Prizant (1983) proposed that this strategy may also be the primary means by which individuals with autism approach the language acquisition process. It may very well be that individuals with autism use of formulaic language in the language acquisition process because of
their ability to rotey reproduce language, an indicator of the lack of an analytical strategy. On the other hand, children with autism are unable to flexibly use formulaic expressions in the same way that L2 learners do because they are not typical learners and have difficulty with the information processing demands required for flexible language use.

**Aphasia and formulaic language.**

Methods for the measurement of formulaic expressions have been developed for use with individuals with aphasia, another population that has processing challenges associated with acquired brain damage. Increased use of FEs compared to neurotypicals is observed in the language of individuals with left hemisphere brain damage. This finding provides supporting evidence of the relationship of FEs to a reduction in linguistic processing resources. Individuals with left hemisphere damage appear to depend on this form of language to meet the time constraints of communication and achieve a degree of verbal fluency (Gloning, Gloning, & Hoff, 1963; Critchley, 1970; Espir and Rose, 1970; Van Lancker, 1973; 1988; 1993).

The use of formulaic language by individuals with left hemisphere damage is explained as the retrieval of a holistically stored unit rather than separate lexical units. These holistic units are thought to remain intact in the lexicon because they have strong functional roles and are robust. Therefore, they require minimal effort to retrieve and act almost reflexively. This reflex-like access is often triggered during functional tasks such as seeing a face. For example, when passing a familiar person the street most individuals with left brain damage can retrieve “Hi, how are you”. In a therapy session, when asked to produce a phrase one may say when meeting someone, individuals with aphasia may
have more difficulty since the stimulus is no longer functional but metalinguistic. The task shifts into a higher level process requiring diverse brain network activation (Wray, 2008). Therefore, the communication performance of these individuals improves in real interaction compared to formal testing which requires metalinguistic skills. Natural contexts are considered to maximize an individual’s capacity for more effective linguistic processing. The mapping of words to contexts is thought to be more concrete (or less abstract) and fosters an understanding of the meaning or function of the words.

**Summary.**

The increased use of formulaic language in L2 language users and in individuals with left hemisphere brain damage, two populations faced with linguistic processing challenges, provides supporting evidence that FEs are related to a reduction in linguistic processing resources. Therefore, the excess use of FEs in the spoken language of individuals with HFA would support an assumption of difficulty with linguistic processing. However, if FEs are not found to be prevalent in the language of adolescents and adults with HFA, it may suggest differences in language acquisition. Alternatively, idiosyncratic language may result from an underlying difficulty with the statistical learning of language, that is the ability of the brain to notice and use statistical regularities in the language during the language acquisition process, an ability that is thought to be impaired in individuals with autism (Scott-Van Zeeland, McNealy, Wang, Sigman, & Bookheimer, 2010).

**Other Indicators of Linguistic Processing Difficulty**

An individual’s language patterns provides insight into their cognitive (meta-cognitive and meta-linguistic) and emotional functioning. For example, verbal
expressions containing interjections and nonspecific words may convey uncertainty or difficulty with word retrieval. Dollaghan and Campbell (1992) have suggested that utterance disruptions in spontaneous language samples of children with language impairments are related to information processing demands. They suggest that the type and frequency of particular disruptions [i.e., repetitions (sound, word, and/or phrase), revisions (word and/or phrase), pauses (silent and filled), and orphans (abandoned utterances)] are indicators of linguistic processing challenges. Increased incidence of utterance disruptions in the spoken language of adults with HFA would provide supportive evidence for an information processing disorder model of autism.

**Purpose of the Study**

Formulaic language is one of the behaviors that is suggestive of autism on the *ADOS* (Lord et al., 1989), the primary diagnostic instrument for autism for research purposes. However, the classification of these language behaviors is loosely operationalized, and few existing measurements of language during discourse tasks in autism have been completed. Despite the strong clinical reports of the use of formulaic language, to our knowledge, no research studies have provided existing measures of this characteristic of language production in individuals with HFA. A measurement of formulaic language would be clinically useful for characterizing the language production challenges of these individuals and would provide support to the model of autism as a disorder of complex information processing.

In addition, previous work with children with language impairments, suggests that measures of speech disruption may provide evidence of linguistic processing difficulties. These types of measures are not typically reported when the language samples of
individuals with autism are analyzed. Measures of the type and frequency of speech disruptions may be useful to characterize the linguistic processing difficulties of individuals with autism.

Different levels of language use may elicit different linguistic features. Discourse, a task that provides multiple opportunities for the integration of cognitive and linguistic features, provides more information about the dynamic nature of an individual’s processing constraints and their language system compared to a task that examines single aspects of language (i.e. a standardized test assessing vocabulary comprehension). Incidence of formulaic language and speech disruptions may occur more often in discourse processing than in sentence or single word production, allowing a measure of problems with lexical access and linguistic processing.

The purpose of this study is to describe the language production of individuals with HFA compared to neurotypicals particularly with respect to features that may be indicative of difficulty with linguistic processing in two different samples of discourse. Standard language, speech disruption and formulaic expressions will be compared between the two groups. Two different studies were completed and will be presented separately below. The first study includes standard language, speech disruptions, and FE measurement analyses of *Telling a Story from a Book* transcripts taken from an administration of the *ADOS*, a task with picture support. The second study includes the same measurements as study 1, but with the *Create a Story* task from the ADOS in which the individual produces a novel narrative.
Study 1

Introduction

Research Questions.

The primary research questions which were investigated in study 1 were as follows:

1. Are there between group differences in the mean number of speech disruptions used in a narrative with picture support (*Telling a Story from a Book*)?

2. Are there between group differences in the mean number of formulaic expressions used in a narrative with picture support (*Telling a Story from a Book*)?

Independent variables.

The independent variable in this study is the participant’s diagnosis, autism or neurotypical.

Dependent variables.

Both quantitative and qualitative data were collected in this study, more specifically, verbal fluency measures and the use of formulaic expressions. The verbal fluency measures were counts of four types of speech disruptions (i.e., repetitions, revisions, filled pauses, and orphans) in the samples. The procedure for identifying these speech disruptions was adapted from Dollaghan and Campbell (1992). The formulaic expressions were measured using a system of identification and classification described in previous research with adults with and without brain damage (Sidtis, Canterucci, & Katsnelson, 2009; Van Lancker Sidtis & Rallon, 2004; Van Lancker Sidtis & Postman, 2006).
Methods

Participants.

Previously collected transcript data from two groups of adolescent and adult males were analyzed for this study. The two groups were from a larger pool of individuals who were part of a program project grant at the University of Pittsburgh Autism Center of Excellence. All participants were between the ages of 15 and 35, had Full Scale and Verbal IQ scores greater than 80 as measured by the Wechsler Abbreviated Scales of Intelligence (WASI; Weschler, 1999), had completed the Telling a Story from a Book task on the ADOS, and had a transcript of at least 100 unmazed words (see further details below).

Group 1, the affected group, includes transcripts from 16 adult males, ages 15 to 34 years, with a diagnosis of HFA (Table 1). Group 1 participants were diagnosed by clinicians trained to research reliability on the diagnostic instruments, using DSM-IV criteria (APA, 2000) on the basis of Autism Diagnostic Interview-Revised (ADI-R; Le Couteur, Lord, & , 2003), the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 2001) and verified by expert clinical judgment. Participants met or exceeded the cutoffs for autism on both the ADI-R and ADOS and had positive evidence of past and current language/communication impairments before three years of age. Individuals who had a clinical diagnosis of Asperger’s disorder but who did not meet stringent research criteria for autism were excluded. Potential participants were also excluded if found to have evidence of an associated neurological, genetic, infectious, or metabolic disorder, such as tuberous sclerosis, fragile X syndrome, or cytomegalovirus. Exclusions were based on neurological history and examination, physical examination,
chromosomal analysis, and, if indicated, metabolic testing. Some participants with autism were taking medication at the time of the study. These medications were used for the management of anxiety, attention, sleep, and restricted–repetitive behaviors.

Group 2, the comparison group, included eight transcripts from the available sample of transcripts from healthy control males, between 15 and 35 years of age (Table 1), matched to the HFA group on age and Verbal IQ. Only 8 control males met these criteria. Individuals in the control group were recruited as community volunteers. Potential control participants were screened by questionnaire, telephone, face-to-face interview, and observed during screening psychometric tests. Exclusionary criteria, evaluated through these procedures, included a history or evidence of birth or developmental abnormalities; acquired brain injury; poor school attendance; a learning or language disability; a current or past history of psychiatric or neurologic disorder; a medical disorder with implications for the central nervous system or requiring regular medication usage; or a family history in first-degree relatives of autism, developmental cognitive disorder, learning disability, mood disorder, anxiety disorder, alcoholism, or other neuropsychiatric disorders thought to have a genetic or familial component.

Table 1. Study 1 Participants

<table>
<thead>
<tr>
<th></th>
<th>Autism (n=16)</th>
<th>Control (n=8)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age</td>
<td>20.26 (5.56)</td>
<td>24.33(4.08)</td>
<td>-1.83</td>
<td>.081</td>
</tr>
<tr>
<td>Mean Verbal IQ</td>
<td>106.44 (13.53)</td>
<td>112.75 (3.33)</td>
<td>-1.76</td>
<td>.095</td>
</tr>
<tr>
<td>Mean Performance IQ</td>
<td>101.81 (14.37)</td>
<td>118.50 (9.58)</td>
<td>-2.96</td>
<td>.007</td>
</tr>
<tr>
<td>Mean Full Scale IQ</td>
<td>104.69 (13.07)</td>
<td>117.75 (6.27)</td>
<td>-2.66</td>
<td>.014</td>
</tr>
</tbody>
</table>
Materials.

The ADOS consists of four modules that are designed for differing developmental and language levels based on an individual’s age and use of conversational level of language. Transcripts were taken from video recordings of the ADOS Module 4, which is appropriate for adolescents and adults with fluent speech (Lord et. al, 2001). ADOS administration was completed at the University of Pittsburgh Autism Center of Excellence.

The Telling a Story from a Book task invites subjects to take turns telling a story as they look at the pictures in a book. All participants used the wordless book, Tuesday, by David Wiesner. All participants confirmed that they had no prior knowledge of the story. Tuesday is about an unpredictable series of events involving frogs in a pond who fly on their lily pads to a nearby town. They enter a woman’s living room as she sleeps in a chair while the television is on, harass a dog frolicking in his yard, and distract a man from his midnight snack. The examiner, who was trained in administering the ADOS and achieved reliability on the ADOS, followed the assessment protocol for providing directions to the participant set by Lord et al. (2001) for both tasks. The examiner began the story for each participant and then took an additional one or two turns.

Procedure.

Each participant was tested individually in a quiet room in the presence of the studyer alone using the assessment protocol as described in the ADOS manual. They were recorded on a Sony DCRHC52 digital video camera mounted on a tripod. Transcripts were created from the digital videos by a trained research assistant who was not blind to
each person’s identity and diagnosis. Both the spoken language output of the examiner and the participant were orthographically transcribed on a HP Pavilion a6125 - Core 2 Duo E4400 as the research assistant viewed the digital video. The videos were reviewed up to five times to determine each utterance due to the poor sound quality of some of the videos. The transcripts began and ended with the participant’s first phrase/sentence which was relevant to the task. If the participant revised or repeated the beginning or ending sentence, that was included in the transcription. Unintelligible words were coded as “X” which is consistent with the SALT transcript protocol. Coding schemes were also added to the transcripts, at the time of transcription, to facilitate automatic analysis by the Systematic Analysis of Language Transcripts-English version (SALT; Miller and Chapman’s, 2008) software. Each transcript was divided into t-units (terminable units), a coding system developed by Hunt (1970) for the determination of phrase boundaries. A t-unit is an independent clause with all its modifiers and subordinate clauses.

A second research assistant, also not blind to diagnosis, watched 65% of the narrative samples, selected at random, and created a second transcript which included the marking of t-units. The two transcripts were then compared word-by-word. Inter-rater reliability for transcript words exceeded .85 (Cohen’s Kappa coefficient). There were less than five instances (in the two studys) where the rater questioned the t-units coded by the original coder. Discrepancies in data were solved through consensus with a third coder, a degreed speech-language pathologist.

Analyses were performed on the first 100 unmazed words in the transcript for each participant. Unmazed words are words which were not excluded based on the coding procedures described by Miller and Chapman, 2008. Types of excluded words
include repetitions, part words, revisions, repetitions, and any words which are not pertinent to the task such as, “how much more time is left”.

First, the SALT software was used to perform language analyses that are routinely performed on language transcripts. These measures included number of utterances, mean length of utterance (MLU) in words and in morphemes, type-token ratio (TTR; or the ratio of the number of different words used out of the total words used), and the percentage of mazed or excluded words over the total words in relation to the 100 unmazed words.

Next, the language samples were coded by the author for the speech disruptions based on the taxonomy created by Dollaghan and Campbell (1992). Measures included the number and type of repetitions (sound, word, and/or phrase), revisions (word and/or phrase), pauses (filled), and orphans (i.e., abandoned utterances). Length and number of silent pauses was not recorded during the initial transcript collection. All of the speech disruptions coding were completed through the process of consensus transcription. In this process, an initial coding of the transcript is completed by the author, after which a second coder, a speech-language pathology graduate student, reviewed the written transcript, and recorded all disagreements. Finally, both transcribers discussed the transcript and resolved all discrepancies. Questions regarding speech disruption coding were solved by consulting a third trained rater, a degreed speech-language pathologist.

Formulaic expressions (FEs) were identified and classified by the author using criteria established by Van Lancker Sibditis and colleagues (Van Lancker Sibditis & Rallon, 2004; Van Lancker Sibditis & Postman, 2006). Van Lancker Sibditis and Postman (2006) operationalize a FE as an utterance for which “a preponderance of native speakers will
fill in a missing word for the expression”. Therefore, to make a determination of novel versus formulaic expression, the author omitted a word to see if the missing word could be deduced by knowing the prior-occurring words. The author first went through the transcript marking any potential FEs. Next, each of the potential FEs were extracted from the transcripts and compiled with one word omitted (e.g., All of a ______; back and ______). The list of potential FEs and some foils (non-FEs) was given to ten speech-language pathology graduate students and they were asked to fill-in the missing word. Utterances that received 70% agreement among raters for the missing word were classified a FE (see Table 9). After coding, the author counted the total FEs, the total number of different or unique FEs, and the total words in the FEs. Informal examinations of between group differences were also completed. Twenty-four out of 60 of the potential FEs given to the raters met the 70% reliability cut-off measure.

Results

**Standard language analyses.**

Standard language measures were derived for each transcript using the SALT software. These measures included number of utterances, mean length of utterance (MLU) of words, (MLU) in morphemes, TTR, and the percentage of mazed words/total unmazed words (100). The mean of each standard language measure for the autism group was compared with measures obtained from the neurotypical group using a two-tailed t test. As expected, no statistically significant differences occurred between groups in any of the desired measures (See Table 2).
Table 2. Study 1 Standard Language Measures

<table>
<thead>
<tr>
<th></th>
<th>Autism (n=16)</th>
<th>Control (n=8)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number of utterances</td>
<td>11.25 (3.28)</td>
<td>9.00 (2.27)</td>
<td>1.74</td>
<td>.58</td>
</tr>
<tr>
<td>Mean mean length of utterance (words)</td>
<td>9.35 (2.09)</td>
<td>11.02 (2.64)</td>
<td>-1.70</td>
<td>.35</td>
</tr>
<tr>
<td>Mean mean length of utterance (morphemes)</td>
<td>11.21 (2.40)</td>
<td>13.17 (2.81)</td>
<td>-1.78</td>
<td>.39</td>
</tr>
<tr>
<td>Mean Type Token Ratio (TTR)</td>
<td>.61 (.08)</td>
<td>.66 (.05)</td>
<td>-1.55</td>
<td>.38</td>
</tr>
<tr>
<td>Mean Percentage of unmazed words over total words</td>
<td>17.69 (7.17)</td>
<td>14.13 (7.55)</td>
<td>1.1</td>
<td>.87</td>
</tr>
</tbody>
</table>

Speech disruptions.

The speech disruption measures were not equally distributed for the two groups; therefore, a nonparametric statistical test was used. A Mann-Whitney U test was carried out between the HFA and control groups on mean number of repetitions, revisions, filled pauses, or orphans. The test showed no statistically significant differences between groups on any of the measures (See Table 3a and b).

Table 3a and b. Means and standard deviations on speech disruptions measures and results of Mann Whitney U test.

<table>
<thead>
<tr>
<th></th>
<th>Autism (n=16)</th>
<th>Controls (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Repetitions</td>
<td>1.56</td>
<td>2.37</td>
</tr>
<tr>
<td>Revisions</td>
<td>2.44</td>
<td>2.10</td>
</tr>
<tr>
<td>Filled Pauses</td>
<td>3.63</td>
<td>5.64</td>
</tr>
<tr>
<td>Orphans</td>
<td>.31</td>
<td>.48</td>
</tr>
</tbody>
</table>
b)

### Table 4. Comparison of FE measures between the two groups.

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 16)</th>
<th>Controls (n = 8)</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitions</td>
<td>13.91 222.50</td>
<td>9.69 77.50</td>
<td>41.50</td>
<td>.131</td>
</tr>
<tr>
<td>Revisions</td>
<td>14.06 225.00</td>
<td>9.38 75.00</td>
<td>39.00</td>
<td>.114</td>
</tr>
<tr>
<td>Filled Pauses</td>
<td>11.19 179.00</td>
<td>15.13 121.00</td>
<td>43.00</td>
<td>.194</td>
</tr>
<tr>
<td>Orphans</td>
<td>13.75 220.00</td>
<td>10.00 80.00</td>
<td>44.00</td>
<td>.082</td>
</tr>
</tbody>
</table>

**Formulaic expressions**

The mean number of FEs in the transcript and the total words in the formulaic expressions were compared using an independent sample two-tailed $t$ test. No statistically significant differences were obtained between the two groups for the mean number of FEs, the mean number of different FEs, or the mean number of words in FEs (See Table 4).

**Discussion**

By virtue of their diagnosis with autism, even individuals with HFA are considered to have underlying problems with language. However, the language challenges of adults with HFA have been difficult to assess because they typically are
unimpaired on standard language measures. A current model of autism suggests that autism is a disorder of complex information processing. This model would suggest that the language problems of adults with HFA may be revealed using measures that have been used to described language processing challenges in other patient populations. The purpose of this study was to determine if measures of speech disruptions and formulaic expressions (FEs) from samples of discourse would reveal language processing differences in adults with HFA. As expected, no significant differences occurred between the two groups on standard language measures. Contrary to the original hypotheses, no statistically significant differences occurred between the groups on the speech disruption or formulaic expression measures. However, differences were noted in the performance in the HFA group with respect to the speech disruptions and the formulaic expressions that suggest further examination of these behaviors is warranted.

Although there is no difference between groups in the mean number of speech disruptions, individual differences were noted. Upon inspection of the data, one can notice that some subjects with HFA had a clinically significant number of disruptions. According to Dollaghan and Campbell (1996), a clinically significant rate is 7 or more disruptions in a 100 word sample. Ten of 16 of the adults with HFA had speech disruptions in this range compared to three out of eight individuals in the control group. This suggests that speech disruptions are not characteristic of autism in general, but perhaps sensitive to a subgroup of individuals who have the most difficulty with language. This hypothesis is consistent with prior studies of language in this population. Tager-Flusberg has proposed the idea that some individuals with autism have a co-existing specific language impairment (SLI). For example, a well-matched study by
Kjelgaard & Tager-Flusberg (2001) found two distinct language profiles in children with HFA. One subgroup performed worse on syntax/morphological tests while the other subgroup had greater semantic/pragmatic deficits. Perhaps it is those individuals who have the clinically significant disruptions. It should be noted that the Dollaghan and Campbell (1996) speech disruption taxonomy was originally proposed as a methodology for the measurement of linguistic processing problems with children with SLI. This notion of a subgroup of individuals with HFA with language challenges similar to those of SLI could be further explored in a study of the variation of language abilities within a group of adults with HFA.

Although no significant differences occurred for the FEs found in the spontaneous speech for the two groups, additional observations were made of the participants’ use. It was noted that a number of the individuals with autism used “odd” phrases that were similar to FEs but did not meet the criteria established for FEs with respect to the regularity of word combinations. For example, for some of the FEs, the individuals with autism used an idiosyncratic version of the FE (ivFE). One subject said “he made a huge mess” which, when given to the raters as “he made a huge _____” the majority response was “mistake”. It was then determined that the more “typical” versions of the phrases are “he made a BIG mess” or “he made a HUGE mistake.” Therefore, the individual with autism was using what should have been a FE but in an idiosyncratic combination of two different FEs. Other instances of idiosyncratic versions of FEs made by different individuals with HFA included, “rule the universe” for “rule the world”, “all is calm and quiet” for “calm and collected” or “peace and quiet”, and “it’s almost as though” for “it’s almost as if” and “it appears as though”.
Not all of the utterances of the controls that were thought to be FEs were coded as such based on the responses received from the raters. For example, an utterance from the neurotypical group which did not reach the reliability standard of 70% use by the raters was “up in the (sky)”. Variable rater responses were obtained to complete this phrase. Responses included: morning, air, as well as the target “sky.” The controls were not using ivFEs because there was not a single common response. The controls were demonstrating the same variability in responses as seen in the data from the raters.

Another unusual language pattern was observed when the adults with HFA described the group of frogs in a picture. Individuals used the phrases, “a swarm of frogs,” “a hoard of frogs”, and “a whole flock of frogs”. Typically those phrases are “a swarm of bees,” “a hoard of pigs,” and “a flock of birds”. Other phrases that were deemed “odd” included: “a laundry hangar” to describe a clothesline, “median horizon” to describe sunset, “a neighborhood allotment” for a neighborhood or city” and a “whole brigade of dogs”.

To a neurotypical listener, the ivFEs are different than the typical usage and may be perceived as an “odd” use of language. In normal language development, the brains of children are thought to detect statistical regularities of language (Saffran, Aslin, & Newport, 1996; Saffran, 2003). For example, if a listener hears the combination, “made a huge mistake” repeatedly he or she begins to expect that phrase to occur that way. As adults, we are thought to depend on these underlying early acquired regularities to recognize when the grammatical and meaning rules of language have been violated. For the adults with HFA, the ivFEs may suggest errors in mapping the meaning or function of the FEs when they are learned. The individual attempts to use the FE but in an
idiosyncratic manner. In turn, when the listener hears this ivFE, he or she needs to process the desired meaning more than would occur if it followed in the expected, typical pattern. This results in the listener perceiving the spoken language of the individual with HFA as “odd.” These qualitative findings may indicate a future route for characterizing the language production of individuals with HFA.

**Study 2**

**Introduction**

Study 2 repeated the measures used in Study 1 with a task that was potentially more demanding for the participants with HFA. The task required the use of creativity and had no inherent structure, therefore, it was thought to have a higher linguistic processing demand.

**Research questions and independent and dependent variables.**

The following research questions will be investigated in study 2:

1. Are there between group differences in the mean number of speech disruptions used in a spontaneously created story with object support (the *Create a Story* task)?

2. Are there between group differences in the mean number of formulaic expressions used in a spontaneously created story with object support (the *Create a Story* task)?

The independent and dependent variables are the same as in study 1.
Methods

**General methods.**

The procedures for Study 2 were similar to study 1 with respect to the collection of the transcripts, establishment of reliability of the transcripts, standard language measures and the measurement of the speech disruptions and formulaic expressions. For this study, transcripts were standardized at 65 words because of the shorter nature of the *Create a Story Task*. A length of sixty-five words was chosen to include as many of the available transcripts as possible while being consistent with other studies using analysis of language transcripts with individuals with autism (Condouris, Meyer, & Tager-Flusberg, 2003).

**Participants.**

Previously collected transcript data from two groups of adult males were used for this study. The two groups were again drawn from a pool of individuals who were part a program project grant at the University Of Pittsburgh Autism Center Of Excellence. All participants had Full Scale and Verbal IQ scores greater than 80 as measured by the Wechsler Abbreviated Scales of Intelligence (*WASI*; Weschler, 1999) were between the ages of 15 and 35 years, had completed the *Create a Story* task from the ADOS, and had a transcript of at least 65 unmazed words.

Group 1, the affected group, included transcripts from six males who were between 15 and 20 years of age with the diagnosis of HFA. Individuals with HFA met the diagnostic and exclusion and inclusion criteria described in study 1. Group 2, the control group, included transcripts from five medically healthy adult males between the ages 20 and 32 years of age, matched to the HFA group on age and Verbal IQ.
Individuals in the control group also met the diagnostic and inclusion/exclusion criteria described in study 1. All of the individuals used in study 2 were also included in study 1. Due to the small size of both samples, a Mann Whitney U test for nonparametric measures was used to evaluate whether the groups were statistically significant on the variables of age and Verbal IQ (See Table 5).

Table 5. Demographics for the two participant groups.

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 6)</th>
<th>Controls (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Age</td>
<td>19.61</td>
<td>4.79</td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>110.67</td>
<td>8.24</td>
</tr>
<tr>
<td>Performance IQ</td>
<td>113.33</td>
<td>9.67</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>113.33</td>
<td>9.18</td>
</tr>
</tbody>
</table>

b)

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 6)</th>
<th>Controls (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Rank</td>
<td>Sum of Ranks</td>
</tr>
<tr>
<td>Age</td>
<td>4.33</td>
<td>26.00</td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>5.17</td>
<td>31.00</td>
</tr>
<tr>
<td>Performance IQ</td>
<td>4.58</td>
<td>27.50</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>4.50</td>
<td>27.00</td>
</tr>
</tbody>
</table>
Materials.

Similar to study 1, the transcripts were created from video recordings of the ADOS (Lord et. al, 2001) except these were from the Create a Story task. The Create a Story task does not include picture support and requires the participants to use five unusual objects while producing a narrative. First, the participants listened to the examiners’ story as he/she manipulated five common objects. The participant then chose five different objects (e.g., a sponge, ball, block, shoelace, and popsicle stick) from a group and made up an original story incorporating these objects. The studyer did not intervene during this narrative discourse as required by the task protocol unless the participant had a question.

Procedure.

The procedures for Study 2 were similar to study 1 with respect to the standard language measures and the measurement of the speech disruptions and formulaic expressions. For this study, transcripts were standardized at 65 words because of the shorter nature of the Create a Story Task.

Results

Standard language analyses.

Due to the small number of participants in each group, a Mann-Whitney U Test was performed to compare the performance of the two groups on standard language measures in the Create A Story transcripts which included mean number of utterances, mean length of utterances (MLU) in words, mean MLU in morphemes, and the type token ratio (TTR). As expected, the statistical test showed no statistically significant differences between groups in any of the standard language analyses (See Table 6).
Table 6. Study 2 Standard Language Measures

a)

<table>
<thead>
<tr>
<th></th>
<th><strong>Autism</strong></th>
<th><strong>Controls</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 6)</td>
<td>(n = 5)</td>
</tr>
<tr>
<td>Mean number of utterances</td>
<td>8.50 ± 2.88</td>
<td>7.20 ± 1.10</td>
</tr>
<tr>
<td>Mean mean length of utterance (words)</td>
<td>7.74 ± 2.03</td>
<td>8.95 ± 1.58</td>
</tr>
<tr>
<td>Mean mean length of utterance (morphemes)</td>
<td>8.95 ± 2.40</td>
<td>9.90 ± 1.55</td>
</tr>
<tr>
<td>Mean Type Token Ratio (TTR)</td>
<td>.65 ± .03</td>
<td>.64 ± .08</td>
</tr>
</tbody>
</table>

b)

<table>
<thead>
<tr>
<th></th>
<th><strong>Autism</strong></th>
<th><strong>Controls</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 6)</td>
<td>(n = 5)</td>
</tr>
<tr>
<td>Mean number of utterances</td>
<td>6.42 ± 38.50</td>
<td>5.50 ± 27.50</td>
</tr>
<tr>
<td>Mean mean length of utterance (words)</td>
<td>5.33 ± 32.00</td>
<td>6.80 ± 34.00</td>
</tr>
<tr>
<td>Mean mean length of utterance (morphemes)</td>
<td>5.67 ± 34.00</td>
<td>6.40 ± 32.00</td>
</tr>
<tr>
<td>Mean Type Token Ratio (TTR)</td>
<td>7.08 ± 42.50</td>
<td>4.70 ± 23.50</td>
</tr>
</tbody>
</table>

Speech disruptions.

To compare between group differences in the mean number of speech disruptions in the *Create A Story* transcripts, a nonparametric statistic, Mann Whitney U test, was performed. No statistically significant differences between groups in their use of speech disruptions (i.e., mean number of repetitions, revisions, filled pauses) were found (See Table 7).
Table 7. Means and standard deviations on speech disruptions measures and results of Mann Whitney U test.

a)

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 6)</th>
<th>Controls (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Repetitions</td>
<td>1.67</td>
<td>1.86</td>
</tr>
<tr>
<td>Revisions</td>
<td>1.0</td>
<td>.63</td>
</tr>
<tr>
<td>Filled Pauses</td>
<td>1.83</td>
<td>2.79</td>
</tr>
<tr>
<td>Orphans</td>
<td>.17</td>
<td>.41</td>
</tr>
</tbody>
</table>

b)

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 6)</th>
<th>Controls (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Rank</td>
<td>Sum of Ranks</td>
</tr>
<tr>
<td>Repetitions</td>
<td>7.17</td>
<td>43.00</td>
</tr>
<tr>
<td>Revisions</td>
<td>6.00</td>
<td>36.00</td>
</tr>
<tr>
<td>Filled Pauses</td>
<td>4.42</td>
<td>26.50</td>
</tr>
<tr>
<td>Orphans</td>
<td>5.92</td>
<td>35.50</td>
</tr>
</tbody>
</table>

Formulaic expressions.

Research question 2 as to whether there were differences in the mean number of formulaic expressions in the spontaneous speech between groups was addressed by performing a Mann-Whitney U Test. The test showed no statistically significant differences between groups in their mean number of FEs, the mean number of different FEs or the mean number of words in FEs (See Table 8).
Table 8. Means and standard deviations on formulaic expression measures and results of Mann Whitney U test.

<table>
<thead>
<tr>
<th></th>
<th>Autism (n = 6)</th>
<th>Controls (n = 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Mean number of FEs</td>
<td>.50</td>
<td>.84</td>
</tr>
<tr>
<td>Mean number of different FEs</td>
<td>.33</td>
<td>.82</td>
</tr>
<tr>
<td>Mean number of words in FEs</td>
<td>2.33</td>
<td>3.67</td>
</tr>
<tr>
<td>Mean number of FEs</td>
<td>6.83</td>
<td>41.00</td>
</tr>
<tr>
<td>Mean number of different FEs</td>
<td>6.42</td>
<td>38.50</td>
</tr>
<tr>
<td>Mean number of words in FEs</td>
<td>6.83</td>
<td>41.00</td>
</tr>
</tbody>
</table>

b)

Discussion

The language challenges of individuals with HFA are difficult to assess due to their nature as problems with linguistic processing rather than acquisition of language structures and content. This study was completed to determine if different language measures were sensitive to the language production constraints in spontaneous language samples of individuals with HFA using a task that was thought to have a significant
linguistic and cognitive processing demand. As expected, no significant between group differences were found in the standard language analyses. Contrary to the original hypothesis, no significant between group differences were found in the speech disruptions and formulaic expressions measures. Possible reasons for no significant findings are presented in more detail in the general discussion section.

Similar to study 1, observations were made regarding the content of the discourse samples of the adults with HFA. These observations included: exaggerated endings (e.g., “then when he goes home the bus blows up and everybody dies”) and stories which resembled that of the examiners, (i.e., had the same plot or same character names). Whereas most of the neurotypicals told stories about real-life events (e.g., a hockey game, going to get glasses, vacations) more adults with HFA (4 out of 6) told stories that were about unrealistic events (e.g., a black hole, a fight between inanimate objects, a cat playing video games) or centered on factual obsessions or circumscribed interests (e.g., rip current, BMWs, cats, weather patterns, tornados, and physics). Odd character names, such as Seisel and King Jamakala were noted in a few of the transcripts. Pronoun omissions and omission or incorrect use of morphology (e.g., “I get back in the car and drives home” and unnormal) consistent with previous studies’ findings, were also observed. Similar to the Telling a Story transcripts, idiosyncratic versions of FEs were found, although to a lesser degree. For example, a participant with HFA used “a slice of toast” when the typical expressions are “a slice of bread” and “a piece of toast.”

**General Discussion**

**Introduction**

Although adults with HFA are considered to have significant language
differences, characterizing these has been challenging. They are typically unimpaired on standard language measures whereas descriptions of their spontaneous speech suggest that they have odd use of language and formulacity. The purpose of these two studies was to determine if measures of speech disruptions and formulaic expressions (FEs) from two different types of discourse (one with and one without picture support) would reveal language processing differences in adults with HFA. The measures were adopted from those previously used with second language learners and disordered populations (i.e., individuals with aphasia, traumatic brain injury, and specific language impaired). Speech disruptions were chosen because of their prevalence in brain injured populations and previous research with suggested that a clinically significant level of speech disruptions were associated with linguistic processing problems in children with developmental language disorders (Dollaghan and Campbell, 1997). A second measure, FEs, are thought to occur as a way to decrease the processing load which relates to the current evidence suggesting that individuals with HFA have difficulty with complex processing which includes language.

No statistically significant findings occurred between the autism and control groups in the measures of speech disruptions or formulaic expressions in either study. Unfortunately, because this study was limited to previously collected transcription data, the samples were much smaller than originally planned. Inspection of the data did suggest atypical topics and language patterns including idiosyncratic versions of formulaic expressions that are suggestive of differences in the acquisition of spoken language. Some of the individuals with HFA also had clinically significant levels of speech disruptions even if this was not a characteristic of the group as a whole. These
patterns were not evident in all the individuals with HFA, suggesting subgroups with varying language strengths and weaknesses.

There are a few possible explanations as to why a subgroup of individuals with autism may have a higher incidence of speech disruptions in their spoken language. As previously stated, Tager-Flusberg proposed the idea that some individuals with autism may have a greater degree of language impairment or a specific language impairment (SLI) in addition to the language challenges associated with autism. Children without autism but with a SLI have individual differences in their deficits. Some children have more difficulty with semantics while others have greater impairment in phonology or syntax (Kjelgaard & Tager-Flusberg, 2001). As evident with adolescents and children with TBI, individuals with word retrieval impairments, or semantic deficits, may have an increased prevalence of speech disruptions (Campbell and Dollaghan, 1995). Perhaps those adults with HFA who demonstrated clinically significant levels of speech disruptions have particular weakness in the area of semantics.

Reasons as to why adults with HFA used idiosyncratic versions of the FEs are difficult to explain. In some way it might seem that their language is more flexible or creative than that of neurotypicals. However, this would be inconsistent with what is generally accepted about the nature of learning and language in individuals with autism (Walenski, Tager-Flusberg, Ullman, 2006). What may seem like flexible language may actually result from a difference in the way individuals with autism acquire language. For neurotypicals, during the language learning process, a word is thought to be processed by the brain by computing statistical regularities of language over repeated exposures to the word (Saffran, Aslin, & Newport, 1996; Saffran, 2003). Individuals with
autism are thought to have difficulty with using statistical regularities in the language-learning process (Scott-Van Zeeland, McNealy, Wang, Sigman, & Bookheimer 2010). This lack of statistical learning could have two results. First, the individuals with autism may produce an idiosyncratic version of an FE (e.g., a swarm of pigs). Second, the neurotypical listener may perceive the ivFE as odd because, based on the expectation of statistical regularity, he or she predicted “bees” instead of “pigs.”

In summary, speech disruptions and FEs are not generally characteristic of adults’ with HFA language. However, the data suggests that some individuals may have a greater impairment in their language use than was suggested by performance on these measures. Additional studies need to be completed to determine if clinically significant levels of speech disruptions or use of idiosyncratic versions of formulaic expressions indicate that these individuals with autism have greater impairment in language than other individuals with autism, or belong to the proposed subgroup with autism and SLI.

**Limitations**

Due to the nature of the study (i.e., an analysis of already collected transcription data), threats to internal validity occurred and must be considered in the interpretation of the results. The testers who collected the language samples were not blinded to group membership. Similarly, the transcriptionists were also unblinded. The determination of FEs followed a strict coding procedure, although judgments for selecting FEs were completed by the author creating the threat of studier bias. Other caveats include the small sample size and short length of samples. The small participant size resulted from the need to standardize the language samples. By adding a length requirement (100 or 65 words) the most fluent adults with autism were preserved. With that in mind, the adults
who are more fluent are less likely to have speech disruptions. Also, silent pauses were excluded during initial transcript collection which may have affected the speech disruption data. Silent pauses are thought to be related to language formulation difficulty. To gain a comprehensive and accurate idea of a subject’s speech disruptions, it would be necessary to also code the length and occurrences of silent pauses.

Based on the present study’s findings, the standard protocol for collecting and analyzing language samples may not fully represent the language difficulties in autism. Possible threats to external validity include situational factors, like different ADOS administrators among participants and any deviation from administration protocol (e.g., describing more of the book than required or adding more or less detail to their Create a Story tasks). These factors were not rigorously controlled for because this study used retrospective data. Medications may have affected participants’ with HFA performance, but the affect is unable to be determined.

Future Directions

An original intention of the study was to compare the differences in the dependent variables across tasks; however, this could not be completed due to the small sample sizes and the lack of Telling and Create stories completed for the same set of participants. This comparison of tasks remains an area of potential investigation. The two tasks are thought to differ in their amount of information processing demands placed on the individual (i.e., by the amount of structure provided with the tasks).

Improvements

Additional changes need to be made before a cross-task analysis can be performed. Larger numbers of participants with and without HFA are needed to increase
the power of the analyses to detect possible group differences. To maintain standardization of samples but include more people, a time limit may be a better option than a word count. Additional questions to investigate within the samples include: Are there differences in the type of repetitions (i.e., phoneme, part-word, or phrase repetitions) between groups; and where are filled and silent pauses occurring in the transcripts? Differences in the amount and duration of silent pauses within the task may also be completed. To further investigate the idiosyncratic versions of FEs noted in the spoken language samples of a number of the participants with HFA, a follow-up study could use an experimental task that required the participants to finish a cloze phrase, measuring the typicality of the responses.

Two new hypotheses that arose from the findings of this study are:

1. Do adults with HFA whose standard score is less than 7 (impaired language) on the Word Associations subtest of the *Clinical Evaluation of Language Fundamentals* – Fourth Edition (*CELF*-4) use clinically significant disrupted speech during spoken narratives production?

2. Do adults with HFA finish a cloze phrase (representing a formulaic expression) with the same words as an age and Verbal IQ-matched group of neurotypical controls?
References


Appendix 1. Formulaic Expressions which received greater than 70% reliability among ten graduate speech-language pathology students. Underlined words were omitted.

Minding his own business
The wrong place at the wrong time
A wakeup call
Back and forth
What to make of it
Check this out
Having a good time
Freak them out
Watching late night television
Hanging around the house
Look out their window
They’re having fun
What’s going on
Safety in numbers
Surprised to see
In a bad mood
Taking over the world
Left out to dry
Lay in the sun
For some reason
All of a sudden
All ready to go
Hell is freezing over
I gotta get outta here