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BOSTON UNIVERSITY

GRADUATE SCHOOL OF ARTS AND SCIENCES

Dissertation

EXPLORATIONS OF LANGUAGE AND COMMUNICATION IN AUTISM SPECTRUM DISORDER: STUDIES OF UNDER-RESEARCHED AND UNDER-SERVED POPULATIONS

by

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DEDICATION

To my Grandma

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EXPLORATIONS OF LANGUAGE AND COMMUNICATION IN AUTISM SPECTRUM DISORDER: STUDIES OF UNDER-RESEARCHED AND UNDER-SERVED POPULATIONS

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ABSTRACT

Two of the most under-researched and under-served populations in the field of autism spectrum disorder (ASD), minimally to low-verbal (MLV) individuals and children from low-resource countries, would benefit the most from engaging their parents in research and intervention. First, parents' unique familiarity with their children could be highly advantageous for language assessment providing a more ecologically valid representation of their children's abilities. Second, parents' verbal input, known to predict children's language, is an important avenue to investigate to guide the development of parent-mediated interventions. Natural language samples, which are used in all three dissertation studies, are ideal for assessing expressive language and for analyzing communicative variations in verbal input.

In Study 1, I examined the feasibility of parents (N=33) collecting language samples at home from their MLV children/adolescents with ASD (6;6–19;7years) following a semi-structured elicitation protocol, ELSA-A. I predicted that because of parents' unique familiarity with their children, they will be better at eliciting speech from

them. The results supported this prediction. When with their parents, the MLV children/adolescents produced twice as much speech than when with examiners. Parents collected longer ELSA-As but administered fewer of the recommended activities. Therefore, although parents are not as good at following semi-structured assessment protocols, they elicit speech that is more representative of their children's everyday abilities.

In Studies 2 and 3, I compared the parental input to 37 Bulgarian-speaking (2;7–9;10 years) and 37 English-speaking (1;8–4;9 years) children with ASD matched on expressive language. I compared input in terms of quantity and quality, such as lexical diversity and sentence types (Study-2), and in terms of how parents addressed their children, focusing on personal pronouns, names, and kinship terms (Study-3). Based on past research, I hypothesized that input would differ in quality but not quantity. Indeed, parents' speech differed in sentence types but not in overall amount. Bulgarian parents asked fewer questions but used more statements. As predicted, they also used significantly more ways to address their children because of the structural characteristics of Bulgarian and potentially different discourse practices. These studies lay the foundation for future cross-linguistic and cross-cultural comparisons in ASD.

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LIST OF ABBREVIATIONS

A-ADOS	Adapted Autism Diagnostic Observation Schedule
ABA	Applied Behavioral Analysis
ADI-R	Autism Diagnostic Interview-Revised
ADOS-2	Autism Diagnostic Observation Schedule – 2nd Edition
ADOS-G	Autism Diagnostic Observation Schedule – General
ASD	Autism spectrum disorder
CLAN	Computerized Language Analysis
CSS	Calibrated severity score
CT	Conversational turns per minute
ELSA-A	Eliciting language samples for analysis – adolescents
FreqUtt	Frequency of utterances per minute
FreqW	Frequency of words per minute
GED	General Education Development
ICC	Intraclass correlation coefficient
ICD-10	International Classification of Disease – 10th edition
IRB	Institutional Review Board
Leiter R	Leiter International Performance Scale – Revised
MLU	Mean length of utterance
MLUw	Mean length of utterance in words
MLV	Minimally and/to low-verbal
NDW	Number of different words per minute

NLS	Natural language samples
PCI	Parent Child Interaction
PDD	Pervasive developmental disorder
SALT	Systematic Analysis of Language Transcripts
SCQ	Social Communication Questionnaire
SES	Socioeconomic status
TD	Typically developing
TNU	Total number of utterances
UNICEF	United Nations International Children's Emergency Fund
VABS-2	Vineland Scales of Adaptive Behavior 2nd Edition
WHO	World Health Organization
WHO CST	World Health Organization's Caregiver Skills Training

GENERAL INTRODUCTION

Expressive language is one of the most heterogeneous characteristics in autism spectrum disorder (ASD; Tager-Flusberg et al., 2009). Some diagnosed individuals present with unaffected language skills, others acquire spoken language but are impaired in comparison to their peers, and yet others, up to one-third, fail to acquire spoken language beyond a small number of single words and fixed phrases (Anderson et al. 2007; DiStefano et al., 2016; Kim et al., 2014). Language abilities in ASD vary not only across individuals, but also within an individual's mastery of different language domains (Tager-Flusberg et al., 2009). For example, some children are at different developmental stages in their receptive and expressive language (Weismer et al. 2010), and across structural domains of language (e.g., phonology, morphology, syntax, and semantics; Tager-Flusberg, 1994; Tager-Flusberg et al., 2009). Regardless of the mixed language profiles of children with ASD, the emergence and quality of their expressive language are some of the strongest predictors of positive future outcomes (Friedman et al., 2019; Howlin et al., 2004; Venter et al., 1992). In addition, better expressive language is associated with fewer maladaptive behaviors, such as aggression, self-injury, and low affect (Dominick et al., 2007; Hartley et al., 2008). This is why language and communication have become targets of behavioral treatments and interventions (e.g., Kasari et al., 2010; Tager-Flusberg & Kasari, 2013). The field is currently moving towards more naturalistic behavioral and parent-mediated intervention approaches (e.g., Masse et al., 2016; Schreibman et al., 2015) that can be implemented in a variety of settings, including the home, and capitalize on naturally occurring activities the child

engages in. The involvement of parents can be extremely advantageous because of their unique familiarity with the child, and because of the predictive role of their linguistic input in later child language development (Nadig & Bang, 2016 for review).

Naturalistic behavioral interventions can be very beneficial when implemented with the most under-researched and under-served populations in the field of ASD: minimally to low-verbal children and adolescents, and children from low-resource countries, who often come from diverse cultural and linguistic backgrounds.

Minimally to Low-Verbal Children and Adolescents

Minimally to low-verbal (MLV) children and adolescents are those who fail to acquire spoken language beyond a minimal level (Tager-Flusberg & Kasari 2013). Their speech typically consists of single words and few fixed phrases (DiStefano et al., 2016). Nevertheless, there is a large heterogeneity across MLV individuals as they have a wide range of age, language ability, non-verbal IQ, and symptom severity (Tager-Flusberg & Kasari, 2013). For example, a middle-schooler who uses 20-30 functional words and has an average non-verbal IQ and an adolescent with no functional words and a mental age of 3 years both fall under the category of minimally to low-verbal. This heterogeneity in ability even within the MLV group poses a challenge in operationally defining what constitutes ‘minimally to low-verbal’ with definitions varying widely across studies (for review see Bal et al., 2016). Despite the inconsistencies in how MLV children and adolescents with ASD have been defined, they make up to one third of diagnosed individuals (Anderson et al., 2007; DiStefano et al., 2016; Kim et al., 2014), and yet remain the most under-researched, neglected end of the spectrum due to their difficulty

complying with highly structured, standardized testing procedures (Tager-Flusberg & Kasari, 2013). Recruiting their parents to deliver interventions and collect data in the home can capitalize on parents' familiarity with their child and lead to more research investigations of this group's abilities.

Bulgarian Children with ASD

One specific group of children representing both the under-researched and the under-served end of the spectrum are Bulgarian toddlers and preschoolers with ASD. This specific population is of interest because it differs from the high-SES Western, English-speaking participants that typically enroll in research in three key areas: language, culture, and access to treatment and intervention services.

Bulgarian children with ASD speak Bulgarian – a language very different from that of the Western English-speaking families typically participating in studies. Bulgarian belongs to the family of Indo-European Slavic languages along with Russian, Serbian, Czech and Polish among others (Gordon et al., 2015). In contrast, English belongs to the Indo-European Germanic language family along with German (Gordon et al., 2015). Although there are numerous differences between Bulgarian and English in their grammar and orthography, the one grammatical difference of particular importance to autism is the use of personal pronouns (e.g., I, me, my, you, your, etc.) as they present a distinct difficulty for children and adolescents with ASD (e.g., Naigles et al., 2016; Lee et al., 1994; Tager-Flusberg, 1994). In English, personal pronouns are obligatory (an exception would be their omission in commands such as, *Look. Come.*). In contrast, in

Bulgarian, personal pronouns are optional in the subject position of a sentence and are often only used for emphasis.

In addition to language differences, there are cultural differences that warrant the study of Bulgarian children with ASD and their families. For example, sociological studies have shown that through shared historical and economic processes over the last century, Eastern European countries as a group systematically differ on key social issues from Western European countries (see Eastern and Western Europeans differ..., 2018), and parents often express traditional views about children's role in the family (Robila & Krishnakumar, 2004). Parents' childrearing practices in Eastern European countries tend to focus on obedience and the development of moral character, which has been reported both in the past (Bronfenbrenner, 1970) and more recently (Robila, 2004). Even more recent accounts of Eastern European immigrant parents reflecting on raising a child in the U.S. show a similar focus (Nesteruk & Marks, 2011). These parents emphasize the difference between the collectivist culture they come from and the individualistic values in the US, and report on the value of obedience and respect for authority common for parenting in their home countries.

Bulgarian families of children with ASD differ from North American families participating in research not only in their language and in their childrearing practices but also in their access to treatment and intervention services. First, there are no publicly available statistics on the number of children with developmental disabilities, including ASD, in Bulgaria. Estimates based on children enrolled in schools, who had special education needs during the last academic year (2019-2021), suggest that there were over

25,000 children with such needs, of whom 15,000 presented specifically with communication difficulties (UNICEF, 2020). Yet, there is no systematically collected data on the access to diagnostic, treatment and intervention services available to children with ASD in the country. In fact, one of the few studies to collect primary data from Bulgarian families of children with ASD reported that 43% of parents endorsed feelings of helplessness when it came to providing care for their children (Daniels et al., 2017). In addition, an unpublished report showed that 48% of parents of children with ASD considered finding adequate counseling help for their child as one of their greatest challenges (Barokova et al., 2020). This suggests that there is a high demand for treatment and intervention services for these families. Of the services that are currently available few are evidence-based. Applied behavioral analysis approaches – the largest category of established interventions (National Autism Center, 2015) that over 200 million Americans have insurance coverage for (Autism Speaks, 2019) – were just recently introduced in the country by few select providers. One solution to this problem of lack of providers and evidence-based services and perhaps the most scalable one is to train and rely on parents to deliver naturalistic behavioral interventions at home.

Finding differences between the language of and parental input to Bulgarian- and English-speaking preschoolers with ASD would 1) motivate future studies to examine the reasons behind these differences and whether they lie in the language alone or in the local culture and values more broadly; and 2) would serve as a motivation, in general, to study populations different from the traditional North American, high-SES, English-speaking research participants in the context of assessment, research, and intervention.

Naturalistic Parent-Mediated Interventions

What constitutes a naturalistic parent-mediated intervention? Naturalistic interventions are those interventions that are implemented in everyday settings, such as the child's home or school, and that capitalize on activities that the child engages in already, such as daily or play routines (for review of naturalistic developmental behavioral interventions see Schreibman et al., 2015). These interventions typically aim to change certain aspects of the child's behavioral repertoire following applied behavioral analysis (ABA) approaches, which reinforce positive behaviors. Naturalistic interventions can target a wide range of domains of functioning such as language and communication, engagement, and play (e.g., Dawson et al., 2010; Landa et al., 2011). Even though originally these interventions were administered by clinicians or examiners (e.g., Dawson et al., 2010; Kasari et al., 2006), an argument has been made about the inclusion of parents in the delivery of the interventions (e.g., Berkowitz & Graziano, 1972; Kasari et al., 2015; Schreibman et al., 2015; Schreibman & Koegel, 2005). Language and communication are domains of functioning, where parents can be central to delivering interventions for two reasons. First, parental input has already been shown to be is a significant predictor of child language ability (e.g., Bang & Nadig, 2015; Fusaroli et al., 2019; Rowe, 2012; Snow, 1977). Second, parents are often the most common conversational partner for their children in early childhood, and as such can apply intervention strategies on a daily basis. A recent meta-analysis showed that parent-mediated language interventions were significantly associated with children's language and communication outcomes (Roberts et al., 2019). In these interventions, parents were

trained on how to respond to their children's communication, how to ask questions, and how to facilitate discussions during book reading.

Because of their naturalistic settings, the involvement of parents, and the implementation of language and communication strategies in everyday interactions, naturalistic parent-mediated interventions are especially suitable for MLV children and adolescents and for low-resource Bulgarian children with ASD. However, before these interventions can be used with these under-researched and under-served populations, some major gaps in the literature need to be addressed. First, there is no consensus on what outcome measures should be used to assess the effectiveness of these interventions. Existing studies rely on non-specific, heterogeneous tools such as adapted but not yet validated surveys or assessments like the Autism Diagnostic Observation Schedule – 2 (Lord et al., 2012) or the Childhood Autism Rating Scale (Schopler et al., 1986) designed to identify autism traits but not to detect change (Provenzani et al., 2019). There is a need for measures of language and communication that can capture the limited language ability of MLV children and adolescents, that are sensitive to change, and that could reflect the involvement of parents in treatment and intervention practices (Barokova & Tager-Flusberg, 2018). Furthermore, before using naturalistic interventions that have been designed for and tested with high-SES, Western English-speaking families, with children from low-resource, non-English speaking countries, we need to understand the cultural and communicative differences characterizing their everyday parent-child interactions (PCIs). An excellent candidate for both the assessment of language and communication of MLV children and adolescents and for the analysis of cultural and

communicative differences in parent-child interactions is the collection of natural language samples (NLS; Barokova & Tager-Flusberg, 2018).

Natural Language Samples

Natural language samples are recordings of the child and their conversational partner's speech. They have been widely used in the child language acquisition literature because they are easy to collect, and they capture both the structural and pragmatic aspects of everyday verbal interactions (Brown, 1973; MacWhinney, 2007). NLS can be collected by an examiner, a teacher or a parent in a variety of settings, including the child's home. The context in which these language samples are recorded can differ as well, ranging from free play to conversation to narrative to even more structured interactions. NLS are especially useful with children and adolescents with ASD because they pose lower social and cognitive demands compared to standardized language assessments administered by a stranger in a lab setting. Often times the standardized assessments are not normed on the participants they are being used with, such as MLV individuals with ASD or non-Western, non-English speaking children, which questions the validity of their scores. In contrast, the nature of NLS allows for these recordings to be collected from any population, and their materials (e.g., developmentally appropriate toys for free play, wordless picture books for narratives, and conversational topics for conversations) can be easily adapted to the context, culture, and even personal interests of the child. This makes NLS a great candidate for assessing language ability of and parental input to non-English-speaking children, for whom the availability of normed standardized assessments is very limited.

The context of the NLS and the individual collecting them should be tailored to the target population and the goals of the study. In terms of the person collecting the sample, trained examiners are objective conversational partners, who can follow the same elicitation protocol with every participating child. In contrast, parents' unique familiarity with their child allows them to talk about topics of interest and to use strategies for engagement that a trained examiner in the lab would not have insight to. Unsurprisingly, the only study to date that compared the speech elicited by parents and by examiners from preschoolers with ASD found that parents did elicit more speech (Kover et al., 2014). The context of the collected NLS in this study was free play with developmentally appropriate toys. Although this context is ideal for examining parental input and how parents typically interact with their child, it has some limitations when used to assess children's language ability and to compare it across parent-child dyads. Free play with toys allows parents to choose what activities to engage their child in, and studies have shown that different activities elicit qualitatively different speech from children with ASD (for a comparison of conversation vs. narrative context see Kover & Abbeduto, 2010). Therefore, parents' choice of activities could inadvertently help reveal the child's true language abilities or mask them under an activity that does not rely on a lot of verbal back-and-forth. As a result, for the purposes of assessing a child's language and communication, and comparing it across children, a more structured language elicitation protocol is needed – one that will be used reliably with all participants across a wide range of age and language ability.

Once collected, NLS are typically transcribed word for word and coded, after which specific measures are extracted depending on the goals of the study. Computer programs (e.g., SALT, CLAN) can be used to automatically extract language measures from the completed transcripts. One transcribed NLS allows for analysis of multiple domains of the speaker's language and communication, including quantity, structural characteristics (phonology, morphology, syntax, semantics), and pragmatic aspects (such as turn-taking, the function of individual utterances, use of gestures, eye contact). Because very general measures of speech (e.g., total number of words or speech vocalizations) can be extracted, this makes NLS especially suitable for capturing the limited verbal abilities of MLV children and adolescents with ASD, who are otherwise subject to floor effects when standardized language assessments are used. In addition, because NLS capture the domain of pragmatics, they are more ecologically valid representations of parent-child interactions than highly structured assessments, and thus allow for more unbiased cross-cultural comparisons.

This dissertation consists of three studies, all of which rely on natural language samples as the most suitable measure of the language ability and parental input of the under-researched and under-served populations they examine.

In **Study 1**, I examined the feasibility of parents (N=33) collecting language samples at home from their MLV children and adolescents with ASD (6;6–19;7years) following a semi-structured elicitation protocol, ELSA-A. ELSA-A was chosen because it has previously been shown to successfully elicit speech vocalizations from children and adolescents with ASD across a wide range of language ability, including MLV

individuals (Barokova et al., 2020). Furthermore, relying on a protocol that is semi-structured controls for parents' choice of activities, while still being representative of children's everyday parent-child interactions. First, I assessed whether parents were able to elicit more speech from their children than examiners, even when controlling for the NLS context. Then I compared the speech of the parents and trained examiners to check for systematic differences in input. In addition, I assessed how good parents were at following the elicitation protocol, and whether they felt comfortable participating in the research process.

This study's findings can help inform best practices in assessing MLV children and adolescents' language ability. Because the emergence and quality of expressive language are one of the strongest predictors of positive long-term outcomes for this population, there is a need for a reliable and valid assessment of their language ability. Such an assessment, first, will allow for MLV individuals to be further characterized based on their ability, which will facilitate the use of more personalized treatment and intervention approaches, and second, will help empirically assess the effectiveness of these approaches.

In **Study 2** and **3**, by examining parental input to Bulgarian children with ASD, I focused on the other most under-researched and under-served population in the field - children from non-Western, non-English speaking families. In populations where there are few available resources for children with ASD, naturalistic parent-mediated interventions are the most scalable approach to reach the most children. Although very informative, the majority of naturalistic parent-mediated behavioral interventions have

been conducted with North American, English-speaking families. Before these interventions can be used with other populations, we need to systematically examine how parents from these populations communicate and interact with their children. Examining verbal input is the first step in the process. Only one study to date has conducted a cross-linguistic comparison of parental input in ASD, but it compared input to French-speaking and English-speaking Canadian children, which although linguistically different, were not that culturally distinct (Bang & Nadig, 2015). To begin to address this gap in the field in Study 2 and 3, I compared the parental input to 37 Bulgarian-speaking (2;7–9;10 years) and 37 English-speaking (1;8–4;9 years) children with ASD matched on expressive language. Bulgarian and English-speaking parents were compared on aspects of their speech previously shown to be associated with child language ability. In Study 2, I compared the quantity and quality of input, such as lexical diversity and sentence types. In Study 3, I compared how parents addressed their children, focusing on personal pronouns, names, and kinship terms. These studies lay the foundation for future cross-linguistic comparisons in ASD and could begin to inform naturalistic parent-mediated interventions.

A COMPARISON OF NATURAL LANGUAGE SAMPLES COLLECTED FROM MINIMALLY AND LOW-VERBAL CHILDREN AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

Assessing the verbal abilities of minimally and low-verbal (MLV) children and adolescents with autism spectrum disorder (ASD) presents a significant challenge and often requires major adjustments and adaptations to traditional assessment methods (Kasari et al., 2013). Natural language samples (NLS), widely used in language acquisition research (MacWhinney, 2007), have been proposed as an optimal approach for assessing the expressive language for individuals at this neglected end of the spectrum (Barokova & Tager-Flusberg, 2018; Tager-Flusberg et al., 2009). Yet, there is no systematic investigation of how to tailor traditional NLS sampling methods to older MLV speakers in a way that would elicit speech most representative of their true ability. One important avenue for investigation is the role of conversational partner. By virtue of familiarity, parents might be better than unfamiliar adult examiners at collecting language samples from their children. The role of familiarity could have important implications in the assessment of MLV individuals with ASD, whose behavioral challenges combined with social withdrawal and difficulty communicating (Lord, 2010) might make them more hesitant to interact with a stranger in the lab. Yet, no study has asked parents to elicit speech from their older MLV children and adolescents. The present study aims to assess the feasibility of parents collecting NLS in their homes, to compare their speech to that of trained examiners collecting NLS in the lab, and to compare the speech parents

and examiners elicit from older MLV children and adolescents with ASD, while following the same elicitation protocol.

Only one study to date has empirically tested the claim that parents might be better than examiners at eliciting speech from children with ASD (Kover et al., 2014). Kover and her colleagues (2014) compared the speech of preschoolers with ASD when playing with their parents and when playing with a trained examiner. Both quantitative and qualitative differences in children's speech were found contingent on conversational partner. Preschoolers produced more utterances (Total Number of Utterances; TNU) and made more requests when with their parents but used more complex syntax (operationalized as Mean Length of Utterance; MLU) when with examiners. Because this study did not compare the language of the parents and examiner, it is not known whether the differences in the children's language reflect differences in their conversational partners. It is also not known whether the same findings would be obtained with older MLV children and adolescents.

Exploring differences in language between parents and examiners is an important avenue for investigation in light of conflicting findings of the association between child and adult language in ASD (e.g., Barokova & Tager-Flusberg, 2019, Fusaroli et al., 2019, Kover et al., 2012). When parents collect the language sample, several studies have reported positive concurrent correlations between child and adult language variables (see Nadig & Bang, 2016 for review). For example, Fusaroli et al. (2019) found that for children with ASD, their MLU, word token and word types were significantly associated with that of their parents. These positive associations were attributed to parents being

responsive to and tailoring their language to their child's language ability. In contrast, when examiners collected a language sample, negative correlations were found between child and adult variables (Kover et al., 2012). In this study, participants were middle schoolers and adolescents with Fragile X syndrome, Down syndrome, and language-matched TD controls and during conversations the examiners' MLU was negatively correlated with the participants' MLU. These negative associations were attributed to examiners adjusting their language by providing more verbal prompts to those children who were less likely to engage and have more limited language. The same explanation has been used to account for similar findings from children with language impairment (DeThrone & Channel, 2007). It is possible that a similar pattern of results could be found for MLV children and adolescents with ASD. However, regardless of the nature of the associations between adult and child language, a key question remains about which conversational partner (parent vs. examiner) can elicit speech that best represents the child's true language ability not influenced by assessment factors, and high cognitive and social demands. The present study aims to address this question to help inform what the most optimal language assessment methods are for MLV children and adolescents.

The role of conversational partners in the collection of language samples from older MLV children and adolescents with ASD is a research avenue worth exploring, but there are some practical considerations that need to be addressed. All the studies that have recruited parents to collect a NLS from their young children with ASD have used free play with toys as the context for obtaining the language sample (e.g., Bang & Nadig, 2015; Fusaroli et al., 2019; Swensen, 2007). While the lack of structure in this context

equates to no additional training for the parents, there is less control over how parents might guide or construe the interaction with their child during play, making it difficult to compare the NLSs across children. To date, parents have not been asked to collect samples from older children and adolescents with ASD, particularly those with severe language deficits, for whom a more structured elicitation protocol rather than free play with toys might be more developmentally appropriate and provide greater control over the elicitation context. In this study we used the Eliciting Language Samples for Analysis - Adolescents protocol (ELSA-A; Barokova et al., 2020) to explore how well parents of older minimally and low verbal children and adolescents with ASD could provide a language sample. Since ELSA-A has already been validated for use in the lab by trained examiners with this population, it is a good candidate to assess the feasibility of parents collecting language samples at home.

The present study has three main aims:

Aim #1: *To compare the expressive language of parents and examiners while collecting NLS using ELSA-A from MLV children and adolescents with ASD*. Based on past research (Kover et al., 2012), we hypothesize that examiners might speak more during ELSA-A than parents because they will provide more verbal prompts to the MLV children and adolescents.

Aim #2: *To compare the expressive language of MLV children and adolescents with ASD during ELSA-A elicited by their parents and by trained examiners*. Based on past research (Kover et al., 2014), we predict that children and adolescents with ASD are going to produce more speech with their parents at home than with examiners in the lab.

Aim #3: *To assess the feasibility of parents collecting a semi-structured language sample in their homes by examining how many parents comply, evaluate their administration fidelity, and how they rate the experience of NLS collection*.

Methods

Participants

Thirty-three (5 female) children and adolescents with ASD between the ages of 6;6 and 19;7 years were included in this study. They were a sub-sample of participants enrolled in a larger study designed to develop and evaluate expressive language outcome measures for use in a variety of research settings, including clinical trials and treatment and intervention studies (Barokova et al., 2020). From the larger study, those participants, who were minimally to low-verbal, operationalized as the administration of the Autism Diagnostic Observation Schedule-2 (ADOS-2) Mod 1 or 2 or adapted ADOS Mod 1 or 2 (A-ADOS; Bal et al., 2019; Lord et al., 2012), and who lived at home were included in the present study. The primary language of all participants was English.

Procedure

IRB approval was obtained prior to participant enrollment. The initial study visit was carried out at either our research lab or at the participants' school, which had a space set up that was comparable to the one in the research lab. During this visit, the participants were administered a battery of standardized assessments, after which a trained examiner collected a language sample from them following the ELSA-A elicitation protocol (for details about ELSA-A see https://sites.bu.edu/elsa/). Before collecting an ELSA-A sample, each examiner went through training, which included

reviewing the instruction manual and video, practicing administering the protocol with adults and receiving feedback. The ELSA-A samples collected by examiners were audio recorded for the purposes of transcription. Parents also completed a demographic form, the Social Communication Questionnaire (SCQ; Rutter et al., 2003) and the Vineland Scales of Adaptive Behavior 2nd edition (VABS-2; Sparrow et al., 2005). Participants' demographic information and standardized assessment scores are presented in Table 1.1 and Table 1.2, correspondingly.

Table 1.1

Demographic information for the 33 participants

Characteristic	Total	
	N	*N*
Gender	33	
Female		5
Male		28
Race	32	
White		21
Black, African American		3
Asian		2
Hispanic, Latino, or Spanish Origin		1
Multiple Races		5
Ethnicity	32	
Non-Hispanic		26
Hispanic		5

Prefer not to respond		1
Caregiver Education	33	
High school degree or GED		3
Vocational or trade degree after high school		2
Associates or 2-year degree		9
Bachelor's Degree or equivalent		8
Master's Degree or equivalent		7
Professional Degree (MD, PhD, JD)		4
Caregiver Income	33	
Prefer not to answer		8
< $20,000		2
$20,000 - $49,999		5
$50,000 - $99,999		5
$100,000 - $149,999		5
Over $150,000		8

Table 1.2

Standardized assessment scores for the 33 participants

Characteristic/ Assessment	Score	N	M	SD	Range
Age in months		33	146.79	45.56	78-235
ADOS-2 or A-ADOS					
Module 1		25			
Module 2		8			

Calibrated Severity Score	33	7.82	1.61	3-10
Leiter-R				
Non-Verbal IQ	33	63.94	21.77	30-102
SCQ				
Reciprocal Social Interaction Score	33	6.12	2.63	2-10
Communication Score	33	3.87	2.68	0-9
VABS-2				
Socialization Standard Score	33	51.45	13.79	31-83
Communication Standard Score	33	50.30	13.87	30-83

Note. ADOS-2 or A-ADOS CSS = Autism Diagnostic Observation Schedule-2 or Adapted Autism Diagnostic Observation Schedule Calibrated Severity Score; Leiter = Leiter International Performance Scale-Revised; SCQ = Social Communication Questionnaire; VABS = Vineland Adaptive Behavior Scales;

Within one to two weeks of this first visit, researchers visited all participants' homes and provided parents with a kit that included the materials necessary to collect ELSA-A at home, and walked them through the administration manual and the instructional video (see https://sites.bu.edu/elsa/ for details). After the home visit, one of the parents was asked to collect ELSA-A from their child. The samples collected at home were audio recorded with a voice recording app (Voice Recorder HD) on a smartphone worn by the parent in an armband. The audio recordings were later shared on a secure Dropbox.

At the end of the larger study, parents were asked to fill out a feedback survey about their experiences collecting ELSA-A at home as well as other aspects of the study.

Standardized Assessments.

Diagnosis. Participants' diagnoses were confirmed with the administration of the ADOS-2 or the adapted ADOS (A-ADOS; Bal et al., 2019; Lord et al., 2012). The ADOS is a semi-structured behavioral assessment of autism symptoms. It involves a series of activities allowing for the observation of core autism symptoms, like deficits in social communication and restricted and repetitive behaviors. Different modules are administered based on participants' chronological age and language ability. In our study, participants between 6 and 12 years were administered ADOS-2 modules 1 and 2 appropriate for younger children with few words to phrase speech (Lord et al., 2012), and participants 12 years and older were administered A-ADOS modules 1 and 2 appropriate for older minimally verbal adolescents and adults (Bal et al., 2019). From the ADOS-2 and A-ADOS calibrated severity scores (CSS; Hus et al., 2014; Hus & Lord, 2014) of 1 to 10 were computed, with 10 indicating the highest symptom severity.

Non-verbal IQ. Participants' non-verbal IQ was assessed with the Leiter International Performance Scales-Revised (Leiter-R; Roid & Miller, 1997). The test provides a composite non-verbal IQ score based on performance on four subscales: figure ground, form completion, classification and analogies, and sequential order. Each subscale involves solving different puzzles and finding pieces that fit a sequence. The test is especially suitable for individuals with ASD who are minimally and low-verbal because its administration and the expected responses do not involve any verbal prompts or responses.

Eliciting Language Samples for Analysis – Adolescent (ELSA-A). Eliciting Language Samples for Analysis - Adolescent (ELSA-A) is a language elicitation protocol specifically designed to collect language samples from older children and adolescents across a wide range of age and language ability. It consists of 8 activities that are developmentally appropriate, engaging, and easy to administer. The activities are categorized based on two elicitation contexts: semi-structured play (ELSA-A games) and narration (Pixar movie shorts). The ELSA-A games include: putting leaves on a paper tree (*Leaf Falling Activity*), pretending to plant an acorn with a shovel (*Planting an Acorn Activity*), playing hide and seek with paper animals hidden around the room (*Discovering Animals Activity)*, helping toy animals who are hurt, thirsty and/or hungry (*Helping Animals Activity*), making a S'more with crackers, chocolate and marshmallows (*S'mores Activity*), drawing and coloring (*Crafts Activity*), and playing a bean bag toss game (*Bean Bag Toss Activity*). The ELSA-A *Pixar Movie Shorts Activity* consisted of the participants watching a Pixar movie short and then narrating the plot and/or labelling the characters. In addition, administrators are encouraged to engage the child/adolescent in a conversation (back-and-forth verbal interaction) about their interests, while transitioning between activities. Detailed information about the ELSA-A protocol, including administration instructions, activity descriptions and a list of materials can be found on our website: https://sites.bu.edu/elsa/; https://sites.bu.edu/elsa/elsa-2/manual/.

Parent Questionnaires.

Demographics. Parents filled out a demographic questionnaire, which asked information about their relationship to the child, highest level of education, and family

income, as well as about the child's race and ethnicity, diagnosis, medical history, and language skills.

Communication. Participants' social communication was assessed with two parent questionnaires: the Social Communication Questionnaire (SCQ; Rutter et al., 2003) and the Vineland Scales of Adaptive Behavior - 2nd edition (VABS-2; Sparrow et al., 2005). The questionnaires were administered in their entirety, but we only used the SCQ reciprocal social interaction (computed by combining responses from questions 9, 10, 19, 26, 27, 28, 29, 30, 31, 32, 33, 36, 37, 39, and 40) and communication domain (computed by combining responses from questions 2, 3, 4, 5, 6, 20, 21, 22, 23, 24, 25, 34, and 35) scores and the VABS socialization and communication standard scores for the present analyses.

ELSA-A feedback survey. Parents were given a survey soliciting their feedback about the experience of collecting ELSA-A at home and about other aspects of the larger study. They rated on 5-point Likert scales statements about the logistics of collecting the sample, the helpfulness of the instructions, and the effectiveness of the protocol in eliciting language from their child (see **Appendix**). Each item on the Likert scale was anchored from "Strongly Disagree", which we converted to 1, to "Strongly Agree", which we converted to 5 for the purposes of analyses. On this scale, a 3 denotes neither agreement or disagreement.

Coding

ELSA-A measures. Using the audio recordings, length of all ELSA-A samples in minutes was obtained and administration fidelity was scored: One point was given for

each ELSA-A activity that was attempted. Since we used the audio recordings of the parent- and examiner-elicited ELSA-As, an activity attempt was operationalized as the administrator talking about, labeling, describing, or asking questions about the materials involved in each specific activity. We computed an administration fidelity score out of 8 for both examiners and parents. Even though this measure of fidelity is very general, it captures whether the administrator engaged the participant with the ELSA-A activities. Considering the variability in participants' characteristics (symptom severity, non-verbal IQ, and communication), using a more focused measure of fidelity (e.g., using a specific number or kind of verbal prompts) would not have been feasible, and it would have imposed too much structure on a protocol that aims to be naturalistic and semi-structured.

ELSA-A Transcription & Measures. All ELSA-A samples, parent- and examiner-collected, were transcribed for speech following standard transcription procedures using the Systematic Analysis of Language Transcripts (SALT) format (Miller et al., 2011). Speech vocalizations were defined as utterances that have a syllable structure and contain a vowel and a consonant of the English language. Speech vocalizations that were phrases or full sentences were broken down into communication units (Miller et al., 2011). Imitated utterances and utterances not directed at a conversational partner were also transcribed. A sequential transcription procedure was followed: each language sample was transcribed by a trained transcriber and then checked by a second transcriber; disagreements were resolved through consensus.

The transcribed ELSA-A samples were analyzed with the Systematic Analysis of Language Transcripts software (SALT-12; Miller & Iglesias, 2012). Key measures across

language domains were obtained for both participants and their conversational partners (examiners/parents; see Table 1.3). Frequency of utterances per minute (FreqUtt), frequency of words per minute (FreqW), and number of conversational turns per minute (CT), a CT defined as one or more consecutive utterances by the same speaker (Miller et al., 2011), were included as global measures of expressive language and social communication. FreqUtt and CT, as obtained from ELSA-A, are appropriate for minimally to low-verbal children and adolescents with ASD, have already been validated with this population, and serve as a broad measure of expressive language (Barokova et al., 2020). Mean length of utterance in words (MLUw) as a measure of syntax and number of different words per minute (NDW) as a measure of lexical diversity were obtained from SALT. In the language development literature, it is generally recommended to have a minimum of 50 to 100 complete, intelligible utterances to obtain reliable MLUw and NDW (e.g., Miller, 1981; Templin, 1957). Since the speech of most of our MLV child/adolescent participants was so limited this criterion could not be followed. For this reason, child/adolescent measure of syntax (MLUw) was not computed, and analyses involving NDW as a measure of lexical diversity should be interpreted with caution.

Table 1.3

Expressive language measures derived from ELSA-A transcripts

Measure (Abbreviation)	Construct or Language Domain	Adult	Child/ Adolescent

Frequency of Utterances per Minute (FreqUtt)	Quantity of language	Yes	Yes
Frequency of Words per Minute (FreqW)	Quantity of language	Yes	Yes
Conversational Turns per Minute (CT)	Social communication	Yes	Yes
Mean Length of Utterance in Words (MLUw)	Syntactic complexity	Yes	No
Number of Different Words per Minute (NDW)	Lexical diversity	Yes	Yes

Results

Out of the 33 parents of MLV children and adolescents enrolled in this study, 22 (19 mothers and 3 fathers) collected language samples in their homes and submitted them to the investigators. All analyses for Aims 1 and 2 were carried out on the data from these 22 participants.

In the following analyses, all variables have been checked for normality, and where appropriate, non-parametric tests were performed, and correction for multiple comparisons was applied.

Aim #1: ***To compare the expressive language of parents and examiners while collecting NLS using ELSA-A from MLV children and adolescents with ASD.***

To compare parent and examiner language, we ran paired-samples t-tests (or Wilcoxon signed-rank tests where appropriate) on all expressive language measures

(FreqUtt, FreqW, CT, MLU, NDW; see Table 1.4). Parents' FreqUtt was significantly higher than that of examiners. The same was true for parents' FreqW and CT. Overall, parents produced more speech more frequently than examiners. No significant differences were found between parent and examiner MLUw and NDW. The parents' and examiners' language did not differ in terms of syntactic complexity and lexical diversity.

Table 1.4

Comparison of parent and examiner expressive language during ELSA-A

Measure	Parent		Examiner		Significance Test
	M	*SD*	*M*	*SD*	*p*
FreqUtt	17.92	6.42	10.40	2.61	$t(21) = -4.602$ $p < .001$
FreqW	63.20	22.55	39.08	9.86	Z = -4.140 $p = .001$
CT	4.35	3.33	2.35	2.00	$t(21) = -4.002$ $p = .001$
MLUw	3.66	.51	3.77	.35	$t(21) = 1.628$ $p = .118$
NDW	11.84	3.67	10.17	2.01	$t(21) = -1.859$ $p = .077$

Note. FreqUtt = frequency of utterances per minute; FreqW = frequency of words per minute; CT = conversational turns per minute; MLUw = mean length of utterance in words; NDW = number of different words per minute;

Aim #2: ***To compare the expressive language of MLV children and adolescents with ASD during ELSA-A elicited by their parents and by trained examiners*.**

To test for differences in child/adolescent speech contingent on conversational partner, we ran paired-samples t-tests (or Wilcoxon signed-rank tests where appropriate) comparing children's FreqUtt, FreqW, CT and NDW from the parent ELSA-A with those from the examiner ELSA-A (see Table 1.5). Participants' FreqUtt with their parents was significantly higher than with examiners. The same was true for FreqW and for CT. On average, children/adolescents produced twice as much speech with their parents than with examiners. Participants also had significantly higher NDW when with their parents than when with examiners, so children/adolescents exhibited greater lexical diversity with their parents than with examiners.

To assess the consistency of participants' language across conversational partners, we computed correlations between their language measures derived from the parent-elicited ELSA-A with those from examiner-elicited ELSA-A. These correlations were all statistically significant: FreqUtt ($r_s(20) = .848$, $p < .001$); FreqW: $r_s(20) = .885$, $p < .001$; CT: $r_s(20) = .708$, $p < .001$; and NDW: $r_s(20) = .880$, $p < .001$.

Table 1.5

Comparison of child/adolescent expressive language during ELSA-A across conversational partner (parent vs. examiner)

Measure	Parent		Examiner		Significance Test
	M	*SD*	*M*	*SD*	*p*
FreqUtt	6.11	4.77	3.26	3.26	$Z = -3.458$

					$p < .001$
FreqW	12.00	12.88	6.46	8.39	$Z = -3.389$
					$p < .001$
CT	4.42	3.34	2.35	2.02	$t(21) = -4.090$
					$p < .001$
NDW	4.02	3.87	2.45	2.90	$Z = -3.389$
					$p < .001$

Note. FreqUtt = frequency of utterances per minute; FreqW = frequency of words per minute; CT = conversational turns per minute; NDW = number of different words per minute;

Aim #3: ***To assess the feasibility of parents collecting a semi-structured language sample in their homes by examining how many parents comply, evaluate their administration fidelity, and how they rate the experience of NLS collection.***

Out of the 33 parents of MLV children and adolescents enrolled in this study, 22 of them, representing two-thirds of the participant sample, collected an ELSA-A sample in their home and submitted it to the investigators. We checked for differences in participant characteristics depending on whether or not the parent contributed a language sample by running independent-samples t-tests (or Mann-Whitney U tests where appropriate), to compare participant-based factors of age, ADOS CSS, Leiter-R non-verbal IQ score, SCQ and VABS socialization and communication scores (see Table 1.6). Participants whose parents collected an ELSA-A did not differ from those whose parents did not, on any of the tested variables.

Table 1.6

Standardized assessment comparison of participants whose parents collected ELSA-A at home to those whose parents did not collect ELSA-A at home

Measure	ELSA-A $N = 22$		NO ELSA-A $N = 11$	
	M	SD	M	SD
Age (in months)	150.18	52.35	140.00	28.45
ADOS-2 or A-ADOS CSS	8.13	1.39	7.18	1.89
Leiter-R Non-verbal IQ	63.95	21.96	63.91	22.46
SCQ Reciprocal Social Interaction Standard Score	5.63	2.50	7.09	2.74
SCQ Communication Standard Score	4.09	2.65	3.45	2.81
VABS-2 Socialization Domain Score	51.68	14.04	51.00	13.94
VABS-2 Communication Domain Score	49.91	13.87	51.10	14.50

Note. ADOS-2 or A-ADOS CSS = Autism Diagnostic Observation Schedule-2 or Adapted Autism Diagnostic Observation Schedule Calibrated Severity Score; Leiter = Leiter International Performance Scale-Revised; SCQ = Social Communication Questionnaire; VABS = Vineland Adaptive Behavior Scales;

We ran Wilcoxon signed-rank tests comparing fidelity of parent administration to that of trained examiners in order to assess how well parents ($N = 22$) were able to administer the ELSA-A at home. On average, parents ($M = 5.73$, $SD = 2.78$) administered significantly fewer ELSA-A activities than trained examiners ($M = 7.09$, $SD = 1.19$; $Z = -2.138$, $p < .05$). Table 1.7 presents how many parents and examiners administered each ELSA-A activity. The Toy Animals activity was administered by the highest number of adults (19 parents and 21 examiners). The S'mores activity was administered by the fewest number of adults (16 parents and 15 examiners). The Crafts and Pixar movie shorts sections were administered by the fewest number of parents (15 and 10, correspondingly).

Table 1.7

Frequency of ELSA-A activity administration by conversational partner (parent & examiner)

Activity Name	Parents ($N = 22$)	Examiners ($N = 22$)
Leaf Falling	16	18
Planting Acorns	17	19
Hide & Seek	16	20
Toy Animals	19	21
S'mores	16	15
Crafts	15	21
Beanbag Toss	17	21
Pixar	10	21

We compared the overall length of ELSA-A sample in minutes across conversational partners. On average, parents (*M* = 28.99; *SD* = 13.63) collected significantly longer ELSA-A samples than examiners (*M* = 21.19; *SD* = 4.34; *Z* = -2.289. $p < .05$). We then compared how much time parents spent on each ELSA-A activity in comparison to trained examiners. Because the total length of ELSA-A differed, we computed the proportion of time spent on each activity out of total ELSA-A length. There were no statistically significant differences in the proportion of time spent on each activity between parents and examiners suggesting that parents took proportionally the same amount of time per activity as examiners.

To evaluate parents' experiences with ELSA-A we analyzed their responses on the feedback survey (see **Appendix A**). Out of the 33 parents of MLV children and adolescents enrolled in the study, 31 filled out the feedback survey, which included questions about ELSA-A as well as other aspects of the larger study. Of these 31, 21 had collected ELSA-A at home and 10 had not. Following best practices for analyzing Likert scales, we conducted qualitative analyses of parent responses for each sub-group (ELSA-A collected vs. no ELSA-A collected) and for all parents (Harpe, 2015). The parents who did not submit an ELSA-A sample still received instruction about it and interacted with the materials when researchers visited them at home. Thus, the comparison of parent responses across groups (ELSA-A collected vs. NO ELSA-A collected) could provide insight as to what determines whether a parent will complete data collection at home. First, we computed the means, medians, and modes for every statement on the survey for each sub-group (see Table 1.8 for descriptive statistics on the statements).

Table 1.8

Measures of central tendency of parents' (ELSA-A and NO ELSA-A) responses from the Parent Feedback Survey

	N = 21 (ELSA-A)			*N* = 10 (NO ELSA-A)[a]		
	Mean	Median	Mode	Mean	Median	Mode
1. The instructions in the guide were easy to follow	4.19	4.00	4.00	4.20	4.00	4.00
2. The video instructions were helpful	4.20	4.00	4.00	4.20	4.00	4.00
3. Setting up the materials for the games was easy	4.24	4.00	4.00	3.80	4.00	3.00[a] (4.00)
4. It was easy to engage my child in the games	3.24	3.00	4.00	3.00	3.00	3.00
5. My child seemed to enjoy the games	3.48	4.00	4.00	3.30	3.50	4.00
6. It was easy to find time to collect the language sample	3.43	4.00	4.00	2.80	3.00	2.00[b] (3.00; 4.00)
7. My child's communication during the games is similar to what I see on a typical day	3.38	4.00	4.00	4.10	4.00	4.00

8. It was easy to engage my child in the Pixar movies	3.43	3.00	3.00	3.60	3.50	3.00
9. My child seemed to enjoy the Pixar movies	3.71	4.00	4.00	3.70	3.50	3.00
10. Recording the session was easy	3.86	4.00	5.00	2.30	2.00	2.00
11. Using Dropbox was easy	3.76	4.00	4.00	3.00	3.00	3.00

Note. Mean, median, mode for all ELSA-A-related statements from the Parent Feedback Survey where 1 = "strongly disagree," 2 = "disagree," 3 = "neither agree nor disagree," 4 = "agree," 5 = "strongly agree."

[a] All parents were familiarized with the ELSA-A protocol and were provided with all materials for it. The parents who did not collect an ELSA-A sample based their responses on going through the instructional materials and watching the instructional ELSA-A videos.

[b] Means to lowest values; the lower value is presented, and the other values are included in parentheses.

Based on visual inspection of these descriptive statistics, overall most parents rated the experience of collecting ELSA-A favorably. In particular, 27 (out of 31) parents agreed or strongly agreed that "The instructions in the guide were easy to follow" and the remaining 4 parents neither agreed nor disagreed. In addition, 24 parents agreed or strongly agreed that "The video instructions were helpful" and 7 neither agreed nor disagreed. No parents disagreed with either statement. For the "Setting up the materials for the games was easy" statement, 25 parents agreed or strongly agreed and 6 parents neither agreed nor disagreed. Overall, most parents also felt comfortable performing the

games: 7 strongly agreed, 16 agreed, 7 neither agreed nor disagreed, and only 1 disagreed. In terms of how representative their child's communication was during ELSA-A, most parents (24) agreed or strongly agreed that their child's communication during the game was similar to their everyday communication, while 3 parents neither agreed or disagreed, 1 parent disagreed, and 3 parents strongly disagreed.

Some differences between parent sub-groups emerged. Parents who did not collect ELSA-A at home provided lower ratings/disagreed more with the following statements "Setting up the materials was easy," "It was easy to find time to collect the language sample," "Recording the session was easy" and "Using Dropbox was easy" than parents who collected ELSA-A at home and sent it (see frequency distributions of parent responses by sub-group in Table 1.9).

Table 1.9

Frequency distributions of parent responses by sub-group (NO ELSA-A vs. ELSA-A)

Statement	Ratings	ELSA-A	NO ELSA-A
		$N = 21$	$N = 10$
Setting up the materials for the games was easy	Strongly Disagree	0	0
	Disagree	0	0
	Neither Agree nor Disagree	2	4
	Agree	12	4
	Strongly agree	7	2
	*missing	1	0
It was easy to find time to collect the language sample	Strongly Disagree	0	1
	Disagree	5	3

	Neither Agree nor Disagree	4	3
	Agree	10	3
	Strongly agree	2	0
	*missing	0	0
Recording the session was easy	Strongly Disagree	0	1
	Disagree	4	6
	Neither Agree nor Disagree	3	2
	Agree	6	1
	Strongly agree	8	0
	*missing	0	0
Using Dropbox was easy	Strongly Disagree	0	0
	Disagree	4	2
	Neither Agree nor Disagree	3	6
	Agree	8	2
	Strongly agree	6	0
	*missing	0	0

Discussion

Our study, which was designed to evaluate how well parents of MLV children and adolescents with ASD could obtain language samples using a structured protocol, has three main findings: 1) Parents produced significantly more speech and engaged in more back-and-forth interaction with their MLV children than the examiners did. 2) The

participants with ASD produced twice as much speech, conversational turns, and number of different words with their parents at home than with trained examiners. 3) Parents, who collected a language sample at home, administered fewer elicitation activities than trained examiners but collected longer samples. Overall, all parents rated the experience of language sampling at home favorably, but parents who did not contribute an ELSA-A language sample reported that they had some difficulty finding time to collect it, record it and send it.

Parents who collected ELSA-A at home, on average, spoke more and engaged in almost twice as much back-and-forth verbal interaction with their children than examiners in the lab. Even though parents spoke more, parents and examiners used a similar number of different words per minute (10 to 11 words), and similar length of utterances (3 to 4 words). This similarity in the quality of language is not surprising considering that the children and adolescents in this study had very limited verbal abilities. However, parents, on average, produced almost twice as many utterances per minute (17.92) and conversational turns (4.35) compared to examiners (FreqUtt: 10.40; CT: 2.35), while also collecting longer language samples. There are several possible explanations for why parents spoke more than examiners. Perhaps parents are better able to communicate with their child because they know what kinds of prompts their child is more likely to respond to and know what kinds of topics their child likes to discuss. Another explanation could be that the children/adolescents themselves feel more comfortable and initiate and/or respond more to their parents, which in turn reinforces parents to speak more. The deeply intertwined nature of the back-and-forth verbal

exchanges between children/adolescents and their parents cannot be disentangled with our analyses.

Nevertheless, the most interesting finding in our study is that the minimally to low-verbal children and adolescents with ASD produced twice as many utterances, words and conversational turns per minute with their parents at home than with examiners, thus suggesting that parents might be able to elicit speech from their children most representative of their actual language ability. There are several possible explanations for this finding. One is that parents provided input that facilitated their child's communication. Another explanation could be that our participants felt more comfortable speaking with their parents or being at home. Since all parent samples were collected at home, we cannot disentangle the relative contributions of the parent as a conversational partner and the home as a NLS setting. In addition to feeling more comfortable at home, another reason for participants to speak more with their parents could be that the parent sample was always collected after the examiner sample, so the children were already familiar with the ELSA-A activities. Regardless of whether it was the parent, the home, familiarity with the materials or a combination of these factors that lead to participants speaking more during the parent ELSA-A, this finding is of tremendous practical importance. It suggests that studies relying on examiner-collected NLS to assess the communication of MLV children and adolescents might significantly underestimate their expressive language in terms of how much/how likely they are to engage in verbal exchanges, but also in terms of the diversity of their lexicon. Our participants, on average, used twice as many different words per minute with their parents than with

examiners. Even though in absolute value, the frequency of utterances per minute with their parents is small (6 utterances per minute), it could be quite meaningful in these individuals' everyday communication compared to the 3 utterances per minute used with examiners. Considering the magnitude of this difference (almost double), future studies should include parents and a home setting in the assessment of their children's expressive language. This will ensure that the sampled speech is representative of children's actual language ability and is not influenced by the role of external factors like the conversational partner and the laboratory setting. Having a more valid representation of MLV children/adolescents' language abilities could ensure that treatments and interventions not only aim at developing new language abilities but also help children generalize the already existing ones. Furthermore, having parents collect natural language samples at home rather than during multiple lab visits could be more convenient for many families and researchers.

If parents collecting NLS at home is the key to better language assessment of the older MLV children and adolescents, and perhaps all individuals with ASD, then what do we, as researchers, need to do to help and encourage and support all parents to collect useable data at home? Even though the majority of parents found the ELSA-A instructions and instructional video helpful and felt comfortable performing the games, one-third either did not collect a sample or collected one but failed to submit it. Based on our results, it was not the characteristics of the child such as age or symptom severity that differentiated between parents who submitted an ELSA-A sample and those who did not. Rather, it was setting up the materials, finding the time to collect the sample, recording it,

and sharing it that parents who did not submit ELSA-A had difficulty with. Therefore, future studies should address these logistical aspects of data collection to encourage more parents to do it. For example, an interactive online platform that walks parents through the process of recording and submitting the language samples can be created rather than relying on different programs and applications for recording and submitting. In addition, examiners can coach the parents in setting up the materials in their homes and could schedule a specific time with them for data collection.

Another aspect of the feasibility of parents collecting language samples at home is the extent to which they follow the instructions/language elicitation protocol. In our study, parents administered fewer activities than trained examiners in the lab and their language samples were significantly longer. Nevertheless, the majority of parents followed the structure of the elicitation protocol and spent proportionately the same amount of time per activity as examiners. Interestingly, the activity administered by the fewest number parents, the making a S'more activity, is the activity administered by the fewest number of examiners, perhaps due to our participants' restricted diets and food allergies. Similarly, the activity administered by the highest number of parents, playing with Toy Animals, is one of the activities administered by most examiners, as well, suggesting that both adult groups considered this activity appropriate for engaging the participants and eliciting verbal communication. The playing with Toy Animals activity also comes early in the ELSA-A protocol, which could be another reason why it is administered by most of the adults. The activity administered by the fewest number of parents and the highest number of examiners is the Pixar movie shorts activity. This is the

only activity in the ELSA-A protocol, which relies on narration as the elicitation context. Asking the child to narrate typically elicits more syntactically complex language (e.g., Kover & Abbeduto, 2010) and is appropriate for children with higher verbal abilities, so perhaps parents did not consider this activity to be one that would encourage their children to communicate and decided to omit it. Despite these differences in administration between parents and examiners, parents were the ones who elicited more speech from their children, suggesting that their unique knowledge about their children could make them better conversational partners for natural language sampling.

Although very informative, our study has a few limitations that should be addressed in future research. Because all of the parent ELSA-A samples were collected at home, we cannot determine the relative contributions of familiarity with the conversational partner/parent and with the home setting to children's language. Furthermore, all parent ELSA-A samples were collected after the examiner ELSA-A samples, so perhaps our participants spoke more at home because they were familiar with the activities, which, in turn, could have led to parents speaking more too. Another limitation is related to the computation of one of the language measures for our participants: since they were all minimally to low verbal, their measure of lexical diversity, NDW, could not be based on 100 complete intelligible utterances as recommended in the literature (e.g., Miller, 1981). Therefore, it is unclear how reliable our finding is about children's more lexically diverse speech with parents. Nevertheless, considering that lexical diversity did not differ between parents and examiners, perhaps, using a higher number of different words with parents is indeed related to children's

familiarity with the conversational partner and setting. Future studies should determine the reliability and validity of such measures specifically for the minimally to low-verbal children and adolescents with autism. In addition, future studies should compare parent and examiner language in the pragmatic domain. Perhaps, parents use more open-ended questions or comment more, which is associated with their children's more lexically diverse speech. From a practical standpoint, more information should be gathered about parents' experiences of data collection at home to determine exactly what aspect of the process they have greatest difficulty with. One third of the parents in our study did not submit an ELSA-A sample, but filled out the feedback survey, so it is unclear whether they collected the sample, but did not record it and send it or whether they did not even attempt data collection. Once it is determined what aspects of data collection parents struggle with the most, these can be addressed to ensure that more parents collect data at home.

Future studies should not only focus on how to facilitate data collection at home, but also examine the feasibility and usefulness of collecting parent ELSA-As from other clinical populations. It is essential to examine how the characteristics of parent-collected ELSA-As and the language measures derived from them vary by child characteristics, like age, language ability, symptom severity, and potentially diagnosis. Clinical populations for whom parent-collected ELSA-As could be particularly useful include those who cannot be assessed with traditional assessment methods like standardized tests and/or parent reports, individuals with ASD more broadly, and children with selective mutism among others.

To allow for comparison of findings across studies, specifically in the context of assessing change in language ability as a result of treatment or intervention, a consistent language elicitation protocol should be followed. The consistency of the protocol requires similar/equivalent elicitation context (activities), conversational partner, and setting. ELSA-A is an excellent candidate because it has already been validated for use with children and adolescents across a wide range of ages and language abilities (Barokova et al., 2020). Furthermore, as our findings suggest, parents can successfully follow the instructions of the protocol and collect ELSA-A at home. Not only that, but parents at home elicit almost twice as much speech from their minimally to low-verbal children and adolescents than trained examiners in the lab. Therefore, parents might be better at eliciting speech from their children that is representative of their actual language abilities. Future studies should capitalize on this and encourage parents to collect samples at home to assess their children’s true language ability

EXPLORING CROSS-LINGUISTIC DIFFERENCES IN PARENTAL INPUT AND THEIR ASSOCIATIONS WITH CHILD EXPRESSIVE LANGUAGE IN ASD: BULGARIAN VS. ENGLISH COMPARISON

Parental input plays a central role in typical language acquisition and development (e.g., Hoff & Naigles, 2002; Huttenlocher et al., 1991; Rowe, 2012; Snow, 1977; Swanson, 2020). In the field of ASD, characterized by heterogeneous expressive language and social communicative deficits, parental input presents an important avenue for investigation. Studies that have reported positive associations between early parental input and later child language in ASD have primarily focused on the structural aspects (morphology and syntax) of input to young English-speaking children (Bang & Nadig, 2015; Fusaroli et al., 2019; Swensen, 2007; Warren et al., 2010). However, few studies have looked at input variability across children from a wider range of ages and/or functioning level (Haebig et al., 2013a, b; Konstantareas et al, 1988), and only one has compared parental input across languages (French vs. English; Bang & Nadig, 2015). Understanding cross-linguistic differences in parental input, especially in discourse – the heart of everyday interactions – is essential considering the rise of more naturalistic and parent-mediated interventions (Schreibman et al., 2015). There are two goals of this study: I. to compare parental input across languages Bulgarian and English, which differ in both linguistic and cultural features, and II. to examine its associations with child language ability.

Many studies have compared parental input to children with ASD or typical development (TD) (see Nadig & Bang, 2016 for review; Bang & Nadig, 2015; Fusaroli et

al., 2019; Swensen, 2007; Warren et al., 2010). When children were matched on language level, often operationalized as expressive vocabulary, no differences in parental input were found. These studies primarily focused on broad measures of parents' speech including total number of utterances (e.g., Bang & Nadig, 2015), mean length of utterances (MLU; Wolchik, 1983), number of word tokens (Warren et al., 2010), word types (Swensen, 2007), and total number of affect-salient (emphatic utterances) and information-salient (asking or giving information) utterances (Venuti et al., 2012). However, when focusing on more specific measures, some differences between ASD and TD parental input have been found. Parents of children with ASD asked fewer wh-questions (Goodwin et al., 2015), used fewer mental state terms (Slaughter et al., 2007), but used their child's name more frequently and used more statements (Venuti et al., 2012). Similar results were reported when parental input to verbal and nonverbal children with ASD matched on chronological age (average ~70months), gender, and SES, was compared (Konstantareas et al., 1988). No differences were found in the quantity of input, but parents of the verbal group used longer utterances and asked/answered more questions, while parents of the nonverbal group used more direct statements. Interestingly, two other studies have reported that parents' follow-in comments and directives predicted later child language in minimally to low verbal, but not in verbally fluent, toddlers with ASD (Haebig et al., 2013a, b), suggesting that this kind of input may play a scaffolding role for children with more limited language.

Overall, research suggests that there are reciprocal influences between parent and child speech. On the one hand, parents modify their input based on the child's language,

level of functioning, IQ, and diagnostic status (e.g., Fusaroli et al., 2019; Konstantareas et al., 1988; Venuti et al., 2012). On the other hand, children's speech is predicted by parents' input earlier in life (e.g., Bang & Nadig, 2015; Bottema-Beutel & Kim, 2020; Fusaroli et al., 2019; Haebig et al., 2013b; Hoff, 2006; Swensen, 2007; Warren et al., 2010). This emphasizes the bidirectional relationship between input and children's language ability and presents an opportunity for interventions to capitalize on. In fact, plenty of research from TD has already identified the features of parental input that facilitate language development from birth to age 5, and how they change over time (for review see Rowe & Snow, 2020). A similar approach is needed in ASD to better inform parent-mediated naturalistic behavioral interventions. Some studies have begun to address this. They have identified that the amount of input (Warren et al., 2010), its lexical diversity (Fusaroli et al., 2019 – word types) and composition (Swensen, 2007 – noun types), syntactic complexity (Bang & Nadig, 2015 – MLU), and the use of questions (Goodwin et al., 2015 – wh-questions; Swensen, 2007 – yes/no questions) all contribute to child language outcomes later on. However, past research has not addressed potential cross-linguistic differences in parental input (Nadig & Bang, 2016 for review). From a clinical perspective, understanding cross-linguistic variation in parental input is necessary to inform parent-mediated naturalistic ASD interventions that so far have been tailored to Western, English-speaking children. Only one study to date conducted a cross-linguistic comparison of input to French- and English-speaking toddlers with ASD, but only focused on broad structural measures of language (Bang & Nadig, 2015). The French-speaking parents used more lexically diverse speech compared to the English-

speaking parents, but no differences were found in the quantity of their speech. In this study, both participant groups were from Canada, so even though they were linguistically different, they were not so culturally distinct. Therefore, more cross-linguistic and cross-cultural comparisons are warranted.

Cross-linguistic comparison of parental input to Bulgarian- and English-speaking children with ASD

To address the gaps in the literature, the present study compares parental input to a sample of Bulgarian- and English-speaking children with ASD matched on language ability. Focusing on Bulgarian families presents a unique opportunity to examine a culture and a language substantially different from that of the high SES, Western, English-speaking families typically enrolled in ASD research. Sociological studies point out that Eastern European countries as a group systematically differ on key social issues from Western European countries (see Eastern and Western Europeans differ..., 2018), and present with traditional views on marriage, gender roles, and children's role in the family (Robila & Krishnakumar, 2004). Similarities across Eastern European countries were found specifically in childrearing attitudes, which focused on obedience, the development of moral character, and a sense of belonging to the collective, reported both in the past (Bronfenbrenner, 1970) but more recently as well (Robila, 2004). Examining Bulgarian parents' input allows us to see whether and how these values are reflected in their conversational practices with their children, for example, in how much parents talk to their children and the prevalence of different sentence types in their speech. In our study, we compare parental input focusing on aspects shown to predict child language

ability (vocabulary) concurrently and/or longitudinally. Each one is described in turn, and potential differences between English and Bulgarian input are highlighted.

Quantity of Input. As previously mentioned, studies have shown that the amount of input is strongly associated with the child's concurrent language ability/vocabulary and later literacy skills (e.g., Fusaroli et al., 2019; Hart & Risley, 1995; Rowe, 2012; Warren et al., 2010). Because no language differences were found in the only cross-linguistic comparison of input in ASD (Bang and Nadig, 2015), we do not predict any differences between the quantity of input of Bulgarian and English-speaking parents either.[1]

Lexical Diversity. Even though the quantity of input matters, its quality, specifically lexical diversity, might play an even more important role in child language development (Fusaroli et al., 2019; Huttenlocher et al., 2010; Pan et al., 2005; Rowe, 2012). Because in our study children are matched on lexical diversity, we do not predict any differences in parental input in this domain.

Lexical Composition. Another avenue for investigation is the lexical composition of parental input, specifically as it pertains to nouns and verbs. In languages where verbs

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[1] **Syntactic Complexity.** Although numerous studies have shown that the syntactic complexity of parental input, as measured by MLU, is strongly associated with child language ability (e.g., Bang & Nadig, 2015; Fusaroli et al., 2019) a Bulgarian vs. English MLU comparison of parental input would be difficult to conduct. In Bulgarian there is no consensus on the computation of MLU that would be equivalent to that in English, thus making it impossible to compare two languages on this measure.

occur relatively more frequently and in specific syntactic structures (e.g., at the end of the utterance), verbs are acquired earlier than in English and are used more often than nouns (in Korean; Choi & Gopnik, 1995; in Mandarin: Tardif, 1996). Even in English, parents' frequency of verbs predicted verb acquisition in TD children (Naigles & Hoff-Ginsberg, 1998). In the field of ASD, Swensen (2007) found that the number of noun types in parental input was positively associated with children's number of word types, tokens, and utterances concurrently, and with child vocabulary 4 months later. In addition, Crandall et al. (2019a, b) reported that parents' use of verbs in follow-in comments was associated with child verb vocabulary at a later time point.

There is no published information on the relative frequency and rate of acquisition of nouns and verbs in Bulgarian. Nevertheless, because Bulgarian has a rich verb inflection system and it is a null-subject, pro-drop language similar to Italian, we speculate that Bulgarian parents, just like Italian parents (Tardif et al., 1997), would not show a preference for verbs over nouns.

Sentence/Utterance Types. A large body of literature has focused on the association between sentence types in parental input and children's language ability (e.g., Haebig et al., 2013a, b; Goodwin et al. 2015; Fletcher et al., 2008). Wh-questions have been the primary target of past research because they are more syntactically and conversationally challenging for children then other types of questions and descriptive statements (Rowe et al., 2004). However, other studies have shown that questions overall including yes/no questions were associated with child vocabulary too (e.g., Blake et al., 2006; Fletcher et al., 2008; Swensen, 2007). In ASD, Goodwin et al. (2015) found that

children's understanding of wh-questions was predicted by the type and complexity of their parents' wh-questions earlier on. In addition, Swensen (2007) found that parents' use of Yes/No questions was associated with children's auxiliary verb use 4 months later.

In our study, we compare parents' use of questions, statements and exclamations overall. We are not focusing specifically on wh-questions because in Bulgarian they are not as syntactically challenging as in English. Considering that there are no previous studies examining discourse practices of Bulgarian parents (only of Eastern-European parents' attitudes), we have no a priori hypothesis about question use of Bulgarian parents. Nevertheless, we predict that question use will be associated with child language ability for both participant groups.

The present study aims to compare Bulgarian- and English-speaking parents' speech (Aim 1) and to examine the concurrent predictors of their children's expressive language ability (Aim 2).

Methods

Participants

Bulgarian-Speaking Sample. The Bulgarian participant sample consisted of 37 (7F) children with ASD and their primary caregivers. The children were between the ages of 2;7 and 9;10 years (M = 70.62, SD = 20.22) and had a community diagnosis of ASD or PDD based on the ICD-10 (WHO, 2013). Their diagnosis was confirmed in this study with the administration of the Autism Diagnostic Observation Schedule-2 by a certified research reliable administrator (ADOS-2; Lord et al., 2012). The ADOS is a semi-structured behavioral assessment of autism symptoms, which consists of a series of

activities. Different modules of the ADOS were administered based on children's chronological age and language ability. Note that the ADOS-2 has been translated to Bulgarian but has not yet been validated with Bulgarian children, which poses a potential limitation to its use with this sample. All families were recruited through word of mouth, posts on online parent forums, and through local service providers in Sofia, Bulgaria.

English-Speaking Sample. The English-speaking participant sample also consisted of 37 (7F) children with ASD and their primary caregivers. They were a sub-sample of a larger longitudinal study examining developmental change in ASD (for more information, see Carter et al., 2007 or Luyster et al., 2008). Children were between the ages of 1;8 and 4;9 years (M = 37.79, SD = 10.44), and their diagnoses were confirmed with the Autism Diagnostic Interview-Revised (Lord, Rutter & Le Couteur, 1994), the Autism Diagnostic Observation Schedule-General (ADOS-G; Lord et al., 2000), and by a clinician. In terms of race, 30 of the children were white, 4 were reported to have more than one race, and data were missing for the remaining 3. All families were recruited through early intervention providers in Massachusetts, USA (see Table 2.1).

Procedure

IRB approval was obtained before both participant samples were tested. All participating families provided informed consent.

Demographic Questionnaire. For both participant samples, the primary caregiver filled out a demographic questionnaire indicating the child's age, sex, and current diagnosis. Information was collected about the family's financial situation, and the mother's education (see Table 2.1). Bulgarian parents wrote in their highest attained

degree, while English-speaking parents selected from a pre-determined set of options. Following what has been done in the literature (Rowe, 2008), we converted each degree level to a numerical value corresponding to the approximate number of years spent attaining the degree (less than high-school = 10 years; high-school or GED = 12; associates or 2-year degree, and courses towards a college degree = 14; college degree = 16; master's degree = 17; and professional degree = 18). Based on past research showing positive associations between parent education and child expressive language ability (e.g., Rowe, 2008), we entered parent education in our analyses predicting child language from parents' speech.

Table 2.1

Demographic characteristics of the Bulgarian-speaking and English-speaking children with ASD

Characteristic	Bulgarian ASD	English ASD
Age in months - *M* (*SD*)	70.62 (20.22)	37.97 (10.48)
Sex (M:F)	30:7	30:7
Parent Education		
Less than high school		1
High school degree or GED	3	6
Vocational or trade skill after high school		
Associates or 2-year degree		3
Courses towards college degree		8
College degree	33	11

Master's degree		6
Professional degree (MD, JD, etc.)		2
*missing	1	
Income		
	Very low – 2	<$20,000
	Low	$20,000 - $40,000 – 3
	Medium – 30	$40,000 - $60,000 – 8
	High – 2	$60,000 - $80,000 – 7
	Very High – 1	>80,000 – 16
*missing	2	3

Parent-Child Interaction (PCI). For both groups, a natural language sample was collected while the primary caregiver engaged their child in free play. All primary caregivers were the mothers of the children except for one father in the Bulgarian sample. The parents in both groups were provided with a bag of the same set of developmentally appropriate toys (e.g., a baby doll, a puzzle, building blocks, 2 pianos, firefighter hats, cars, balls, and animals), and instructed to play with their child as they normally would at home. All PCIs were video-recorded and transcribed.

Transcription & Measures. The PCIs were transcribed following standard transcription procedures using the Systematic Analysis of Language Transcripts (SALT) format (Miller et al. 2011). All child and adult utterances were segmented into communication units defined as independent clauses (Loban, 1976). Each utterance ended with an end of sentence punctuation indicating its type (statement, question,

exclamation). A consecutive transcription approach was used, where each PCI was transcribed by a first transcriber, who was a native speaker, and later checked by a second transcriber. Disagreements were resolved through consensus.

Transcribed PCIs were analyzed using the SALT-12 software (Miller & Iglesias, 2012). Key measures of language were obtained for both the child and the parent: total number of utterances, word tokens, word types, statements, questions, and exclamations, nouns and lexical verbs (excluding auxiliaries, modal verbs, and copula). Because SALT-12 could not extract nouns and verbs from the Bulgarian transcripts, these were extracted with the help of an html script[2]. Adapting Ogura et al.'s (2006) lexical composition measures, we computed percentage of verb tokens out of total verb and noun tokens to assess the relative use of verbs in parents' speech. Because the PCIs ranged in duration, here we only focus on the measures from the first 10 minutes of the interaction. Because 7 out of the 74 PCIs that were less than 10 minutes long, all of our language measures were converted into rate per minute or a proportion out of total number of utterances. The final set of measures extracted for the child and the parent can be found in Table 2.2.

Table 2.2

Comparisons of parents' transcript-derived measures of input by language

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[2] First, a dictionary of all words used by Bulgarian parents was extracted. This dictionary was manually tagged for nouns and lexical verbs by a native Bulgarian speaker. Then each Bulgarian transcript was compared against the tagged dictionary and number of parent produced nouns and verbs was extracted.

Measures extracted	Bulgarian ASD M (SD)	English ASD M (SD)	Comparison Statistic	Effect Size
Quantity				
Number of utterances per minute	19.90 (6.22)	16.26 (4.96)	$t(72) = 2.78$ $p = .007$	Cohen's $d = .66$
Number of word tokens per minute	53.88 (20.49)	59.49 (23.49)	$U = 76$ $p = .440$	$r = .09$
Lexical Diversity				
Number of word types per minute	17.13 (5.68)	16.15 (3.59)	$t(72) = .89$ $p = .379$	Cohen's $d = .21$
Lexical Composition				
Percentage of verb tokens out of total noun and verb tokens	54.24 (8.01)	45.27 (7.39)	$t(72) = 5.00$ $p < .001$	Cohen's $d = 1.16$
Sentence/Utterance Types				
Percentage of questions out of total number of utterances	18.51 (9.48)	36.33 (12.85)	$U = 1195$ $p < .001$	$r = .64$
Percentage of exclamations out of	9.57 (11.20)	1.80 (2.54)	$U = 284$ $p < .001$	$r = .51$

total number of utterances				
Percentage of statements out of total number of utterances	71.92 (12.12)	61.86 (12.96)	*t*(72) = 3.45 *p* = .001	Cohen's *d* = .80

Note. Because there are 7 comparisons, we applied a Bonferroni multiple comparisons correction (critical p = .05/7 = .007). In terms of effect sizes, Cohen's r was computed by diving Z by the square root of N. According to Cohen (1988), a small effect size based on Cohen's d is .2, medium is .5, and large is .8. According to Coolican (2009), a small effect size based on r is .1, a medium effect is .3, and a large effect is .5.

Participant-Matching. The Bulgarian-speaking and English-speaking children with ASD were matched on expressive vocabulary operationalized as number of word types produced per minute (Bulgarian: *M* = 2.83, *SD* = 3.30; English: *M* = 3.06, *SD* = 3.37; Mann-Whitney *U* = 701, *p* = .858). Expressive vocabulary was chosen as the matching criterion based on past research showing no differences in parental input to children with ASD and children with TD, when they were matched on expressive vocabulary (for review, see Nadig & Bang, 2016). Because the children could not be matched on age, we controlled for it in our analyses.

Planned Analyses

Aim 1. To compare Bulgarian- and English-speaking parents' speech, we conducted independent samples t-tests or Mann-Whitney U tests, when the variables did not fit a normal distribution. Because there were 11 comparisons, we applied a

Bonferroni multiple comparisons correction ($p = .05/11 = .004$). As recommended in Fritz et al. (2011), effect size statistics Cohen's *d* and *r* were computed for parametric and non-parametric comparisons, respectively.

Aim 2. To examine the concurrent predictors of child expressive language (number of different word types per minute), we ran a hierarchical linear regression. At level 1, we entered demographic characteristics – child's age, maternal education, and group status (Bulgarian vs. English). At level 2, we entered parents' language measures. And at level 3, we entered interaction effects between significant predictors and child group status (Bulgarian vs. English).

Results

Aim 1

Bulgarian- and English-speaking parents did not differ in quantity of speech, specifically, utterances per minute ($t(72) = 2.78$, $p = .007$, but critical p value after Bonferroni correction is .004) and words tokens per minute (Mann-Whitney $U = 76$, $p = .440$, see Table 2.2 for descriptive statistics and effect sizes). The two parent groups did not differ in word types per minute ($t(72) = .89$, $p = .379$) either. However, Bulgarian parents had a significantly higher percentage of verb tokens out of total verb and noun tokens used ($t(72) = 5.00$, $p < .001$). This comparison had large effect size (Cohen's $d = 1.16$). We conducted the same analyses with verb types out of total verb and noun types and obtained the same significant difference.

Parents' utterances also differed in terms of type. Bulgarian-speaking parents had a significantly higher percentage of exclamations (Mann-Whitney $U = 284$, $p < .001$) and

statements ($t(72) = 3.45$, $p < .001$), but had a lower percentage of questions than English-speaking parents (Mann-Whitney $U = 1195$, $p < .001$).

Aim 2

First, to examine the relations between child NDW and child demographic characteristics and parental input, we conducted zero-order Spearman's Rho correlations (due to the not normally distributed variables). Child age in months ($r_s(72) = .388$, $p = .001$), parent word types ($r_s(72) = .309$, $p = .007$), and percentage of parent questions ($r_s(72) = .384$, $p = .001$) were significantly correlated with child NDW (see Table 2.3). In contrast, maternal education, parent word tokens and percentage of verb tokens out of verb and noun tokens were not significantly associated with child word types and were omitted from further analyses.

Table 2.3

Zero-Order Spearman Rho correlations

	Child word types per min	Child age in months	Maternal educa-tion[!]	Parent words per min	Parent word types per min	% Parent questions	% Verbs out of total nouns & verbs
Child word types per min	1	___	___	___	___	___	___
Child age in months	.388**	1	___	___	___	___	___

Maternal education	-0.143	0.156	1	___	___	___	___
Parent words per min	0.21	0.148	0.164	1	___	___	___
Parent word types per min	.309**	.413***	0.169	.846***	1	___	___
% Parent questions	.384**	-.296*	-0.077	.343**	.267*	1	___
% Verbs out of total nouns & verbs	-0.12	.319**	0.114	0.065	0.078	-.435***	1

[1]Maternal education – 1 missing data point, so correlations are out of 73. Bonferroni p = .00238

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

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

*** Correlation is significant at the 0.001 level (2-tailed)

After controlling for child age, the correlations between child word types and parent word types ($r_s(69)= .304$, $p = .009$), and percentage of parent questions ($r_s(69)= .627$, $p < .001$) remained statistically significant, and these variables were included as predictors in the regression analyses.

Next, we ran a hierarchical linear regression to predict child word types. At level 1, we entered child characteristics, including the child's age in months and group status (Bulgarian vs. English). These variables significantly predicted child word types, $F(2, 71) = 15.275$, $p < .001$, $R^2 = .301$. About one-third (30%) of the variance in child language ability was explained by the model. Both child age and group status added significantly to the prediction ($p < .001$). One unit increase in child age was associated with .113 unit increase in child word types, while holding group status constant. Having a Bulgarian group status was associated with a 3.936 unit decrease in child word types, holding age constant. At level 2, based on the results of the zero-order correlations, we added parents' word types and percentage of questions to the model. The variables significantly predicted child word types, $F(4, 69) = 15.659$, $p < .001$, $R^2 = .476$. The prediction of the model at level 2 was significantly improved compared to the model at level 1, *F change* (2, 69) = 11.517, $p < .001$. Almost half (47%) of the variance in child word types was explained by the model. However, when parent language variables were included, only child age and parent percentage of questions significantly added to the prediction, while group status and parent word types did not. One unit increase in child age was associated with .076 unit increase in child word types, and one unit increase in percentage of parent questions was associated with a .127 unit increase in child word types, while holding all other variables constant. Entering interaction terms between group status and parent word types, and percentage of parent questions did not statistically improve the prediction of the model (see Table 2.4).

Table 2.4

Regression analyses concurrently predicting child language ability (word types per minute).

Level	R^2	*F*	*df*	*p*	*b*	*SE b*	*Beta*	*p*
Level 1	.301	15.275	2, 71	<.001				
Constant					-1.245	.908		.175
Age in months					.113	.021	.785	.000
Group status					-3.936	.937	-.598	.000
Level 2	.476	15.659	4, 69	<.001				
Constant					-5.163	1.244		.000
Age in months					.076	.023	.523	.001
Group status					-.477	1.103	-.072	.667
Parent word types per minute					.046	.077	.065	.556
Parents' % of questions					.127	.028	.551	.000
Level 3	.481	10.343	6, 67	<.001				
Constant					-6.488	2.078		.003
Age in months					.081	.024	.562	.001
Group status					1.196	2.395	.182	.619
Parent word types per minute					.108	.122	.154	.382
Parents' % of questions					.130	.033	.563	.000

Group Status by word types per min	-.093	.149	-.265	.536
Group Status by % Questions	-.018	.061	-.056	.765

Statistics: R^2 = R-square; *F* = F-test for the significance of the model; *df* = regression degrees of freedom, residual degrees of freedom; *b* = unstandardized beta coefficients; *SE b* = standard error of the beta coefficients; *Beta* = standardized beta

Discussion

Our study has three main findings: Bulgarian and English parental input differed in its lexical composition and in the distribution of sentence types, and parents' use of questions was a significant concurrent predictor of their child's language ability.

Overall, we found that input to Bulgarian and English-speaking children with ASD did not differ in terms of quantity (see Table 2.2). Bulgarian and English-speaking parents did not differ in their talkativeness, frequency of utterances and words per minute, similar to what was found in the French vs. English cross-linguistic comparison (Bang & Nadig, 2015). Unlike in Bang & Nadig (2015), our parents did not differ in the lexical diversity of their speech either. This finding is attributed to the fact that we matched the children in both groups on lexical diversity, and based on an interactionist framework of communication we would expect their parents not to differ in lexical diversity either.

Even though our groups did not differ in quantity of input, they differed in quality, specifically, in the parents' use of nouns and verbs. Overall, Bulgarian parents

used more verbs than nouns in their speech, whereas this pattern was reversed for English-speaking parents. From the languages in which noun to verb ratio in TD parental input has been examined, in terms of verb morphology and pro-drop quality, Bulgarian is most similar to Italian or more so than to Mandarin, Korean or Japanese. Nevertheless, our Bulgarian parents' preference for verbs is in line with reports of Japanese (Ogura et al., 2006) and Mandarin-speaking parents emphasizing verbs over nouns in their input, but not with Italian and English-speaking parents, who used similar number of verb and noun types (Tardif et al., 1997). Therefore, the lower rate of nouns in relation to verbs in Bulgarian input as compared to English is a novel finding.

From a linguistic standpoint, Bulgarian is a null-subject, pro-drop language. These features allow for the omission of the sentence subjects, nouns and pronouns, thus leaving the verb at sentence-initial position and emphasizing it. The same is true for Italian and yet, Italian parents do not use more verbs than nouns in their input. Perhaps, the difference in the use of nouns could lie in socio-cultural reasons. For example, Tardif (1996) suggested that Mandarin-speaking children's lack of noun bias early on could be attributed to their parents playing a different "language learning game." In particular, English-speaking mothers have been reported to place emphasis on talking about objects and prompting their children for object labels (Bridges, 1986; Goldfield, 1993), which might not be the focus of attention of Mandarin-speaking, and in our study, of Bulgarian-speaking parents. Another possible explanation could be that past studies have looked cross-linguistic differences in input to TD children, whereas our study focuses on children with ASD. Therefore, there could be something specific to how Bulgarian

parents interact with their children with ASD that is driving the difference. For example, they might be using more imperative forms (Look. Come. Stop.), which could explain the emphasis on verbs in their speech. Regardless of the reasons for this group difference, it is noteworthy because words that appear more frequently in parental input are typically learned earlier (Gentner, 1982). For example, Swensen (2007) found a positive longitudinal association between parents' noun tokens and children with ASD vocabulary four months later, and Crandall et al., (2019a, b) found positive associations between parents' use of verbs, specifically in follow-in comments, and children's vocabulary longitudinally. Therefore, future studies should examine how the frequency of nouns and verbs in Bulgarian parents' speech is associated with children's speech and vocabulary later on, and how the time and rate of acquisition of nouns and verbs in Bulgarian children with ASD compares to that of English-speaking children with ASD.

Our second main finding is the group difference in sentence types. Bulgarian parents used significantly more statements and exclamations than English-speaking parents, who used significantly more questions. Statements and exclamations pose very different cognitive and social demands than questions. The parent can be narrating what is happening in the interaction or reacting enthusiastically to the child's behavior (using exclamations) and yet this would require minimal verbal response from the child. Even the use of imperatives/directives, which in our transcripts were marked as statements, often requires the child to complete an action but not necessarily verbally respond in the social interaction. In contrast, posing questions to the child puts them at the center of the interaction and requires them to respond. Based on this, it would appear that the

Bulgarian children's input, which contained only 18% questions, was less conversationally demanding than the input to our English-speaking children, which contained 36% questions.

There could be multiple different interpretations why English-speaking parents used almost twice as many questions than Bulgarian parents. Perhaps, Bulgarian parents have a different communication/play style with their children. Sociological and anthropological studies show that Eastern European parents value obedience and respect for authority in their parenting (Nesteruk & Marks, 2011; Robila, 2004), so this could make them more likely to take the lead and less likely to ask questions. In order to test this interpretation, we would need to have a TD Bulgarian and English-speaking control groups to use for comparison. An alternative explanation for this difference in sentence types could be attributed to specific characteristics of the children and their access to intervention services. Our English-speaking sample comprised of children, who on average received 20 hours of intervention a week. In contrast, our Bulgarian children had much more limited access to services with some of them just starting their participation in interventions. Therefore, it could be that parents who received more guidance on how to verbally engage their children, the English-speaking parents, were more likely to use more questions. Another related explanation could be about the child's symptom severity and cognitive ability. The Bulgarian children, who had received less intervention and were older could have more severe behavioral symptoms, which would, in turn, change their parents' interaction style to being more directive rather than following and asking

questions. Future research should examine the association between question use and child symptom severity and cognitive ability in more detail.

Regardless of the reason for the group difference in question use, our regression analyses showed that parents' use of questions was a significant predictor of children's concurrent language ability for both groups. There was no interaction effect between group status and question use on child language, suggesting that the predictive power of parents' questions was similar across groups. This finding is in line with a large body of research reporting positive associations between parents' question use and child language both in TD and in ASD (e.g., Goodwin et al., 2015; Leech et al., 2013; Rowe et al., 2017; Swensen, 2007). Considering that questions play such an important role in language development, parent-mediated interventions designed for Bulgarian parents should emphasize the use of questions. Special focus should be paid on the types of questions used in terms of how conversationally challenging and developmentally appropriate they are for the specific child.

To further inform evidence-based intervention practices, future research should delve deeper into the language of Bulgarian parents, examining the different question types used to determine which one is the strongest predictor of child language ability. Furthermore, studies should examine the use of imperative forms, because they have been shown to serve a scaffolding role (Haebig et al., 2013b) for children with lower language ability, but not for verbally fluent children. This would help determine the relative contributions of these sentence types and how they should be tailored to the child's ability. From a broader perspective, future research should examine the play style of

Bulgarian parents too, focusing on how their values and views on parenting are manifested in their interactions with children.

Future research should also address one of the main limitations in the present study, namely the fact that the participant groups were not matched on chronological age. Past studies have shown that when TD and ASD children are matched on expressive language but not on chronological age, there are no differences in verbal parental input suggesting that parents are tailoring their speech not to the age of their child but to their language ability (Bang & Nadig, 2015). Nevertheless, one could argue that group differences in the present study can be attributed to children's age. One way to address this is to statistically control for age in the group comparisons. All comparisons in this study were also run, while controlling for children's age using multiple linear regressions, and the same pattern of group differences was found. Another way to address the different chronological ages of the two groups is to code the parent-child interactions for the specific activities that the dyads were engaging in to ensure that there is no different pattern of activities (e.g., book reading, social games, etc.) that could involve different parental input.

Last but not least, future research should address another main limitation in our study: the lack of a Bulgarian TD control group. Including such a control group would allow us to determine whether the observed group differences are specific to the speech of Bulgarian parents directed to children with ASD or whether they are a reflection of a broader cross-cultural difference.

Our study was the first to conduct a cross-linguistic comparison of parental input to children with ASD. We found that parents' speech did not differ in terms of amount or structural aspects of language, but that it differed in its lexical composition and sentence types. In addition, the strongest concurrent predictor of child language ability in both groups was parents' use of questions. These findings lay the foundation for future cross-linguistic comparisons in ASD and begin to inform how parent-mediated naturalistic interventions should be tailored to a non-Western, non-English-speaking participants.

HOW DO PARENTS REFER TO THEIR CHILDREN WHILE PLAYING? A CROSS-LINGUISTIC COMPARISON OF PARENTAL INPUT TO BULGARIAN- AND ENGLISH-SPEAKING CHILDREN WITH ASD

Parents who are typically children's primary caregivers are the most common conversational partner for their children in early childhood. Their linguistic input plays a key role in child language development (Bang & Nadig, 2015; Bottema-Beutel & Kim, 2020; Fusaroli, Weed, Fein, & Naigles, 2019; Hoff & Naigles, 2002; Huttenlocher et al., 1991; Rowe, 2012; Snow, 1977; Swanson, 2020; Venker et al., 2015; Warren et al., 2010; Wolchik, 1983), and they are the ones facilitating the child's socialization in the community (e.g., Andreakis et al., 2019; Brownell et al., 2013; Maccoby, 1994). Everyday interactions with caregivers also help children achieve other cognitive feats. For example, acquiring a sense of self, the understanding that one is different from others, is deeply rooted in everyday conversations, where parents continuously delineate the difference between self and other with every reference to themselves and their child. In fact, the most frequently used word in the English language (in spoken contexts) is the first-person singular pronoun 'I' (Pennebaker, 2011). Understanding personal pronouns along with other frequently used instances of person-reference (e.g., *honey, sweetie, baby, Mony, mommy*) in child-directed speech is central to successful conversations. Considering the functions and high frequency of person-reference in parental input, it is important to examine how structural differences across languages along with cultural differences in discourse practices affect the way parents refer to themselves and their children. Focusing on person-reference for children with autism spectrum disorder (ASD)

in particular, presents a unique opportunity to examine how parents address their children, who have difficulty using personal pronouns and understanding discourse roles (e.g., Carmody & Lewis, 2012; Lee et al., 1994; Tager-Flusberg, 1994), and for whom this aspect of parental input might be especially important. In the present study, we compare how Bulgarian and English-speaking parents refer to themselves and their children with ASD during a free play interaction. Bulgarian parents were chosen for comparison because their language and discourse practices in relation to person-reference are sufficiently different from those of English-speaking, North American parents.

Person-Reference in ASD

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social communication difficulties and restricted and repetitive behaviors (American Psychiatric Association, 2013). How children with ASD use person-reference – refer to themselves and others – has been extensively studied. Almost every description of language ability in ASD mentions difficulty with personal pronouns (e.g., Lord & Luyster, 2009; Kanner, 1946; Rutter, 1979; Tager-Flusberg et al., 2005). Some studies relying on natural language sampling report relatively low prevalence of pronoun reversal errors, when children use 'you' instead of 'I' or the other way around, in English-speaking participants (<1% in Barokova & Tager-Flusberg, 2019; 3% in Naigles et al., 2016; 13% in Tager-Flusberg, 1994). Other studies relying on pronoun elicitation tasks report pronoun avoidance – their participants do not reverse their pronouns but are more likely to use nouns and names as compared to typically developing (TD) controls. This was found in English-speaking children (Lee et al., 1994), in Italian-speaking children

(Mazzaggio & Shield, 2020), and in native ASL signers (Shield, Meier, & Tager-Flusberg, 2015). Nevertheless, the majority of studies in the field are conducted with English-speaking participants with ASD and focus only on the use pronouns and names. The presentation of person-reference in ASD could vary based on the structural characteristics (syntax and morphology) of the language, and this has been shown in null-subject, pro-drop languages and in languages that use pronominal clitics (e.g., Terzi et al., 2019; Durrleman & Delage, 2016). Children with ASD, who speak pro-drop languages (in which pronouns can be omitted) avoid personal pronouns by using nouns and names (in Italian: Mazzaggio & Shield, 2020) and determiner phrases (in Greek: Terzi et al., 2019). Children with ASD, who speak languages with pronominal clitics, typically comprehend and produce these clitic forms less than TD controls (Durrleman & Delage, 2016; Fortunato-Tavares et al., 2015; Terzi et al., 2014, 2016).

Although there are cross-linguistic differences in the use of person-reference by children with ASD, no study has examined how their parents use person-reference in languages other than English. Furthermore, even in English, only two studies to date have looked at parents' use of person-reference. One study showed that parents of infants who have an older sibling with ASD use their child's name significantly more than parents of TD infants (He et al., 2018). A second study showed that parents' use of personal pronouns correlated with children's use of personal pronouns at 3 years of age (Barokova & Tager-Flusberg, 2019). To build on and expand past research, the present study compares how parents of Bulgarian and English-speaking children with ASD use person-reference in everyday interactions.

How do parents refer to their children and themselves in everyday interactions?

Person-reference in everyday interactions can be categorized based on referent, who is being referred to (self vs. other), and form, how one is being referred to. In terms of referent, because parents are the most common other for their children early on, and because the acquisition of third person reference has been reported to follow a different developmental trajectory (e.g., Scholes, 1981), we only focus on parents' reference to themselves and their child, and not on reference to other people.

In terms of form, to provide a comprehensive account we focus on four distinct ways parents refer to their children in everyday interactions: personal pronouns, names, terms of endearment, and kinship terms. Each one is described in turn, and differences between English and Bulgarian are emphasized.

Personal Pronouns. Personal pronouns are one of the most common ways in which parents, and speakers in general, verbally distinguish themselves from their conversational partners in everyday interactions. Despite being used frequently, in the context of child-directed speech, pronouns are difficult to acquire and comprehend because of their shifting referent depending on who the speaker is.

In English, personal pronouns take different forms based on grammatical person and number, natural gender and case (for details see Table 3.1 A).

Table 3.1

A. Personal pronouns in the English language.

	Nominative	Accusative	Reflexive
Singular			

1st person	I	me	myself
2nd person	you	you	yourself
3rd person	he – masculine	him	himself
	she – feminine	her	herself
	it - neuter	It	itself
Plural			
1st person	we	us	ourselves
2nd person	you	you	yourselves
3rd person	they	them	themselves

B. Personal pronouns in the Bulgarian language.

	Nominative	Accusative		Dative		Reflexive*	
		Full Form	Clitic Form	Full Form	Clitic Form	Full Form	Clitic Form
Singular							
1st person	az	mene	me	na mene	mi	na sebe si	si
2nd person	ti	tebe	te	na tebe	ti	na sebe si	si
3rd person	toy – masculine	nego	go	na nego	mu	na sebe si	si
	tya – feminine	neya	ya	na neia	i	na sebe si	si
	to - neuter	nego	go	na nego	mu	na sebe si	si
Plural							
1st person	nie	nas	ni	na nas	ni	na sebe si	si

2nd person	vie	vas	vi	na vas	vi	na sebe si	si
3rd person	te	tyah	gi	na tyah	im	na sebe si	si

*Reflexive personal pronouns also change by case (accusative and dative). Here only the dative (full and short forms are included)

In Bulgarian, personal pronouns are also characterized by grammatical person, number, gender, and case (see Table 3.1 B). However, one of the differences between English and Bulgarian pronouns is that in Bulgarian reflexive personal pronouns and personal pronouns in the accusative and dative case have a full form and a clitic form (a shortened form that is syntactically independent but phonologically bound to another word). A unique feature of Bulgarian pronominal clitics is that they are subject to obligatory doubling in specific contexts (Kuenhast, 2009; Schick & Beukema, 2001). For example[3]:

(1) Na men mi e studeno.

To me me is cold.

'I am cold.'

Pronoun-dropping. In addition to the different forms of personal pronouns and their obligatory doubling, how parents use them can be affected by the syntactic and pragmatic rules in the language. In Bulgarian, as a null-subject, pro-drop language, pronouns can be omitted when they can be inferred based on the grammar or the pragmatic context (Kiss,

[3] All examples in Bulgarian are transliterated from Cyrillic into the Latin alphabet.

1995). Because Bulgarian verbs are inflected for person, number and gender, the subject of the verb can often be inferred, which allows for its omission, as in:

(2) Iskam voda.

want(1SG) water

'I want water.'

In its null-subject, pro-drop quality as well as rich verb inflection system Bulgarian resembles Italian and Spanish – from the more commonly researched languages. To our knowledge, there are few studies examining the use of personal pronouns in child-directed speech to Italian or Spanish-speaking children and comparing it to that of English-speaking children (e.g., Tardif et al., 1997). In Tardif et al. (1997), Mandarin-, Italian-, and English-speaking parents of TD children were compared on their use of pronouns (not just personal pronouns) that appeared in the subject position. They found that Italian- and Mandarin-speaking parents dropped significantly more syntactic subjects than English-speaking parents, who were more likely to pronominalize the sentence subjects (use 'it' instead of 'the car'). Different rates of pronoun dropping were observed based on the function of the utterances.

Based on the findings from this study showing lower rates of pronouns (higher rates of pronoun dropping) in Italian (Tardif et al., 1997), we hypothesize that Bulgarian parents will use fewer personal pronouns than English-speaking parents when they are referring to themselves and their children.

Names. Another way parents refer to their children in everyday interactions is with their name. Parents can opt for the child's full name, shortened version of the full

name or various nicknames (e.g., Jonathan, Jon, Johnny, Jimbo). Names used in conversations are easier to comprehend than personal pronouns because they typically have a fixed referent (Johnny talking with his mother is the only Johnny in the interaction). Durkin et al. (1982) reported that parents' use of their TD children's name was not related to the children's age but rather to the communicative situation, with names being used primarily to attract attention and to provide instructions. Because we do not have any a priori hypotheses about potential differences in parents' play or communication style, we do not predict any differences in the use of names across Bulgarian and English-speaking parents.

Terms of Endearment. In addition to names, parents can use a wide range of nouns to address their child, such as 'honey,' 'sweetie,' 'baby,' 'love,' 'sugar'. We call these terms of endearment. Because it is up to the parent to choose how often and what terms of endearment to use with their child, we do not predict language differences in their use.

Kinship Terms. Another way parents can refer to themselves and their children is with kinship terms – denoting the relationships between family members. Although it is common for parents across languages to use kinship terms to refer to themselves (e.g., a mom talking about herself in 3rd person and using 'mommy'), only in Bulgarian it is acceptable from a discourse point of view for the parent to use kinship terms that would belong to them (e.g., 'mother', 'mama') to refer to their child. Although not extensively studied, this phenomenon has been reported for Arabic speakers (Aljenaie, 2006). A related but not as extensive use of kinship terms is found in Spanish speakers using

'mami' and 'papi' to refer to female and male children respectively and to other adults as well. Because the use of kinship terms has not been examined systematically, we only predict that Bulgarian parents will use them more than English-speaking parents.

Because of the acceptable use of kinship terms in Bulgarian along with personal pronouns, names and terms of endearment, we predict that Bulgarian parents will use significantly more different ways to address their children than English-speaking parents.

In summary, we compare person-reference in parental input to Bulgarian- and English-speaking children with ASD matched on language ability. We use a natural language sampling approach to examine parental input that is representative of everyday interactions, and focus on person-reference not just in terms of personal pronouns, but also in terms of names, nouns, and kinship terms providing a more comprehensive account of the phenomenon.

Methods

Participants

Institutional Review Board (IRB) approval for the project, and informed consent from each family was obtained prior to participant enrollment.

Bulgarian-speaking Sample. 37 (7F) Bulgarian-speaking children between 2;7 and 9;10 years (*M* = 70.62 months, *SD* = 20.22) and their primary caregiver participated in this study (Table 3.2). They were recruited from posts on parent online forums, and from local centers providing services for children with developmental disorders in Sofia, Bulgaria. All children had a community diagnosis of ASD or PDD based on ICD-10 (WHO, 2003). Their diagnosis was confirmed with the administration of the Autism

Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012). Note that the ADOS-2 has been translated to Bulgarian but has not yet been validated with Bulgarian children, which poses a potential limitation to its use with this sample. No information about race and ethnicity was collected from the Bulgarian-speaking sample.

English-speaking Sample. 37 (7F) English-speaking children with ASD between 1;8 and 4;9 years (*M* = 37.97 months, *SD* = 10.48; Table 3.2) were included in this study. These participants were part of a larger study examining developmental trajectories in ASD conducted in Massachusetts, USA (see Luyster et al, 2008 for details; Barokova & Tager-Flusberg, 2019 drew on the same dataset). All children had an autism diagnosis confirmed with the administration of the Autism Diagnostic Observation Schedule-General (ADOS-G; Lord et al., 2000) and the Autism Diagnostic Interview-Revised (ADI-R; Lord et al., 1994). In terms of race, 30 of the children were white, 4 had more than one race, and 3 had missing data. In terms of ethnicity, 34 of the children were Non-Hispanic, and 3 had missing data.

Procedure

Bulgarian families' participation consisted of one or two visits to a testing space in one of three centers providing services for children with developmental disorders in Sofia, Bulgaria. During the visits, the parents filled out a demographic questionnaire, a communication development questionnaire and an autism screener. In the meantime, the children were administered the ADOS. After that, the parent-child interaction data were collected. Data collection took place in two waves: in the summer of 2018 and in the summer of 2019.

English-speaking participants took part in a longitudinal study testing them once a year for three consecutive years. For each visit, demographic information was collected from the child's parents. In addition, a battery of standardized assessments was administered to the child to confirm their autism diagnosis and to assess their cognitive and language abilities. Data collection took place between 2003 and 2007. Data from only one time point were used per participant.

Demographic Information. Parents filled out a demographic questionnaire asking about their child's age, sex, and diagnosis, and about parent education (Table 3.2).

Diagnostic Confirmation. Both participant samples were administered the ADOS to confirm the children's ASD diagnosis. The ADOS is a semi-structured behavioral assessment consisting a series of activities, which allow for the observation of core autism symptoms. Different modules are administered based on the chronological age and language ability of the child. The ADOS-2 (Lord et al., 2012) was used with the Bulgarian sample, and the ADOS-G (Lord et al., 2000) was used with the English-speaking sample. Because different versions were used (the most up to date at the time of testing), this does not allow for a comparison of scores across the two samples.

Table 3.2

Demographic characteristics of the Bulgarian-speaking and English-speaking children with ASD

Characteristic	Bulgarian ASD	English ASD
Age in months - *M* (*SD*)	70.62 (20.22)	37.97 (10.48)
Sex (M:F)	30:7	30:7

Parent Education		
High school degree or GED or lower	3	7
Vocational skill, associates or 2-year degree, or courses towards college degree	-	11
College degree	33	11
Master's or Professional (MD, JD) degree	-	8
*missing	1	-

Parent-Child Interactions. A parent-child interaction was videorecorded, while the parent was engaging their child in free play with developmentally appropriate toys. All parents were the mothers of the children except for one father in the Bulgarian sample. The set of toys included a baby doll, 2 firefighter hats, 2 balls, 2 cars, 2 school buses, 2 sharks, a puzzle with numbers, 2 musical toys, and a set of building blocks. The parent was instructed to play with their child as they normally would at home.

The parent-child interactions (PCIs) from both the English and Bulgarian samples were video-recorded and later transcribed using the Systematic Analysis of Language Transcripts-12 software (SALT; Miller & Iglesias, 2012). The PCIs were transcribed for speech and segmented into communication units defined as independent clauses with their modifying clauses (Loban, 1976). Each PCI was transcribed by a trained transcriber, then checked by a second transcriber. Disagreements were resolved through consensus. Number of Different Words produced by the child was extracted from all transcripts using SALT-12, and number of different words per minute (NDW) was computed to account for the different duration of the interactions.

The Bulgarian- and English-speaking children with ASD were matched on sex (30 males and 7 females) and NDW during the PCI (BG: *M* = 2.83, *SD* = 3.30; ENG: *M* = 3.06, *SD* = 3.37; Mann-Whitney *U* = 701, *p* = .858). The choice of this language measure for matching the participant groups was motivated by past literature showing that when children with ASD and TD were matched on expressive vocabulary, there were no differences in their parental input in general measures of communication (for review see Nadig & Bang, 2016). Because the children could not be matched on age, their age in months was included in the regression analyses.

Person-Reference Coding. Transcripts were coded for how the parents referred to and addressed their child and themselves. At Step 1, each instance/token of person-reference was coded for referent or who was being referred to (child vs. parent). At Step 2, each token of person-reference was coded for form or how the child/parent was being referred to (personal pronoun, name, term of endearment or a kinship term; see Table 3.3). We also counted the number of different ways the parent referred to their child within each form category (e.g., 4 different names: Jonathan, Jon, Johnny, Joe; 2 different terms of endearment: honey, sweetie, etc.).

Table 3.3

Person-Refence coding scheme of parental input. Coding every instance of person-reference for referent (who) and for form (how)

Form/ How one is being referred to?	**Referent/ Who is being referred to?**	
	Child	Parent

Personal Pronouns	You, yourself	I, me, myself
Names	John, Johnny	Simona, Moni
Terms of Endearment	Honey, sweetie, darling, baby	N/A
Kinship Terms[%]	Mom, mommy[&]	Mom, mommy

[%]The kinship terms were adjusted to account for the identity of the adult (mother, father, grandparent).

[&]The use of kinship terms to address the child was only found in the Bulgarian transcripts.

Coding reliability was achieved separately for English and Bulgarian. Prior to coding for reliability, each coder coded 3-4 files and received extensive feedback after each one. All transcripts were coded by the first author. A native English speaker coded 24% (N = 9) of English transcripts, and a native Bulgarian speaker coded 24% (N = 9) of the Bulgarian transcripts. Reliability was computed by calculating an intraclass correlation coefficient (ICC) between the primary coder’s and the second coder’s codes. ICC of .95 was achieved for Bulgarian, and .99 was achieved for English.

Person-reference codes were extracted from each PCI using either the first 10 minutes of the interaction or, when the PCI was shorter, its full duration (7 out of the 74 PCIs). First, we computed the relative frequency of each form of person-reference (personal pronouns, names, terms of endearment, or kinship terms) as a percentage out of

total child-reference tokens. This allowed us to account for the variability in total number of person-reference tokens across participants (as done in He et al., 2018; Tardif et al, 1997). Second, we operationalized the number of different ways parents referred to their child as a child-reference type-token ratio. This ratio was computed as the number of different types of ways parents addressed their child (e.g., 'honey' and 'sweetie' would be two different types even though they belong to the same person-reference form of terms of endearment) out of total number of child-reference tokens.

Analysis Plan

All analyses were conducted separately for parents' reference to their child and parents' reference to themselves. First, we reported the number of Bulgarian- and English-speaking parents who used each person-reference form. Then we compared the relative frequency of each person-reference form and type-token ratio across languages (Bulgarian vs. English) by running a series of multiple linear regressions. In each regression, we regressed the relative frequency of a person-reference form (pronouns/names/terms of endearment/kinship terms) onto the child's age and language (Bulgarian vs. English). Regression analyses allowed us to look for cross-linguistic differences, while controlling for children's chronological age. Bonferroni correction for multiple comparisons was applied to all regression analyses.

Results

First, we examined the number of parents who used each of the person-reference forms to refer to their child. As can be seen in Table 3.4A, almost all Bulgarian (N = 35) and all English-speaking (N = 37) parents used personal pronouns to address their child.

The number of parents, who used their child's name was much lower for both groups with only 9 Bulgarian and 7 English-speaking parents using it. There were group differences in the use of terms of endearment, where over twice as many English-speaking parents (*N* = 23) used terms of endearment than Bulgarian-speaking parents (*N* = 10). However, the majority of Bulgarian-speaking parents (*N* = 32) used kinship terms to address their child, whereas none of the English-speaking parents did.

Overall, English-speaking parents used an average of 40.46 (*SD* = 19.52) person-reference tokens to address their child during the PCI, while Bulgarian-speaking parents used only 22.57 (*SD* = 14.66) tokens. A multiple linear regression model revealed that 22% of the variance in the total number child-reference tokens was explained by variance in child age and language (Table 3.5A; $F(2, 71) = 10.27$, $p < .001$, $R^2 = .22$). Language was the only significant contributor to this model ($p < .001$). Speaking Bulgarian during the interaction rather than English was associated with a lower number of child-reference tokens, even after accounting for child age. That is, Bulgarian-speaking parents, on average, addressed their child less than English-speaking parents.

Table 3.4

A. *The number of parents across groups, who used each form of person-reference.*

	Bulgarian ASD *N*	English ASD *N*
Reference to Child		
Personal Pronouns	35	37

Name	9	7
Terms of Endearment	10	23
Kinship Terms	32	0
Reference to Parent		
Personal Pronouns	34	37
Name	0	0
Terms of Endearment	0	0
Kinship Terms	23	31

B. The relative frequency of person-reference forms (pronouns, names, etc.).

	Bulgarian ASD *M* (*SD*)	English ASD *M* (*SD*)
Reference to Child[a]		
% Personal Pronouns	34.86	72.66
	(21.61)	(13.84)
% Name	41.51	22.89
	(22.23)	(13.67)
% Terms of Endearment	3.41	4.45
	(8.86)	(5.15)
% Kinship Terms	20.22	0
	(14.71)	
Type/Token Ratio	.30	.09
	(.18)	(.05)

Reference to Parent[b]		
% Personal Pronouns	72.71	70.49
	(32.23)	(21.97)
% Kinship Terms	27.29	29.51
	(32.23)	(21.97)
Type/Token Ratio	.42	.23
	(.25)	(.11)

[a]*All 37 Bulgarian and 37 English-speaking parents were included in these computations.*

[b]One Bulgarian parent did not use any reference to themselves and was excluded from these analyses.

Next, we examined the relative frequencies of person-reference forms across the two language groups (see Table 3.4B). English-speaking parents most frequently used personal pronouns when referring to their child, at a rate of 72.66% (i.e., on average, 72 out of 100 child-reference tokens were personal pronouns). In contrast, Bulgarian-speaking parents only used personal pronouns to refer to their child at a rate of 34.86%. A multiple linear regression model revealed that 65% of variance in personal pronoun use was explained by variance in child age and language ($F(2, 71) = 65.92$, $p < .001$, $R^2 = .65$; see Table 3.5A). Both age and language added significantly to this prediction ($p < .001$). One unit increase in child age was associated with 0.57 unit increase in personal pronouns, while holding language constant. This suggests that the older the child, the more pronouns their parents used when referring to them. Speaking Bulgarian was associated with 56.56 unit decrease in personal pronouns, while holding child age

constant. Therefore, as predicted, Bulgarian-speaking parents, on average, used significantly fewer pronouns than English-speaking parents, even while controlling for their children's age.

The second most frequently used form of child-reference for English-speaking parents was the child's name, used at a rate of 22.89%. In contrast, Bulgarian-speaking parents used it the most out of all child-reference forms, at a rate of 41.51% (see Table 3.4B). Another multiple linear regression model revealed that speaking Bulgarian was associated with significantly more child name tokens used ($p < .001$; see Table 3.5A).

Terms of endearment were used scarcely by both English-speaking ($M = 4.45$, $SD = 5.15$) and Bulgarian-speaking parents ($M = 3.41$, $SD = 8.86$), and there was no statistically significant difference between the groups (see Table 3.5A).

The last form of child-reference, kinship terms, was not used by English-speaking parents at all, but was used at a rate of 20.22% by Bulgarian-speaking parents (see Table 3.4B). As predicted, our regression model showed that Bulgarian-speaking parents used significantly more kinship terms than English-speaking parents (see Table 3.5A).

In terms of the number of different ways parents used to address their children, the type-token ratio of English-speaking parents ($M = .09$, $SD = .05$) was significantly lower than that of Bulgarian-speaking parents ($M = .30$, $SD = .18$; see Table 3.5A). That is, Bulgarian-speaking parents used a significantly larger variety of ways to refer to their children than did English-speaking parents (see Figure 3.1).

Table 3.5

A. Regression analyses predicting parents' use of person-reference to their child. Multiple comparisons correction (p = .05/26 = .002)

DV Predictors	R^2	*F*	*df*	*p*	*b*	*SE b*	*Beta*	*p*
Total child-reference tokens	.22	10.27	2, 71	< .001				
Constant					36.36	5.58		<.001
Age in months					.11	.13	.13	.397
Language					-21.41	5.76	-.56	<.001
Personal pronouns	.65	65.92	2, 71	<.001				
Constant					50.84	5.08		<.001
Age in months					.57	.12	.503	<.001
Language					-56.56	5.24	-1.086	<.001
Names	.27	13.05	2, 71	<.001				
Constant					35.03	5.76		<.001
Age in months					-.32	.131	-3.56	.017
Language					29.05	5.95	.71	<.001
Terms of endearment	.05	1.89	2,71	.158				
Constant					8.09	2.30		.001
Age in months					-.096	.05	-.31	.069
Language					2.09	2.38	.15	.380
Kinship terms	.52	38.99	2, 71	<.001				

Constant					6.04	3.28		.07
Age in months					-.16	.074	-.25	.04
Language					25.46	3.38	.88	<.001
Type/Token Ratio	.36	20.34	2, 71	<.001				
Constant					.126	.05		.007
Age in months					-.001	.001	-.092	.50
Language					.228	.046	.666	<.001

B. Regression analyses predicting parents' use of person-reference to themselves[@].

DV Predictors	R^2	*F*	*df*	*p*	*b*	*SE b*	*Beta*	*p*
Total parent-reference tokens	.41	7.19	2, 70	.001				
Constant					10.69	2.76		<.001
Age in months					.16	.06	.41	.012
Language					-10.90	2.88	-.60	<.001
Personal pronouns	.14	5.69	2, 70	.005				
Constant					46.14	8.39		<.001
Age in months					.64	.19	.541	.001
Language					-19.14	8.76	-.352	.032
Kinship terms	.14	5.69	2, 70	.005				
Constant					53.86	8.39		<.001
Age in months					-.64	.19	-.541	.001
Language					19.14	8.76	.352	.032

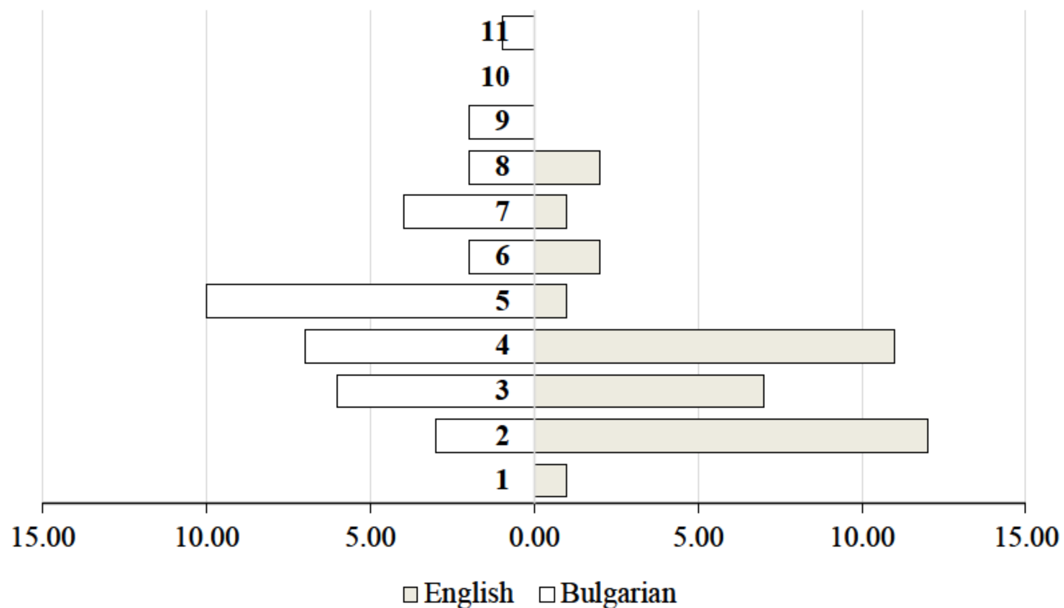
Type/Token Ratio	.27	13.26	2,70	<.001				
Constant					.355	.06		<.001
Age in months					-.003	.001	-.365	.016
Language					.309	.063	.725	<.001

[@]One Bulgarian parent did not use any reference to themselves and was excluded from these analyses.

Statistics: R^2 = R-square; F = F-test for the significance of the model; *df* = regression degrees of freedom, residual degrees of freedom; b = unstandardized beta coefficients; *SE b* = standard error of the beta coefficients; *Beta* = standardized beta coefficients.

Figure 3.1

Distribution of the number of different ways the parents used to address their child by group (with Bulgarian in white and English in gray).



Next, we conducted similar analyses to examine how parents referred to themselves (Table 3.4A). Just like with child-reference, the majority of Bulgarian (*N* = 34) and all English-speaking (*N* = 37) parents referred to themselves with personal pronouns. However, the pattern for the use of kinship terms was quite different with 23 Bulgarian-speaking parents and 31 English-speaking parents using 'mom' and 'mommy' to refer to themselves. No parents used names or terms of endearment to refer to themselves. We tested for a language difference in parents' total number of self-reference tokens (English: *M* = 16.84, *SD* = 8.53; Bulgarian: *M* = 11.33, *SD* = 9.03) by running a multiple linear regression. The model accounted for 41% of variance in parents' self-reference tokens ($F(2, 70) = 7.19$, $p < .001$, $R^2 = .41$; Table 3.5B). However, only language significantly contributed to the prediction ($p < .001$). Bulgarian-speaking parents, on average, used significantly fewer self-reference tokens than English-speaking parents during the parent-child interaction.

In terms of the relative frequency of person-reference forms in parents' self-reference, both English-speaking and Bulgarian-speaking parents preferred to use personal pronouns, (English: *M* = 70.49, *SD* = 21.97; Bulgarian: *M* = 72.71, *SD* = 32.23; Table 3.4B). The second most frequently used form of person-reference used by parents in both groups was kinship terms (English: *M* = 29.51, *SD* = 21.97; Bulgarian: *M* = 27.29, *SD* = 32.23). In terms of diversity of person-reference use, English-speaking parents had a type-token ratio of .23 (*SD* = .11), while Bulgarian-speaking parents had a type-token ratio of .42 (*SD* = .25). We ran regression analyses to examine language differences in the use of self-reference by the parents. After correction for multiple comparisons, there were

no significant effects of language on the parents' use of personal pronouns and kinship terms (see Table 3.5B). There was, however, a significant language effect on parents' type-token ratio, with Bulgarian parents having a significantly higher type-token ratio. Bulgarian-speaking parents used a significantly larger variety of ways to refer to themselves than did English-speaking parents.

Discussion

No study to date had examined how parents refer to their children with ASD in a language other than English. Examining cross-linguistic differences in input, especially in the aspects of language that children with ASD typically struggle with, like person-reference, could be very informative considering the key role of verbal input in language development. Personal pronouns are more difficult to acquire than one's proper name because of their shifting referent. However, little is known about how parents typically refer to their children in pro-drop languages. Our study begins to address these questions with its two main findings: 1) The way Bulgarian and English-speaking parents referred to their children with ASD differed both in terms of how many parents chose to use a specific person-reference form and in terms of how frequently they used it; and 2) Bulgarian parents used more different ways to refer to their children than English-speaking parents.

The pattern of parents' child-reference use differed across groups. Most accounts of person-reference in ASD have focused on the use of personal pronouns. In our study, almost all parents in both groups used personal pronouns, albeit at different rates. Personal pronouns made up the majority of English-speaking parents' person-reference.

They used pronouns at a rate of 73% when they referred to their children, and at a rate of 70% when they referred to themselves. The prevalence of this particular form of person-reference justifies the focus on it in past research. Nevertheless, the distribution of person-reference forms in Bulgarian parents' speech paints a different picture. Bulgarian parents used personal pronouns to refer to themselves at the same rates as English-speaking parents (72%). However, when referring to their children, they used pronouns only 35% of the time – less than half the rate of English-speaking parents. This finding suggests that studies of person-reference in child-directed speech in languages other than English, especially those with different grammatical structure, should account for other forms of refence too.

What could explain the drastically lower rates at which Bulgarian parents used personal pronouns to refer to their children in comparison to English-speaking parents? On the one hand, Bulgarian has a very rich system of personal pronouns and clitic forms that are subject to obligatory doubling, which could lead to higher rates of pronoun use from a syntactic standpoint. On the other hand, from a discourse standpoint, personal pronouns are mostly used in Bulgarian for emphasis and can be dropped at the discretion of the speaker. Therefore, the lower frequency of pronouns in Bulgarian could be attributed to pronoun dropping. This explanation goes along with findings that Italian parents of TD children dropped more pronouns in their child-directed speech than English-speaking parents (Tardif et al., 1997). However, why then are Bulgarian parents not dropping personal pronouns at the same rate when they are referring to themselves? One interpretation can be attributed to their conversational style. For example, Bulgarian

parents could be using more commands (imperative forms) with their children, and commands allow for pronouns to be dropped more so than other utterances and for the child's name to be used instead (e.g., *Come. Come here, Johnny. Look. Johnny, look.*). In fact, Tardif et al. (1997) reported that Italian parents dropped pronouns in the subject position in 96% of commands, in 60% of declaratives, and in 58% of interrogatives, which supports this interpretation. Interestingly, English-speaking parents dropped pronouns in the subject position at similar rates in commands (93% of the time), but at much lower rates in declaratives (3%) and in interrogatives (14%; Tardif et al., 1997). Even though Tardif and her colleagues focused more broadly on all pronouns in the subject position, one can speculate that a similar tendency to drop pronouns can be applied to personal pronouns. Therefore, it could be that Bulgarian and English-speaking parents are equally likely to use personal pronouns to refer to themselves and others, but that Bulgarian parents proportionally used more commands with their children, which led to the different rates of pronouns referring to the child. In order to test this hypothesis, future studies should examine the play style of the parents and how it interacts with their communicative style.

Another possible interpretation of the lower rates of personal pronouns for Bulgarian parents could be that from a discourse perspective whenever they did use child-reference, they simply substituted the pronouns with other forms of reference that are pragmatically acceptable, such as their child's name. Our results show that the child's name indeed was proportionally their most frequently used form of child-reference. In addition, the pragmatically acceptable use of kinship terms ('mommy') to address their

child provides Bulgarian parents with more different ways to address their child, which could account for the language difference in pronoun use as well.

In contrast to the majority of parents, who used personal pronouns to refer to their child, fewer parents in both groups used their child's name. Nevertheless, proportionally the child's name constituted, on average, 23% of English-speaking parents' and 42% of Bulgarian-speaking parents' child-reference – a statistically significant difference. So even though not many parents used their child's name, when they did, they used it very frequently. As past research has shown (Durkin et al., 1982) and we confirmed, parents' use of their child's name is not related to the child's age. Therefore, our finding of a language difference could be accounted for by a discourse difference, where Bulgarian parents are more likely to use their child's name in everyday interactions.

Parents' use of terms of endearment presented a very different pattern. Only 10 Bulgarian, but more than half of English-speaking parents ($N = 23$) used this form of child-reference, which often serves the pragmatic purpose of emphasizing the love and connection between the parent and the child (e.g., consider parents calling their child *baby, honey, sweetheart*). Regardless of the difference in number, parents in both groups used terms of endearment at similarly low rates making up, on average, only 3% and 4% of parents' child-reference tokens respectively. Therefore, terms of endearment are not among the most preferred forms of address in parent-child interactions for both Bulgarian and English-speaking parents.

The fourth and last category of child-reference was kinship terms. Kinship terms followed the opposite pattern of use compared to terms of endearment, with the majority

of Bulgarian parents (*N* = 32) but none of the English-speaking parents using them. Considering that kinship terms in Bulgarian, first, emphasize the relationship between the child and the parent and, second, are often used in their diminutive forms (e.g., mamence 'mommy' instead of maiko 'mother') thus expressing affection, perhaps they serve a similar pragmatic function to that of terms of endearment used by English-speaking parents. Indeed, if both kinship terms and terms of endearment express love and affection, then this would account for the differences in the number of parents across groups who chose to use these specific forms of child-reference. Examining the rate at which Bulgarian parents used kinship terms showed that kinship terms made up, on average, 20% of all instances of their child-reference. This is the first study to report the use of kinship terms in parental input in ASD. In fact, only one study to date has reported the similar use of kinship terms in parental input to TD children, specifically for speakers of Arabic (see Aljenaie, 2006), although anecdotal evidence has been provided for other languages (e.g., Romanian, CHILDES forum). Kinship terms are nouns and thus should have a fixed referent in the interaction; indeed, for English this is always the case. However, in the speech of Bulgarian parents, 'mommy' could be referring to either the child or the parent. In fact, it is quite common for parents to use the same kinship term twice within a single utterance – each time with a different referent as in *Mamo, ela pri mama.* 'Mommy, come to mommy'. In these instances, one can identify the correct referent based on context or, sometimes, based on the use of vocative forms (e.g., mama -> mamO, mamE) and diminutives (e.g., mama -> mamENCE, mamICHKO). Nevertheless, imagine how confusing it could be for a child to keep track of the shifting

referent of the same kinship term used multiple times in an interaction. Interestingly, more Bulgarian parents (*N* = 32) used kinship terms for child-reference than for self-reference (*N* = 23). This difference could be a reflection of the difficulty associated with the shifting referents of kinship terms, which, in turn, leads to fewer parents using these terms to refer to both themselves and their child within the same interaction. Nevertheless, considering the high cognitive and linguistic demands that kinship terms pose on listeners, future studies should investigate how and when children begin to comprehend them, and whether they influence children's language and social cognitive development.

With their lower rates of personal pronouns and higher rates of names and kinship terms, it comes as no surprise that Bulgarian parents overall used more different ways to refer to their children than English-speaking parents. For example, one Bulgarian parent used up to 11 different ways to address their child within the 10-minute interaction (see Figure 3.1). Those included the child's full name, 3 different shortened forms of the child's name, 'boy,' 4 different forms of kinship terms, and 2 personal pronouns. Not only that but Bulgarian parents used more different terms (type-token ratio) to refer to themselves as well. This difference between groups found both in child-reference and in parents' self-reference could be attributed to different discourse practices. It is unclear, however, whether the higher number of different ways to refer to one's child is tailored to the child's abilities (cognitive, behavioral, etc.) or whether it would, in turn, influence their person-reference. Past research has shown that parents who used both pronouns and nouns/names to refer to themselves and their TD children have children who acquire

personal pronouns more readily than parents who only used personal pronouns (Smiley et al., 2011). In addition, Barokova and Tager-Flusberg (2019) found that parents' use of personal pronouns was positively correlated with children with ASD's use of personal pronouns concurrently. However, no study has examined the role of kinship terms, which can be especially confusing for children learning how to refer to themselves and others. Therefore, future studies should examine the potential associations between parents' and children's use of kinship terms, in particular, and between the diversity of their person-reference forms, more broadly, while also testing for language differences.

There were more similarities than differences in how parents across groups referred to themselves. The majority of Bulgarian (*N* = 34) and English-speaking (*N* = 37) parents used personal pronouns ('I', 'me', 'myself') for self-reference, and there were no differences across groups in how frequently pronouns were used. With regards to kinship terms, 23 Bulgarian parents and 31 English-speaking parents used them for self-reference. Despite this difference in number, there was no difference across groups in how often this form of reference was used out of total self-reference tokens. Parents' self-reference in both groups was associated with their children's age. The older the children, the more pronouns and fewer kinship terms their parents used. A similar trend of using increasingly more pronouns as children with ASD got older across time points was reported in Barokova and Tager-Flusberg (2019) too[4]. This pattern goes along with the

[4]The present study uses a subset of the data set reported in Barokova & Tager-Flusberg (2019). Here we report on age effects within groups at a single point in time, while Barokova & Tager-Flusberg reported an increase in parents' use of pronouns across time points, when children were 3, 4 and 5 years old.

explanation that personal pronouns are more difficult to comprehend (due to their shifting referent) than proper names or nouns and thus parents are more likely to use them with older children, who have better language abilities.

There are two more general patterns in our findings that need to be addressed. One is that there was an overall difference in the total number of child-reference tokens and in self-reference tokens between groups. Bulgarian parents referred to their children and to themselves significantly less than English-speaking parents. Because this difference was found in both child- and self-reference, it could be attributed to linguistic factors. Bulgarian's pro-drop quality allowing for the omission of person-referential language in the subject position could lead to the overall lower rates of person-reference tokens for Bulgarian parents. An alternative non-linguistic interpretation could be that there is something fundamentally different in how Bulgarian parents communicate with their children that leads to these lower rates of person-reference, for example, parents opt for labelling toys or describing the environment without referring to their child or themselves. Future studies should examine the pragmatic functions of parents' utterances, the specific activities chosen during the PCI, and how these interact with person-referential language.

The second general pattern in our findings pertains to the distribution of person-reference forms, specifically, the absence of language differences in parents' self-reference and their presence in parents' child-reference. When talking about themselves, Bulgarian parents used personal pronouns and kinship terms at proportionally similar rates as English-speaking parents. In contrast, when addressing their children, Bulgarian

parents' choice and frequency of using person-reference forms was different from that of English-speaking parents. This difference in Bulgarian parents' reference contingent on the identity of the referent (parent or child) suggests that it cannot be solely linguistic factors that determine the ways parents address *their children* in everyday interactions, but rather that there are other 'external' or discourse/pragmatic factors at play. For example, there could be differences in parents' play style that translate into different forms of address that are most pragmatically appropriate.

Limitations & Future Research

This is the first account of person-reference in parental input to non-English-speaking children with ASD. The pattern of person-reference forms used by Bulgarian parents significantly differed from that used by English-speaking parents, which underscores the importance of studying languages other than English when examining language and communication, two key areas of difficulty, in ASD. Although very informative our study possesses some limitations that should be addressed in future research. The main limitation is the lack of TD control groups. Because we did not have a Bulgarian TD control group, it is unclear whether the differences found for the Bulgarian group are typical only of the speech of Bulgarian parents of children with ASD or whether they are typical of Bulgarian parents in general.

In addition to adding a TD control group, future research should also explore which variables, in addition to child age, are associated with parents' choice of person-reference forms and the frequency of their use. For example, at the level of the child, their cognitive ability and symptom severity could be related to parents' preference for a

certain form of person-reference. At the level of the interaction, it could be that Bulgarian parents' play and communication style is different from that of English-speaking parents, such that it leads to higher rates of the child's name for example, which has been shown to be used more often to provide instructions and attract attention (Durkin et al., 1982). Furthermore, future studies should examine whether and how Bulgarian parents' use of a higher number of different ways to refer to their children is related to their children's own understanding and use of person-reference.

The present study examined how parents of children with ASD refer to them, while playing. We found striking differences between Bulgarian and English-speaking parents in this very specific aspect of their everyday communication. Questions remain about the potential cascading effects these differences might have on children's understanding of person-reference as well as on their interactions with their most common conversational partners. Furthermore, finding group differences on such a granular level of the parent-child interaction lays the foundation for future cross-linguistic comparisons of parental input in ASD examining play and communication styles more broadly.

GENERAL DISCUSSION

In the field of autism research, the most under-researched and under-served populations are those who are minimally to low-verbal and those who come from non-Western, non-English speaking, low-resource families. The language abilities and linguistic environments of these two groups have been largely overlooked in past studies due to the lack of appropriate assessment tools. For MLV children and adolescents, it is their difficulty complying with structured testing procedures and very limited verbal skills subject to floor effects that affect their participation in research. For Non-Western, non-English speaking children and adolescents with ASD, it is the lack of unbiased, culturally appropriate measures. One solution to both these problems is the collection of language samples. The studies that comprise this dissertation addressed these gaps in the literature, first, by examining the feasibility of parents collecting ELSA-A samples for the purpose of language assessment of their MLV children with ASD, and, second, by exploring the cross-linguistic differences in verbal parental input to English-speaking and Bulgarian-speaking children with ASD during a free play interaction.

Broader Implications

Study 1 showed that including parents in the data collection process, specifically when it comes to the assessment of language and communication – domains inherently interactive, can be integral to revealing their children's true verbal abilities. The elicitation context in this study, ELSA-A – a semi-structured language elicitation protocol designed by researchers specifically for children and adolescents across a wide range of language ability, ensured that differences in child language across conversational partners

(parent vs. examiner) could not be attributed to their choice of activities. I found that MLV children and adolescents produced twice as much speech that was also more lexically diverse when with their parents compared to when with examiners. This finding suggests that relying solely on trained examiners/strangers in the lab to assess the verbal skills of children with ASD, who by definition struggle with social communication and interactions, might dramatically underestimate their abilities. In addition, this finding should prompt us to examine how exactly parents so successfully engage their children, even those with such limited verbal skills, and for longer periods of time (twice longer) in order to inform the development of assessments and interventions. Revealing MLV children and adolescents' true language and communication abilities, unbiased by assessment context and conversational partner, could help focus interventions not only on teaching participants new skills but also on capitalizing on their already existing ones. This could be done following the model of personalized medicine, where specific practices and intervention goals are tailored to the individual.

The present study not only demonstrated the clinical importance of engaging parents in the data collection process but also showed that it was feasible to do so. Even though not all families submitted a language sample, all of them submitted feedback forms on their experience participating in the project. Their responses pointed to important directions in identifying strategies for parent participation. Specifically, analyses showed that it was not child or demographic characteristics that determined which parents collected a language sample, but that it was a matter of logistics such as finding time to do it, setting up the materials, recording the sample, and sharing the file

online. These findings are encouraging because such logistical matters can be easily addressed. For example, research teams can schedule in advance with parents when they will collect the sample, potentially provide them with sibling care during that time, and guide them online on how to set up the materials. Furthermore, with the widespread use of Zoom and other platforms for online communication that dramatically increased over the past year, researchers might be able to use such programs to live-record the language sample and coach parents in following the protocol in the moment of data collection. Such strategies and flexibility in data collection are worth the effort considering the quality and representativeness of the collected data and the convenience they provide parents, who would not have to make multiple visits to the lab. In addition, removing such logistical barriers to participation could encourage more families, who otherwise might not have the time or resources to do so, to enroll in research studies. It is important to note that the participant sample in this study consisted largely of white English-speaking high-SES families, so it is unclear whether the findings would apply to other more racially, ethnically, and linguistically diverse groups. Nevertheless, future studies should examine their specific barriers to participation, and then work on addressing them.

While Study 1 established the importance of including parents in the process of language assessment of MLV children and adolescents with ASD, Studies 2 and 3 confirmed the need to inform intervention and treatment approaches by parents' already existing practices, views, and priorities. Studies 2 and 3 were among the first to conduct a cross-linguistic comparison of verbal parental input in ASD (apart from Bang & Nadig, 2015). Because children's communication does not develop in isolation, examining

parental input is an important step in understanding how language deficits in ASD manifest themselves in languages other than English. Study 2 found that even though there were no differences in the quantity of input to Bulgarian and English-speaking children with ASD, there were important differences in its quality. Specifically, Bulgarian parents used more verbs than nouns, whereas the pattern was reversed for English-speaking parents. Although this might seem like a rather trivial difference in the lexical composition of the two groups' input, it can have long-term cascading effects on children's development of language and cognitive abilities. In particular, words that appear more frequently in parental input are typically acquired earlier (Gentner, 1982). In turn, the acquisition of verbs allows for the production of simple sentences (Brandone et al., 2007), and verb lexical diversity is a better predictor of children's grammatical outcomes than noun lexical diversity (Hadley et al., 2016). More broadly, verbs facilitate a focus on actions and relations between objects, while nouns facilitate a focus on states and objects. This focus in everyday communication could potentially be linked to the timing of children's development of specific cognitive abilities. For example, Gopnik et al. (1996) reported that children speaking Korean, a language that emphasizes verbs, successfully solved a means-ends task earlier than children speaking English, a language that emphasizes nouns more, who, in turn, successfully solved a sorting task earlier. Studies like this one point to the potentially far-reaching implications of the lexical composition of parents' verbal input. Regardless of whether parents emphasize verbs or nouns in their verbal input, when designing parent-mediated language interventions, it is

important to acknowledge cross-linguistic differences and to capitalize on what parents are already doing.

Study 2 found a difference in another aspect of parental input that has been shown to be a strong predictor of children's long-term language abilities and literacy skills, namely the use of questions (e.g., Blake et al., 2006; Cristofaro & Tamis-LeMonda, 2012; Fletcher et al., 2008; Goodwin et al., 2015; Haebig et al., 2013a, b; Leech et al., 2013; Rowe et al., 2017). Bulgarian parents' speech contained twice fewer the number of questions than that of English-speaking parents. Despite this large difference in question use, the percentage of questions parents asked was a significant concurrent predictor of children's language ability for both groups. This finding has important research and clinical implications. First, it shows that in addition to previously reported differences in question use associated with parents' individual characteristics such as sex (e.g., Rowe et al., 2004), there are group differences at the level of the language that need to be acknowledged. Second, despite these group differences, the association between parents' question use and their child's language remained. That is, what has been found in past research about English-speaking families could hold for other populations. However, one cannot assume that by default the baseline rules governing the interaction between parent and child would be the same across communities. In fact, past research with English-speaking families should initially be used to inform research with non-Western, non-English speaking families. Questions, in particular, are a subject worth exploring in the context of cross-cultural research because they are not only conversationally challenging for the child, thus influencing their language, but they are also socially demanding

because they require the child's response and engagement in the interaction (Rowe et al., 2004), which makes them an ideal target for parent-mediated interventions.

Study 3 reported on yet another linguistic difference in the input to Bulgarian and English-speaking children with ASD with potential effects on children's engagement and communication development. Bulgarian parents significantly differed from English-speaking parents in the way they addressed and referred to their children. The most frequently used words in everyday conversations of English speakers are function words, and among them personal pronouns (Pennebaker, 2011). These often unnoticed and overlooked words continuously delineate the distinction between self and other in everyday communication, and thus could aid children's development of a sense of self. Not only that but from a strictly linguistic perspective, past research has shown that the more different ways the parents use to refer to their child, the earlier their child correctly uses personal pronouns (Smiley et al., 2011). The fact that there were no group differences in parents' reference to self, but there were differences in parents' reference to their child suggests that there is something unique to the way parents choose to communicate with their children. The striking difference in the number of different ways Bulgarian parents use to call their children, with one parent using up to 11 different types in the span of 10 minutes, suggests that this is an avenue of input worth exploring further especially as it relates to children's comprehension of person-reference. For example, the higher number of different child-reference types could be associated with Bulgarian children's earlier understanding and use of person-reference potentially due to the more lexically diverse exposure. Alternatively, the significantly higher number of different

ways that Bulgarian parents use to address their children could initially be too confusing, especially the use of kinship terms, and thus be associated with a delay in children's comprehension and production. Furthermore, the Bulgarian-specific use of kinship terms to refer to one's child, one, justifies the need for more studies with non-Western, non-English speaking groups, and two, emphasizes that there might be fundamental differences, even at the level of person-referential language, in parent-child communication across groups.

The group differences from Study 2 and 3 combined point to systematic differences in parent-child interactions at the level of verbal input or perhaps to fundamentally different "language learning games" (as Tardif (1996) calls it) that parents are playing. The reported differences at the level of lexical composition, sentence types, and child-reference are potentially the tip of the iceberg when it comes to examining parental input in ASD cross-linguistically and cross-culturally. If such major differences are observed at the structural level of the language used and in the choice of specific sentence types and forms of address, one can only speculate about the differences at the level of pragmatics, even more grounded in cultural traditions. For example, differences should be investigated at the level of turn-taking, specifically whether the verbal exchanges between the parent and the child involve an equal amount of back-and-forth, and at the level of the pragmatic functions of parents' utterances, specifically the use of comments on the child's behavior and internal states, the use of praise, and the use of commands. Furthermore, the content of parents' speech should be examined as well, in particular, as it pertains to talking about the past and the future because such narratives

could be linked to cultural traditions and decontextualized language has been associated with children's language outcomes (Rowe, 2013). In addition, it is worth examining how cross-cultural differences in parents' values and child-rearing practices are manifested in their everyday communication and interaction with their children. For example, whether values about teaching children respect and obedience are manifested in parents' use of commands and imperative forms or in other ways.

Another important direction for future research is to examine differences in parental input contingent on parent gender, child gender, and the parent-child gender match. Past studies have reported differences between fathers' and mothers' speech, as well as differences based on the gender of the child (e.g., Bellinger & Gleason, 1982; for a meta-analysis see Leaper et al., 1998; Rowe et al., 2004). However, studies have not yet examined gender differences in input to children with ASD. Unfortunately, in our sample there was only one Bulgarian father that participated in a parent-child interaction, and there were only seven Bulgarian and seven English-speaking female participants, which did not allow us to examine gender differences in input and whether they varied across the two participant samples.

The findings from this dissertation justify the inclusion of parents in the assessment and study of children with ASD's language and communication, and emphasize the need for studying the speech of their parents in order to inform parent-mediated treatments and interventions. However, in order for the inclusion of parents in the assessment and in the intervention process to be successful, both should be guided and motivated by parents' needs and priorities. Therefore, future research should identify

those and integrate them in research and intervention practices, while paying special attention to cross-cultural and -linguistic differences.

Future Directions

First, from practical standpoint, research should determine how best to encourage parent participation. A good starting point, based on our findings, is to focus on the convenience of the families: do they need to visit the lab, do they have to follow specific instructions, are they expected to use programs and applications they are not familiar with, are they comfortable with recording a visit in their home, do they need childcare for the duration of the recording, are they comfortable following the research procedures, are the instructions in the preferred language of the parent. Addressing these very practical needs of the parents could, in turn, attract more families to participate, especially those who otherwise would not be able overcome these barriers to participation.

Second, from a clinical standpoint, the content of the treatments and interventions should be informed by both what the parents are already doing (which is not always known by default) and by what the parents need and prioritize the most. A recent study by Frost et al. (2020) identified the eight strategies that successful naturalistic developmental behavioral interventions have in common. These include the child and adult to be facing each other during interactions (be face-to-face), following the child's lead and focus of interest, adjusting verbal input to child's ability, responding to the child's communication attempts, and creating situations that prompt the child to communicate, among others. All these strategies, first, are deeply grounded in everyday parent-child interactions, and second, can be capitalized on in parent-mediated

interventions. Of course, before such strategies are implemented with a specific group, researchers should make sure that that they are aligned with the groups' cultural values and child-rearing practices. Understanding what parents are already doing with their children, for example, always facing each other during communication or following the child's lead, would allow intervention facilitators and trainers to focus on other aspects of parents' communication and engagement that could be improved, thus tailoring the intervention to the needs of the specific family and where group differences are found – to the specific group. Take for example the finding that Bulgarian parents, on average, asked fewer questions than English-speaking parents. Parent-mediated interventions targeting the language and communication of Bulgarian children with ASD, which otherwise would not specifically focus on question use, could use this finding and incorporate a lesson or a training session for parents on the importance of asking questions during play and book reading. This approach of including a brief educational component on a very specific aspect of parents' communication that is positively associated with child language outcomes has been successful in the past (see Leech et al. (2018) for an example of training parents to use decontextualized language) and could be used to tailor interventions to specific groups. In addition to adapting interventions to the group's unique parent-child interaction pattern, special attention should be paid to how treatments and interventions created for a specific population, e.g., North American English-speaking families, are adapted to the culture of populations with which they are used. For instance, a recent study by Liu and colleagues (2020) reported on the lack of sophisticated cultural adaptations of parent-mediated interventions used in mainland

China, Hong Kong, and Taiwan, with only 3 out of 21 studies reporting that cultural adaptations were made before the intervention was implemented. Underestimating the importance of cultural adaptations can affect the successful implementation of the interventions and more importantly their effectiveness. The way the World Health Organization's Caregiver Skills Training (WHO CST) program – developed to address the needs of families of children with developmental disabilities, is being adapted to a wide range of socioeconomic, cultural, geographic and resource contexts is an excellent example of how naturalistic parent-mediated interventions should be adapted (Salomone et al., 2019). Recommended adaptations include but are not limited to (1) translating and adapting the language of the intervention to correspond to the literacy level of the participants, (2) changing the content such that names of characters, places, and specific daily and play routines are representative of what the participants are experiencing, and last but not least (3) choosing when and where the intervention should take place (e.g., after work hours, on weekends, on an individual basis, in a group setting, etc.). In summary, future studies implementing parent-mediated interventions with a new population, should, first, examine the pattern of parent-child interaction for this population, and, second, adapt the intervention to the local culture.

Just as important as tailoring treatment and intervention services to the local culture is the acknowledgement and consideration of the parents' specific needs and priorities. What parents prioritize the most in their child's daily functioning might not always be the target of intervention. For example, even though language and communication are one of the strongest predictors of positive future outcomes in ASD

(Friedman et al., 2019; Howlin et al., 2004; Venter et al., 1992) and they have become the main targets of various interventions (e.g., Kasari et al., 2010; Tager-Flusberg & Kasari, 2013), they should not be the only targets. Consider families who also prioritize their child's independence and daily living skills, such as self-feeding, toileting, dressing oneself, and helping out with chores – these were the top challenges for 32.9% of parents of children with ASD in a large-scale study from six Latin American countries (Paula et al., 2020). One way to incorporate parents' priorities into the intervention is to include measures of parent-identified target behaviors, such as the one used in Arnold et al. (2003) – essentially asking parents to identify a specific concern and to describe the child's behavior associated with it at different stages of the intervention. This way the parent has more agency in the process of determining target outcome measures of the intervention. Furthermore, including the parents' priorities is likely to promote their participation and engagement in the intervention program.

If parents are not directly asked about their needs and priorities when it comes to their children's development, the targets of interventions can be biased towards the views, values and culture of the researchers and creators of interventions. Take for example a study showing systematic differences in how Canadian and Korean immigrant parents of children with ASD conceptualize what constitutes "family quality of life" (Fong et al., 2021). Or yet another study reporting different perspectives on children with ASD's functioning contingent on whether the parents were from high- vs. low-/middle-income countries (Viljoen et al., 2021). If there are fundamental differences in conceptualization of quality of life and daily functioning, one can only wonder how these

would be reflected in parents' everyday interactions with their children or in the "language learning game" they are playing.

Conclusions

As a whole, this dissertation's findings highlight the importance and the potential implications of including parents in research and in treatment and intervention practices. Parents' unique familiarity with their children makes them ideal conversational partners in the context of language assessments in ASD. Moreover, comparing verbal parental input to children with ASD from different cultures reveals fundamental differences in the way parents communicate with them. These studies have implications in determining best language assessment practices and parent-mediated intervention approaches that are adapted to and reflect parents' culture, language, needs, and priorities.

APPENDIX

Parent Feedback Survey Questions about ELSA-A

Each statement was rated as one of the following options: “strongly disagree,” “disagree,” “neither agree nor disagree,” “agree,” or “strongly agree.”

ELSA-A: Games

The instructions in the guide were easy to follow

The video instructions were helpful

Setting up the materials for the games was easy

I was comfortable performing the games

It was easy to engage my child in the games

My child seemed to enjoy the games

It was easy to find time to collect the language sample

My child's communication during the game is similar to what I see on a typical day

ELSA-A: Pixar Movie Shorts

The instructions in the guide were easy to follow

The video instructions were helpful

I was comfortable showing the Pixar movies and asking my child to describe it

It was easy to engage my child in the Pixar movies

My child seemed to enjoy the Pixar movies

It was easy to find time to show the Pixar movies

My child's communication during the Pixar movies is similar to what I see on a typical day

My child communicated more during the Pixar movies compared to the games

ELSA-A: Recording and File Sharing

Recording the session was easy

Using Dropbox was easy

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