The Pennsylvania State University
The Graduate School

College of Health and Human Development

CHARACTERISTICS OF THE SPOKEN LANGUAGE
INTERACTIONS OF YOUNG BEGINNING COMMUNICATORS
WITH AUTISM SPECTRUM DISORDER AND THEIR MOTHERS:
A PRELIMINARY INVESTIGATION

A Dissertation in
Communication Sciences and Disorders

by
Beth Ellen Davidoff

© 2018 Beth Ellen Davidoff

Submitted in Partial Fulfillment
of the Requirements
for the Degree of
Doctor of Philosophy

August 2018
The dissertation of Beth Ellen Davidoff was reviewed and approved* by the following:

Janice C. Light  
The Hintz Family Endowed Chair in Children’s Communicative Competence  
Dissertation Advisor  
Chair of Committee

Kathryn D. R. Drager  
Professor of Communication Sciences and Disorders

Carol A. Miller  
Professor of Communication Sciences and Disorders and Linguistics

Karen L. Miller  
Associate Professor of Spanish and Linguistics

Diane L. Williams  
Professor of Communication Sciences and Disorders  
Head of the Department of Communication Sciences and Disorders

*Signatures are on file in the Graduate School
ABSTRACT

This descriptive research study investigated the characteristics of the spoken language interactions of 13 mother-child dyads including children with autism spectrum disorder (ASD) during daily interactions at home. The children ranged in age from 26 to 76 months of age, and all had language abilities that ranged from no spoken words to early spoken word combinations. Three main research questions were addressed: (1) What are the general characteristics of the utterances children with ASD and their mothers are observed to produce? (2) What are the semantic-syntactic characteristics of the spoken words children with ASD and their mothers are observed to produce, and children are reported by mothers to produce and understand? (3) Is there a relationship between the words a child with ASD produces and the words his/her mother produces, such that the dyad produces a common set of spoken words (a shared lexicon)? Mothers made digital audio recordings of daily interactions with their children during typical activities at home. Sixty minutes of these interactions per dyad were transcribed and analyzed. Mothers completed a parent report questionnaire on their children’s receptive and expressive vocabulary.

There was considerable variability across children and mothers on all language measures, which varied by the children’s phase of spoken language development. The five children at the Intentional/Presymbolic phase produced substantially more unintelligible than intelligible utterances, expressed less than five spoken word types and less than 20 word tokens in a 20-minute natural language sample, and obtained age equivalent language production scores below 15 months per parent report. The six
children at the First Words phase produced more intelligible utterances, although they also produced many unintelligible utterances. They generally produced five or more word types and 20 word tokens but less than 30 spoken word types per 20-minute natural language sample and obtained age equivalent language production scores between approximately 15 and 24 months per parent report. The two children at the Word Combinations phase produced more intelligible utterances than the other children, and produced fewer unintelligible utterances. They expressed more than 30 spoken word types in a 20-minute natural language sample, but less than 92 different word types in 65 utterances. They had mean lengths of utterance in morphemes between 1.2 and 1.7 and they obtained age equivalent language scores that were at approximately the 24-month level. Children at all phases of spoken language development were reported to understand more words than they were reported to produce.

During their 60-minute interaction, each mother-child dyad produced a shared lexicon of words (i.e., words that were produced by both the child and the mother), ranging from two to more than 100; the dyads’ shared lexicons increased in size as the children’s spoken language development level increased. The shared lexicons of the dyads with children at the presymbolic phase included words that related to social/interaction and action word types, while those of the dyads with children at the symbolic phases shared words across all word semantic/syntactic word types (social/interactive, noun, action/state, descriptive, closed class). The frequency of words produced by the mothers, and mother and child imitation were related to the shared lexicons.
The results support the social-interactionist theories of language development; specifically, that mothers provide scaffolds including frequent word tokens, semantic and temporal contingency to child utterances, and attunement to their children’s level of spoken language development. The receptive and expressive vocabularies of the children were consistent with those of children with other developmental disabilities and younger children with typical language development as reported in the literature.

The results of this study suggest that imitation may play a role in the shared lexicon of the children and their mothers. Imitation by mothers and their children may play an important role in language learning for children with ASD. This hypothesis proposes an alternative view of immediate echolalia (i.e., a child’s repetition of all or part of another person’s speech) than that traditionally proposed. Furthermore, results suggest that vocabulary targets for children with ASD at these early phases of spoken language development should be selected from the words that caregivers use with their children during spontaneous daily interactions rather than from “core vocabulary” lists. Results suggest that frequency of maternal words also facilitates language learning. Another important strategy for intervention may be to increase the number of times new words are presented to children with ASD within the language interactions of mothers and other communication partners. For those beginning communicators with ASD who are not yet producing spoken language, the use of augmentative and alternative communication (AAC) may be considered.

Future directions for research include replication of the current study with additional participants, and using video to capture the nonlinguistic context, gestures, and
unaided communication in the dyads’ interactions. The results of this research would inform the development of interventions with caregivers to support the spoken language development of their children with ASD who are beginning communicators. Future studies should investigate the effects of such intervention.

*Keywords:* characteristics, spoken language interactions, beginning communicators, autism spectrum disorder (ASD)
# TABLE OF CONTENTS

LIST OF FIGURES ........................................................................................................... xi

LIST OF TABLES ............................................................................................................... xiv

ACKNOWLEDGEMENTS ................................................................................................. xvi

Chapter 1 Introduction and Review of the Literature ...................................................... 1

  Statement of the Problem ......................................................... 2
  Defining the Subgroup of Young Children with ASD who have Limited Speech.. 3
  Social-Interactionist Theories of Lexical Development ........................................... 6
  Maternal Language Influences on Children Who Are Typically Developing .......... 8
    Preintentional/Presymbolic Communicators ....................................................... 8
    Intentional/Presymbolic to Early Symbolic Communicators ................................. 9
  The Role of Imitation in Language Learning ......................................................... 11
  Imitation by Mothers ....................................................................................... 11
  Imitation by Children ...................................................................................... 12
  Additional Influences of Maternal Language on Early Language Learning .......... 18
  Maternal Language Influences on Beginning Communicators with ASD .......... 20
  Maternal Verbal Responses to Infants with or at Risk for ASD .............................. 20
  The Role of Imitation ....................................................................................... 22

A Synthesis of the Evidence on the Characteristics of Caregiver Language and
  Young Children with ASD who are Beginning Communicators ......................... 26
  Quantity and Quality of Maternal Spoken Language with Beginning
    Communicators with ASD ............................................................................... 30
  Limitations of the Research and Gaps in our Knowledge .................................... 32

The Current Study .................................................................................................... 37

  Research Questions ..................................................................................... 37
  Question 1: .................................................................................................. 37
  Question 2: .................................................................................................. 39
  Question 3: .................................................................................................. 40

Chapter 2 Method ....................................................................................................... 42

  Research Design ............................................................................................... 42
  Participants .................................................................................................... 43
  Inclusion Criteria ........................................................................................... 43
  Recruitment .................................................................................................... 44
  Number of Participants .................................................................................. 45
  Participant Demographics .......................................................................... 46
  Materials ....................................................................................................... 49
Chapter 4

Contribution of the Current Study

Clinical Implications

Maternal and Child Spoken Language Interactions Across Dyads

Summary

Dyad 9

- Considering Imitation and Expansion
- Reconsidering Echolalia
- Increasing Frequency of Specific Words in Maternal Language Input
- Targeting Vocabulary
- Broadening the Scope of Language Samples
- Shared Lexicons

- General Characteristics of Mothers’ Utterances
- Mothers’ Talkativeness and Complexity
- Semantic-Syntactic Characteristics of Mothers’ Spoken Words
- Mothers’ Vocabulary Composition
- The Relationship Between Children’s and Mothers’ Spoken Words
- The Shared Lexicons of the Dyads

- Shared Lexicons – Frequency of Words
- Shared Lexicons – Imitation

Dyad 2

Beginning Communicators with ASD at the Word Combinations Phase

- General Characteristics of Children’s Utterances
- Children’s Talkativeness and Complexity
- Semantic-Syntactic Characteristics of Children’s Spoken Words
- Children’s Vocabulary Composition - Observed
- Children’s Vocabulary Composition - Reported
- General Characteristics of Mothers’ Utterances
- Mothers’ Talkativeness and Complexity
- Semantic-Syntactic Characteristics of Mothers’ Spoken Words
- Mothers’ Vocabulary Composition
- The Relationship Between Children’s and Mothers’ Spoken Words
- The Shared Lexicons of the Dyads

- Shared Lexicons – Frequency of Words
- Shared Lexicons – Imitation

Dyad 9

Summary

Chapter 4 Discussion

Maternal and Child Spoken Language Interactions Across Dyads

- General Characteristics of Children’s and Mothers’ Utterances
- Talkativeness
- Complexity
- Semantic-Syntactic Characteristics of Children’s and Mothers’ Words
- Vocabulary Composition – Observed
- Vocabulary Composition – Reported
- Shared Lexicon
- Frequency of Words
- Imitation

Clinical Implications

- Broadening the Scope of Language Samples
- Targeting Vocabulary
- Increasing Frequency of Specific Words in Maternal Language Input
- Reconsidering Echolalia
- Considering Imitation and Expansion
- Using Augmentative and Alternative Communication

Contribution of the Current Study
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitations of the Current Study</td>
<td>228</td>
</tr>
<tr>
<td>Future Directions for Research</td>
<td>231</td>
</tr>
<tr>
<td>Conclusion</td>
<td>233</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>235</td>
</tr>
<tr>
<td>Appendix A Institutional Review Board Research Approval Letter</td>
<td>265</td>
</tr>
<tr>
<td>Appendix B Telephone/Email Script</td>
<td>267</td>
</tr>
<tr>
<td>Appendix C Instructions for Digital Voice Recording</td>
<td>268</td>
</tr>
<tr>
<td>Appendix D Instructions for Completing MacArthur-Bates Communicative Development Inventories</td>
<td>269</td>
</tr>
<tr>
<td>Appendix E Parent Interview Questions</td>
<td>270</td>
</tr>
<tr>
<td>Appendix F Adapted CHAT Manual</td>
<td>271</td>
</tr>
<tr>
<td>Appendix G Operational Definitions of Semantic/Syntactic Categories</td>
<td>286</td>
</tr>
<tr>
<td>Appendix H Normative Data on Lexical Diversity (D)</td>
<td>290</td>
</tr>
<tr>
<td>Appendix I Shared Lexicon for Dyad 3 (40 shared word types)</td>
<td>291</td>
</tr>
<tr>
<td>Appendix J Shared Lexicon for Dyad 7 (47 shared word types)</td>
<td>292</td>
</tr>
<tr>
<td>Appendix K Shared Lexicon for Dyad 8 (33 actual shared word types/34 extrapolated)</td>
<td>293</td>
</tr>
<tr>
<td>Appendix L Shared Lexicon for Dyad 10 (61 actual shared word types/74 extrapolated)</td>
<td>294</td>
</tr>
<tr>
<td>Appendix M Shared Lexicon for Dyad 11 (100 shared word types)</td>
<td>295</td>
</tr>
<tr>
<td>Appendix N Shared Lexicon for Dyad 13 (15 shared word types)</td>
<td>296</td>
</tr>
<tr>
<td>Appendix O Steps for Determining Child’s Phase of Spoken Language Development</td>
<td>297</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 3-1: Proportion of word classes out of total word types produced by the children at the Intentional/Presymbolic phase during the 60-minute natural language samples... 90

Figure 3-2: Frequency of words produced and words understood by the children at the Intentional/Presymbolic phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form. .......................... 92

Figure 3-3: Proportion of word classes out of the total words produced (A) and understood (B) by the children at the Intentional/Presymbolic phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form. ................................................................. 93

Figure 3-4: Proportion of word classes out of the total word types produced by the mothers of the children at the Intentional/Presymbolic phase during the 60-minute natural language samples........................................................................... 97

Figure 3-5: Proportion of words in the shared lexicon out of the total word types produced by the child, and also out of the total word types produced by the mother, at the Intentional/Presymbolic phase during the 60-minute natural language samples... 100

Figure 3-6: Proportion of the children’s (A) and the mothers’ (B) imitations out of their total responses for the dyads with children at the Intentional/Presymbolic phase during the 60-minute natural language samples........................................................................... 102

Figure 3-7: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the Intentional/Presymbolic phase during the 60-minute natural language samples........................................................................... 103

Figure 3-8: Proportion of the specific noun types out of the total word types produced by Angela (Mother 5) during the 60-minute natural language sample......................... 108

Figure 3-9: Proportion of word classes out of the total word types produced by the children at the First Words phase during the 60-minute natural language samples. Data for Child 8 and Child 10 have been extrapolated to 60-minutes.............................. 116

Figure 3-10: Frequency of words produced (A) and words understood (B) by the children at the First Words phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form. *Child 2: the number of words understood equaled the number of words produced because the MacArthur-Bates – Words and Sentences form was used and it does not separately report words understood. ................................................................................. 119
Figure 3-11: Proportion of word classes out of the total words produced (A) and understood (B) by the children at the First Words phase per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form. ........................................................................................................................................ 120

Figure 3-12: Proportion of word classes out of the total word types produced by the mothers of the children at the First Words phase during the 60-minute natural language samples. Data for Mother 8 and Mother 10 have been extrapolated to 60-minutes. ........................................................................................................................................ 123

Figure 3-13: Proportion of words in the shared lexicon out of the total word types produced by the child, and also out of the total word types produced by the mother, at the First Words phase during the 60-minute natural language samples. Data for Dyad 8 and Dyad 10 have been extrapolated to 60-minutes. ................................................................................................................................. 125

Figure 3-14: Proportion of word classes out of the total shared word types produced by the dyads of the children at the First Words phase during the 60-minute natural language samples. Data for Dyad 8 and Dyad 10 have been extrapolated to 60-minutes. ................................................................................................................................. 126

Figure 3-15: The proportion of the words in the shared lexicon produced frequently by the children at the First Words phase and the proportion of words in the shared lexicon produced frequently by the mothers during the 60-minute natural language samples. Data for Dyad 8 and 10 have been extrapolated to 60-minutes. ................................................................................................................................. 127

Figure 3-16: Proportion of the children’s (A) and the mothers’ (B) imitations out of the total responses for dyads with children at the First Words phase during the 60-minute natural language samples. Data for Dyads 8 and 10 have been extrapolated to 60-minutes. ........................................................................................................................................ 129

Figure 3-17: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the First Words phase during the 60-minute natural language samples. Data for Dyads 8 and 10 have been extrapolated to 60-minutes. ........................................................................................................................................ 131

Figure 3-18: Proportion of specific noun word type semantic categories out of the total noun word types produced during the 60-minute natural language samples by Carlos (A) and his mother Susana (B). ........................................................................................................................................ 135

Figure 3-19: Proportion of word classes out of the total word types produced by the children at the Word Combinations phase during the 60-minute natural language samples. ........................................................................................................................................ 145

Figure 3-20: Frequency of words produced (A) and the words understood (B) by the children at the Word Combinations phase, as per parent report on the MacArthur-Bates Communicative Development Inventories form. ........................................................................................................................................ 147

Figure 3-21: Proportion of word classes out of the total words produced (A) and understood (B) by the children at the Word Combinations phase, as per parent report
on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form........................................................................................................ 149

Figure 3-22: Proportion of word classes out of the total word types produced by the mothers of the children at the Word Combinations phase during the 60-minute natural language samples........................................................................................................ 151

Figure 3-23: Proportion of words in the shared lexicon out of the total word types produced by the child, and also out of the total word types produced by the mother, at the Word Combinations phase during the 60-minute natural language samples........ 153

Figure 3-24: Proportion of word classes out of the total shared word types produced by the dyads of the children at the Word Combinations phase during the 60-minute natural language samples........................................................................................................ 154

Figure 3-25: The proportion of the words in the shared lexicon produced frequently by the children at the Word Combinations phase and the proportion of words in the shared lexicon produced frequently by the mothers during the 60-minute natural language samples. ........................................................................................................ 155

Figure 3-26: Proportion of the children’s (A) and the mothers’ (B) imitations out of the total responses for dyads with children at the Word Combinations phase during the 60-minute natural language samples. ........................................................................................................ 157

Figure 3-27: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the Word Combinations phase during the 60-minute natural language samples........................................................................................................ 158

Figure 3-28: Proportion of the specific noun word type semantic categories out of the total noun word types produced during the 60-minute natural language samples by Adam (A) and his mother Miranda (B). ........................................................................................................ 162
LIST OF TABLES

Table 1-1: Selected intervention studies of caregiver language input to young children with ASD who were beginning communicators. .............................................................. 27

Table 2-1: Summary of dyad demographic information.................................................. 48

Table 2-2: Proportion of dyads out of total number of dyads engaged in specific activities during natural language samples. ................................................................. 53

Table 2-3: Word classes and semantic/syntactic categories for word type coding. ........... 61

Table 2-4: Language measures for children, mothers, and dyads.................................. 68

Table 2-5: Minimum criteria for spoken language benchmarks for the domains of phonology, vocabulary, grammar, and pragmatics adapted from Tager-Flusberg et al. (2009)................................................................................................................. 84

Table 3-1: Descriptive statistics for the children at the Intentional/Presymbolic phase during the 60-minute natural language samples.................................................. 89

Table 3-2: Descriptive statistics for the mothers of the children at the Intentional/Presymbolic phase during the 60-minute natural language samples. .............. 95

Table 3-3: Shared lexicons of the dyads with children at the Intentional/Presymbolic phase who produced spoken language during the 60-minute natural language samples. ........................................................................................................... 99

Table 3-4: Words reported as understood by Galen (Child 5) per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form.................................................................................................................. 106

Table 3-5: High frequency word types (n = 77) and word tokens produced by Angela during the 60-minute natural language sample with her son Galen (Dyad 5)........ 109

Table 3-6: Descriptive statistics for children at the First Words phase during 60-minute natural language samples................................................................. 114

Table 3-7: Descriptive statistics for the mothers of the children at the First Words phase during the 60-minute natural language samples........................................... 122

Table 3-8: Word types (n = 75) of the shared lexicon of Susana and Carlos (Dyad 2) and word tokens of Susana produced during the 60-minute natural language sample. ....... 137
Table 3-9: Descriptive statistics for the children at the Word Combinations phase during the 60-minute natural language samples........................................................................144

Table 3-10: Descriptive statistics for mothers of the children at the Word Combinations phase during 60-minute natural language samples.................................................................150

Table 3-11: Word types \((n = 167)\) of the shared lexicon of Miranda and Adam (Dyad 9) and word tokens of Miranda produced during the 60-minute natural language sample........................................................................................................................................164
ACKNOWLEDGEMENTS

I want to express my thankfulness to so many people for helping me along this journey toward my dream of empowering one person at a time to achieve the power and beauty of communication:

First, I wish to thank Janice Light, my advisor and mentor, who has inspired me for years through her research and teaching. You gave me the opportunity to pursue my doctoral studies through the AAC Leadership Grant, without which my dream would have never been possible. Learning from you has been an amazing process: you have helped me to constantly stretch my mind and encouraged me to think critically and ask ever more challenging questions!

I also want to extend my appreciation to the additional members of my doctoral committee, Kathy Drager, Carol Miller, and Karen Miller, who gently guided me to look carefully in new directions and to think in new ways. Each of you brought an important perspective to my work and I have greatly benefited from your insights.

A special thanks to the other faculty members of the Department of Communication Sciences and Disorders, who taught me about so many facets of communication, language and the field of augmentative and alternative communication, in particular. My knowledge has broadened and deepened through my interactions with you, and the ways you’ve encouraged me to think outside the box.

To all the families with whom I have worked through the years: thank you for welcoming me into your lives and allowing me to work with you and your loved ones. You have taught me so much! I am also so grateful to the families who participated in my research study; thank you for sharing a little slice of your lives with me.

Warmest thanks to my fellow doctoral students and graduate assistants, and my new colleagues, who offered support and encouragement throughout this journey.

My deepest gratitude goes to my whole family: my beautiful mother whose love and compassion for others inspired me to make a difference; my adoring father who offered his wise words of encouragement every day of my life; my amazing and loving children who never questioned my decision to pursue my doctorate and who have supported me in countless ways; my beautiful grandchildren who fill my life with joy.

And to my love, Marty: words cannot express how much I wish to thank you, for it was with your love and support from the very beginning, and through each and every day, that has helped me achieve my dream!
Chapter 1

Introduction and Review of the Literature

Significant impairment in social communication is a defining characteristic of children diagnosed with autism spectrum disorder (American Psychiatric Association, 2013; Lord, Bishop, & Anderson, 2015; Tek, Mesite, Fein, & Naigles, 2014). Parents often become aware of their child’s difficulties in understanding and responding to speech and communication early in their child’s development when milestones such as babbling, interest in social play, response to name, and the emergence of first true words may be delayed or fail to develop (Chawarska, et al., 2007; Herlihy, Knoch, Vibert, & Fein, 2015; Kozlowski, Matson, Horovitz, Worley, & Neal, 2011). Early intervention is critical. In fact, Mayo, Chlebowski, Fein, and Eigsti (2015) determined that young children diagnosed with autism spectrum disorder (ASD) who acquired first words by 24 months of age had better outcomes in cognitive and adaptive skills than children who acquired first words later, up to 40 months of age.

Despite intensive intervention efforts, approximately one-quarter to one-third of the children diagnosed with autism spectrum disorder (ASD) are unable to communicate effectively by combining spoken words or symbols to express their thoughts, hopes, and dreams (Anderson et al., 2007). Parents want to help their children, who often exhibit frustration at their inability to communicate effectively (Cardon, Wilcox, & Campbell, 2011). There are numerous intrinsic and extrinsic factors that may contribute to difficulties with expression beyond single words.
The aim of this research study was to explore one aspect of this enigma: the characteristics of the spoken language interactions of young beginning communicators with ASD and their mothers during daily routines at home.

**Statement of the Problem**

Children with ASD who are beginning communicators with limited speech are at a disadvantage in language learning. They tend to have numerous challenges: difficulties with social engagement; stereotypic and repetitive actions on objects; diminished response to and initiation of bids for joint attention; deficits in communicative gestures such as pointing and showing; restricted consonant inventories (vocalizations are less “speech-like”); unconventional vocalizations; and limited production of words (Cervantes, Matson, & Goldin, 2016; Wetherby, Watt, Morgan, & Shumway, 2007).

Iverson and Wozniak (2007, 2016) proposed that young children with ASD who have limited spoken language communicate less frequently and as a result, caregivers have fewer opportunities to provide appropriate language models. They suggested that this has a cascading effect which results in less linguistic input from caregivers, and this, in turn, results in further impairment of the child’s language development. Thus, if children with ASD produce few if any recognizable spoken words, it may become very difficult for their caregivers to provide responsive linguistic feedback to maintain and promote their children’s further language development. Understanding the characteristics of, and the relationships between, caregivers’ and children’s spoken language may elucidate the nature of the influence between bidirectional input and output for young
children with ASD who have limited speech and ultimately help them achieve better language outcomes.

**Defining the Subgroup of Young Children with ASD who have Limited Speech**

This study is specifically focused on young children with ASD who are *beginning communicators*. At the outset, it is necessary to clarify the use of the acronym, ASD, which stands for autism spectrum disorder. This is the current terminology used in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, published by the American Psychiatric Association (DSM-5; APA, 2013, p. 53), which states,

The essential features of autism spectrum disorder are persistent impairment in reciprocal communication and social interaction (Criterion A), and restricted, repetitive patterns of behavior, interests, or activities (Criterion B). These symptoms are present from early childhood and limit or impair everyday functioning (Criteria C and D).

The DSMs have been designed for both clinical and research purposes, and they have been modified and updated through the years. The consequence of these changing diagnostic criteria is that past and current research reflects the changing terminology for autism and its related disorders. Because the current research study reflects the diagnostic criteria published in DSM-5, the terminology that is being used to refer to the children in this subgroup will be autism spectrum disorder (ASD). In order to simplify the synthesis of research over the past several decades, I will use the term ASD to refer to the children in this target group. Please note that the actual terminology used in the individual research studies may be different, reflecting the DSM that was in use at the time the research was conducted and published.
In an attempt to develop a standard reference for research and treatment in the behavioral sciences, Kasari, Brady, Lord, and Tager-Flusberg (2013) defined this subgroup of children with ASD and limited speech as being *minimally verbal* and described the following characteristics:

The minimally verbal child has a small repertoire of spoken words or fixed phrases that are used communicatively. The exact number of words may vary across children, from no spoken words or phrases to perhaps 20 or 30, depending on a range of factors including age, intervention history, and access to alternative/augmentative communication (AAC) systems. The spoken words or phrases that a child uses will often be restricted to limited contexts and may only be used to communicate one or two functions (e.g. requests with familiar adults). Moreover, the rate of spoken language is usually very low and may include scripted phrases that have been highly trained (e.g. I want X). In some cases, the minimally verbal child may also use echolalic or stereotyped language that does not appear to be functionally communicative. (p. 480)

Kasari et al. further indicated that this subgroup also included children who may have larger receptive than expressive spoken vocabularies, as well as children who use augmentative and alternative communication (AAC) systems to communicate expressively through modalities other than speech. Such AAC systems may include manual signs, picture symbols, and other unaided and aided systems. The term *minimally verbal*, is potentially confusing when applied to children who may understand some language and may be able to produce language through AAC. Consequently, in this paper I refer to this subgroup as young children with ASD who are beginning communicators. They may understand spoken and/or augmented language (i.e., language expressed via AAC) and they may spontaneously produce few, if any, single words (spoken or augmented), but they have not progressed to express novel, creative (i.e., as opposed to stereotyped or echolalic) multiword combinations, phrases, or
sentences (Norrelgen et al., 2015; Rose, Trembath, Keen, & Paynter, 2016; Tager-Flusberg & Kasari, 2013; Thurm, Manwaring, Swineford, & Farmer, 2015). Caregiver and partner language can be spoken as well as augmented (i.e., produced via visual modalities). In this research study, the focus is only on caregiver spoken language.

It is important to recognize that there is substantial diversity within this subgroup of children with ASD who are beginning communicators. Included are children who are developing along a continuum from using preintentional behaviors to symbolic communication (Siegel & Cress, 2002). This continuum includes behaviors that are: preintentional; intentional but presymbolic; or symbolic. Preintentional behaviors are behaviors produced reflexively by the child which are not partner directed; instead, the partner infers communicative intent on the child’s part. In intentional presymbolic communication, the child directs behaviors such as gestures, vocalizations, and eye gaze toward a communication partner and waits for the partner’s response, often persisting or changing behaviors if the intended goal is not achieved. With symbolic communication, the child uses spoken words, word approximations, picture symbols, manual signs, or orthographic symbols (written words or letters) that refer to people, objects, actions, and events in the world. With symbolic communication, children may be at the early first words stage where they express single symbols, or they may produce symbol combinations or more complex messages. This study explored maternal and child spoken language interactions at each of these stages of early communication development: Intentional/Presymbolic, First Words, and Word Combinations.

In the following sections, I discuss maternal language influences during the early stages of lexical development within the broader theoretical approach, the social-
interactionist theories of language acquisition, and summarize the research highlighting what we know about early lexical development in infants and toddlers who are typically developing. This is followed by a synthesis and evaluation of the research in maternal language influences on vocabulary development in children with ASD who are beginning communicators, highlighting what we currently know and what we do not yet know. Finally, I present the rationale and questions for the current descriptive research study.

**Social-Interactionist Theories of Lexical Development**

Social-interactionist theories of language acquisition share the idea that children develop language within social interactions. Vygotsky (1962) suggested that adults help children in their development by providing “guidance” to support them in their zone of proximal development (ZPD). Vygotsky proposed,

> The area of the ZPD is comprised of actions that children are capable of understanding, but are not capable of performing. In other words, it is the zone within which children act with understanding and awareness with the help of an adult. If children are not able to interact meaningfully, then collaborations will not be successful. (Zaretskii, 2009, p. 78)

This type of collaborative interaction between caregiver and child enables the child to move from prelinguistic to linguistic communication. This collaborative interaction is embedded in what Bruner (1975, 1983) calls the Language Acquisition Support System (LASS). Within this LASS, caregivers provide scaffolds during routines, scripts, and formats in which early language evolves (Ratner & Bruner, 1978). Like a scaffold that is temporarily erected when a building is constructed, interactive language games and routines are, “very special scaffolds in self-destructing gradually as the need
lessens, to be replaced by a new support for a more elaborate construction” (Cazden, 1983, p. 8). Bruner’s social-interactionist approach to language acquisition has also been referred to as a social-pragmatic approach (Ambridge & Lieven, 2011; Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998). Over time, caregivers’ scaffolds change in response to their children’s language development.

An important aspect of social-interactionist theories is that infants and toddlers are not passive recipients of maternal language influences. Two current perspectives on social-interactionist approaches to language acquisition highlight children’s active participation. Kuhl (2007) proposed the concept of social gating: that “social interaction is essential for natural speech learning” (p. 110). She and her associates (Kuhl, Tsao, & Liu, 2003) found that 9-month-old American infants who observed adults engaging in live social interactions in Mandarin learned the language much better than infants exposed to the identical content in auditory-only or televised interactions. In the live presentations, the infants actively engaged in social interactions with the Mandarin-speaking adults. This active engagement increased arousal, attention, and motivation, which Kuhl and colleagues believe is crucial for language learning.

Another contemporary social-interactionist approach, the emergentist coalition model proposed by Golinkoff, Hirsh-Pasek and colleagues (Golinkoff, Can, Soderstrom, & Hirsh-Pasek, 2015; Hirsh-Pasek et al., 2015) also emphasized the infant’s active role in language acquisition with caregivers. Hirsh-Pasek et al. (2015) described the conversational duet between infants and caregivers: “When words are introduced within parent-supported shared activities, a child can learn their meaning and practice their use. Without sufficient scaffolding, parents’ words might flow by like background noise, with
no impact on child learning,” (p. 1081). This active role also occurs as infants solicit their caregivers’ involvement when they point at objects (Rowe & Goldin-Meadow, 2009), show objects while sitting, bring objects while walking to their caregivers (Karasik, Tamis-LeMonda, & Adolf, 2013), vocalize (McGillion et al., 2013), and babble (McGillion, et al., 2017). Thus, it is the active participation of both members of the dyad that leads to the child’s language learning. As Tamis-LeMonda, Bornstein, and Baumwell (2001) emphasized,

Indeed, maternal responses occur in the context of children’s participation in exploratory and communicative activities. By definition, maternal responsiveness reflects the temporal sequence of child-act mother-respond, which clearly depends on the outward expression of initiation and intent on the part of the child…. Mothers certainly cannot imitate vocalizations that do not occur. (p. 763)

**Maternal Language Influences on Children Who Are Typically Developing**

**Preintentional/Presymbolic Communicators**

By three months of age, very young, typically developing infants engage in *proto-conversations* with their mothers (Bateson, 1975), where the partners engage in alternating vocalizations. In addition, infants between the ages of 12 and 20 weeks of age have demonstrated the ability to imitate vowel sounds produced by an unfamiliar adult in experimental tasks (Kuhl & Meltzoff, 1996). More recent research has shown that infant vocalizations also take on an *instrumental* function around five months of age, when, again in an experimental setting, babies try to elicit interaction with an unfamiliar partner who unexpectedly stops responding to their vocalizations (Goldstein, Schwade, &
Bornstein, 2009). The foregoing research suggests that contingencies (including imitation) between mothers’ and infants’ behaviors appear to play a role in the development of infants’ presymbolic vocalizations. However, imitation also plays an important role in language learning during infants’ transition to intentional, presymbolic communication and early symbolic communication.

**Intentional/Presymbolic to Early Symbolic Communicators**

There is a substantial body of evidence regarding maternal language input to infants and toddlers who are typically developing. This research has shown that caregiver language that is responsive to the infant’s focus of attention is related to children’s vocabulary development (Tomasello & Farrar, 1986). Infants demonstrate their focus of attention in many ways during this period of intentional/presymbolic communication. They look at objects and people in their immediate environment. They touch and manipulate objects and toys. They hold out objects to show or give to their caregivers. They point at things, people, or events that capture their attention. Infants also demonstrate their focus of attention while vocalizing, which they produce in isolation or as an accompaniment to any of these other actions. Research has shown that infants’ vocalizations that were directed toward objects they touched, held, manipulated, or gestured towards (object-directed vocalizations), indicated to their caregivers that they were ready to learn about the objects. These vocalizations then elicited semantically and temporally contingent language from their caregivers (Goldstein, Schwade, Briesch, & Syal, 2010).
Infants also produce *mother-directed vocalizations* as they look toward their mothers’ bodies, hands, or faces. When expressing these vocalizations, infants may or may not engage in eye contact or be in physical contact with their mothers. Gros-Louis, West, and King (2014) determined that mothers’ *sensitive*, contingent responses to their 8- to 14-month-olds infants’ mother-directed vocalizations in earlier months predicted more speech-like (i.e., consonant-vowel) vocalizations and vocabulary in later months. The authors defined sensitive responses as acknowledgements, attributions, naming, directions, questions, playful verbalizations, and imitations/expansions. When 8-month-old infants’ vocalizations were more “speech-like” (i.e., contain consonant-vowel combinations), mothers responded with imitations and expansions more than when the vocalizations contained only vowels (Gros-Louis, West, Goldstein, & King, 2006).

Maternal spoken language that follows the child’s focus of attention and describes it has been called *linguistic mapping* or *follow-in* language or commenting. Maternal spoken language that corresponds to infants’ gestures such as showing, giving, or pointing is designated as a *translation* of the gesture. A number of investigations have determined that these *social-pragmatic* characteristics of maternal language are correlated with or predict infants’ later vocabulary and language development (Iverson & Goldin-Meadow, 2005; Rowe and Goldin-Meadow, 2009; Wu & Gros-Louis, 2014). However, numerous studies highlight the critical role of spoken maternal language that is responsive to infants’ vocalizations and particularly, speech-like vocalizations and babbling.

The research suggests that in early language development, when infants are moving from being intentional/presymbolic communicators to symbolic communicators,
what seems to be important is a mother’s response that is temporally and meaningfully linked to the infant’s or toddler’s prior vocalization or verbalization. For example, McGillion et al. (2013) found that mothers’ utterances that were both semantically- and temporally-contingent to infants’ vocalizations at nine months of age predicted the children’s expressive vocabulary at 18 months. More specifically, in another study, McGillion et al. (2017) determined that although both babbling and pointing signal that children are interested in communicating about something, it is infants’ babbling at nine months of age that predicted their vocabulary production of first words. In contrast, children’s gestures at nine months predicted children’s expressive vocabulary comprehension at 18 months.

**The Role of Imitation in Language Learning**

**Imitation by Mothers**

Bloom, Margulis, Tinker, and Fujita (1996) investigated the early conversations between mother-child dyads at the language development milestones of first words (at approximately 13 months) and at the vocabulary spurt (at approximately 19 months when the children have achieved a 50-word vocabulary). These researchers found that children tended to talk before mothers’ speech and mothers tended to talk after children’ speech. Most of the time, the child initiated the conversation. Bloom et al. (1996) indicated that the functions of mothers’ responses were to acknowledge what the child had said, repeat it (i.e., imitate it), or clarify it if it was not understood.
Different types of caregiver verbal responsiveness have been found to be related to different language milestones in their children’s development at different points in time (Tamis-LeMonda et al., 2001). Specifically, these researchers determined that, as children begin to explore their environment at 9 months of age, mothers’ productions of affirmations (e.g., “Yes,” “That’s right.”) and descriptions (e.g., “That’s a spoon you’re holding”) predicted the infants’ first imitations and first words. Mothers’ imitations and expansions of children’s utterances at 13 months predicted children’s expressive vocabulary of 50 words. Mothers’ imitations/expansions and play prompts (e.g. “Why don’t you feed the doll?”) predicted children’s first word combinations; and mothers’ imitations/expansions and production of questions (“What’s that?”) predicted children’s first talk about the past. These findings were also supported by later research indicating that, at the first words phase of development, mothers’ verbal imitations of their children at 13 months predicted children’s expressive vocabulary at 17 months (Masur, Flynn, & Eichorst, 2005).

**Imitation by Children**

During the periods of language development between the emergence of first words, achievement of the vocabulary spurt where children attain a 50–word vocabulary, and early word-combinations, children’s imitation of their mothers’ spoken language may function in other ways to help advance language learning. Masur and Eichorst (2002) found that children’s imitation of *novel* words during natural play interactions with their mothers at 13 months, when they are first acquiring a spoken word vocabulary, predicted
their expressive vocabulary of both reported words and observed words at 17 months for common nouns as well as non-nouns: actions and requests (*read, what’s that?*); personal-social words and conventional vocalizations (*thank you, uh oh*), modifiers (*red, two*); activities, games, animal noises (*peekaboo, moo*); and pronouns and functors words (*that, to*). Imitations of novel words at 13 months also predicted non-noun vocabulary at 21 months, the point in language development when children begin to combine nouns and non-nouns such as actions and modifiers to express varied semantic relations.

Although some researchers have investigated either mothers’ imitation of children or children’s imitation of mothers, others have studied mother and child imitation simultaneously, arguing that there is a mutual bidirectional influence of mother and child on one another. Masur and Rodemaker (1999) found that mothers and infants increased their vocal, verbal, and action imitations of one another over the course of development from 13 months to 21 months during play and caregiving (bath time) activities. These investigators suggested that some mothers and children develop an “imitative conversational style” that varied across dyads but remained constant within certain dyads, and this imitative style may have been utilized across contexts to help children learn new words.

As children develop larger vocabularies and they begin to produce successive, single word utterances prior to combining words, mother-child conversations can evolve over multiple speaking turns. In fact, more recent research with typically developing infants and toddlers has suggested that maternal imitation and infants’ “return” imitations are related to children’s lexical development (Masur & Olson, 2008). For example, children’s return imitations (i.e., children imitating their mothers’ imitation) at 13 months
predicted their expressive vocabulary at 17 months and 21 months. Furthermore, Masur and Olson (2008) determined that children often also responded with actions to their mothers’ imitations of their utterances, as in an example when a child reached for a toy pitcher and said “milk,” to which the mother responded, “Oh, you’re gonna put milk in there.” The child then responded by pretending to pour the milk from the pitcher. As these investigators suggested, “Thus at a time when children have few verbal responses available to them, these action responses may help extend playful interchanges, perhaps providing opportunities for enriched interactions supportive of language growth” (p. 713). This growth may be in expressive as well as receptive language.

Mother-child conversations involve different types of imitations. Imitations by either member of the dyad can be exact, expanded, or reduced. Exact imitations preserve the meaning and structure of the model utterance; expanded imitations add one or more semantic or syntactic elements to the model utterance; and reduced imitations delete one or more semantic or syntactic elements from the model utterance (Sokolov, 1993; Sokolov & Moreton, 1994). Masur and Olson (2008) also determined that when mothers of 17-month-olds produced expansions of their children’s single word utterances, more advanced toddlers produced socially related non-imitative single word utterances. They offered the example of a child saying “cup,” to which the mother responded “cup” [imitation] followed by, “you want that cup?” [expansion]. The child’s return verbalization was “water.” Masur and Olson suggested that, “It is possible that mothers’ intervening imitation serves a scaffolding function for such successive single-word utterances to bridge the transition to more complex constructions, like cup of water.” (p.714).
More recently, Olson and Masur (2012) investigated the types of imitations that mothers produced in response to children’s imitations that contained either familiar or non-familiar words. Familiar words were defined as words that were either observed to be expressed by the child or reported to be expressed by the child per caregiver report, and non-familiar words were novel words or words that the child was reported to understand but was not reported or observed to produce. Olson and Masur found that the types of return imitations produced by mothers changed as their children’s language developed. At 13 months, when children spontaneously imitated either familiar or non-familiar words produced by their mothers, mothers more often responded with return imitations that were exact imitations (nothing was changed in their production). At their children’s young age, these return imitations would usually be single words. The mothers’ imitations provided another example of the word immediately after the child produced it, thus increasing the saliency of the word.

As the children got older (at 17 months) and their language development increased, mothers continued to produce exact return imitations of non-familiar words, but more often produced expanded imitations after their children’s imitations of familiar words. Exact imitations of non-familiar words thereby functioned to make the non-familiar word more salient. Further “attunement” of mothers to their children’s increasing language abilities occurred as mother’s produced return imitations that were reduced in comparison with their original models that were imitated by their children. Olson and Masur (2012) illustrated this with the example of a mother saying “little duck,” which the child imitated by saying “duck,” (a familiar word), to which the mother produced the reduced return imitation, “duck,” (which can also be considered an exact of
the child’s utterance). However later, when children were 21 months of age, mothers produced more complex return imitations to their children’s imitations of familiar words. The example provided by the researchers was when the mother said, “It’s a yellow duck,” the child imitated “duck,” and the mother produced the return imitation, “The yellow duck’s swimming.” Olson and Masur suggested that such expanded imitations could facilitate children’s development of sentences, in addition to other classes of words such as descriptive and action words.

A recent study by Che, Brooks, Alarcon, Yannon, and Donnelly (2018) investigated the overlap of words in conversations between mothers and young children at 14-, 20-, and 32-months of age. The term overlap rather than imitation was chosen to describe the words that were “re-used” by either mothers or children from preceding utterances of their partners. Che et al. (2018) indicated that, “although the two concepts are similar, the term imitation seems less appropriate as a description of utterances where the shared content may be only a single word” (p. 73). This is in contrast to other investigators who described a repetition of one or more words as imitation, but differentiated between exact, expanded, and reduced imitations (Sokolov 1992, 1993; Sokolov & MacWhinney, 1990; Zampini, Fasolo, & D’Odorico, 2011). The authors determined that mothers who had higher percentages of overlap of their children’s utterances when the children were 14 months had children with higher mean length of utterances (MLU) at 20 months. Furthermore, mothers with higher percentages of overlap when the children were 20 months had children with higher lexical diversity and utterance complexity at 32 months.
The role of imitation by mothers and children during this transitional phase of language development from single-word utterances to two-word combinations has also been incorporated into experimental research designed to teach children semantic relations that they have not yet begun to produce. Building upon the earlier work of Bloom, Hood, and Lightbown (1974), a descriptive study by Scherer and Olswang (1984) first investigated the spontaneous conversations between mothers and their children, when the children had utterances with MLUs between 1.0 and 2.0 morphemes. They found that when children produced a topic-initiating utterance and mothers followed with a topic-continuing utterance that was an expanded imitation of the child’s preceding utterance, children were more likely to immediately imitate their mothers’ expansion. These return imitations included semantic relations that were in the mothers’ expansions.

Next, Scherer and Olswang (1984) conducted a single-subject multiple baseline experiment with the same participants to determine the effect of mothers’ use of expansions on children’s production of semantic relations. They found that mothers’ expansions of children’s imitations helped the children learn two-term semantic relations that were understood but were not yet produced in their spontaneous utterances. In the training, numerous exemplars of the targeted semantic-relations were embedded in naturalistic play. The training resulted in the children’s imitations increasing to maximum, followed by spontaneous productions, and then decreases of imitation. Generalization to untrained exemplars was also demonstrated. Scherer and Olswang (1984) proposed that there was a contingent relationship between mothers’ expansions and children’s imitations. The investigators suggested,
Not only do expansions encourage the child to take a turn, but more specifically, they encourage him/her to imitate the mother’s utterance…. Thus, the mother’s expansions might be thought of as facilitating the child’s use of imitation in conversation, which may structure interactions for maximum language learning (pp. 384-385).

This progression from comprehension of language to imitation to spontaneous production was proposed by Whitehurst and Vasta (1975) as the mechanism by which imitation can facilitate language development in children who are typically developing.

**Additional Influences of Maternal Language on Early Language Learning**

In addition to the role of imitation by mothers and children, there are other characteristics of maternal language that appear to influence language learning, including general characteristics such as frequency of utterances and words, as well as more specific lexical characteristics.

The literature on typically developing infants and toddlers also indicates that there are significant relationships between the frequency of words in maternal language and the frequency of those words in child language. This frequency of words involves the *data-providing* aspects of the mothers’ language (Hoff & Naigles, 2002). Specifically, for 10- to 20-month olds, their first words and the contexts in which they produced those words were significantly related to the frequency with which their mothers used those words (Harris, Barrett, Jones, & Brookes, 1988; Hart, 1991). In addition, the amount that mothers talked to their very young children in the first words stage of language development was related to the rate and the order of acquisition of those words, and mothers’ use of object words strongly correlated with their children’s order of acquisition.
of those object words (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). Moreover, the frequency with which mothers produced words in isolation also predicted children’s production of those words (Brent & Siskind, 2001). Goodman, Dale, and Li (2008) found that, within the categories of content words (i.e., nouns, verbs, descriptive words, etc.), the more frequent words parents produced were those that young children learned first.

During the transition from first words to word combinations, caregiver responsiveness continues to influence language development, but the quantity and quality of caregiver language becomes increasingly more important. Hoff and Naigles (2002) found that it was the number of words, the number of different words, and the mean length of utterances in morphemes of mothers’ language when engaged in conversations with 21-month-old children (range = 18 to 29 months) that predicted the children’s vocabulary 10 weeks later. Furthermore, Rowe (2012) proposed that from one- to two-years of age, the quantity (i.e., the amount) of caregiver language was most important for child language development when infants were first learning words, whereas the quality (i.e., the diversity and sophistication) of caregiver language was most important for toddlers from two- to three-years of age, when they were beginning to produce sentences.

Research by Hsu, Hadley, and Rispoli (2017) also showed that diversity of verbs in parental language used with toddlers at 1;9 years of age predicted the children’s verb production four months later. These investigators proposed that verbs help young language learners expand language to simple sentences. This is because certain verbs require direct objects, locative phrases, or no obligatory arguments, and when children learn verbs they also learn these characteristics. For example, Hadley, Rispoli, and Hsu
(2016) indicated that the verb *put* requires both a direct object and a locative phrase to be grammatical: “*I put the book on the table,*” whereas the verb *find* requires a direct object to be grammatical, “*I found the book.*” In this earlier study, Hadley et al. (2016) found that the grammatical complexity of children’s language at 30 months was predicted by their production of lexical verbs at two years of age.

**Maternal Language Influences on Beginning Communicators with ASD**

**Maternal Verbal Responses to Infants with or at Risk for ASD**

Research regarding maternal language and beginning communicators with ASD has sought to determine whether mothers engage in quantitatively and qualitatively similar spoken language interactions as mothers of children who are developing typically, and whether their young children with ASD engage in quantitatively and qualitatively similar presymbolic and symbolic communication. Although children with ASD are typically not diagnosed with the disorder until 3 years of age, symptoms are often present much earlier (Wetherby et al., 2007). As a result, descriptive research regarding social-communicative interactions between mothers and infants who have early symptoms of ASD has traditionally been accomplished through retrospective analysis of home videotapes or more recently through prospective studies of infants at high risk for ASD who have an older sibling diagnosed with the disorder, either through individual cases, or longitudinal group investigations comparing these infants with infants at no- or low-risk.
The results of this research have indicated that during presymbolic and early symbolic phases of spoken language development, infants later diagnosed with or at heightened risk for ASD had: (a) delays in the onset of canonical (reduplicative) babbling (Iverson & Wozniak, 2007; Patten et al., 2014); (b) low rates of vocalizations and canonical babbling (Patten et al., 2014); (c) more non-speech vocalizations such as squeals and growls (Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011); (d) limited vocalizations directed to others (Dawson, Osterling, Meltzoff, & Kuhl, 2000); (e) fewer mother-directed show and pointing gestures (Leezenbaum, Campbell, Butler, & Iverson, 2014); (f) fewer responses from mothers to non-word vocalizations (i.e., vocalizations that contained speech sounds but were not yet used referentially); (g) similarly high rates of maternal verbal responses to infant word production at 18 months (Leezenbaum et al., 2014). Furthermore, Northrup and Iverson (2015) determined that 9-month-old infants at low- or high-risk of ASD who were later diagnosed with language disorders (LD), “were more likely to vocalize when their mothers were speaking, and dyads with LD infants were less coordinated in the average durations of their latencies to respond than dyads with ND [not language disordered]” (p. 54).

Together, these research findings suggest that maternal spoken language interactions with very young children with or at risk for ASD may be reduced and less coordinated with their infants’ vocalizations and communicative gestures, which in turn may impact the infants’ spoken language learning.
The Role of Imitation

As young children with, or at risk for, autism begin to produce spoken language, they often engage in echolalic speech. Echolalia has been defined as, “the immediate or delayed repetition of the speech of another” (Roberts, 2014, p. 55) or “the direct imitation of others’ speech” (Carpenter & Tomasello, 2000, p. 46). According to the current Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013), echolalia is a type of stereotypic or repetitive speech that is an example of a restricted, repetitive pattern of behavior (one of the diagnostic criteria of ASD). Often, these stereotypic or repetitive behaviors appear to develop later than the social communication deficits (Wetherby et al., 2007). The body of literature on imitation in children with ASD has focused on the function of echolalia (Prizant & Duchan, 1981; McEvoy, Loveland, & Landry, 1988; Rydell & Mirenda, 1991, 1994; Stiegler, 2015) and its relationship to language development (McEvoy et al, 1988; Roberts, 1989; 2014; Tager-Flusberg & Calkins, 1990).

Two types of echolalia have been identified: immediate echolalia and delayed echolalia. Immediate echolalia refers to the immediate repetition of a preceding utterance or sound produced by another individual or entity, while delayed echolalia refers to the repetition of an utterance or sound produced by another individual or entity (e.g., television, movie, etc.) at an earlier point in time. Furthermore, immediate and delayed echolalia can be unmitigated, wherein imitations are produced without change from the source utterance or mitigated, that is, changed in some way either by modifying the syntax, semantics, or intonation of the original utterance (Fay & Schuler, 1980). Some
researchers have indicated that mitigated echolalia is a positive prognostic indicator (Bebko, 1990; Prizant, 1983; Roberts, 2014). At early stages of language learning, imitation in children who are typically developing is usually immediate and unmitigated, and with time becomes mitigated, as children reduce or expand upon the prior utterances of their communication partners (Olson & Masur, 2012). Delayed imitation can also occur, but more in the context of songs, language games (i.e., riddles, jokes, etc.), stories, and social pretend play (Schuler & Wolfberg, 2000; Stiegler, 2015). Some investigators suggest that exact, immediate echolalia is an earlier strategy and mitigated echolalia is a later-developing strategy in language acquisition for some typically developing children (Clark, 1977; Kirchner & Prutting, 1987; Olson & Masur, 2012).

In an attempt to determine what the function of echolalia was for children with ASD, Prizant and Duchan (1981) investigated the immediate echolalia in the communication of four boys diagnosed with autism and who ranged in age from 4;8 years to 9;3 years. The children were video recorded while interacting at home with family member(s), at school with a teacher or speech-language clinician, and in a group at school. Prizant and Duchan identified seven functional categories of immediate echolalia, which could be grouped into whether a child’s echolalia involved one of three broad functional categories: non-interactive, interactive, or cognitive. These categories differed as to whether the child’s utterance was directed toward another individual, whether there was evidence the child appeared to comprehend the communication partner’s prior utterance, and whether the echolalia was used to communicate some message. Utterances that involved delayed echolalia could serve additional communicative functions (Prizant & Rydell, 1984). Echolalic utterances that served an
interactive function could be used for turn-taking, producing a declarative utterance, requesting, or answering a yes-no question.

Prizant (1983) also proposed that “echolalia provides the ‘raw material’ for further language growth, thus explaining its prognostic value” (p. 294). In his view, children with ASD who produce echolalia move through different stages from a gestalt or holistic way of processing and producing language to later stages that are more analytical and creative. Peters (1977) proposed that typically developing children fall along a continuum from gestalt to analytic language learning, and at times can use both language learning strategies. The idea of a continuum of developmental echolalia was also suggested by Fay and Schuler (1980), with the idea that typically developing children produce language along a continuum, which “…progresses from a more automatic repetition to a less automatic variety; from a general level of noncomprehension to a level of comprehension; from a nonsymbolic (prelinguistic) stage of development to a symbolic (linguistic) stage” (p. 28).

McEvoy et al. (1988) attempted to replicate the findings of Prizant and Duchan (1981) with a larger, and older group of children with ASD. McEvoy et al. found that, “the percentage of language that was echolalic was high at early stages of language development but decreased as language skills improved” (p. 657). They also found that the most prevalent function of echolalia in their subjects was turn-taking, which they argued, was a social function but did not result in an exchange of information. This appears to be a return to the notion that echolalia consists of meaningless repetition.

The relationship of language comprehension to echolalia has been proposed by other researchers. For example, Roberts (1989) found that children with autism who had
lower levels of language comprehension tended to produce more immediate echolalia than children with autism who had higher levels of language comprehension. In a later study, Roberts (2014) indicated that for children with autism who had intellectual functioning within normal limits and who were developing spoken language, the amount of exact echolalia decreased and the amount of mitigated or modified echolalia increased as language comprehension and expression increased as measured by standardized testing. Roberts (2014) concluded that “echolalia plays an important role in the language development of children with autism” (p.55). She suggested that less able children with autism may engage in echolalia for a longer period of time than the children in her later study.

Building on the earlier research of Prizant and Duchan (1981), other researchers have looked not only at the echolalic language of children with ASD but also at the spoken language of the children’s communication partners to determine if there are any relationships between them. For example, Rydell and Mirenda (1991, 1994) found that preschoolers with ASD produced more utterances overall and more echolalic utterances following utterances with high linguistic constraint, that is, utterances that were more demanding and required a specific type of spoken response from the children. More recently, investigators have used conversation analysis to conduct more fine-grained explorations of the repetitive speech behaviors in individuals with autism and their communication partners (Sterponi & Shankey, 2014; Stribling, Rae, & Dickerson, 2007). These case studies determined that echolalia produced by children with ASD, whether immediate versus delayed, or immediate repetition of others or repetition of self, was
used interactively by these children within social interactions, and their communication partners viewed echolalic utterances as purposeful and meaningful.

A Synthesis of the Evidence on the Characteristics of Caregiver Language and Young Children with ASD who are Beginning Communicators

Given the important influences of caregiver language on language learning for children who are developing typically, it is critical to consider what we currently know about caregiver language characteristics and young children with ASD who are beginning communicators. For young children with ASD who struggle to develop spoken language that meets their daily communication needs, the goal of research on caregiver language is to determine evidence-based practices that will help caregivers provide a beneficial language environment for their children. As Haebig, McDuffie, and Ellis Weismer (2013b) proposed:

Clinically, this line of research is important as it can inform the content of parent mediated intervention programs that target the use of empirically-based language facilitation strategies that can be used by parents when they interact with their children during play and other daily routines (p. 2220).

Nine intervention studies were reviewed and are summarized in Table 1-1. The primary goal of each study was to teach caregivers to use responsive language input strategies with the secondary goal to increase children’s communication and language outcome measures. A brief overview of the characteristics of these studies follows.

The average number of participants per study was 52 dyads; however, the case study had three dyads. The mean age of the children was 38 months (range = 20 to 57 months). Six of the nine studies reported the children’s expressive language using the
MacArthur-Bates Communicative Development Inventories (MCDI; Fenson, 2007), a parent report measure of vocabulary. Several of the studies had group scores below 50 words, suggestive of beginning communicator status for the children.

Table 1-1: Selected intervention studies of caregiver language input to young children with ASD who were beginning communicators.

<table>
<thead>
<tr>
<th>Authors</th>
<th># of Dyads</th>
<th>Mean Age (m)</th>
<th>MCDI Pre-test</th>
<th>Groups</th>
<th>Setting</th>
<th>Language Sample (minutes)</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldred et al. (2004)</td>
<td>28</td>
<td>50</td>
<td>28.0</td>
<td>25.5</td>
<td>SCI</td>
<td>TAU</td>
<td>Lab</td>
</tr>
<tr>
<td>Bartley (2013)</td>
<td>82</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>PII</td>
<td>IES</td>
<td>Home</td>
</tr>
<tr>
<td>Carter et al. (2011)</td>
<td>62</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>HMTW</td>
<td>BAU</td>
<td>Lab</td>
</tr>
<tr>
<td>Girolametto et al. (2007)</td>
<td>3</td>
<td>35</td>
<td>30</td>
<td>N/A</td>
<td>HMTW</td>
<td>None</td>
<td>Home</td>
</tr>
<tr>
<td>Green et al. 2010</td>
<td>152</td>
<td>45</td>
<td>93.5</td>
<td>111.1</td>
<td>PACT</td>
<td>TAU</td>
<td>Lab</td>
</tr>
<tr>
<td>McConachie et al. (2005)</td>
<td>51</td>
<td>38</td>
<td>34.64</td>
<td>30.75</td>
<td>HMTW</td>
<td>Delayed</td>
<td>Home</td>
</tr>
<tr>
<td>McDuffie et al. (2014)</td>
<td>8</td>
<td>44</td>
<td>42.25</td>
<td>-</td>
<td>VTC</td>
<td>None</td>
<td>Clinic/Lab</td>
</tr>
<tr>
<td>Siller et al. (2013)</td>
<td>70</td>
<td>57</td>
<td>-</td>
<td>-</td>
<td>FPI</td>
<td>PAC</td>
<td>Lab</td>
</tr>
<tr>
<td>Venker et al. (2011)</td>
<td>9</td>
<td>41</td>
<td>128.30</td>
<td>-</td>
<td>HMTW-A</td>
<td>Waitlist</td>
<td>Research Clinic</td>
</tr>
</tbody>
</table>

Mean: 51.67, 59.45, 55.78, 16.22


A number of parent-implemented programs were investigated which had standardized procedural manuals. The Hanen More Than Words Program (Sussman, 1999) was the most common approach, with three studies utilizing the standard More
Than Words curriculum and one using a Hanen-approved adapted version. Most of these intervention programs involved group instruction with individualized coaching sessions to practice strategies. Pre- and post-intervention assessments included a caregiver-child play session using a standard set of toys (and in some studies storybooks and other activities). These play sessions were videotaped and later analyzed for the outcome measures.

The main results across all of the studies were as follows. First, the caregivers in the experimental groups were able to learn the responsive language facilitation strategies targeted in the studies and used them more post-intervention than the caregivers in the control groups. These spoken responsive language strategies included: (a) follow-in comments or language that is meaningfully related to the child’s focus of attention; (b) linguistic mapping that translated or interpreted child’s non-symbolic communication acts; (c) follow-in directives for behavior (i.e., commands or requests); (d) follow-in directives for language that required a response from the child (i.e., questions, commands, or requests); (e) imitations and expansions that related to the child’s previous spoken utterance; (f) other spoken language that involved responses such as affirmations, praise, and interjections. It is important to note that the first three strategies (a, b, and c) did not relate to the children’s spoken utterances or non-speech vocalizations, whereas the next two strategies (d and e) did relate to the children’s spoken utterances, and the final strategy (f) could relate to non-symbolic or symbolic communicative acts, non-speech vocalizations, or actions produced by the child. These strategies were found to increase as a result of caregiver training. Spoken responses that were not related to the
child’s focus of attention or which redirected the child’s focus of attention were found to decrease as a result of training across the different interventions.

Second, several studies determined that increases in children’s language abilities appeared to be related to the effects of the parent training. These child language abilities included: (a) initiation of non-symbolic intentional communication acts including gestures such as showing, giving, and pointing (Aldred, Green, & Adams, 2004; Girolametto, Sussman, & Weitzman, 2007; Green et al., 2010); (b) initiation of symbolic communication acts (i.e., spontaneous production of spoken words, manual signs, etc.); (c) prompted behaviors or prompted spoken language (Venker, McDuffie, Ellis Weismer, & Abbeduto, 2011); (d) receptive and expressive abilities as measured by parent report or other objective indices of language abilities (Girolametto et al., 2007; Green et al., 2010).

In some cases, although caregivers learned the strategies, children did not increase in their use of communicative acts (McDuffie et al., 2013).

A third finding across many of the intervention research studies was that there appeared to be differential effects of treatment depending on certain baseline characteristics of the children, including: (a) age and/or cognitive status (Aldred et al., 2004); (b) autism severity (McConachie, Van Randle, Hammad, and LeCouteur, 2005); (c) play skills (Carter et al., 2011; McDuffie et al., 2013); and (d) spoken language skills (Siller, Hutman, & Sigman, 2013). In general, children who were younger and/or had greater cognitive impairment, greater autism severity, less advanced play skills, and less advanced language skills appeared to benefit more from caregivers’ implementation of the responsive strategies than children with more advanced abilities. In one study conducted by Bottema-Beutel, Yoder, Hochman, and Watson (2014), when the parents
produced follow-in comments while they were engaged in reciprocal and coordinated play with their children, the children had higher receptive language skills when measured eight months later, compared to children who engaged in play that was not reciprocal and coordinated.

It is intriguing that a pattern of differential effects of intervention emerged out of this synthesis of the research. Specifically, children with presymbolic or early spoken language skills benefitted more from the responsivity strategies their caregivers learned than did children with more advanced spoken language skills. Equally intriguing is why in some cases, children with somewhat more advanced language skills showed a decrease in their performance on language measures when their parents made increased use of these responsivity strategies.

Despite the importance, to my knowledge, the specific characteristics of caregiver spoken language interactions with children with ASD who are beginning communicators have not been widely addressed in the literature, nor have the specific characteristics of the children’s spoken language. However, a recent pilot study did attempt to explore quantitative and qualitative characteristics of maternal spoken language with this group of children.

**Quantity and Quality of Maternal Spoken Language with Beginning Communicators with ASD**

A pilot descriptive study by Breakstone (2016) sought to describe the characteristics of spoken language interactions of six mothers with their young children with ASD and limited spoken language who were between 2:0 and 6:0 years of age.
Mothers made digital voice recordings of their interactions with their children during one 2- to 3-hour period at home. One hour of each dyad’s interaction was transcribed and analyzed for: (a) quantitative characteristics: total number of utterances and word tokens spoken by mothers per hour; mean length of utterance; and (b) qualitative characteristics: total number of different words spoken per hour; lexical diversity; semantic roles and other types of utterances expressed by mothers; and the proportions of declarative, imperative, interrogative utterances produced.

Breakstone (2016) concluded that there was a great deal of variability across the six mothers. This was evident from the total number of utterances expressed; the number of words and the number of different words spoken; and the diversity of the words mothers used in talking to their young children. Results were consistent with the limited published literature on caregiver language and young children with ASD who have limited spoken language. Results suggested that the mothers’ language was not impoverished; on the contrary, most mothers were talkative and conversed about a variety of semantic roles, used varied utterances types, and produced diverse vocabulary as determined by the number of different words produced and measures of lexical diversity. The study added to the literature by describing the semantic content of the language-learning environment provided by mothers while interacting with their young children with ASD during routines and activities in their natural environments.
Limitations of the Research and Gaps in our Knowledge

The foregoing synthesis of evidence underscores several limitations. First, in many of the studies there were heterogeneous groups of children with different levels of functioning. Some may have been intentional presymbolic or emerging symbolic communicators, whereas other children in the same study were using spoken word combinations or sentences flexibly and regularly. These children may have been at very different stages of language development. The research on language acquisition in typically developing children indicates that the characteristics of caregivers’ language impact children’s language differently at different points in development. This may be the same for children with ASD who are older but at comparable stages of language acquisition. Interventions that focus solely on caregivers’ use of responsive language strategies may not be as appropriate for children with ASD at later stages of language learning.

A related limitation of these studies is that most of the responsive strategies taught to caregivers of children with ASD who are beginning communicators have focused on children’s presymbolic or nonsymbolic behaviors rather than on speech-like vocalizations or spoken language. This is in sharp contrast to the research on caregiver responsivity to typically developing children which has focused on caregivers’ semantically and temporally contingent spoken language responses to children’s vocalizations and spoken words.

In fact, research on language development in typically developing children emphasizes that the data-providing characteristics of caregiver language were more
important for language development when children were beginning to combine words. This is when the quantity and quality of caregiver language become more influential for children’s language learning. A lack of attention to these characteristics of caregiver language could potentially explain why the children with ASD who had somewhat more advanced language showed attenuated growth in some correlational and intervention studies.

By extension, then, another limitation of these studies is the lack of data on the quantity and quality of caregiver and child language. Girolametto et al. (2007) was the only study of those surveyed which reported the number of different words used by the children pre- and post-treatment from the language samples. Since the transition from presymbolic to symbolic communication to multi-symbol communication is a gradual process, beginning communicators may need the data-providing features of caregiver language throughout these phases of language development. The recent pilot study by Breakstone (2016) described the quantity (i.e., number of utterances, number of words, mean length of utterances) and quality (number of different words, lexical diversity, and semantic categories) of maternal language to young children with ASD who were beginning communicators. However, there were several limitations to the study by Breakstone (2016). For example, there were few participants. Furthermore, the focus was on only mothers’ language, and mothers’ vocabulary was described broadly. In addition, there was limited description of the children’s communication, and there was significant variation in the children’s skills.

Another limitation in this research on caregiver language and children with ASD who are beginning communicators is that the majority of studies investigated caregiver-
child interactions in less than natural conditions. In other words, caregivers and children were usually seen in a research lab or clinic rather than in their homes. Furthermore, most of the studies used a standard set of potentially unfamiliar toys. For children with ASD, the characteristics of these settings may not be conducive to children’s optimal performance. In fact, in some of the studies, the researchers indicated that parents had difficulty engaging their children with some of the materials. There are advantages to conducting the research in a lab or clinic, most notably, fewer of the distractions that are prevalent in the home environment. In addition, use of a standard set of toys limits the variability that occurs when families use their own toys and objects. Yet, this variability can be important because it highlights the similarities and differences across families. Relatedly, in these studies of caregiver language and young children with ASD with limited spoken language, a restricted number of contexts were explored, primarily play, and in a few studies, book-sharing. Caregiving contexts were rarely investigated. We know from research on typical language development that caregiver language characteristics vary across contexts, and caregivers use different types of utterances and different types of words depending on the context (Hoff-Ginsberg, 1991; Rowe, 2008, 2012).

An additional limitation in this research is how change in children’s language development was measured. In most studies, this was done either through a parent report measure such as the MacArthur-Bates Communicative Development Inventories or standardized assessment tools such as the Preschool Language Scale among others. Kasari et al. (2013) pointed out the disadvantages in using standardized assessment measures for children with ASD who are beginning communicators with limited speech,
such as children’s lack of compliance to following standardized test directions, and lack of validation of standardized tests on samples of children with ASD. Furthermore, some of the studies discussed the potential for bias that could be involved in using parent report measures since caregivers were aware of their participation in the treatment or control conditions. Kasari et al. recommended using language samples obtained from caregiver-child interactions to supplement these other language assessment methods.

A final limitation is that relatively few studies have focused on the relationships between maternal language input and vocabulary development in children with ASD who are beginning communicators at early phases of spoken language development. More often, participants in this research consisted of heterogeneous groups of children, some of whom had limited speech. As Tager-Flusberg and Kasari (2013) indicated, children with ASD and limited spoken language are at “the neglected end of the spectrum.” The Interagency Autism Coordinating Committee (2011) renewed the call for more research on this subgroup of children with ASD.

These limitations in the current research on caregiver language input to children with ASD who are beginning communicators reveal some of the gaps in our knowledge. Specifically, we have incomplete information regarding the types of responsive input caregivers provide to young children with ASD in their natural environments. In addition, we do not have information regarding the quantity or quality of this input: how many words the caregivers use, how many different types of words they use, and the complexity of their utterances. As children make the transition from presymbolic, to symbolic, and eventually to multi-symbolic communication, information about the types
of symbols they use when caregivers provide responsive input may illuminate
relationships between caregivers’ and children’s spoken language interactions.

Furthermore, the current literature provides little information about how
caregivers’ language varies in natural contexts throughout their daily interactions with
their young children with ASD who are beginning communicators. All of this
information is important if the goal is to describe beneficial language learning
environments for children and their caregivers, and ultimately to design intervention
programs to help caregivers achieve optimal language learning environments.

From the research with children who are developing language typically, we know
that it is important to consider the specific lexical characteristics of caregiver language
because of the relationships with later expressive vocabulary development in their
children. Similarly, for children with ASD who are beginning communicators, perhaps a
more focused investigation of what caregivers talk about, rather than only how they
communicate, would provide valuable information on the relationships between
caregivers’ language and their children’s vocabulary at this early stage of language
acquisition.

Given the importance of the data-providing aspects of caregiver language and the
limited research to date, the current study was designed to address some of the limitations
of the pilot study. It would then be possible to begin to fill this knowledge gap by
expanding what we know about the language mothers use with their young children with
ASD who are beginning communicators by focusing on the relationships between the
specific lexical aspects of their spoken language interactions.
To date, we know very little about the content of the spoken language of children with ASD who are beginning communicators, other than it is limited. In addition, we know very little about the content of the language caregivers use when talking to their young beginning communicators with ASD who have limited speech. We do not know about the relationship between the two. In light of this dearth of information, the focus of the current investigation was on the characteristics of caregivers’ and children’s spoken language interactions during naturalistic activities in the families’ homes.

The Current Study

Research Questions

The purpose of this study was to conduct a descriptive analysis of the characteristics of the spoken language interactions of young beginning communicators with ASD and their mothers during daily activities in their homes. There were three research questions addressed by the current study.

Question 1:

The first research question was: What are the general characteristics of the utterances children with ASD and their mothers are observed to produce during daily interactions at home, including the number of utterances, the number of words, the number of different words, the grammatical complexity of utterances, and lexical diversity?
It was predicted that there would be variation across children and mothers on both the quantity and quality of spoken language. It was also anticipated that there would be increases in many of these general characteristics for mothers and children at different phases of language development. These increases would occur as children transition from the presymbolic communication, to the emergence of first words, to the vocabulary spurt, and to early word combinations. Social-interactionist theories of language development stress that the environment and social interaction between children and mothers play a prominent role in children’s early acquisition of the language. Research indicates that it is the quantity of maternal language during interactions that exerts the greatest influence in the earliest phases. Specifically, the total amount of utterances and total number of words, and total number of different words have been found to be positively associated with and predict later vocabulary development in children who are developing typically (Hart & Risley, 1995; Huttenlocher et al., 1991; Rowe, 2008, 2012), as well as children who have ASD (Bang & Nadig, 2015; Konstantareas, Zajdeman, Homatidis, & McCabe, 1988; Warren et al., 2010). Other aspects of language complexity (lexical diversity, grammatical complexity) have also been found to be positively associated with or predictive of higher language level (Rowe, 2012). Furthermore, young children vary greatly in the amount of spoken language they produce at these early phases, as do their caregivers. Caregivers who produce more utterances with their young children have also been shown to have more words, more different words, higher lexical diversity, and longer utterances (Rowe, 2008).

Another important general characteristic of children’s spoken language is the amount of unintelligible versus intelligible utterances produced by the children, and
Furthermore, how many utterances contain recognizable words, word approximations, conventional vocalizations, and unconventional vocalizations, and other non-speech sounds. Research indicates that mothers are more responsive to “speech-like” vocalizations of young children at the presymbolic phase of language development (Gros-Louis, West, Goldstein, & King, 2006; Leezenbaum et al., 2014). It would be useful to differentiate intelligible utterances with spoken words and conventional vocalizations from unintelligible utterances that have less speech-like characteristics.

**Question 2:**

The second question was: What are the semantic-syntactic characteristics of the spoken words children with ASD and their mothers are observed to produce during daily interactions at home, and children are reported by mothers to produce and understand?

It was hypothesized that children with ASD who were beginning communicators and their mothers would produce and understand spoken words related to the objects and activities with which they were engaged during daily interactions while playing, sharing books, eating meals, and participating in care giving and social routines. It was also predicted that children with ASD would be reported to understand more words than they were reported to express (Charman, Drew, Baird, & Baird, 2003; Ellis Weismer et al., 2011; Luyster, Lopez, & Lord, 2007; Rescorla & Safyer, 2013). Furthermore, it was also predicted that there would be variability across the children at different phases of spoken language development, and as a result of different contexts and activities for each family (Hoff-Ginsberg, 1991).
Question 3:

The third question was: Is there a relationship between the words a child with ASD produces and the words his/her mother produces during their daily interactions, such that the dyad produces a common set of spoken words (i.e., a shared lexicon)?

a. Does the dyad’s shared lexicon include words that the mother and/or child produces more frequently during their natural language sample?

b. Does the dyad’s shared lexicon include words that the mother and child imitate during their natural language sample?

It was predicted that the dyad’s shared lexicon would consist of the words produced frequently by the mother and/or child in their natural language sample, and it would consist of words that the mother and child imitated from each other’s prior utterances during the natural language sample. It was also predicted that shared lexicons would vary across dyads as a result of different contexts and activities for each family.

At the early phases of spoken language acquisition, when children are building a lexicon, the words they learn first are those used most often by their caregivers (Brent & Siskind, 2001; Goodman et al., 2008; Hart, 2004; Huttenlocher et al, 1991). If a child and his/her mother engage in joint activities with objects during daily interactions, and the child talks about these objects and activities, the mother produces semantically and temporally contingent talk about the same objects and activities in response to the child (Tamis-LeMonda et al., 2001). Imitation is one type of contingent talk. When contingent talk occurs, words are repeated. The mother imitates and expands upon the child’s utterance, and the child imitates the mother’s utterance (Olson & Masur, 2012; Tamis-LeMonda et
al., 2001). In doing so, there is an overlap in the words the child and mother produce during these interactions (Che et al., 2018; Sokolov, 1993; Sokolov & Overton, 2004).

Overall, the current research study was designed to enhance understanding of the bidirectional influence and relationship between the general and specific characteristics of the spoken language interactions of young beginning communicators with ASD and their mothers.
Chapter 2

Method

Research Design

A descriptive research design was selected for the current study. There were several reasons for this choice of methodology. First, there is a lack of naturalistic observation (Schiavetti & Metz, 2006, p.49) of maternal language input to young children with ASD who are beginning communicators, particularly with regard to their interactions in daily routines within their natural environments. Second, although the previous literature review demonstrated that numerous experimental studies have been conducted to teach parents to use various types of responsive strategies to promote language development when interacting with their children with ASD, in-depth descriptions of caregiver-child interactions at the level of lexical characteristics have rarely been undertaken or reported for this group of children with ASD. Third, little is known about the relationships between mothers’ language input and the concurrent language abilities of their children with ASD who are beginning communicators. Although there is information regarding the relationships between the social-pragmatic characteristics of caregiver language input and vocabulary development in young beginning communicators with ASD, the data-providing characteristics of the caregivers’ lexicon have been largely overlooked. A descriptive study is the first step to better understand the nature of a phenomenon in order to generate hypotheses to test in future
studies. As Grimes and Schulz (2002) stated, “Descriptive studies often represent the first scientific toe in the water in new areas of inquiry” (p. 145).

Participants

Inclusion Criteria

The dyads selected for inclusion in the current study were composed of a mother and her child with ASD.

Mothers

A mother was selected for inclusion in the study based on the following criteria: (a) she was the mother, stepmother, or female guardian of a child between the ages of 2;0 and 6;0 years of age with a diagnosis of autism or autism spectrum disorder who met the inclusion criteria below; (b) the woman was the primary caregiver of the child; and (c) English was the primary language spoken in the home.

Children

A child was selected for inclusion in the study based on the following general criteria: (a) the child was between 2;0 and 6;0 years of age; (b) had a diagnosis of autism or autism spectrum disorder, or for children who were younger, a “best estimate diagnosis” of autism or autism spectrum disorder based on direct observation, clinical
judgment, and developmental assessment by qualified professionals such as psychiatrists or psychologists (Lord et al., 2006); (c) had hearing and visual acuity within normal limits; (d) had receptive vocabulary consisting of one or more concepts but less than or equal to 396 words as measured by parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures Form (ceiling); (e) had expressive vocabulary between 0 and 50 word types (spoken words, signs, picture symbols, or written words); and (f) had a mean length of utterance between 0.0 and 3.0. Children with language abilities in this range at this age would be considered to be within the first three phases of spoken language acquisition described by Tager-Flusberg et al. (2009): Phase 1: Preverbal Communication, Phase 2: First Words, and Phase 3: Word Combinations. Children with ASD who were at Phase 4: Sentences and Phase 5: Complex Language were excluded from the study.

Recruitment

Prior approval was obtained from the Institutional Review Board (IRB) of Penn State University (See Appendix A). Printed flyers were distributed to administrators of various early intervention and preschool programs, and several outpatient clinics. Participants were also recruited with the assistance of the Interactive Autism Network (IAN) Research Database at the Kennedy Krieger Institute, Baltimore, Maryland through IRB-approved emails. Nationwide recruitment was conducted via emails that were sent to families based on parents’ responses to the IAN survey indicating that their child had
been diagnosed with ASD and was nonverbal or had limited speech. These emails were sent to families across the United States.

Once a family contacted the investigator, a telephone/email screening was conducted to determine whether the family met the eligibility criteria (see Appendix B). This screening consisted of a telephone or email script with specific questions regarding the inclusion criteria, for example: “Are you the mother of a child with autism or autism spectrum disorder? Or has your child received a best clinical estimate of autism spectrum disorder?” “Does your child have a vocabulary of 0 to 50 different words (spoken, written, signed, photos, or pictures)?” The caregiver’s spoken (via telephone) or written (via email) responses to these questions were evaluated to determine whether the mother and child met the inclusion criteria. If the mother and child met the eligibility criteria according to mother report, a follow-up appointment was made to explain the project and obtain informed consent. In appreciation for participation in the research study, caregivers were given a $20 Target gift card for each child participant at the conclusion of their participation.

Number of Participants

Thirteen mother-child dyads were recruited for the study in keeping with sample sizes from prior research of caregiver language input to children with typical development and to children with language delays, including ASD, (e.g., Akhtar, Dunham, & Dunham, 1991; Brent & Siskind, 2001; Girolametto, Weitzman, Wiigs, & Pearce, 1999; Goldin-Meadow, Goodrich, Sauer, & Iverson, 2007; Konstantareas et al.,
1988; Ratner, 1988; Retherford, Schwartz, & Chapman, 1981; Watson, 1998; Wolchik, 1983). The current study collected a large natural language sample from each dyad for analysis, and in-depth analyses were conducted of each mother’s and child’s spoken language. Six of the mother-child dyads participated in the earlier pilot study by Breakstone (2016). These six samples were re-analyzed for new measures in the present investigation. Seven new dyads were recruited to also participate in the current study.

**Participant Demographics**

Table 2-1 lists the demographic characteristics of the children and caregivers who participated in the current study. All of the caregivers were mothers. There were 13 different dyads involving 12 mothers and 13 children. One mother participated twice because both of her sons met the inclusion criteria for participation (the children in Dyads 12 and 13). The dyads included one girl and 12 boys with ASD. The children ranged in age from 26 months to 76 months at the time of data collection. The families were from a wide geographic area across the U. S. This resulted in a geographically and ethnically diverse group. All but two mothers provided information about their ethnicity and that of their children using the categories for race and ethnicity from the National Institutes for Health (U.S. Department of Health & Human Services, National Institutes of Health, 2015): four self-identified as Hispanic; two as Asian; and five as White, Non-Hispanic. One child was identified as Black, one as Asian, two as Hispanic, three as having mixed ethnicity (two were Hispanic and White, and one was Asian and White), and five as White. All families spoke English as their primary language, but several
caregivers \((n = 6)\) indicated that their children were exposed to a language other than English through parents or grandparents for varying amounts per day. These additional languages included: Spanish (Dyads 2, 5, 12, and 13), Swahili (Dyad 3), and Tamil (Dyad 6).

Of the 13 children, 10 produced spoken words and three produced no spoken words during the natural language sample. According to parent report, six of the children had been exposed to AAC strategies and/or devices in the past or used them primarily in their school settings. Two used an iPad with an AAC application (app) and the others used the Picture Exchange Communication System (PECS; Bondy & Frost, 2001), or manual signs. Seven children had not been introduced to aided or unaided AAC.

On average, the mothers who responded \((n = 11)\) had a mean of 16.4 years of education. As a group, the mothers were well-educated, with 14 or more years of education. Three of the mothers indicated that they were homemakers, while the majority of mothers were employed in various professions outside the home.
<table>
<thead>
<tr>
<th>Dyad</th>
<th>Child gender</th>
<th>Child age (months)</th>
<th>Child disability</th>
<th>Produced spoken language</th>
<th>Language development phase</th>
<th>AAC use</th>
<th>Languages spoken in the home (primary/other)</th>
<th>Mother/child ethnicity</th>
<th>Mother education (years)</th>
<th>Mother occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>M</td>
<td>67</td>
<td>ASD</td>
<td>No</td>
<td>Presymbolic/Intentional</td>
<td>PECS* book</td>
<td>English</td>
<td>W/W</td>
<td>16</td>
<td>Education Administrator</td>
</tr>
<tr>
<td>2*</td>
<td>M</td>
<td>39</td>
<td>ASD</td>
<td>Yes</td>
<td>First Words</td>
<td>None</td>
<td>English/Spanish</td>
<td>H/H</td>
<td>17</td>
<td>Executive Assistant</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>44</td>
<td>ASD</td>
<td>Yes</td>
<td>First Words</td>
<td>iPad/AAC app</td>
<td>English/Swahili</td>
<td>W/B</td>
<td>18</td>
<td>Educator</td>
</tr>
<tr>
<td>4*</td>
<td>F</td>
<td>58</td>
<td>ASD</td>
<td>Yes</td>
<td>Presymbolic/Intentional</td>
<td>Manual signs</td>
<td>English</td>
<td>W/W</td>
<td>16</td>
<td>Software Developer</td>
</tr>
<tr>
<td>5*</td>
<td>M</td>
<td>26</td>
<td>ASD</td>
<td>No</td>
<td>Presymbolic/Intentional</td>
<td>Manual signs</td>
<td>English/Spanish</td>
<td>H/H</td>
<td>14</td>
<td>Homemaker</td>
</tr>
<tr>
<td>6*</td>
<td>M</td>
<td>27</td>
<td>ASD</td>
<td>No</td>
<td>Presymbolic/Intentional</td>
<td>None</td>
<td>English/Tamil</td>
<td>A/A</td>
<td>16</td>
<td>Computer Engineer</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>48</td>
<td>ASD; FX; SPD</td>
<td>Yes</td>
<td>First Words</td>
<td>None</td>
<td>English</td>
<td>W/W</td>
<td>15</td>
<td>Behavior Technician</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>76</td>
<td>ASD; ADHD; PANDAS</td>
<td>Yes</td>
<td>First Words</td>
<td>None</td>
<td>English</td>
<td>W/W</td>
<td>18</td>
<td>Higher Educator</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>47</td>
<td>ASD</td>
<td>Yes</td>
<td>Word Combinations</td>
<td>None</td>
<td>English</td>
<td>A/A&amp;W</td>
<td>17</td>
<td>Executive Assistant</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>64</td>
<td>ASD</td>
<td>Yes</td>
<td>First Words</td>
<td>Pictures</td>
<td>English</td>
<td>N/A*</td>
<td>17</td>
<td>Educator</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>53</td>
<td>ASD</td>
<td>Yes</td>
<td>Word Combinations</td>
<td>iPad/AAC app</td>
<td>English</td>
<td>N/A*</td>
<td>N/A*</td>
<td>N/A*</td>
</tr>
<tr>
<td>12**</td>
<td>M</td>
<td>33</td>
<td>Nonverbal Autistic; CAS</td>
<td>Yes</td>
<td>Presymbolic/Intentional</td>
<td>None</td>
<td>English/Spanish</td>
<td>H/H&amp;W</td>
<td>17</td>
<td>Homemaker</td>
</tr>
<tr>
<td>13**</td>
<td>M</td>
<td>63</td>
<td>Nonverbal Autistic; CAS</td>
<td>Yes</td>
<td>First Words</td>
<td>None</td>
<td>English/Spanish</td>
<td>H/H&amp;W</td>
<td>17</td>
<td>Homemaker</td>
</tr>
</tbody>
</table>

**Note:** * Dyads who participated in the pilot study. **Dyad 12 and Dyad 13: the mother was the same individual. *Produced spoken language during natural language sample.

1Ethnicity: W = White; H = Hispanic; B = Black; A = Asian. 2ASD = Autism Spectrum Disorder. 3PECS = Picture Exchange Communication System (Bondy & Frost, 1994).

5FX = Fragile X syndrome. 6SPD = Sensory processing disorder; 7ADHD = Attention deficit hyperactivity disorder; 8PANDAS = Pediatric autoimmune neurological disorder associated with strep; 9N/A = not currently available. 10Parent report of diagnosis. 11CAS = Childhood Apraxia of Speech.
Materials

Two sets of materials were provided to the mothers: digital recording equipment for data collection and the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007). The families were shipped a package with the digital recording equipment and MCDI form. The following documents were included in the package: (a) Appendix C: Instructions for Digital Voice Recording; (b) Appendix D: Instructions for Completing the MCDI and returning the equipment to the researcher; and (c) a pre-paid return shipping label. When the recordings and the MCDI form were completed, the mothers were instructed to pack all of the equipment and the completed MCDI questionnaire in the original shipping carton. They then called FedEx for a pickup at their convenience. All packing materials were provided.

Digital Voice Recording Equipment

Sony Model ICD-PX333 digital voice recorders were used. This small device was placed in an iGadgitz (brand name) leather case, which was worn either on a belt or attached to a belt loop with a supplied carabiner. In addition, a Sony Tie-clip microphone model ECM-CS3 (electret condenser microphone compatible with Sony digital voice recorders) was provided to be attached to the mother’s shirt or sweater with the wire concealed so the child would not pull it. All of the equipment was placed in a sturdy plastic box with typed instructions. Refer to Appendix C for the Instructions for the
Digital Voice Recordings. The digital recorder, microphone, and the settings were set prior to giving the equipment to the mother.

MacArthur-Bates Communicative Development Inventories

In addition to the digital voice recording equipment, the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007) questionnaire was included with instructions in the package. Refer to Appendix D for the Instructions for Completing the MacArthur-Bates Communicative Development Inventories. This parent report measure of vocabulary was available in two forms in the present study: (a) the Words and Gestures form for use with children having language developmental ages from 8 months to 18 months; and (b) the Words and Sentences form for use with children having language developmental ages from 16 months to 30 months. Either the Words and Gestures form or the Words and Sentences form was included in the package depending on the child’s language level as reported by the mother in a follow-up interview (see Data Collection Procedures below). Eleven mothers completed the Words and Gestures form for their children; one of these mothers completed the Words and Gestures questionnaire for each of her two sons. One other mother completed the Words and Sentences form.
Data Collection Procedures

Once it was determined that a mother and child met eligibility criteria, and the mother indicated a desire to participate in the study, the researcher obtained informed consent and conducted a phone or email interview (see Appendix E). In this interview, the researcher obtained information about the child, the mother, and the family as well as the mother’s and child’s daily routines. Additional information about the child’s communication abilities (i.e., language development milestones, speech and language therapy history and current status, AAC history and current status) was also obtained during the interview.

After this interview, the mother was instructed to use the digital recorder to record her interactions with her child during one 2- to 3-hour period. In order to obtain natural language samples that reflected the dyads’ typical daily activities, the mothers chose the interactions that they recorded.

Since the goal of the current study was to capture mother-child interaction in natural environments, mothers were asked to include a variety of caregiving, mealtime, play, and book reading activities when they recorded their interactions with their children in an effort to sample as many of these naturally-occurring contexts as possible. Since the contexts were not strictly controlled there was variation across dyads in terms of the activities; these differences may have affected the vocabulary and other language characteristics the dyads used.

In addition, mothers were asked to record only when they were interacting with their child, if possible, and not when other family members or other individuals were
present. If they preferred, they were permitted to record over several times and/or dates if it was difficult to record two- to three hours at one time.

**Transcription and Coding**

All of the MP3 audio recordings received from the dyads were downloaded from the digital recorders to a dedicated computer and then transcribed and analyzed according to the procedures described below.

**Selection of Interaction Segments for Analysis**

Table 2-2 indicates the specific activities in which each mother-child dyad engaged during their natural language sample. Overall, the group of mothers and children participated in numerous activities throughout the recording time. Of the ten types of activities, the most frequent activities in which the majority of dyads engaged were: eating meals or snacks (.92); playing with electronic media and games (.77); and caregiving, such as bathing, toileting, and brushing teeth (.77).
Although each family was asked to record 2-3 hours of interactions, the amount of time varied across families, ranging from 48.55 minutes to more than 8 hours. The entire

### Table 2-2: Proportion of dyads out of total number of dyads engaged in specific activities during natural language samples.

<table>
<thead>
<tr>
<th></th>
<th>ADL</th>
<th>Eat Meals</th>
<th>Play: Toys</th>
<th>Sing Songs</th>
<th>Play: Gross Motor</th>
<th>Play: media</th>
<th>Read stories</th>
<th>Daily Care</th>
<th>Art</th>
<th>Interact: pet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyad 1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 7</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 8</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 9</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 10</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 11</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 12</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyad 13</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion</td>
<td>.46</td>
<td>.92</td>
<td>.69</td>
<td>.54</td>
<td>.46</td>
<td>.77</td>
<td>.46</td>
<td>.77</td>
<td>.15</td>
<td>.31</td>
</tr>
</tbody>
</table>

Note: 1. The mothers in Dyad 12 and Dyad 13 were the same individual. 2. ADL = Activities of daily living, which include dressing, undressing, getting ready for bed and for school. 3. Daily care activities, which include bathing, toileting, brushing teeth, napping.
recording for each dyad was transcribed, with the exception of one dyad (Dyad 2) from the pilot study (Breakstone, 2016) for whom the first 3 hours was transcribed of the more than 8 hours provided. Because the families were allowed to choose the type and duration of “typical” activities in which they engaged with their child for the recordings, it was not possible to limit activities in the selected transcripts. Consequently, the first 60 minutes of the transcribed interaction were selected for analysis for all but two dyads; one mother engaged in interaction with her child for only 57.97 minutes (Dyad 10) and the other engaged in only 48.55 minutes (Dyad 8). For these two dyads, the data were extrapolated to 60 minutes.

Observer effects can often be a concern with language samples that are obtained through audio- or video-recordings made by researchers who are present at the time and place the recordings are made (Gardner, 2000). Participants may be uncomfortable in the presence of researchers or may act differently than they normally would in their natural environments. In the current study, attempts were made to minimize the observer effect; there were no observers in the home during the recordings as the mothers made them independently.

**Transcription**

The Codes for the Human Analysis of Transcripts of Child Speech (CHAT) from the Child Language Data Exchange System (CHILDES) project (MacWhinney, 2000) were used to transcribe the mother-child recordings of their interactions. A graduate research assistant, blind to the goals of the study, was trained in the transcription program
and procedures, meeting weekly for several months with the researcher to learn the transcription conventions, and practice transcription of recordings of mother-child dyads. The graduate research assistant was trained until he reached a criterion of $\geq 90\%$ correct transcription compared to the standard. The standard was based on the transcriptions by the researcher of practice recordings of children’s and mothers’ utterances for two interactions. Once he attained criterion, he began to transcribe the recordings of the participants. The training process took approximately two to five hours weekly over a five-month period. The graduate research assistant also learned how to use the CHECK command in CLAN to check the formats of the transcripts on a regular basis for accuracy. The CHECK command allows the transcriber to check the accuracy of the transcription as it is being produced, in order to guarantee accuracy before any further analyses are conducted (MacWhinney, 2000).

Once the data were collected from the participants, the digital audio recordings were downloaded to a dedicated computer preloaded with the CLAN software. The CHAT manual is available as a free download on the CHILDES website (https://childes.talkbank.org), as is a manual for speech-language pathology clinicians (Ratner & Brundage, 2016). In addition, the researcher created an abbreviated manual for quick reference (Appendix F); this was adapted from the CHAT manuals. The CHAT software allowed the MP3 audio recording to be synchronized with the transcript, which improved the accuracy and efficiency of transcription. The researcher and/or the graduate assistant prepared each CHAT file with the appropriate standardized HEADER on the transcript, which consisted of specific programming lines of text indicating the beginning of the transcript, the languages used, the participant identifications (i.e., the
speaker TIER, CHI for child participant and MOT for mother), and the identification of the media file that was attached to the transcript.

Wearing headphones, the transcriber listened to the recording and transcribed the mother and child utterances. The CHAT software has an integrated “walker controller” feature that allows one utterance to be heard and transcribed. As per the CHAT manual recommendations, an operational definition of a C-unit or utterance boundary was determined by two or more of the following criteria: (a) silence or pause of more than 2 seconds; (b) terminal utterance contour; (c) syntax that makes a complete sentence or word(s) that make a complete, appropriate contribution to a conversation. After approximately 50-100 utterances, the transcriber used the CHECK command to check the accuracy of the transcription format, and correct any errors. This is accomplished in the following procedure. The selected CHAT file that has been transcribed is highlighted and the command CHECK is run. Any errors in formatting are indicated in a separate window; these can be printed to a file. Common errors include: using spaces and not tabs; missing “utterance delimiters,” such as a space followed by a period (.) or a question mark (?); and incorrect transcription “syntax.” If there are no errors, a message indicating “Success second pass complete” is indicated. Once all errors have been corrected, the CHECK command is re-run until this “Success second pass complete” message is indicated.

For each interaction, all of the mother’s and child’s utterances were transcribed, including the following: (a) utterances that were fully intelligible consisting of identifiable English words; conventional interjections such as *gosh, well*; conventional
vocalizations\(^1\) such as *ooh, mm, uhoh*; words representing sound effects and onomatopoeic words; (b) utterances that were unintelligible (i.e., consisting of words that were unclear and could not be identified as English words; non-word spoken vocalizations such as babbling or jargon; non-speech vocalizations such as laughing, crying, kissing sounds, other vegetative sounds such as sneezing and coughing); or (c) partially intelligible (i.e., consisting of identifiable words as described above and unintelligible segments or non-word vocalizations). If the transcriber identified a word as partially intelligible, but the mother did not appear to understand the child as judged by her subsequent utterance, the utterance was marked as unintelligible.

In addition, if other individuals were present in the room, they were identified by a different speaker tier caption (e.g., FAT for father, SIS for sister, BRO for brother, etc.) and their utterances were transcribed. Five transcripts (Dyads 1, 2, 12, 13, and 14) included some utterances of speakers other than the mother and child; those utterances were deleted from the transcripts and the revised transcripts were then subjected to the subsequent analyses using the automatic data analysis provided through CLAN. For one participant, the child’s AAC device was activated and this was transcribed as another speaker TIER. Given the limitations of audio-recordings, it was not possible to determine who activated the AAC speech generating device. Comments regarding any other environmental sounds that were perceived by the transcriber (e.g., such as doors

\(^1\) Masur and Olson (2008, p. 707) included “conventional vocalizations” (e.g., *uh, oh, mmm*) in their longitudinal analyses of mother-child dyadic interactions in typically developing beginning communicators at comparable language levels to the children in the current study, ages 10 to 21 months.
opening, dogs barking, someone singing, etc.) were reported on a separate comment tier with the code \textit{% com:} as indicated in the CHAT manual.

When transcriptions were completed for the recordings, each transcript was checked for final accuracy with the CHECK command in CLAN. All transcripts passed this check.

\textbf{Interrater Agreement for Transcriptions}

The following method for determining interrater agreement for transcriptions has been used in the literature for detailed transcriptions of child language, most recently in Burgess, Audet, and Harjusola-Webb (2013) and Hirsch-Pasek et al. (2015). Interrater agreement had been determined previously for the six transcripts from Breakstone (2016) using the following procedures. The researcher independently transcribed the six transcripts. Using random number generation software, randomly selected samples were identified constituting 20\% of the utterances in the transcripts for each of the participants in the study. Trained graduate and undergraduate research assistants, blind to the goals of the study, listened to the randomly selected section of the transcript while viewing the transcript that was originally created by the researcher.

All content was checked for accuracy. Errors were marked on the transcript. Errors included the following: (a) incorrect word(s) transcribed (e.g. \textit{okay wait} was incorrectly transcribed instead of \textit{hey wait}); (b) missing word(s); (c) missing child unintelligible or non-speech vocalizations, such as laughing, crying, etc.; and (d) incorrect speaker tier identification (e.g. the speaker tier was labeled incorrectly as CHI
when it was MOT). An utterance was considered incorrect if any of the above errors occurred; if an utterance contained one or more errors, the entire utterance was considered incorrect. Percentage of agreement for each of the randomly selected transcript segments (mother’s and child’s utterances combined) was calculated by taking the number of agreements at the utterance level divided by the number of agreements plus the number of disagreements at the utterance level (total), and multiplying by 100. The mean percentage of agreement for the first six transcripts was 96%; percentages of agreement ranged from 94 to 100% across the 6 segments. Any disagreements or discrepancies were resolved by discussion and consensus.

Interrater agreement for the second set of seven transcripts was conducted following the same procedures. The trained graduate research assistant, blind to the goals of the study, independently transcribed five of the seven transcripts and the researcher independently transcribed two of the transcripts. Using random number generation software, randomly selected samples were identified constituting 20% of the utterances in the transcripts for each of the participants in the current study. The second transcriber (i.e., whoever did not transcribe the original transcript, either the researcher or the graduate research assistant) listened to the randomly selected section of the transcript while viewing the transcript that was originally created by the first transcriber. All content was checked for accuracy. Errors were marked on the transcript according to the method that was previously described. Percentage of agreement for each of the randomly selected transcript segments (mother’s and child’s utterances combined) was calculated by taking the number of agreements divided by the number of agreements plus the number of disagreements (total), and multiplying by 100. The mean percentage of
agreement for the next seven transcripts was 93%; percentages of agreement ranged from 88 to 98%. Any disagreements or discrepancies were resolved by discussion and consensus.

**Automatic Data Analysis using CLAN**

**Morphemization and Parts of Speech**

After the reliability of the transcriptions was assessed, 60-minute segments of recordings were identified. As mentioned previously, two dyads provided less than 60 minutes (Dyads 8 and 10). The mother’s and children’s utterance tiers (i.e., transcript lines corresponding to the mother’s and the child’s utterances) in each transcript were automatically morphemicized, or broken down into grammatical morphemes by using the MOR and POST commands in CLAN. The transcripts for the six dyads from Breakstone (2016) had previously been morphemicized. These procedures were implemented on the transcripts for the seven new dyads in the current study as well. Both partially intelligible and fully intelligible utterances were analyzed. Fully unintelligible utterances were not analyzed.

In addition, the following procedures were implemented for the transcripts from all dyads. First, the frequency of each word within each part of speech category was obtained via CLAN using the FREQ command that input the frequency of use of these morphemicized words in a CLAN output file. This information addressed the major parts of speech listed in Table 2-3. These data were then imported into Microsoft Excel as a
text file using TextWrangler software. This resulted in a list of word types with
frequencies (tokens) and parts of speech. All further analyses were performed in CLAN
using these morphemicized files.

Table 2-3: Word classes and semantic/syntactic categories for word type coding.

<table>
<thead>
<tr>
<th>Word class</th>
<th>Semantic/syntactic category</th>
<th>MOR Code</th>
<th>Part of speech</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Names</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Vehicles</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Toys</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Food and Drink</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Clothing</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Body Parts</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Furniture and Rooms</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Small Household Items</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Outside Things and Places to Go</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Words about Time</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Unspecified Common Nouns</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>People Words</td>
<td>n</td>
<td></td>
<td>Common noun</td>
</tr>
<tr>
<td>Names of People</td>
<td>n:prop</td>
<td></td>
<td>Proper noun</td>
</tr>
<tr>
<td>Character names</td>
<td>n:prop</td>
<td></td>
<td>Proper noun</td>
</tr>
<tr>
<td>Action Words</td>
<td>v</td>
<td></td>
<td>Main verbs</td>
</tr>
<tr>
<td>State Words</td>
<td>v</td>
<td></td>
<td>Main verbs</td>
</tr>
<tr>
<td>Copula</td>
<td>cop</td>
<td></td>
<td>Copula</td>
</tr>
<tr>
<td>Descriptive Words</td>
<td>adj</td>
<td></td>
<td>Adjectives</td>
</tr>
<tr>
<td>Descriptive Words</td>
<td>adv</td>
<td></td>
<td>Adverbs</td>
</tr>
<tr>
<td>Closed Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determiners</td>
<td>det</td>
<td></td>
<td>Determiners</td>
</tr>
<tr>
<td>Quantifiers</td>
<td>qu</td>
<td></td>
<td>Quantifiers</td>
</tr>
<tr>
<td>Question Words</td>
<td>wh</td>
<td></td>
<td>Wh- Questions</td>
</tr>
<tr>
<td>Prepositions</td>
<td>prep</td>
<td></td>
<td>Prepositions</td>
</tr>
<tr>
<td>Infinitives</td>
<td>inf</td>
<td></td>
<td>Infinitives</td>
</tr>
<tr>
<td>Pronouns</td>
<td>pro</td>
<td></td>
<td>Pronouns</td>
</tr>
<tr>
<td>Helping Words</td>
<td>aux</td>
<td></td>
<td>Auxiliary verbs</td>
</tr>
<tr>
<td>Helping Words</td>
<td>mod</td>
<td></td>
<td>Modals</td>
</tr>
<tr>
<td>Connecting Words</td>
<td>coord</td>
<td></td>
<td>Coordinators</td>
</tr>
<tr>
<td>Connecting words</td>
<td>conj</td>
<td></td>
<td>Conjunctions,</td>
</tr>
<tr>
<td>Articles</td>
<td>art</td>
<td></td>
<td>Articles</td>
</tr>
<tr>
<td>Possessive</td>
<td>poss</td>
<td></td>
<td>Possessive</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound Effects (onomatopoeia)</td>
<td>on</td>
<td></td>
<td>Communicators</td>
</tr>
<tr>
<td>Animal Sounds (onomatopoeia)</td>
<td>on</td>
<td></td>
<td>Communicators</td>
</tr>
<tr>
<td>Communicators</td>
<td>co</td>
<td></td>
<td>Communicators</td>
</tr>
<tr>
<td>Interjections</td>
<td>co</td>
<td></td>
<td>Communicators</td>
</tr>
<tr>
<td>Games and Routines</td>
<td>co</td>
<td></td>
<td>Communicators</td>
</tr>
</tbody>
</table>

The word class and semantic/syntactic categories in Table 2-3 were derived from the semantic/syntactic categories of the MCDI; the Vocabulary Checklists are organized by semantic categories such as animals, vehicles, places to go, people, action words, descriptive words and syntactic categories such as pronouns, quantifiers and articles, prepositions, etc. Syntactic categories corresponding to the parts of speech of nouns, verbs, states, adjectives, adverbs comprised the open class words; quantifiers, prepositions, pronouns, etc. comprised the closed class words. Social words consisted of sound effects, animal sounds, communicators, games and routines, etc. The parts of speech are the morphological codes that are generated from the morphemization in CLAN (MacWhinney, 2000). Many studies of caregiver input and child language utilize the semantic/syntactic categories and morphological codes specified (Bates, Bretherton, & Snyder, 1988; Charman et al., 2003; Luyster et al., 2007; Zampini et al., 2011). There is a substantial research base that utilizes CHILDES and the specific analyses such as the MOR and FREQ.

Next, the researcher inspected and adjusted the mother’s utterances for word types/parts of speech as follows. For this research study, different inflections of a word were treated as the same word type, which is a common practice in studies of caregiver input and early child language development. Singular and plural forms of nouns were automatically morphemicized in the frequency output as two different word types. The researcher then recoded the separate types as one type preserving the total number of tokens. For example, if a transcript had the following word types, dog (one type, 4 tokens) and dogs (one type, 2 tokens), these would be recoded as one word type, dog, with 6 tokens. Similarly, words with irregular plural morphology were recoded as one
type (e.g., foot/feet or mouse/mice). Proper names with different variations were also recoded as one type: Bud/Buddy). In the case of verbs, different verb inflections were coded as one type. For instance, eat, eats, eating, and ate were recoded as one verb type, eat. In English, certain words may be used as either a noun or a verb (e.g., the word drink). When such ambiguities were present, the individual utterances were checked in the transcript to determine which part of speech was used in these cases, and the number of tokens per type. The number of different types and tokens per type were indicated in the EXCEL file for the mother or the child as needed (i.e., verb drink, with 3 tokens; noun drink, with 6 tokens)

Following these adjustments, the researcher examined the data for any errors in the automatic coding of morphemes. An error might occur in the automatic coding of a speaker’s single word utterance. For example, if the single word utterance bubbles was incorrectly coded as a third person singular of the verb bubble (v|+3S) rather than a plural noun (n:PL), the researcher identified that utterance in the morphemicised transcript and examined the data. In such a case, the researcher inspected the transcription, and if necessary, listened to the utterances prior to the target utterance to determine the linguistic context in which this utterance occurred. A decision was then made regarding the part of speech of the target word. An error might also occur when a word could be used as either a noun or a verb, as in the word call. It was necessary to determine whether the automatic coding was correct or incorrect by examining the transcript to identify the context of the target utterance. If the coding was judged to be incorrect (i.e., an error), the FREQ output file was corrected.
From these adjusted and corrected data, a Microsoft Excel worksheet was created of words produced by the mother from the most frequent to the least frequent. The same procedures outlined above were applied to all of the mothers’ utterances, and then to all of the children’s partially and fully intelligible utterances. Fully unintelligible children’s utterances were not analyzed.

**Accuracy of Automatic Morpheme Coding**

The criterion for accuracy of automatic coding of morphemes (i.e., results of the MOR command of CLAN) was set at 90%. Accuracy was calculated by tabulating the number of agreements and then dividing by the number of agreements plus disagreements (total) and multiplying by 100 to determine the percent of accuracy agreement. The mean accuracy agreement for the mothers’ data was 95% (range = 92% to 97%) and 95% for the children’s data (range = 88% to 100%) for all 13 dyads. The accuracy percentage for one child was only 88%; this transcript had very few word types, (i.e., 16 word types), hence two errors in coding resulted in a percentage of accuracy agreement of 88% for this child.

**Coding of Semantic/Syntactic Categories**

Next, the researcher coded maternal vocabulary from the language samples according to the operational definitions in Appendix G, based on the semantic/syntactic categories of the MacArthur-Bates Communicative Development Inventories, Words and
Gestures and Words and Sentences forms, and the definitions of major parts of speech from the Unabridged Merriam-Webster online dictionary (unabridged.merriam-webster.com). Table 2-3 summarizes these semantic/syntactic categories.

The rationale for coding the mothers’ and children’s word types using these semantic/syntactic categories was to allow comparisons between the children’s receptive and expressive vocabulary as reported by their mothers on the MacArthur-Bates Communicative Development Inventories, and their spontaneous natural language samples. These semantic/syntactic categories characterize the words beginning communicators use as their language develops from understanding spoken words to producing first words, and then combining words into early phrases and sentences. Furthermore, the use of the same semantic/syntactic categories for the spontaneous natural language samples of the dyads in the present study facilitated comparisons between these dyads and those in the child language research in typical and atypical language development. As mentioned previously, a large body of literature has utilized the MacArthur-Bates Communicative Development Inventories (or similar parent report measures) to characterize the vocabulary of young children who are typically developing as well as children with ASD (e.g., Charman et al., 2003; Luyster et al., 2007, 2008).

Finally, using the same semantic/syntactic categories for both the mother’s and child’s spoken word types allowed analyses of the relationships between the two members of each dyad.

After each word type was coded using the semantic/syntactic categories listed in Table 2-3 and operationally defined in Appendix G, the semantic/syntactic categories were grouped in *word classes*, which correspond to the open- and closed-class words of
the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007) and which have been widely used in child language research. Open-class words are defined as words that are from noun, verb, adjective, and adverb classes, to which new words can readily be added in a language. Closed-class words, in contrast, are defined as prepositions, pronouns, auxiliaries, determiners, etc., all of which share grammatical functions; new words cannot be readily added into these categories in a language (Hoff, 2014). These word classes included: open-class words such as \textit{proper nouns} and \textit{common nouns} (e.g., animal names, vehicles, toys, food and drink, clothing, body parts, furniture and rooms, small household items, outside things and places to go, words about time, people); social/interactive words (sound effects and animal sounds, games and routines); action/state words (verbs); and descriptive words (adjectives, adverbs).

Closed-class words were also coded: \textit{quantifiers} (determiners, cardinal numbers); \textit{question words} (e.g., who, what, where, when, why, how); \textit{prepositions and locations}; \textit{infinitives} (to); \textit{articles}; \textit{pronouns}; \textit{helping verbs} (e.g., auxiliary verbs and modals), and \textit{connecting words} (conjunctions and coordinators). Two additional categories (\textit{unspecified common nouns} and \textit{miscellaneous function words}) were included for those word types that could not be coded in the specified categories.

\textbf{Reliability of Semantic/Syntactic Categorization Coding}

A second coder, an undergraduate research assistant majoring in speech-language pathology and blind to the goals of the study, was trained in the coding system based on the operational definitions in the coding manual (Appendix G). Transcripts of other
mother-child dyads were used for training. The second coder then independently coded a random selection of 20% of the utterances in each of the participant transcripts. The semantic-syntactic codings of these transcript selections by both the researcher and the second coder were then compared to determine coding reliability. The number of agreements was divided by the number of agreements plus disagreements (total) multiplied by 100. Mean inter-rater agreement was 98% and ranged from 94% to 99%. Any discrepancies were discussed and consensus was reached.

Measures and Data Analysis

Table 2-4 summarizes the language measures calculated for the children and the mothers in the current study. These measures related to general characteristics of the language samples, as well as more specific lexical characteristics. In addition, measures were obtained via the parent report (MacArthur-Bates Communicative Development Inventories) of children’s receptive and expressive vocabulary.

General Characteristics of Children’s Utterances

In order to answer the first research question regarding the general characteristics of the utterances that children with ASD are observed to produce during daily interactions with their mothers at home, descriptive statistics (frequency and proportion) were calculated for the following measures of talkativeness, lexical complexity, and grammatical complexity as indicated below.
Table 2-4: Language measures for children, mothers, and dyads.

<table>
<thead>
<tr>
<th>For whom</th>
<th>Measure</th>
<th>What was measured</th>
<th>Where measured</th>
<th>How measured</th>
<th>Why measured</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Utterance Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>Talkativeness</td>
<td>Total frequency count: unintelligible utterances produced by child</td>
<td>NLS transcript</td>
<td>CLAN commands: FREQ; MOR</td>
<td>Mothers provide less spoken language input to children who produce utterances that are less “speech-like” (TD, ASD)</td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Talkativeness</td>
<td>Total frequency count: intelligible utterances</td>
<td>NLS transcript</td>
<td>CLAN commands: FREQ; MOR</td>
<td>Amount of caregiver talk has been shown to be positively related to child language development (TD, ASD)</td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Talkativeness</td>
<td>Total frequency count: word tokens</td>
<td>NLS transcript</td>
<td>CLAN commands: FREQ; MOR</td>
<td>Amount of caregiver talk has been shown to be positively related to child language development (TD, ASD)</td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Lexical diversity</td>
<td>Total frequency count: word types</td>
<td>NLS transcript</td>
<td>CLAN commands: FREQ; MOR</td>
<td>Lexical diversity (i.e., the variety of words used in everyday spoken language) of caregiver language input has been shown to be positively related to child’s lexical diversity (TD, ASD)</td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Lexical diversity</td>
<td>Parameter (D)</td>
<td>NLS transcript</td>
<td>CLAN command: VOCD (KIDEVAL)</td>
<td>Lexical diversity of caregiver language input has been shown to be positively related to child’s lexical diversity (TD, ASD)</td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Syntactic complexity</td>
<td>MLU&lt;sub&gt;n&lt;/sub&gt;</td>
<td>NLS transcript</td>
<td>CLAN: MLU&lt;sub&gt;n&lt;/sub&gt; command (KIDEVAL)</td>
<td>The syntactic complexity of caregivers’ language input has been shown to be positively related to their children’s subsequent grammatical complexity (TD, ASD)</td>
</tr>
<tr>
<td><strong>Semantic-syntactic Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child/Mother</td>
<td>Vocabulary composition—observed (produced)</td>
<td>Proportion of semantic-syntactic word class types (social, nouns, actions/states, descriptive, closed class) produced out of all word types</td>
<td>NLS transcript</td>
<td>CLAN command: FREQ&lt;sup&gt;1&lt;/sup&gt;Semantic/syntactic coding</td>
<td>Caregivers’ use of open-class vs. closed-class word types is positively related to their children’s use the same word classes (TD, ASD)</td>
</tr>
<tr>
<td>Child</td>
<td>Vocabulary composition—reported (understood)</td>
<td>Parent report words understood plus words spoken by child: frequency; proportion of word class out of total words understood</td>
<td>MCDI</td>
<td>Raw score and age-equivalent score; Proportion of total word types</td>
<td>Caregiver report on MCDI has been shown to be a valid measure of receptive language in children (TD, ASD)</td>
</tr>
<tr>
<td>Child</td>
<td>Vocabulary composition—reported (produced)</td>
<td>Parent report words spoken by child: frequency; proportion of word class out of total words produced</td>
<td>MCDI</td>
<td>Raw score and age-equivalent score; Proportion of total word types</td>
<td>Caregiver report on MCDI has been shown to be a valid measure of receptive language in children (TD, ASD)</td>
</tr>
<tr>
<td>Dyad</td>
<td>Shared lexicon</td>
<td>Total frequency of the same word types spoken by both mother and child</td>
<td>NLS transcript</td>
<td>CLAN command: FREQ</td>
<td>This measure is predicted to be an index of the relationship between a mother’s and child’s language</td>
</tr>
<tr>
<td>Dyad</td>
<td>Imitativeness</td>
<td>For each mother and child: Total proportion of imitation out of total number of responses; proportion of EXACT, REDUCED, and EXPANDED imitation to total frequency of imitation</td>
<td>NLS transcript</td>
<td>CLAN commands: CHIP; KWAL</td>
<td>Caregiver imitation has been shown to be related to child language development (TD)</td>
</tr>
</tbody>
</table>

Note. 1 NLS = Natural language sample. 2 CLAN = Computerized Language Analysis of Child Language Data Exchange System (CHILDES) Project (MacWhinney, 2000). 3 FREQ = FREQ program command for frequency analysis. 4 TD = Typical development. 5 ASD = Autism spectrum disorder. 6 MOR = MOR program command for morphosyntactic analysis. 7 VOCD = VOCD command for measure of lexical diversity. 8 MLU<sub>n</sub> = MLU program command for mean length of utterance in morphemes. 9 KIDEVAL = KIDEVAL program command for multiple analyses of child language data. 10 Semantic/syntactic coding = researcher assigned codes for semantic and syntactic categories (see Appendix G). 11 MCDI = MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007). 12 EXACT = Exact imitation; REDUCED = Reduced imitation; EXPANDED = Expanded imitation. 13 CHIP = CHIP command examines caregiver-child imitation. 14 KWAL = KWAL command to extract the specific exact, expanded, and reduced imitations.
Children’s Talkativeness

The first measure was the child’s talkativeness. This measure is an important characteristic of maternal and child language because of the positive relationships between the number of utterances and words spoken by caregivers and their children’s language development (Hart & Risley, 1995; Huttenlocher et al., 1991; Tamis-LeMonda et al., 2001).

For those children who produced no speech during the spontaneous language samples, the total frequency of unintelligible utterances was calculated using the CLAN command FREQ. By default, FREQ ignores words in the transcript that are coded as unintelligible or partially unintelligible (i.e., xxx); vocalizations including speech sounds that were not identifiable as conventional, spoken words (i.e., yyy, &ba); or non-speech vocalizations that were transcribed beginning with 0 (i.e., 0 [=! laughs], 0 [=! kissing sound], etc.). “Switch” commands (i.e., +sxxx +syyy +s0) were added to the FREQ command to obtain the frequency of these unintelligible utterances. Because all children who produced spoken utterances also produced unintelligible utterances, the frequency of their unintelligible utterances was also calculated using the same FREQ command with switches.
For those children who produced speech during the spontaneous language samples, each child’s talkativeness was calculated using the FREQ program command of CLAN. This measure involved two calculations within each child’s natural language sample transcript: the total frequency count of utterances; and the total frequency count of word tokens. The total number of word tokens was operationally defined as the total number of all words spoken in the natural language sample transcript by the child.

**Children’s Grammatical Complexity and Lexical Diversity**

The second general characteristic was utterance complexity. Complexity was comprised of lexical diversity and grammatical complexity. Lexical diversity is “a measure of how many different words are used in a text” or in speech (Johansson, 2008, p. 61). Lexical diversity is an important measure of children’s and mothers’ spoken language. The lexical diversity of mothers’ language input has been found to be positively correlated with children’s language development for children who are typically developing (Che et al., 2018; Rowe, 2008, 2012) and children with ASD who are beyond the beginning communicator stage of language development (Bang & Nadig, 2015; Burgess et al., 2013). In the current study, there were two calculations of lexical diversity of the children’s spoken language: (a) the frequency of word types; and (b) a parameter labeled $D$. The frequency of word types was operationally defined as the total number of different words produced in the language sample by the child. It was automatically calculated using the frequency program command FREQ of CLAN.
The second measure of children’s lexical diversity, the parameter $D$, was calculated by using the VOCD command in the CLAN software program. According to Owen and Leonard (2002), $D$ is “a measure [of lexical diversity] that uses repeated calculations of type-token ratio (TTR) to estimate how TTR changes as the speech samples increase in size” (p. 927). $D$ is less affected by the number of tokens in the sample compared with the type/token ratio measurement, which MacWhinney (2000) indicated declines as the sample size increases. Higher frequencies of maternal overlap when typically developing children are 20 months of age have been found to be associated with children’s higher lexical density as measured by $D$ one year later (Che et al., 2018).

The syntactic complexity of utterances was another measure of the children’s language output. This is an important characteristic as well, as research indicates that the syntactic complexity of caregivers’ language input as measured by mean length of utterance in morphemes (MLU$_m$) is positively related to children’s later language development levels for children with typical development and those with ASD (Bang & Nadig, 2015) who are beyond the beginning communicator phase of language development. The amount of overlap in mothers’ and young children’s language predicted higher MLU in children one year later (Che et al., 2018). Children’s MLU$_m$ was calculated automatically using the KIDEVAL command of CLAN.
**Semantic-Syntactic Characteristics of Children’s Spoken Words**

Bates et al. (1988) maintained that measures of vocabulary obtained through observational recordings (i.e., via natural language samples) represent “what the child prefers to use” (p.96). In contrast, measures of vocabulary comprehension and production obtained via parent report (i.e., parent interviews or questionnaires like the MacArthur-Bates Communicative Development Inventories) represent “what the child knows.”

In order to answer the question about semantic-syntactic characteristics of the spoken words children are observed to produce during daily interactions with their mothers at home, descriptive statistics (frequency and proportions) were calculated for the following measures of observed vocabulary and reported vocabulary as indicated below.

**Children’s Vocabulary Composition - Observed**

Vocabulary composition of child language was addressed with one measure. The proportion of word class types to the total number of word types was the measure of vocabulary composition that was calculated from the children’s natural language sample transcripts. This is an important characteristic of maternal and child spoken language because research has indicated differences in the relationships between maternal language input and child spoken language development for different word classes (Bates et al., 1994; Pine, Lieven, & Rowland, 1997; Rescorla & Safyer, 2013).
The following language measures were calculated for each child: the total frequency of word types produced per semantic-syntactic category; and the proportions of word classes (i.e., social/interactive, noun, action/state, descriptive, closed class) produced out of the total number of word types.

**Children’s Vocabulary Composition - Reported**

Vocabulary composition was also analyzed using the MacArthur-Bates Communicative Development Inventories. The MacArthur-Bates Communicative Development Inventories are standardized parent report measures that provide an assessment of the children’s current receptive and expressive language abilities (Fenson et al., 2007). The MacArthur-Bates Communicative Development Inventories are well-validated instruments and are widely recommended and used in evaluations and research with children with typical development as well as those with developmental disabilities including ASD (Charman et al., 2003; Luyster et al., 2007; Smith, Mirenda, & Zaidman-Zait, 2007; Tager-Flusberg et al., 2009).

The MacArthur-Bates Communicative Development Inventories (MCDI) consists of three forms: the Words and Gestures form, used with children from 8 months to 18 months; the Words and Sentences form, used with children from 16 months to 30 months; and the CDI-III, used with children from 30 to 37 months. The MCDI can be used with older children who have developmental delays. The Words and Gestures form consists of two parts: Part I: Early Words and Part II: Actions and Gestures. Although caregivers completed the entire questionnaire, only Section D of Part I was analyzed for
the current study. Section D consists of the Vocabulary Checklist; this is comprised of 19 subsections of vocabulary items that are organized in the following semantic-syntactic categories: (a) *Sound Effects and Animal Sounds* (12 words); (b) *Animal Names (Real or Toy)* (36 words); (c) *Vehicles (Real or Toy)* (9 words); (d) *Toys* (8 words); (e) *Food and Drink* (30 words); (f) *Clothing* (19 words); (g) *Body Parts* (20 words); (h) *Furniture and Rooms* (24 words); (i) *Small Household Items* (36 words); (j) *Outside Things and Places to Go* (27 words); (k) *People* (20 words); (l) *Games and Routines* (19 words); (m) *Action Words* (55 words); (n) *Words About Time* (8 words); (o) *Descriptive Words* (37 words); (p) *Pronouns* (11 words); (q) *Question Words* (6 words); (r) *Prepositions and Locations* (11 words); and (s) *Quantifiers* (8 words).

The Words and Sentences form consists of two parts: Part I: Words Children Use and Part II: Sentences and Grammar. Although caregivers complete the entire questionnaire, only Section A of Part I was analyzed for the current study. Section A of the Words and Sentences form consists of the Vocabulary Checklist, with 680 vocabulary words organized in the same semantic/syntactic categories as the Words and Gestures form with additional items in most subsections. The Words and Sentences Vocabulary Checklist separates *Outside Things and Places to Go* (subsections 10 and 11), expands subcategory (20) to include *Quantifiers and Articles*, and has two additional categories: (21) *Helping Verbs* and (22) *Connecting Words*. In effect, the Words and Sentences form includes all of the vocabulary items from the Words and Gestures form with an additional 284 vocabulary items.

The Words and Gestures form asks caregivers to mark words their child either *understands* or *understands and says*, and therefore is a parent report measure of both
receptive and expressive vocabulary. The Words and Sentences form asks caregivers to mark only the words their child says, and therefore is a parent report measure of only expressive vocabulary. Both forms score the vocabulary in similar manners. On the Words and Gestures form, the total comprehension score is obtained by summing the responses for understands and the responses for understands and says. The total production score is obtained by summing the responses for understands and says only. On the Words and Sentences form, the score is obtained by summing the words the child says. Although the MacArthur-Bates Communicative Development Inventories were designed for use with children whose language development level is 8-37 months, the developers indicate in the user’s guide and technical manual that it is appropriate to use the parent report questionnaires with children who are chronologically older but at a comparable developmental level. Because of this, the Words and Gestures form was appropriate for the majority of the children in this sample as a measure of receptive vocabulary.

As indicated previously, the MacArthur-Bates Communicative Development Inventories (MCDI) forms were given to all of the mothers to complete. Only mothers’ responses to the Vocabulary Checklist section were used in the current study. The instructions printed at the beginning of the Vocabulary Checklist indicate how the caregiver should complete the form (MCDI-WG; Fenson et al., 2007, p. 2):

The following is a list of typical words in young children’s vocabularies. For words your child understands but does not yet say, place a mark in the first column (understands). For words that your child not only understands but also uses, place a mark in the second column (understands and says).
Furthermore, the technical manual emphasizes that caregivers should be told not to prompt their child or provide a model to imitate; caregivers should consider their child’s spontaneous use of the vocabulary words. This was explained to the mothers in the written instructions included with the materials that were sent to them. Percentile rank and age equivalent scores were obtained from the technical manual for the MCDI-WG form based on the parents’ reports.

The following language measures were calculated for each child: the total frequency of word types reported to be produced per semantic-syntactic category; the proportions of word classes (i.e., social/interactive, noun, action/state, descriptive, closed class) reported to be produced out of the total number of word types; the total frequency of word types reported to be understood per semantic-syntactic category by each child; the proportions of word classes (i.e., social/interactive, noun, action/state, descriptive, closed class) reported to be understood out of the total number of word types.

**General Characteristics of Mothers’ Utterances**

In order to answer the first research question regarding the general characteristics of the utterances that the mothers produced during daily interactions with their children at home, descriptive statistics (frequency and proportion) were calculated for the following measures of talkativeness, lexical complexity, and grammatical complexity as indicated below.
Mothers’ Talkativeness

For mothers, measures of spoken vocabulary were the same as those calculated for children’s language. The spoken language measures for mothers are listed in Table 2-4, and include the following for talkativeness: total frequency of utterances; and total number of word tokens. The total frequency of spoken words in the individual mother’s natural language transcript was calculated using the FREQ command from CLAN; this was the measure of word tokens.

Mothers’ Grammatical Complexity and Lexical Diversity

Frequency of word types was calculated using FREQ as one measure of lexical diversity, and the CLAN command VOCD was used to calculate the second measure of lexical diversity, the parameter $D$. The mother’s spoken word types were coded using the semantic/syntactic categories listed in Table 2-3 (and Appendix G). As mentioned previously with regard to children’s language, the word class categories included: open class words (nouns, action/state words, descriptive words); closed class words; and other words (social-interactive words).

Semantic-Syntactic Characteristics of Mothers’ Spoken Words

In order to answer the question about semantic-syntactic characteristics of the spoken words that the mothers produced during daily interactions with their children at
home, descriptive statistics (frequency and proportions) were calculated for the observed vocabulary composition as indicated below.

**Mothers’ Vocabulary Composition**

For mothers, measures of semantic/syntactic characteristics of spoken words were the same as those calculated for children’s language. The following language measures were calculated: the total frequency of word types produced per semantic-syntactic category by each mother; and the proportions of word classes (i.e., social/interactive, noun, action/state, descriptive, closed class) produced out of the total number of word types.

**The Shared Lexicons of the Dyads**

In order to answer the third research question about the relationship between the words a child produces and the words his/her mother produces during daily interactions, descriptive statistics (frequency) were calculated for the following measures of the shared lexicon for each dyad, as indicated below. The shared lexicon referred to the words that both the child and the mother produced in common during their 60-minute natural language sample. This represents one block of time during which the mother and child interacted and communicated, using spoken words reflecting the activities in which they were engaged. At a different day and time, the shared words they used would be different.
A measure of shared vocabulary between a mother and child was calculated by performing a frequency analysis (using the FREQ command of CLAN) of the individual frequency lists of the word types for the mother and child in each dyad. This analysis resulted in a merged list of words that were produced by both mother and child which were coded with the number 2; words that were unique to the mother or the child were coded with the number 1. This method was similar to that used by Hu (1994), who described the “common features” among mothers’ vocabulary during interactions with their two-year-old typically developing children.

The proportion of shared words out of the total word types produced by the child and also out of the total word types produced by the mother was calculated. In addition, the proportion of word classes (i.e., social-interactive, action/state, noun, descriptive, closed class) out of the total shared word types produced by each dyad was determined.

**Shared Lexicons – Frequency of Words**

In order to answer the third research question about whether the dyad’s shared lexicon includes words that the mother and/or child produces frequently during their natural language sample, descriptive statistics were calculated for the most frequent words for each dyad’s shared lexicon, as indicated below.

For each mother and child in each dyad, calculations were made of the proportion of the words in the shared lexicon that were produced frequently by the mother and the proportion of the shared words that were produced frequently by the child. The word frequency lists of each of the mothers and each of the children were analyzed separately.
to determine their most frequently used words by examining the number of word tokens for each word type. Each list was ordered from most to least frequent per semantic/syntactic category. Those word types that were used five or more times during the language sample were designated as being used most frequently by the mother or child (i.e., *most frequent word list*). For the mothers, the criterion of five or more tokens was selected to determine the most frequently used words based on studies of focused stimulation interventions which consider high density of input as five to 10 productions of a word (Girolametto, Pearce, & Weitzman, 1996a, 1996b; Lederer, 2014; Ellis Weismer & Robertson, 2006). For the children, the criterion of five or more word tokens was selected because, in the literature, a beginning communicator’s *emerging* use of words has been identified as under three exemplars or tokens in a language sample, while a child’s *productive* use or mastery has been identified as three or more tokens (Lahey, 1988; Lederer, 2014). Therefore, five tokens in one hour of interaction would be considered frequent production of a spoken word.

**Shared Lexicons—Imitation**

In order to answer the third research question about whether the dyad’s shared lexicon consists of words that the mother and child imitate during their natural language sample, descriptive statistics (frequency and proportion) were calculated for the following measures of imitation for the mother and child in each dyad: the proportion of each mother’s total imitative utterances out of the mother’s total responses; and the proportion of each child’s total imitative utterances out of the child’s total responses. In
addition, the proportion of each imitation type was calculated: proportion of exact
imitations out of the total imitative utterances; proportion of expanded imitations out of
the total imitative utterances; and proportion of reduced imitations out of the total
imitative utterances. These proportions were calculated for the child and mother of each
dyad separately.

The mother-child shared lexicon could potentially be related to the amount of
imitativeness between mother and child, with the mother imitating the child and/or the
child imitating the mother. The CLAN command CHIP uses one speaker as a source and
the other speaker as the response to determine the degree of overlap in words between the
source and the response over an utterance window of up to 7 utterances, which includes
the target utterance and 6 previous utterances (default). The minimum amount of
overlap is one word, as defined by the CHIP program (Sokolov & Moreton, 1994). CHIP
determined the total proportion of imitated utterances (i.e., overlap in words and/or
grammatical morphology) to the total number of responses for the mother as the source,
and the same measure with the child as the source. According to MacWhinney (2000, p.
61), CHIP determines the proportion of imitations out of the total number of imitations
produced by the speaker), that were exact imitations (i.e., the response and the source
utterance pairs match exactly with no changes); reduced imitations (i.e., the response and
source utterance pairs have deletions, but no additions or substitutions); and/or expanded
imitations (i.e., the response and source utterance pairs have additions, with no deletions
or substitutions).

Previous research regarding imitation which has employed this type of analysis
using CHIP has indicated that the analyses utilized a default window of 7 (Che, et al.,
2018; Sokolov, 1993; Sokolov, 1992; Sokolov & Moreton, 1994). The average distance between source and response utterances reported by Sokolov (1993) for children was 1.27 utterances; Che et al. (2018) reported an average distance of 1.6 for mothers and 1.3 for children. In addition, the KWAL program of CLAN was used to extract and examine exact, expanded, and reduced imitations within a window of three prior utterances (Sokolov & Moreton, 1994).

**Determining the Children’s Phase of Spoken Language Development**

Based on the observed data from the natural language samples and the reported data from the MacArthur-Bates Communicative Development Inventories, the spoken language benchmarks outlined by Tager-Flusberg et al. (2009) were adapted to determine the phase of spoken language development for each of the thirteen beginning communicators with ASD. As recommended by these investigators, multiple sources of information (i.e., natural language samples and parent report questionnaires) were used to determine the spoken language development phase for each child. Specifically, each child’s natural language sample was examined for the following characteristics: (a) phonology (i.e., listing speech sounds produced in observed vocalizations, spoken word approximations, and/or spoken words); (b) observed vocabulary (i.e., word types); and (c) grammar (i.e., MLU in morphemes). In addition, age equivalent scores on the MacArthur-Bates Communicative Development Inventories (i.e., reported expressive vocabulary) were obtained or estimated, and then these values were compared with the spoken language benchmarks proposed by Tager-Flusberg et al. (2009). Because only
audio-recordings were available in the present investigation, it was not possible to accurately determine pragmatics of language for the children.

Tager-Flusberg et al. indicated that the specification of benchmarks for the “preverbal” phase (i.e., which is identified as the Intentional/Presymbolic phase in the present study) was “outside the scope of the goals” of their research article. Consequently, benchmarks below those specified as minimum requirements for the First Words phase were used to identify children at the Intentional/Presymbolic phase in this study. Furthermore, Tager-Flusberg et al. (2009) stated, “Although we present our benchmarks in each of the developing phases of language, it is important to keep in mind that these phases are dynamic and overlapping periods that, in reality, have no clear boundaries” (p. 647). They indicated that for many children, and in particular those with ASD, there may be a “mixed phase profile” where a child exhibits behaviors for one phase in several domains (i.e., phonology, vocabulary, grammar, and/or pragmatics), and for another phase for other domains.

Table 2-5 summarizes the minimum criteria for four of the phases of spoken language development, adapted from Tager-Flusberg et al. (2009). Objective criteria (i.e., the frequency of word types, the frequency of word tokens, and calculation of MLU$_m$, which were all obtained through automatic data analysis using the computer software of CLAN) were used to determine the child’s phase of spoken language development. Age equivalent scores for the MCDI were obtained from the User’s Manual (Fenson et al., 2007). Speech sounds from the transcripts were also listed for words produced by the child.
Table 2-5: Minimum criteria for spoken language benchmarks for the domains of phonology, vocabulary, grammar, and pragmatics adapted from Tager-Flusberg et al. (2009).

<table>
<thead>
<tr>
<th>Phase of Spoken Language Development</th>
<th>Language Domain</th>
<th>Intentional/Presymbolic 1</th>
<th>First Words</th>
<th>Word Combinations</th>
<th>Sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonology</td>
<td>NLS 2</td>
<td>CV 4</td>
<td>Closed syllables (VC 5 or CVC 6)</td>
<td>≥ 16-24 different consonant sounds including some of the following: /ʃ, θ, s, z, l, ʒ/</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td>or</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 4 of the early 8 consonant sounds: /m, b, y, n, w, d, p, h/</td>
<td>or</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>NLS</td>
<td>&lt; 5 word types and &lt; 20 word tokens in 20 minutes</td>
<td>≥ 5 word types and ≥ 20 word tokens in 20 minutes</td>
<td>≥ 30 word types in 20 minutes</td>
<td>≥ 92 different word types in 65 sentences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
<td>or</td>
<td>or</td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>MCDI 7</td>
<td>AE ≥ 15 months: 17 words produced by boys only; 26 words produced by girls only, AE ≥ 18 months: 81 words produced by boys only; 91 words produced by girls only</td>
<td>AE ≥ 15 months: 252 words produced by boys only; 346 words produced girls only</td>
<td>AE ≥ 36 months. AE 30 months: 520 words produced by boys only; 582 words produced by girls only</td>
<td></td>
</tr>
<tr>
<td>Grammar</td>
<td>NLS</td>
<td>&lt; 1.0</td>
<td>MLU m 10 ≥ 1.8</td>
<td>3 longest utterances = 3.8 morphemes</td>
<td>MLU ≥ 3.0</td>
</tr>
<tr>
<td></td>
<td>MCDI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pragmatics</td>
<td>NLS</td>
<td>Comment + 1 other function (request, label, take turns)</td>
<td>Comment + request + turn-taking</td>
<td>Two full turns on the same topic following adult utterance</td>
<td></td>
</tr>
</tbody>
</table>

Note. This table is adapted from Tager-Flusberg et al. (2009). 1 Intentional/Presymbolic = preverbal in the original phases described by the authors. 2 NLS = Natural Language Sample. 3 V = Vowel. 4 CV = Consonant + Vowel. VC 5 = Vowel + Consonant. 6 CVC = Consonant + Vowel + Consonant. 7 MCDI = MacArthur-Bates Communicative Development Inventories. 8 AE = Age-equivalent score. 9 MLU m = Mean length of utterance in morphemes.
In order to determine the phase of spoken language development for each child, a scoring system and form based on Table 2-5 were created outlining the steps involved. Appendix O illustrates the form used which outlines the steps for determining each child’s phase of spoken language development with reference to the criteria specified in Table 2-5. Four speech/language domains (i.e., phonology, semantics, syntax/morphology, and pragmatics) were outlined based on the recommendations of Tager-Flusberg et al. (2009). The present study was designed to investigate the earlier phases of spoken language development in beginning communicators with ASD. Because of this, more weight was given to the phonology and semantics domains, as advances in speech sound development and vocabulary characterize the earlier phases of spoken language development, while advances in syntax and morphology characterize the later phases. Furthermore, the use of audio recordings only made it difficult to determine pragmatic characteristics of the children’s spoken language use. For each step, the researcher filled in the child’s values for each language measure, and then placed a checkmark under the column corresponding to the phase of development. Each column was tallied and the phase with the most tally marks was the one identified for that child.

To determine reliability for the decision-making process regarding the children’s phase of spoken language development, a second coder (i.e., a graduate research assistant in speech-language pathology who was blind to the goals of the study) independently completed the form for each child. The forms completed by both the researcher and the second coder were compared to determine reliability of phase determination. The number of agreements was divided by the number of agreements plus disagreements (total) multiplied by 100. Mean inter-rater agreement was 100%. For one child, both the
researcher and the second coder determined that the child had a mixed phase profile with equal tally marks in three phases. In this case, discussion resolved which phase assignment was most appropriate for that child (Child 13).

The children in the present study represented three patterns: children who were at the Intentional/Presymbolic phase (Child 1, Child 4, Child 5, Child 6, and Child 12); children at the First Words phase (Child 2, Child 3, Child 7, Child 8, Child 10, and Child 13); and children at the Word Combinations phase (Child 9 and Child 11). The data for these three patterns of children and their mothers were then analyzed and will be presented separately in the following chapter.

**Case Study Analysis**

Three dyads from the 13 were selected for more detailed case study analysis: one with a child at the Intentional/Presymbolic phase (Child 5), one with a child at the First Words phase (Child 2), and one with a child at the Word Combinations phase (Child 9). The case studies of the three dyads are presented to elucidate the patterns of maternal spoken language and child spoken language described within the present study of young children with ASD who are beginning communicators. The cases are presented developmentally by spoken language phase, following the presentation of results for all children, mothers, and dyads at that phase of spoken language development. According to Yin (2012), descriptive case studies,

…can offer rich and revealing insights into the social world of a particular case. These insights can then assume greater importance if the case being studied, as with many well-known case studies, covers the following: situations not normally accessible to social scientists (revelatory cases),
instances of exceedingly successful ventures (exemplary cases), one-of-a-kind situations (unique cases), extreme conditions (extreme cases), or even ordinary conditions (typical cases). (p. 49)

One mother-child dyad was chosen to identify a more typical case at each phase. That is, the cases that were selected represented mothers and children who engaged in some of the “ordinary” day-to-day behaviors described for the dyads at each phase of spoken language development.

The case study analysis was based on information from several sources: the interview with the mother; the observed vocabulary data from the dyad’s natural language sample; and the mother’s responses on the Vocabulary Checklist of the MacArthur-Bates Communicative Development Inventories (i.e., words reported). The transcripts of each case were also analyzed to determine the dyad’s patterns of interaction. Pseudonyms are used for the children and their mothers throughout these case studies.
Chapter 3

Results

This chapter presents the overall results, which detail the lexical characteristics of the spoken language of the 13 children with ASD and the spoken language of their mothers. The results are presented separately for the dyads with children at each developmental phase in order from earlier to later phases of beginning communication (i.e., Intentional/Presymbolic; First Words; and Word Combinations). After the presentation of the overall results for each language development phase, an individual case study is presented to illustrate patterns as well as unique characteristics of the interaction between mother and child dyads.

Beginning Communicators with ASD at the Intentional/Presymbolic Phase

General Characteristics of Children’s Utterances

Children’s Talkativeness and Complexity

Five of the children in the present study (ages 26 to 67 months) were beginning communicators who were at the Intentional/Presymbolic phase of spoken language development: Child 1, Child 4, Child 5, Child 6, and Child 12. Table 3-1 presents the descriptive statistics for the measures of spoken language obtained for these children.
during the interactions that occurred between the children and their mothers in their homes during everyday activities.

All of these children produced many more unintelligible utterances (range 45 to 1064 in 60 minutes) than intelligible ones. Three of the five children produced no intelligible utterances during the natural language samples (Child 1, Child 5, and Child 6); one child (Child 4) produced only two intelligible utterances; and the remaining child (Child 12) produced 23 intelligible utterances in 60 minutes. These latter two children produced fewer than five word types in the 60-minute samples (less than one word type per 20 minutes). The two children’s word types consisted of conventional spoken words and conventional vocalizations: Child 4 produced no and all-done; Child 12 produced eat, sit, yay, and mm).

Table 3-1: Descriptive statistics for the children at the Intentional/Presymbolic phase during the 60-minute natural language samples.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age (m)</th>
<th>Total Unintelligible Utterances</th>
<th>Total Intelligible Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>MLUm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 1</td>
<td>M</td>
<td>67</td>
<td>279</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Child 4</td>
<td>F</td>
<td>58</td>
<td>1064</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Child 5</td>
<td>M</td>
<td>26</td>
<td>606</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Child 6</td>
<td>M</td>
<td>27</td>
<td>45</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Child 12</td>
<td>M</td>
<td>33</td>
<td>138</td>
<td>23</td>
<td>23</td>
<td>4</td>
</tr>
</tbody>
</table>

*Note.* MLUm = Mean length of utterance in morphemes.
**Semantic-Syntactic Characteristics of Children’s Spoken Words**

**Children’s Vocabulary Composition – Observed**

Figure 3-1 illustrates the proportion of word type classes out of the total number of spoken word types produced by each of the children at the Intentional/Presymbolic phase that used intelligible spoken words during interactions with their mothers. Child 4 produced *all_done* and *no*, both of which are social/interactive words. Child 12 produced one social/interactive interjection, *yay*; a conventional vocalization *mm*; and two action words, *eat* and *sit*. Child 4 and Child 12 produced no other semantic-syntactic word classes, including common nouns. Child 1, Child 5, and Child 6 did not produce any intelligible spoken words.

![Diagram](image_url)

Figure 3-1: Proportion of word classes out of total word types produced by the children at the Intentional/Presymbolic phase during the 60-minute natural language samples.
Children’s Vocabulary Composition – Reported

Figure 3-2 illustrates the children’s raw scores (word frequencies) from their mothers’ report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form (MCDI-WG), including the words that the children were reported to produce and to understand. Inspection of the graph indicates that only one of the five children (Child 1) was reported to produce words, in this case 12 spoken words. The other four children were reported to produce no spoken words. According to the technical manual of the MCDI (Fenson et al., 2007), Child 1 had an age equivalent score of 14-15 months for words produced (for boys only). Child 5, Child 6, and Child 12 had age equivalent scores of 8-9 months for words produced (for boys only). Child 4 had an age equivalent score below 8 months for words produced (for girls only).

Further inspection of the graph in Figure 3-2 reveals that all five children who were at the Intentional/Presymbolic phase were reported to understand some spoken words; the total number of words understood by each child ranged from 18 to 373 words. For all five children, word comprehension, as reported by their mothers on the MCDI-WG form, was greater than production. There was wide variability across the children on this measure, especially compared to the much lower frequencies for words reported to be produced by the children.

Fenson et al. (2007, pp. 42-43) indicated that “CDI scores for older children can only be interpreted normatively—that is, relative to other children, when the scores are at or below the median for the oldest age group in the norming samples (18 months for CDI: Words and Gestures and 30 months for CDI: Words and Sentences).” For Words and Gestures, the median number of words produced (50th percentile) at 18 months for girls only is 91, and for boys only it is 81. For Words and Sentences, the median number of words produced (50th percentile) at 30 months for girls only it is 582, and for boys only it is 520.
Figure 3-3 depicts the proportion of the semantic/syntactic word classes out of the total frequency of word types reported to be produced (Graph A) and understood (Graph B) by the children at the Intentional/Presymbolic phase. According to the mothers’ reports on the MCDI, only one child (Child 1) produced any semantic/syntactic word classes. Graph 3-3A illustrates that the words he was reported to produce were limited to nouns and social-interactive words. Graph 3-3B illustrates that the five children were reported to understand a broader range of word classes. There is a total of 396 words in the MCDI-WG Vocabulary Checklist. Nouns comprise approximately .60 (n = 237) of the total words in the checklist, and the other categories have fewer words and lower
proportions. As depicted in Figure 3-3, nouns predominate in the reported vocabulary of these children.

![Graph A](image-url)  
**A**

![Graph B](image-url)  
**B**

**Figure 3-3:** Proportion of word classes out of the total words produced (A) and understood (B) by the children at the Intentional/Presymbolic phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form.
Nonetheless, although it is apparent that nouns predominate, all of the children at the Intentional/Presymbolic phase were reported to understand words across a range of semantic/syntactic categories, including action/state words, and descriptive words. At this early stage of language development, the closed class words that relate more to grammatical components (i.e., pronouns, questions, prepositions, quantifiers) had low proportions and were reported to be understood by only four of the five children. There was a low proportion of closed class word types out of all the words in the MCDI-WG vocabulary checklist \( (n = 36; .09) \).

It is noteworthy that for three of the children who were at the Intentional/Presymbolic phase, the words relating to social interaction (sound effects/animal sounds/interjection; games and routines) comprised a sizeable class of words that they were reported to understand, and in the case of Child 1, reported to produce.

**General Characteristics of Mothers’ Utterances**

**Mothers’ Talkativeness and Complexity**

Descriptive statistics for mothers’ spontaneous language samples are presented in Table 3-2. There was variation across mothers of children at the Intentional/Presymbolic phase in terms of their total utterances, total word tokens, and total word types. Not surprisingly, mothers with higher frequencies of utterances also tended to have higher frequencies of word tokens and vice versa. In contrast, there was less consistency across
the measures of language complexity for the mothers. Mothers’ mean length of utterance in morphemes, a measure of utterance grammatical complexity, ranged from 2.65 to 4.14. For example, Mother 1 had extremely low values on the measures of total utterances, total word tokens, total word types, and lexical diversity. However, the syntactic complexity of Mother 1’s utterances was high. Overall, these results suggest that the mothers varied in talkativeness and the number and diversity of the words they produced, but overall the mothers used fairly short utterances when talking with their children who were at the Intentional/Presymbolic phase of spoken language development.

Table 3-2: Descriptive statistics for the mothers of the children at the Intentional/Presymbolic phase during the 60-minute natural language samples.

<table>
<thead>
<tr>
<th></th>
<th>Total Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>Lexical Diversity ($D^1$)</th>
<th>MLUm$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother 1</td>
<td>101</td>
<td>403</td>
<td>103</td>
<td>39.41</td>
<td>4.14</td>
</tr>
<tr>
<td>Mother 4</td>
<td>850</td>
<td>2,492</td>
<td>265</td>
<td>54.53</td>
<td>3.09</td>
</tr>
<tr>
<td>Mother 5</td>
<td>607</td>
<td>1,519</td>
<td>293</td>
<td>89.11</td>
<td>2.65</td>
</tr>
<tr>
<td>Mother 6</td>
<td>779</td>
<td>2,028</td>
<td>340</td>
<td>63.46</td>
<td>2.79</td>
</tr>
<tr>
<td>Mother 12</td>
<td>1,235</td>
<td>4,035</td>
<td>542</td>
<td>78.93</td>
<td>3.50</td>
</tr>
</tbody>
</table>

Note: $^1D$ is a measure of lexical density computed by VOCD in CLAN (MacWhinney, 2000). $^2$MLUm = Mean length of utterance in morphemes.
Semantic-Syntactic Characteristics of Mothers’ Spoken Words

Mothers’ Vocabulary Composition

Figure 3-4 presents an overview of the vocabulary composition of the mothers of the children who were at the Intentional/Presymbolic phase of spoken language development. The majority of the mothers’ word types consisted of open class words: action/state, nouns, and descriptive words. Mothers’ use of actions, states, and descriptive word classes reflected the fact that mothers were not simply labeling objects and people in the environment, but also talking about their characteristics and relationships. Social-interaction word types (e.g., sound effects, animal sounds, interjections, games and routines) comprised smaller proportions of the mothers’ total word types for four of the five mothers. The mothers’ production of closed class words (e.g., quantifiers, pronouns, question words, prepositions, articles, and auxiliary verbs) comprised smaller proportions than the open class words (i.e., nouns, actions/states, and descriptive words) for all of the mothers. Mother 1 produced a larger proportion of closed class words than other word type classes which appears to be reflected in her higher MLU.
Overall, the mothers of the children at the Intentional/Presymbolic phase produced similar proportions of the major semantic-syntactic word classes in their spoken language to their children. Yet, there was some individual variation across the mothers. For example, Mother 1 produced a substantially lower proportion of social-interactive word types and a markedly higher proportion of closed class word types than the other mothers. In addition, Mother 6 produced a higher proportion of nouns than the other mothers. However, there appeared to be less variability in the composition of the mothers’ vocabulary than there was in their overall talkativeness.

Figure 3-4: Proportion of word classes out of the total word types produced by the mothers of the children at the Intentional/Presymbolic phase during the 60-minute natural language samples.
The Relationship Between Children’s and Mothers’ Spoken Words

In addition to considering the semantic-syntactic characteristics of the mothers’ and children’s spoken language, the word types that the mothers and children in each dyad produced in common (their shared lexicon) was also explored.

The Shared Lexicons of the Dyads

Only two of the five dyads in the Intentional/Presymbolic subgroup had children who produced spoken utterances during the language samples and these children produced a limited number of words. Therefore, the shared lexicons for these two dyads were limited, as shown in Table 3-3, which lists the words shared by the mother and child in Dyad 4 and in Dyad 12. For Dyad 4, two social/interactive word types were shared and in Dyad 12, two social/interactive and two action words were shared by the mother and child.
Figure 3-5 displays the proportion of words in the shared lexicon out of the total word types produced by the child in the interaction and also out of the total word types produced by the mother. It is apparent that the shared lexicon represented a much greater proportion of the child’s lexicon than his or her mother’s for both dyads. Specifically, the mean proportion of overlap of the shared vocabulary in these samples with the child’s lexicon in the sample was 1.0 for both Child 4 and Child 12. In contrast, the proportion of overlap of shared vocabulary to total vocabulary (word types) with the mother’s lexicon in these sample was .01 for Mother 4 and Mother 12. These values indicate that although the shared lexicons made up an extremely small proportion of the mothers’ total word types, for the two children at the Intentional/Presymbolic phase, the few words in the shared lexicons were all used by their mothers.

### Table 3-3: Shared lexicons of the dyads with children at the Intentional/Presymbolic phase who produced spoken language during the 60-minute natural language samples.

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Frequency in Child’s Lexicon (tokens)</th>
<th>Semantic/Syntactic Word Type</th>
<th>Frequency in Mother’s Lexicon (tokens)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyad 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>all_done</td>
<td>1</td>
<td>Social/Interactive Communicator: Routine</td>
<td>72</td>
</tr>
<tr>
<td>no</td>
<td>1</td>
<td>Social/Interactive Communicator: Routine</td>
<td>10</td>
</tr>
<tr>
<td>Dyad 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mm</td>
<td>5</td>
<td>Social/Interactive Communicator: Conventional Vocalization</td>
<td>26</td>
</tr>
<tr>
<td>yay</td>
<td>1</td>
<td>Social/Interactive Communicator: Interjection</td>
<td>28</td>
</tr>
<tr>
<td>eat</td>
<td>16</td>
<td>Action/State Word Verb</td>
<td>81</td>
</tr>
<tr>
<td>sit</td>
<td>1</td>
<td>Action/State Word Verb</td>
<td>24</td>
</tr>
</tbody>
</table>
In order to gain a better understanding of the relationship between the words that the mothers and their children produced, the next analysis looked at the word types in the shared lexicons in relation to the mothers’ most frequently used words, as measured by their word tokens.

For the children at the Intentional/Presymbolic phase who produced spoken words, the shared lexicon for each dyad was compared to the mother’s and the child’s most frequent word types (i.e., word tokens) to determine what proportion of the shared words was among the mother’s or the child’s most frequently used words (i.e., produced five or more times in the natural language sample). As shown in Table 3-3, only Child 12 produced any shared word types at least 5 times, with 5 tokens for the social-
interactive word type *mm*, and 16 tokens for the action word type *eat*. The shared word types in the shared lexicon were produced very frequently by the mothers in Dyad 4 and Dyad 12. The values indicate that the children heard the shared lexical items 10 or more times to as many as 81 times in their mothers’ spoken language during the 60-minutes of interaction.

**Shared Lexicons – Imitation**

To further examine the commonality of dyads’ shared lexicons, the next analysis investigated the characteristics of imitation in the language samples of the mothers and their children.

Figure 3-6 presents the proportion of total spoken imitations out of the total responses for the children and their mothers at the Intentional/Presymbolic phase. Here, it is clear that most of the mothers did not typically imitate their children. The proportion of spoken imitative utterances out of the total number of mother responses to her child ranged from 0 to .67. This result is not surprising: Child 1, 5, and 6 produced no spoken words and Child 4 and 12 produced a small number so there were not many utterances from the children for the mothers to imitate. However, Mothers 4 and 12 did imitate their children or produced linguistically contingent responses some of the time when there was an opportunity to do so. Child 12 and Child 4 imitated their mothers in a proportion of .30 to 1.00 imitative utterances out of the total child responses, respectively.
Figure 3-7 shows the proportions of the different types of imitation (i.e., exact, expanded, or reduced) out of the total imitations for mothers and their children with ASD who were at the Intentional/Presymbolic phase of spoken language development. Both Child 4 and Child 12 produced reduced imitations of their mothers’ spoken utterances; Child 12 also produced a number of exact imitations. These children produced no
expansions. The other three children produced no spoken utterances and, therefore, no imitative utterances.

Figure 3-7: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the Intentional/Presymbolic phase during the 60-minute natural language samples.
Only Mothers 4 and 12 imitated their children. Mother 4’s exact imitations were .50 and Mother 12’s were .90 of their total imitations, and their expanded imitations were .50 and .10 of their total imitations respectively. Specifically, Mother 12 produced proportionally more exact imitations than expanded imitations, and Mother 4 produced proportionally equal amounts of exact and expanded imitations. Furthermore, mothers produced no reduced imitations which would be expected given the low MLU of their two children who produced only single word utterances. Mothers’ production of imitations (either exact or expanded) appeared to be related to the amount that their children produced spoken utterances generally.

**Dyad 5**

The case study of Dyad 5 (Angela and her son Galen) illustrates a typical example of the mothers and their children who were beginning communicators at the Intentional/Presymbolic phase of spoken language development. Galen, 26 months of age at the time of data collection, was the youngest child in the study. He lived at home with his mother and father and was the only child in his family. His mother, Angela, self-identified as being of Hispanic/Latino ethnic background. She was a stay-at-home mother and homemaker with 14 years of education.

Angela described her son as a “happy and healthy kid” who had recently been diagnosed with ASD. She indicated that he had “zero words” and would typically “guide [her] to what he wanted.” He had been receiving early intervention services for approximately six months: a developmental therapist and a speech-language therapist.
each saw him in the family’s home one time per week, and an occupational therapist one
time per month. An ABA therapy approach (i.e., Applied Behavior Analysis) was
recommended to the family but they had not yet been able to find a provider. Galen was
participating in a therapy via teleconferencing that was designed to provide action
imitation under the direction of a local university medical center.

The speech-language pathologist and mother also employed a strategy that
involved “narrating” what they were doing as they interacted with Galen. The mother
stated that Galen “loves a few board books” and enjoys playing with his ring-stacking toy
and with cars on a track. Angela also indicated that her son “spins things” like the rings
of his stacking toy, and that Galen likes running back and forth in their home. His
mother described her son as being “pretty vocal.”

Angela reported that her son understood 18 words on the MacArthur-Bates
Communicative Development Inventories – Words and Gestures form (MCDI-WG), but
he did not yet say any spoken words. Table 3-4 lists the words Galen was reported to
understand organized by the major word classes. Many of the words he understood were
games and routines (bath, bye-bye, night-night, no, peekaboo). The other semantic
categories include the following word types: one animal sound and an animal name (moo,
cow), one vehicle (car), three food/drink words (banana, cookie, milk), two people words
(Mommy, Daddy), several other common nouns (bathtub, blanket, park, swing), and one
action word (eat). According to his mother’s responses on the MCDI-WG, Galen did not
yet understand any words belonging to the open class of descriptive words or any closed
class words. His age equivalent score at the 50th percentile for boys only on the MCDI-
WG was below 8 months for Words Understood, and 8-9 months for Words Produced.
During the natural language sample, Galen and his mother engaged in a variety of activities: reading storybooks; changing his diaper; playing with a toy car, hula hoop, rings, and a ball; playing with a sound-making toy; playing on a slide; eating a meal; and looking out the window. Consistent with his mother’s description, Galen produced a high number of unintelligible vocalizations: 606 utterances. These unintelligible vocalizations consisted of primarily low vowel sounds such as sound in [a], and back consonant + vowel combinations [ga] and [da]). Galen also produced some reduplicative babbling [ga ga] and [da da]. A full description of his inventory of speech sounds was beyond the scope of the present study, however, his production of speech sounds appeared to be very limited. Galen also produced vowel prolongations and some non-speech sounds such as laughing, crying, and coughing.

Table 3-4: Words reported as understood by Galen (Child 5) per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form.

<table>
<thead>
<tr>
<th>Open class¹</th>
<th>Closed class</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>cow</td>
<td>moo</td>
<td>bath</td>
</tr>
<tr>
<td>car</td>
<td>bath</td>
<td>bye-bye</td>
</tr>
<tr>
<td>banana</td>
<td>night-night</td>
<td>no</td>
</tr>
<tr>
<td>cookie</td>
<td></td>
<td>peekaboo</td>
</tr>
<tr>
<td>milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bathtub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>blanket</td>
<td></td>
<td></td>
</tr>
<tr>
<td>park</td>
<td></td>
<td></td>
</tr>
<tr>
<td>swing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daddy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mommy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. ¹ Open class, closed class, and other categories are from the Vocabulary Checklist of the MacArthur-Bates Communicative Development Inventories – Words and Gestures form (MCDI-WG; Fenson et al., 2007).
Galen produced no intelligible vocalizations nor any consistent vocalizations that approximated words. His mother did not respond to any of his vocalizations as if she interpreted them as being “word-like.” Angela was observed to respond with a conventional vocalization (mhm) or an interjection (my goodness) following some of his vocalizations. She imitated his vocalizations occasionally.

As previously shown in Table 3-2, Angela produced 607 utterances, 293 word types, and 1,519 word tokens during the 60-minute sample. Her mean length of utterance in morphemes was 2.65 morphemes. All of these values suggest that Angela was not a highly talkative mother and that she did not use grammatically complex language with her young son. Interestingly, however, the lexical diversity ($D = 89.11$) of Angela’s language input to Galen was high (see Appendix H; after Durán et al., 2004). This suggests that the spoken language she provided was relatively rich and varied in the semantic content of words.

Figure 3-8 illustrates the proportion of specific noun word types out of the total noun types that Angela produced during the natural language sample while interacting with Galen. She talked about a wide range of concepts with her son. Nouns included: people (baby, boy, cop, doctor, police); clothing (pamper, pants, shirt, socks); furniture/rooms (bed, chair, door, drawer, dresser, kitchen, room, tv, window); toys (basket, basketball, book, hula-hoop, page, ring, toy); and animals (cat, chick, monkey, rooster, sheep). Many of these words were used infrequently. Yet it is apparent that Angela’s spoken language to Galen involved talk about a rich and diverse assortment of things in their world.
Table 3-5 lists the high-frequency word types and word tokens that Angela produced during the natural language sample. High-frequency words were those that she expressed five or more times. Angela expressed 77 high-frequency word types during the 60-minute natural language sample. Of these, eight were social/interactive words. Open class words included: 13 different proper and common nouns; 22 different actions and states, including eight general all-purpose verbs (Rice & Bode, 1993); and 11 descriptive word types. Twenty-three closed class words were among the most frequent words. These word types reflected the activities in which this mother and child participated and the variety of objects with which they interacted. The richness of Angela’s vocabulary appears to be related to the high frequency and diversity of the open class words in her natural language sample. It is interesting to note that three of the words that Angela
reported Galen understood, *car, Mommy,* and *eat,* were among Angela’s high frequency words.

Table 3-5: High frequency word types (*n* = 77) and word tokens produced by Angela during the 60-minute natural language sample with her son Galen (Dyad 5).

<table>
<thead>
<tr>
<th>Tokens</th>
<th>Open Class</th>
<th>Tokens</th>
<th>Closed Class</th>
<th>Tokens</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Type</td>
<td>Type</td>
<td>Type</td>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td><em>go</em></td>
<td>9</td>
<td><em>baby</em></td>
<td>78</td>
<td><em>you</em></td>
</tr>
<tr>
<td>49</td>
<td><em>be</em></td>
<td>9</td>
<td><em>jump</em></td>
<td>53</td>
<td><em>the</em></td>
</tr>
<tr>
<td>40</td>
<td><em>good</em></td>
<td>8</td>
<td><em>not</em></td>
<td>30</td>
<td><em>it</em></td>
</tr>
<tr>
<td>28</td>
<td><em>Mommy</em></td>
<td>7</td>
<td><em>careful</em></td>
<td>19</td>
<td><em>that</em></td>
</tr>
<tr>
<td>25</td>
<td><em>Child’s name</em></td>
<td>7</td>
<td><em>fall</em></td>
<td>19</td>
<td><em>to</em></td>
</tr>
<tr>
<td>21</td>
<td><em>here</em></td>
<td>7</td>
<td><em>rock</em></td>
<td>19</td>
<td><em>your</em></td>
</tr>
<tr>
<td>19</td>
<td><em>spin</em></td>
<td>7</td>
<td><em>sock</em></td>
<td>17</td>
<td><em>be</em></td>
</tr>
<tr>
<td>19</td>
<td><em>want</em></td>
<td>6</td>
<td><em>have</em></td>
<td>17</td>
<td><em>on</em></td>
</tr>
<tr>
<td>18</td>
<td><em>car</em></td>
<td>6</td>
<td><em>hula_hoop</em></td>
<td>16</td>
<td><em>what</em></td>
</tr>
<tr>
<td>17</td>
<td><em>job</em></td>
<td>6</td>
<td><em>push</em></td>
<td>14</td>
<td><em>do</em></td>
</tr>
<tr>
<td>16</td>
<td><em>Buddy</em></td>
<td>6</td>
<td><em>see</em></td>
<td>13</td>
<td><em>a</em></td>
</tr>
<tr>
<td>16</td>
<td><em>let</em></td>
<td>6</td>
<td><em>so</em></td>
<td>13</td>
<td><em>and</em></td>
</tr>
<tr>
<td>16</td>
<td><em>round</em></td>
<td>5</td>
<td><em>crash</em></td>
<td>13</td>
<td><em>us</em></td>
</tr>
<tr>
<td>15</td>
<td><em>come</em></td>
<td>5</td>
<td><em>hungry</em></td>
<td>12</td>
<td><em>my</em></td>
</tr>
<tr>
<td>14</td>
<td><em>down</em></td>
<td>5</td>
<td><em>hurt</em></td>
<td>9</td>
<td><em>more</em></td>
</tr>
<tr>
<td>13</td>
<td><em>eat</em></td>
<td>5</td>
<td><em>make</em></td>
<td>9</td>
<td><em>we</em></td>
</tr>
<tr>
<td>12</td>
<td><em>crank</em></td>
<td>5</td>
<td><em>need</em></td>
<td>8</td>
<td><em>one</em></td>
</tr>
<tr>
<td>12</td>
<td><em>put</em></td>
<td>5</td>
<td><em>pamper</em></td>
<td>8</td>
<td><em>one</em></td>
</tr>
<tr>
<td>12</td>
<td><em>slide</em></td>
<td>5</td>
<td><em>pumpkin</em></td>
<td>7</td>
<td><em>I</em></td>
</tr>
<tr>
<td>11</td>
<td><em>do</em></td>
<td>5</td>
<td><em>say</em></td>
<td>7</td>
<td><em>in</em></td>
</tr>
<tr>
<td>11</td>
<td><em>on</em></td>
<td>5</td>
<td><em>try</em></td>
<td>7</td>
<td><em>me</em></td>
</tr>
<tr>
<td>11</td>
<td><em>ring</em></td>
<td>5</td>
<td><em>wheel</em></td>
<td>6</td>
<td><em>can</em></td>
</tr>
<tr>
<td>10</td>
<td><em>ready</em></td>
<td>5</td>
<td><em>where</em></td>
<td>5</td>
<td><em>to</em></td>
</tr>
</tbody>
</table>

*Note.* General all-purpose verbs are marked with underlined text. Word types that occur more than once belong to different semantic/syntactic categories.

This mother engaged in a variety of routines with her child during the language sample. For example, the mealtime consisted of several utterances that Angela repeated each time she was feeding Galen. This is illustrated in the following scenario from the transcript:
5203 *MOT: want more?
521   *MOT: mm.
522   *MOT: that’s good!
523   *MOT: mm.
524   *MOT: that’s good!
525   *CHI: 0[=! unintelligible vocalization].
526   *CHI: 0[=! unintelligible vocalization].
527   *MOT: mm.
528   *MOT: that’s good!
529   *CHI: yyy[=! m]
530   *MOT: mm.

This series of utterances by the Angela occurred throughout the meal, with occasional unintelligible vocalizations by Galen. The child did produce a bilabial nasal sound [m] that may have been in imitation of his mother (i.e., lines 529 - 530) and which his mother then repeated. This was a very rare occurrence during the language sample.

Other routines occurred during toy play. In the next example, the mother and child rolled the rings down the slide one at a time. The following excerpt from the transcript illustrates this play routine:

815   *MOT: ring go down the slide!
816   *MOT: crash!

3 Numbers indicate the number of the utterance in the transcript of the dyad. The transcripts use the CHAT format (MacWhinney, 2007), which has specific conventions for speaker tiers (e.g., *MOT for mother, *CHI for child), capitalization, spelling, and punctuation.
This type of predictable and repetitive routine characterized much of the dyad’s interactions. Galen did not produce spoken words in response to his mother’s spoken utterances, and Angela engaged in frequent self-repetitive utterances as depicted in the examples above.

To summarize, the case study of Dyad 5 illustrates the pattern of spoken language used by mothers during their interactions with their young children with ASD who produced few to no intelligible spoken words at the Intentional/Presymbolic phase. Although Galen was at a very early phase of spoken language development, and he produced a large number of unintelligible vocalizations, he produced no spoken language. Overall, he rarely engaged in vocal imitation of the sounds his mother produced, even when she attempted to imitate his vocalizations. His mother reported that he did not produce spoken or signed words. Angela did indicate that Galen understood 18 words, which consisted mostly of nouns and social-interactive word types.
Galen’s mother Angela was not a highly talkative mother, and her spoken language consisted of grammatically simple utterances as measured by her mean length of utterance. In contrast, the semantic content of her language input was rich and varied. It is important to note that although only a few of the nouns that Angela reported Galen understood were words that she used in the language sample (e.g., *blankie, car, Mommy*), many of the words she expressed were on the MCDI-WG, indicating that she was using words that young children are typically reported to understand and produce at Galen’s age. This pertains to nouns as well as other word classes. Furthermore, the spoken language she used with her toddler consisted of many words that she produced five or more times during the hour-long language sample. Angela also engaged in much self-repetition in the natural language sample, which may have been related to the absence of speech from Galen.
Beginning Communicators with ASD at the First Words Phase

General Characteristics of Children’s Utterances

Children’s Talkativeness and Complexity

Six children (ages 39 to 76 months) in the present study were beginning communicators who were at the First Words phase of spoken language development: Child 2, Child 3, Child 7, Child 8, Child 10, and Child 13. Table 3-6 indicates the descriptive statistics for the children during their interactions with their mothers in everyday activities in their homes. Some of the children had lower values of talkativeness (i.e., the number of utterances and the number of word tokens) than the others. The children at the First Words phase produced more unintelligible utterances than intelligible utterances, with the exception of Child 8; the ratio of intelligible to total utterances ranged from .23 to .57.

During the 60-minute⁴ natural language samples, three of the children produced less than 50 different words, and three produced more than 50 but less than 100 different words. Values for lexical diversity, as measured by the number of different words and D, suggest that the vocabulary of the six children was not rich or varied. Using the stages of grammatical development described by Brown (1973), the children’s calculated MLU indicates that three of the children were at Early Stage I (MLU = 1.00 to 1.49); two

---

⁴ The data for Dyad 8 and Dyad 10 have been extrapolated to 60 minutes throughout the analyses unless otherwise specified.
children were at Late Stage I (MLU = 1.50 to 1.99), and one was at Stage III (2.49 to 2.99). The speech sounds produced by the children at the First Words phase were varied. They used spoken words to comment, request, and take turns during interactions with their mothers. Overall, these values indicate that there was variability across these measures among these six children.

Table 3-6: Descriptive statistics for children at the First Words phase during 60-minute natural language samples.

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Age (m)</th>
<th>Total Unintelligible Utterances</th>
<th>Total Intelligible Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>Lexical Diversity ($D$)</th>
<th>MLU_m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 2</td>
<td>M</td>
<td>39</td>
<td>222</td>
<td>158</td>
<td>265</td>
<td>79</td>
<td>24.12</td>
<td>1.70</td>
</tr>
<tr>
<td>Child 3</td>
<td>M</td>
<td>44</td>
<td>128</td>
<td>39</td>
<td>89</td>
<td>42</td>
<td>23.10</td>
<td>2.53</td>
</tr>
<tr>
<td>Child 7</td>
<td>M</td>
<td>57</td>
<td>128</td>
<td>84</td>
<td>114</td>
<td>52</td>
<td>25.87</td>
<td>1.53</td>
</tr>
<tr>
<td>Child 8</td>
<td>M</td>
<td>76</td>
<td>95</td>
<td>125</td>
<td>142</td>
<td>36</td>
<td>6.32</td>
<td>1.17</td>
</tr>
<tr>
<td>Child 10</td>
<td>M</td>
<td>64</td>
<td>335</td>
<td>274</td>
<td>295</td>
<td>84</td>
<td>15.60</td>
<td>1.34</td>
</tr>
<tr>
<td>Child 13</td>
<td>M</td>
<td>63</td>
<td>98</td>
<td>39</td>
<td>40</td>
<td>16</td>
<td>N/A</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Note. 1 Data for Child 8 and Child 10 have been extrapolated to 60 minutes, with the exception of MLU_m and $D$. 2 $D$ = is a measure of lexical diversity computed by VOCD in CLAN (MacWhinney, 2000). $D$ was calculated for all children except Child 13, who did not produce the minimum number of utterances required (n = 50). 3 MLU_m = Mean length of utterance in morphemes.

It should be noted that two of these children with ASD presented “mixed phase profiles” as discussed by Tager-Flusberg et al. (2009). Specifically, Child 3 had 42 word types in the 60-minute natural language sample, which equates to 14 word types in 20 minutes. This indicates that he was within the First Words phase and below the Word Combinations phase. He also produced 89 word tokens in 60 minutes, which equates to 29 word tokens in 20 minutes, also within the First Words phase. However, his MLU_m was 2.53, which situates him in the Word Combinations phase. Many of his utterances consisted of phases such as I want X, or appeared to be examples of delayed echolalia.
(e.g., *all_done wipe the nose* and *all_done fix the nose*). It may be that these were rote or trained responses. In addition, this child’s ratio of intelligible to total utterances (i.e., unintelligible plus intelligible) was more similar to the children at the First Words phase than the children at the Word Combinations phase. As a result, it was determined that he was at the First Words phase.

Similarly, Child 13 was on the “cusp” between the Intentional/Presymbolic and the First Words phases. He just met the minimum criteria for First Words with 16 word types in 60 minutes, which equates to 5 word types in 20 minutes. Yet, he produced less than the minimum number of word tokens, with 40 tokens in 60 minutes, which equates to 13 word tokens in 20 minutes. In contrast, he produced a greater variety of consonant sounds and CVC syllables, which was more similar to the children at the First Words than the Intentional/Presymbolic phase. Furthermore, his ratio of intelligible to total utterances was also more similar to the children at the First Words phase than those at the Intentional/Presymbolic phase. Consequently, it was determined that he was at the First Words phase. Thus, it is apparent that in order to determine the spoken language development phase of the children, it is necessary to consider multiple spoken language domains and to view these phases as an overlapping continuum as described by Tager-Flusberg et al. (2009).
Semantic-Syntactic Characteristics of Children’s Spoken Words

Children’s Vocabulary Composition – Observed

Figure 3-9 depicts the proportion of word type classes out of the total frequency of spoken word types produced by the children who were at the First Words phase during their interactions with their mothers. In general, there was considerable variability across the six children who were at the First Words phase of spoken language development. For three of the six children, the word class of nouns comprised the largest proportion of their total word type vocabulary. For two other children, the class of social-interactive word types comprised the largest proportion of their total word type vocabulary. For the sixth child, the closed class comprised the largest proportion of his total word type vocabulary.

Figure 3-9: Proportion of word classes out of the total word types produced by the children at the First Words phase during the 60-minute natural language samples. Data for Child 8 and Child 10 have been extrapolated to 60-minutes.
At this phase of spoken language development, the vocabulary composition of the spoken language produced by the majority of beginning communicators with ASD consisted of comparatively higher proportions of noun word types and lower proportions of action/state and descriptive word types. Child 3 produced equal proportions of action/state and noun word types. This suggests that the children were talking about things and people around them, and they were also talking about the characteristics of, and relationships between, these entities but to a lesser extent. All of the children also used social-interactive word types consisting of social games and routines, animal sounds, sound effects, and interjections. Closed class words comprised low proportions of the total words for most of the children at the First Words phase.

**Children’s Vocabulary Composition – Reported**

All but one mother completed the MacArthur-Bates Communicative Development Inventories – Words and Gestures form, which is used for children with language abilities from 8- to 18 months of age. Mother 2 chose to complete the Words and Sentences form (MCDI-WS) designed for children from 16- to 30 months of age; Child 2’s raw score was below some of the other children whose mothers completed the Words and Gestures form. The MCDI-WS only provides a way for caregivers to indicate words the child produces, therefore, Child 2 is credited with understanding and producing the same number of words. Only those words from the Words and Sentences form that appeared on the MCDI-WG form were included in the analyses for Child 2. This may be an
underestimate of Mother 2’s report of her child’s language abilities, as Child 2 was reported to produce an additional 38 words on the MCDI-WS form.

Figure 3-10 indicates the frequency of words on the MCDI-WG form for the children who were at the First Words phase of spoken language development. The number of words reported to be produced by the children ranged from 8 to 290 (see Graph A). Three mothers reported that their children produced fewer words than they were observed to produce during the natural language samples: Child 3, Child 10, and Child 13.

Graph B of Figure 3-10 shows the number of words understood by the children at the First Words phase as reported by their mothers out of the 396 words on the MCDI-WG. There was a wide range of words reported to be understood by the children at the First Words phase. It is clear from the comparison of Graphs A and B that five of the six children were reported to understand substantially more words than they were reported to produce. The exception was Child 2 for whom a separate report of words understood was not available from the MCDI-WS form his mother completed. As noted earlier, the reported data may underrepresent the number of words he produced and understood.
Figure 3-10: Frequency of words produced (A) and words understood (B) by the children at the First Words phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form. *Child 2: the number of words understood equaled the number of words produced because the MacArthur-Bates – Words and Sentences form was used and it does not separately report words understood.

Figure 3-11 illustrates the proportion of semantic/syntactic word classes out of the total word types that the children who were at the First Words phase were reported to
produce (Graph A) and to understand (Graph B). For all six children, the noun class was the largest proportion of word types out of the total word types they were reported to produce (range = .69 to .88), and for five of the six children, the social-interactive word class was the next largest proportion out of their total words (range = 0 to .16).

**Figure 3-11:** Proportion of word classes out of the total words produced (A) and understood (B) by the children at the First Words phase per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form.
Similar values are seen in Graph B of Figure 3-11 for the proportion of words reported to be understood out of the total words understood for the children at the First Words phase. Although some of the children were reported to not produce several words classes (notably, descriptive and closed class words), all of the children were reported to understand words across all word classes.

**General Characteristics of Mothers’ Utterances**

**Mothers’ Talkativeness and Complexity**

Descriptive statistics for the natural language samples of the mothers with children at the First Words phase are presented in Table 3-7. As shown here, there was wide variation across most measures for the mothers of the children at the First Words phase. For example, mothers differed substantially in their talkativeness during the 60-min interactions with their children. The most talkative mother produced more than three times as many utterances as the least talkative mother, and the most talkative mother produced more than three times the number of word tokens as the least talkative mother.

There was also wide variation in the complexity of utterances spoken by the mothers of children who were at the First Words phase. The total number of different words (i.e., word types) expressed by the mothers varied substantially in the natural language samples. The mother with the highest value produced more than twice as many different word types as the mother with the lowest value. The lexical diversity of the mothers’ language spoken language, as measured by $D$, indicated that the vocabulary of
the mothers of the beginning communicators at the First Words phase was quite rich. Furthermore, these mothers used spoken language that ranged in mean length of utterance from 2.67 to 4.74 morphemes, indicating that their utterances varied in grammatical complexity.

Table 3-7: Descriptive statistics for the mothers of the children at the First Words phase during the 60-minute natural language samples.

<table>
<thead>
<tr>
<th>Mother</th>
<th>Total Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>Lexical Diversity (D^2)</th>
<th>MLUm^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother 2</td>
<td>1,301</td>
<td>4,427</td>
<td>493</td>
<td>86.79</td>
<td>3.65</td>
</tr>
<tr>
<td>Mother 3</td>
<td>603</td>
<td>2,596</td>
<td>353</td>
<td>71.62</td>
<td>4.62</td>
</tr>
<tr>
<td>Mother 7</td>
<td>1,039</td>
<td>3,828</td>
<td>659</td>
<td>109.34</td>
<td>4.18</td>
</tr>
<tr>
<td>Mother 8</td>
<td>436</td>
<td>1,795</td>
<td>332</td>
<td>77.15</td>
<td>4.38</td>
</tr>
<tr>
<td>Mother 10</td>
<td>803</td>
<td>1,993</td>
<td>318</td>
<td>90.00</td>
<td>2.67</td>
</tr>
<tr>
<td>Mother 13</td>
<td>1,370</td>
<td>6,114</td>
<td>802</td>
<td>134.04</td>
<td>4.74</td>
</tr>
</tbody>
</table>

Note. 1 Data for Mother 8 and Mother 10 have been extrapolated to 60 minutes, with the exception of MLUm and D. 2D is a measure of lexical density computed by VOCD in CLAN (MacWhinney, 2000). 3MLUm = Mean length of utterance in morphemes.

Semantic-Syntactic Characteristics of Mothers’ Spoken Words

Mothers’ Vocabulary Composition

Figure 3-12 illustrates the proportion of word classes out of the total number of word types produced by the mothers during interactions with their children who were at the First Words phase of spoken language development. As illustrated by Figure 3-12,
the noun class had the largest proportion of all of the word classes for all six mothers.

Mothers produced similar proportions of the three word classes of action/state word types, descriptive word types, and closed class types. The word class of social-interactive word types comprised the smallest proportion of the mothers’ total number of word types. Although the mothers had substantial variability in the talkativeness and complexity of the spoken language they used with their children who were at the First Words phase, vocabulary composition across the word classes appeared to be more consistent for all of the mothers.

Figure 3-12: Proportion of word classes out of the total word types produced by the mothers of the children at the First Words phase during the 60-minute natural language samples. Data for Mother 8 and Mother 10 have been extrapolated to 60-minutes.
The Relationship Between Children’s and Mothers’ Spoken Words

As with the mothers and their children who were at the Intentional/Presymbolic phase, the relationships between the spoken words of the mothers and of their children at the First Words phase were investigated by (a) exploring the dyads’ shared lexicons; (b) analyzing the shared lexicons and the mothers’ and children’s most frequently used words; and (c) examining the proportions of imitative utterances within their natural language samples.

The Shared Lexicons of the Dyads

The word types which each mother and child had in common were investigated to determine the dyad’s shared lexicon. Figure 3-13 indicates the proportion of words in the shared lexicon out of the total word types produced by the child in the interaction and also out of the total word types produced by the mother at the First Words phase of spoken language development. As was the case with the dyads with the Intentional/Presymbolic communicators who produced spoken language, the dyad’s shared lexicon was a large proportion of each child’s lexicon. The proportion of overlap of the shared vocabulary with the child’s lexicon in the samples ranged from .90 to .95. Since the mothers produced a large number of words, the proportion of overlap of the shared vocabulary with the mothers’ total lexicon in these samples was small (range from .02 to .24). The overwhelming majority of the word types used by the children at the First Words phase were also used by their mothers during the natural language samples,
but their mothers produced a much larger number of different words in addition to those in the shared lexicon.

Figure 3-13: Proportion of words in the shared lexicon out of the total word types produced by the child, and also out of the total word types produced by the mother, at the First Words phase during the 60-minute natural language samples. Data for Dyad 8 and Dyad 10 have been extrapolated to 60-minutes.

Figure 3-14 illustrates the proportion of word classes out of the total word types in the shared lexicon produced by the dyads with children at the First Words phase. As depicted in the graph, there was considerable variability in the composition of the dyads’ shared lexicons across the six dyads. Because the shared lexicon was primarily defined by the children’s words, the patterns illustrated in Figure 3-14 are comparable to those of the children’s word class proportions previously described in Figure 3-9, but quite different from those of the mothers’ word class proportions depicted in Figure 3-12.
The shared lexicon for each dyad was compared to the mother’s and the child’s most frequently produced word types as measured by the number of tokens, to determine whether word frequency played a role in the dyads’ shared lexicons. As discussed previously, most frequent word types were defined as those word types produced five or more times during the 60-minute natural language sample, and these words were designated as the *most frequent words*. The words that were produced most frequently by the children were shared words, and for four of the six mothers, the majority of these shared words were also words that the mothers produced most frequently.

**Shared Lexicons – Frequency of Words**

![Graph showing proportion of word classes out of total shared word types produced by the dyads of the children at the First Words phase during the 60-minute natural language samples. Data for Dyad 8 and Dyad 10 have been extrapolated to 60-minutes.]

Figure 3-14: Proportion of word classes out of the total shared word types produced by the dyads of the children at the First Words phase during the 60-minute natural language samples. Data for Dyad 8 and Dyad 10 have been extrapolated to 60-minutes.
Figure 3-15 depicts the proportion of the words in the shared lexicon that were produced frequently by the child and the proportion of the words in the shared lexicon that were produced frequently by the mother in their natural language sample. Overall, the children who were at the First Words phase did not produce many words five or more times, and they produced few shared words five or more times: the proportion of most frequent shared word types out of the total shared word types produced by the children was low, as depicted in the graph. Yet, all of the words that each child produced frequently were shared words, with the exception of one word that was produced frequently by Child 2 (beep), which was not a word his mother also produced in the sample collected.

![Graph showing proportion of words produced frequently](image)

**Figure 3-15**: The proportion of the words in the shared lexicon produced frequently by the children at the First Words phase and the proportion of words in the shared lexicon produced frequently by the mothers during the 60-minute natural language samples. Data for Dyad 8 and 10 have been extrapolated to 60-minutes.
In contrast, the proportion of most frequent shared word types out of the total shared word types produced by the mothers was substantially higher as shown in the right side of the graph. However, there was variability for the mothers, as indicated by the range of values. Thus, for four of the six mothers of children at the First Words phase, the majority (i.e., more than .50) of the dyads’ shared word types were words that these mothers produced five or more times in their natural language samples. This suggests that frequency of word use by mothers of children at the First Words phase may have influenced the words that the mothers and children shared in common.

**Shared Lexicons – Imitation**

First, the proportion of total imitations out of the total responses was examined for the mothers and their children who were at the First Words phase; this is shown in Figure 3-16. Five of the six children produced imitations in at least .20 of their responses to their mothers’ utterances. For the children (Graph A), the proportion of imitative utterances out of the total number of child responses had a range of values (.15 to .43). For the mothers (Graph B), the proportion of imitative utterances out of the total number of mothers’ responses also had a range of values. Since the mothers produced many more responses than their children, the proportions of these responses that were imitative is somewhat smaller (.11 to .40). Five of the six mothers produced imitations in at least .15 of their responses to their children’s utterances. One dyad (Child 10 and Mother 10) produced proportionally more imitative utterances than the other five dyads. In general,
the majority of the mothers’ and children’s responses were not imitations of their partner’s utterances.

Figure 3-16: Proportion of the children’s (A) and the mothers’ (B) imitations out of the total responses for dyads with children at the First Words phase during the 60-minute natural language samples. Data for Dyads 8 and 10 have been extrapolated to 60-minutes.
Figure 3-17 depicts the proportions of exact, expanded, and reduced imitations out of the total imitations in the children’s and mothers’ natural language samples. For four of the children, there were higher proportions of reduced imitations than exact imitations out of the total number of imitations; while for two children, the proportion of exact imitations was greater than reduced imitations. Furthermore, there were much lower proportions of children’s expanded imitations; two children did not produce any expanded imitations. The limited proportion of expanded imitations would be expected given the children’s low MLU, as previously discussed.

The proportions of exact imitations and expanded imitations out of mothers’ total imitations was variable across the mothers. The proportion of mothers’ reduced imitations was very small. This not surprising in light of their children’s low MLU. In fact, three of the six mothers in the First Words subgroup did not produce any reduced imitations of their children’s utterances. Once again, the child and mother of Dyad 10 produced larger proportions of imitations than the other children at the First Words phase and their mothers. Specifically, nearly three-quarters of Child 10’s imitative utterances were exact imitations of his mother’s utterances, with .25 reduced imitations out of the total number of imitations. Mother 10 produced a similarly large proportion of exact imitations (.74) and a lower proportion of expanded imitations (.26) out of her total number of imitative utterances in the natural language sample.
Figure 3-17: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the First Words phase during the 60-minute natural language samples. Data for Dyads 8 and 10 have been extrapolated to 60-minutes.
**Dyad 2**

The pattern of results for Dyad 2 (Susana and her son Carlos) provides an example of the mothers and their children who were at the First Words phase of spoken language development. Carlos was a 39-month-old boy who, according to parent report, had diagnoses of ASD and sensory processing disorder. He was the youngest child in the First Words subgroup. His mother, Susana, a single parent, self-identified that both she and her son were of Hispanic ethnicity. Carlos had received early intervention services which included 20 hours of Applied Behavioral Analysis (ABA) therapy as well as occupational therapy and speech-language therapy. At the time of enrollment in this study, he attended a preschool program for children with disabilities where he received related services of occupational therapy and speech-language therapy.

In describing her son’s current communication abilities, Susana indicated that Carlos pointed and sometimes used single words but “doesn’t try to talk” and sometimes combined words into short phrases, but “most of the time it’s gibberish talk.” English was the primary language spoken in the home, although Carlos was exposed to Spanish approximately 4 hours per day as his grandmother cared for him when his mother was at work and he was not in school. Susana had 17 years of education and was employed as an executive assistant. She stated that Carlos had not used any augmentative and alternative communication devices or unaided communication strategies other than pointing. Susana also stated that her son enjoyed playing with cars and trucks and that “he is fascinated with wheels, lights, and fans.” She and her son often read *Thomas the Train* books together.
Given Susana’s description of her son’s communication skills and his age as reported in the initial caregiver interview, the MacArthur-Bates Communicative Development Inventories-Words and Sentences (WS) form was given to her to complete rather than the MacArthur-Bates Communicative Development Inventories-Words and Gestures (MCDI-WG) form. The MCDI-WS form includes the same words on its Vocabulary Checklist as the MCDI-WG form plus an additional 284 words (680 compared to 396). On the completed MCDI-WS form, most of the words Susana identified as words Carlos could say corresponded to words on the MCDI-WG form.

On the MCDI-WS, Carlos attained an age equivalence score of 22-23 months. Carlos produced slightly more unintelligible utterances than intelligible utterances, produced 79 word types in 60 minutes, which equates to 26 words in a 20-minute language sample, and utilized a range of earlier developing speech sounds. Thus, he met the minimum benchmark criteria for the First Words phase of spoken language development as delineated by Tager-Flusberg et al. (2009).

During the natural language sample that was transcribed and analyzed for the present study, Carlos and his mother were engaged in a variety of activities together: singing songs; getting dressed, brushing teeth; playing with a toy truck, car, tractor, and a ball; playing a naming routine with an electronic toy; eating a snack or meal; reading stories; drawing; and getting ready for a nap. During these activities, Carlos produced many unintelligible utterances.

Descriptive statistics, presented previously in Tables 3-6 and 3-7, revealed that during the natural language sample, both Carlos and his mother were talkative. Carlos produced a high number of unintelligible utterances, which outnumbered his intelligible
utterances; the proportion of intelligible utterances out of his total utterances was .42. Most of the unintelligible utterances consisted of strings of sounds that were uninterpretable and did not appear to be related to conventional words. In addition, some of these vocalizations were high-pitched and others were lower-pitched and resembled humming. Carlos also occasionally engaged in laughing, crying, and producing animal and vehicle sound effects. Furthermore, Carlos had a lexical diversity value \((D)\) of 24.12, indicating that his spoken vocabulary was diverse. Compared to the normative data summarized in Appendix H, the lexical diversity of his spoken language as measured by \(D\) was similar to that of younger, 21- to 24-month-old children who were typically developing (after Durán et al., 2004).

Susana was also very talkative in terms of the number of utterances and the number of word tokens she expressed. Her vocabulary diversity as measured by \((D)\) was 86.79 (see Appendix H; after Durán et al., 2004). The number of different word types and her \(D\) value were in the middle of the range of the mothers of children at the First Words phase. The mean length of her utterances as measured in morphemes was 3.65, indicating that she used shorter and less grammatically complex utterances.

Both Susana and her son produced a wide range of semantic/syntactic categories in the word types they expressed in their natural language sample. This was illustrated previously in Figure 3-9 and Figure 3-12. Proportions of specific noun word types out of the total noun types produced by Carlos and his mother during the natural language sample are depicted in Figure 3-18. In Graph A, it is apparent that Carlos talked primarily about vehicles, animals, and clothing, as evidenced by the higher proportions of these semantic categories. In contrast to her son, Susana (Graph B) talked about all of the
semantic-syntactic categories, but primarily about the outside and unspecified nouns, as well as people and body parts.

Figure 3-18: Proportion of specific noun word type semantic categories out of the total noun word types produced during the 60-minute natural language samples by Carlos (A) and his mother Susana (B).
The shared lexicon of the dyad represented .95 of the total word types Carlos produced in the language sample. These shared word types and Susana’s word tokens are presented in Table 3-8. Here the prominence of open class words, and specifically nouns, is readily observed. The dyad’s shared lexicon includes several more specific verbs (*be*, *help*, *let*, *open*, *read*, *say*, *stop*, *turn*, *wash*) in addition to general all-purpose verbs (*go*, *look*, *see*). All of these more specific word types would appear to be integral components of the interactions between the mother and her child, and they revolved around the activities in which the dyad was engaged. It is interesting to note that the four words from Carlos’ lexicon that were not expressed by his mother in this sample were the numbers *three* and *four*, the verb *set* (as in *ready, set, go*), and the social-interactive word *beep*, which is a sound effect or onomatopoeic word.

This dyad’s shared lexicon was related to the mother’s most frequently produced words; that is, word types that Susana used five or more times (high-frequency words). As was discussed previously and shown in Figure 3-15, Carlos produced a small proportion of the words in the shared lexicon frequently (.20) and Susana produced a much larger proportion (.71) of the words in the shared lexicon frequently. Table 3-8 illustrates the dyad’s shared words and the frequency of those words in Susana’s lexicon. As can be seen in Table 3-8, most of the open class, closed class, and social-interactive words (i.e., those in the “other” class) were high-frequency word types used five or more times by Susana during the 60-minute natural language sample. Fifteen of these shared words were also produced five or more times by Carlos in the language sample (*go*, *Thomas, train, see, truck, wash, you, a, no, oh, yeah, bye, ooh, choo, uoh*).
Carlos and his mother produced similar proportions of imitations out of their total responses (.26 and .27 respectively, as depicted in Figure 3-16). In terms of the types of imitation they engaged in with each other out of the total number of imitations expressed (see Figure 3-17), Carlos produced proportionately more reduced imitations than exact imitations of his mother’s prior utterances, and he produced a very limited proportion of expanded imitations, which would be expected for his language level. Susana produced
a higher proportion of expanded imitations than exact imitations, and also produced a lower proportion of reduced imitations of her son’s prior utterances.

Some examples of the shared lexicon and the types of imitations produced by Dyad 2 illustrate the dynamics of this relationship. Lines 622 – 625 of the transcript demonstrate their imitation of one another during an interaction with an electronic toy:

622  *MOT:  it’s raining in the jungle !
623  *CHI:  the jungle !
624  *MOT:  yeah (…) in the jungle !
625  *CHI:  jungle.

In the preceding example, Susana began the exchange and Carlos produced a reduced imitation of her prior utterance. Then, in a return imitation, Susana produced an expanded imitation of his utterance which was followed by another reduced imitation by the child.

In a second example, Susana was reading a Thomas the Train book to Carlos. The following exchange then occurred:

1426  *MOT:  look at all the trains .
1427  *MOT:  you wanna [: want to] turn the page ?
1428  *CHI:  the train ?
1429  *MOT:  the train ?
1430:  *MOT:  look!
1431:  *MOT:  what’s that ?
1432  *CHI:  train !
1433  *MOT:  Thomas .
In line 1428, Carlos produced a reduced imitation of his mother’s utterance in line 1426. The mother then produced an exact imitation of Carlos’s utterance in line 1429. She subsequently asked him a question which elicited a response from him. Over the next three lines, Susana provided more specific information about the train and then produced expanded imitations of his utterance. These are examples of imitation that occurred within a prior three-utterance window. There were six tokens of the word *train* in this one exchange between the mother and child.

A third example occurred in lines 120 to 124. Susana wanted to help Carlos brush his teeth when he noticed his toy vehicles:

120  *CHI:  look !
121  *CHI:  a car truck .
122  *MOT:  look a car and a truck ?
123  *CHI:  0 [=! unintelligible vocalization] .
124  *MOT:  that’s a car .

The child initiated the exchange and his mother expanded on his utterance by adding several words. Subsequent to an unintelligible vocalization by Carlos, Susana produced another utterance that included the word *car* and then clarified the identity of his toy. It is interesting to note that Susana and many other mothers often produced an exact, expanded, or reduced imitation of their child’s prior utterance using a rising intonation, as if they were attempting to confirm their child’s utterance.
At one point during the language sample (utterance 352), Carlos began crying. From his mother’s ensuing utterances, it appeared as though his grandmother had been with him just prior to the recorded session and had left to go home. Ten utterances later, (utterances 362-363), his mother said,

362 *MOT:  she see you later.
363 *MOT:  she’s gonna see you later.
364: *CHI:  xxx see you.
365: *MOT:  I see you later.
366 *MOT:  Mama’s [/] Grandma’s gonna see you later.

Another five utterances intervened, followed by the following utterances:

372 *CHI:  see you see you see you see you.
373 *MOT:  ye(a)h see you later Grandma.
374 *CHI:  see you.
375 *MOT:  and see you later Tia.
376 *MOT:  Auntie.
377 *CHI:  0 [=! child is crying].
378 *MOT:  no she’ll see you later.
381 *MOT:  what are you watching?
382 *CHI:  xxx see you.
383 *MOT:  P_J_Max?
384 *CHI:  see you.
385 *MOT:  what?
386 *MOT:  what?
387 *MOT: what’s the matter?
388 *CHI: see you?
389 *MOT: I know.
390 *MOT: pointing at the door.\(^5\)
391 *MOT: you’re gonna miss Grandma.
392 *MOT: me too.

Utterance 372 appears to be an example of delayed imitation, since it occurred beyond the window of three prior maternal utterances and the words *see you* were produced rapidly and repetitively. An expanded imitation by his mother was then followed by a reduced imitation by the child, which was again followed by another expanded imitation by the mother and a subsequent self-repetition. Carlos then produced a reduced imitation of line 378 in line 382, and then a self-repetition. His final utterance in 388 could be considered spontaneous since it occurred beyond the three-utterance window and did not have the same repetitive, rapid characteristics as utterance 372. Once Susana acknowledged his distress, Carlos eventually stopped crying and appeared to resume engagement in the activities with his mother.

In summary, the case study of Dyad 2 elucidates the results for children and mothers at the First Words phase. According to parent response on the MCDI-WS, Carlos was reported to understand and say word types across a range of semantic-syntactic categories, which was also true of the words he was observed to produce during the natural language sample.

\(^5\) This is what Susana said, apparently describing Carlos’ gesture as he pointed at the door.
Both Carlos and his mother were talkative and their vocabulary was relatively diverse. The First Words phase of language development can be viewed as a continuum between Intentional/Presymbolic behaviors to the production of Word Combinations. Carlos may be closer to the upper range of the First Words phase than to the lower range, as indicated by the complexity measures of lexical diversity and grammatical complexity. The complexity of Susana’s spoken language input was more in the mid-range for measures of lexical diversity and grammatical complexity.

Almost all of the spoken words Carlos produced during the language sample were words that he shared in common with his mother. Their shared lexicon from the language sample of 75 words appeared to be related to the mother’s most frequently used words (i.e., word types with $\geq 5$ tokens in the natural language sample). Carlos also produced 15 of the shared words frequently. Furthermore, the shared lexicon was also related to the mother’s and child’s imitations of each other’s prior utterances. Finally, Carlos appeared to have engaged in a limited amount of delayed imitation, an example of which occurred when he was upset that his grandmother had left his home.
Beginning Communicators with ASD at the Word Combinations Phase

General Characteristics of Children’s Utterances

Children’s Talkativeness and Complexity

There were two children in the present study who were beginning communicators at the Word Combinations phase of spoken language development: Child 9 and Child 11. Table 3-9 presents the descriptive statistics for these children. The children’s ages were 47 and 53 months. As indicated in Table 3-9, they produced substantially more intelligible utterances than unintelligible utterances; the ratio of intelligible to total utterances was .74 for Child 9 and .81 for Child 11. Both children produced a wide range of consonant sounds as well as syllable types, characteristic of the Word Combinations phase. During the 60-minute natural language samples, the children produced similarly high frequencies of word tokens. Child 9 produced 528 word tokens in 60 minutes, which equates to 176 word tokens in 20 minutes. Child 11 produced 588 word tokens in 60 minutes, which equates to 196 word tokens in 20 minutes. These values surpass the spoken language benchmark minimum criteria of ≥ 20 word tokens in 20 minutes for the First Words phase, and ≥ 100 word tokens in 20 minutes for the Word Combinations phase. This suggests that both children were in a stage of rapid vocabulary growth, which would be characteristic of the early Word Combinations phase of spoken language development. All of these values suggest that both Child 9 and Child 11 were relatively talkative children.
Although these two children were comparable in terms of their talkativeness, the complexity of their language was dissimilar. The mean length of utterance in morphemes for Child 9 was 1.69 (Brown’s Late Stage I) and for Child 11 it was 1.23 (Brown’s Early Stage I). These values are below the spoken language benchmark criteria of an $MLU_m$ of 1.8 morphemes for the Word Combinations phase, potentially suggesting a “mixed phase profile,” with grammatical development less advanced than vocabulary development. In fact, both children met or exceeded the spoken language benchmark minimum criteria of 30 words in a 20-minute language sample for the Word Combinations phase.

Specifically, Child 9 produced 185 word types in 60 minutes, which equates to 62 word types in 20 minutes, and Child 11 produced 106 word types in 60 minutes, which equates to 35 word types in 20 minutes. Child 9 produced a substantially higher number of different word types than Child 11. Moreover, for the additional lexical diversity parameter ($D$), the two children at the Word Combinations phase differed from one another on this measure as well. These values indicate that Child 9 had a much more diverse and rich vocabulary than Child 11.

Table 3-9: Descriptive statistics for the children at the Word Combinations phase during the 60-minute natural language samples.

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Age (m)</th>
<th>Total Unintelligible Utterances</th>
<th>Total Intelligible Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>Lexical Diversity ($D$)</th>
<th>MLUm$^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 9</td>
<td>M</td>
<td>47</td>
<td>121</td>
<td>344</td>
<td>528</td>
<td>185</td>
<td>64.72</td>
<td>1.69</td>
</tr>
<tr>
<td>Child 11</td>
<td>M</td>
<td>53</td>
<td>115</td>
<td>482</td>
<td>588</td>
<td>106</td>
<td>11.14</td>
<td>1.23</td>
</tr>
</tbody>
</table>

*Note:* $D$ is a measure of lexical diversity computed by VOCD in CLAN (MacWhinney, 2000). $MLUm = \text{Mean length of utterance in morphemes.}$
Semantic-Syntactic Characteristics of Children’s Spoken Words

Children’s Vocabulary Composition - Observed

The proportion of word type classes out of the total number of word types for the children at the Word Combinations phase is illustrated in Figure 3-19. Both Child 9 and Child 11 expressed spoken words across the five semantic/syntactic word classes. The children produced comparable proportions of descriptive words, actions/states, as well as closed class words. However, they differed in terms of how large a proportion of their total word types was comprised of nouns and social/interactive words. Specifically, Child 9 produced a larger proportion of nouns than Child 11, whereas Child 11 produced a larger proportion of social-interactive words than Child 9.

![Figure 3-19: Proportion of word classes out of the total word types produced by the children at the Word Combinations phase during the 60-minute natural language samples.](image-url)
Children’s Vocabulary Composition – Reported

The raw scores of Child 9 and Child 11 on the Words and Gestures form of the MacArthur-Bates Communicative Development Inventories (MCDI-WG) are depicted in Figure 3-20. Mothers of both Child 9 and Child 11 reported that their children were able to produce and understand many spoken words. As shown in Figure 3-20, both of these boys who were at the Word Combinations phase were reported to understand more words than they were reported to say.
Figure 3-20: Frequency of words produced (A) and the words understood (B) by the children at the Word Combinations phase, as per parent report on the MacArthur-Bates Communicative Development Inventories form.

Figure 3-21 shows the proportion of semantic/syntactic word type classes that the children were reported to produce (A) and understand (B). Inspection of these graphs reveals that the children had similar proportions of word classes out of their total word types as reported for both words produced and words understood. For both Child 9 and
Child 11, Graph A indicates that the children produced word types across all five word classes, and for both children, the noun class had the largest proportion of word types out of their total word types reported produced. The next largest class was social/interactive words; followed by action/state word types; and descriptive words. Closed class words comprised the smallest proportion of word types for both children. The main difference between the words the children were reported to produce versus understand was that both children were reported to understand a larger proportion of action/state words than they produced.
Figure 3-21: Proportion of word classes out of the total words produced (A) and understood (B) by the children at the Word Combinations phase, as per parent report on the MacArthur-Bates Communicative Development Inventories – Words and Gestures form.
General Characteristics of Mothers’ Utterances

Mothers’ Talkativeness and Complexity

Descriptive statistics for the natural language samples of the two mothers of children who were at the Word Combinations phase are presented in Table 3-10. The two mothers expressed a comparable number of total utterances. However, they differed in the other measures of talkativeness and complexity of the spoken language they used with their children.

Table 3-10: Descriptive statistics for mothers of the children at the Word Combinations phase during 60-minute natural language samples.

<table>
<thead>
<tr>
<th></th>
<th>Total Utterances</th>
<th>Total Word Tokens</th>
<th>Total Word Types</th>
<th>Lexical Diversity ($D^1$)</th>
<th>MLUm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mother 9</td>
<td>1,135</td>
<td>3,468</td>
<td>427</td>
<td>75.72</td>
<td>3.24</td>
</tr>
<tr>
<td>Mother 11</td>
<td>1,068</td>
<td>4,932</td>
<td>645</td>
<td>111.88</td>
<td>4.93</td>
</tr>
</tbody>
</table>

Note: $D^1$ = measure of lexical diversity measured by VOCD software in CLAN (MacWhinney, 2000); MLUm = Mean length of utterance in morphemes.
Semantic-Syntactic Characteristics of Mothers’ Spoken Words

Mothers’ Vocabulary Composition

Figure 3-22 depicts the proportion of word type classes out of the total word types produced by the mothers. Overall, the mothers produced comparable proportions of the five word classes. Out of their total word types, the word class of nouns comprised the largest proportion of word types for both mothers. The smallest proportion of their total word types was comprised of social/interactive word types. It is noteworthy that although the mothers used utterances that differed in semantic and syntactic complexity, the composition of their expressive vocabulary in terms of word classes was quite similar.

![Proportion of word classes](image)

**Figure 3-22:** Proportion of word classes out of the total word types produced by the mothers of the children at the Word Combinations phase during the 60-minute natural language samples.
The Relationship Between Children’s and Mothers’ Spoken Words

As with the dyads whose children were at the earlier phases of spoken language development, the relationships between the spoken words of the mothers and their children who were at the Word Combinations phase were explored by (a) describing their shared lexicons; (b) examining the frequency of occurrence of the dyads’ shared lexicon; and (c) analyzing the proportions of the mothers’ and children’s imitative utterances within the natural language samples.

The Shared Lexicons of the Dyads

Figure 3-23 presents the proportion of words in the shared lexicon out of the total word types produced by the child in the interaction and also out of the total word types produced by the mother for dyads at the Word Combinations phase. During their language samples, the shared lexicon of Dyad 9 comprised .90 of the child’s total lexicon of word types and the shared lexicon of Dyad 11 also comprised .90 of the child’s lexicon of total word types. As expected, the shared lexicon accounted for a smaller proportion of the mothers’ total lexicon as the mothers produced a much greater number of words in the language sample. It is interesting to note that the shared lexicon for the mother in Dyad 9 comprised a higher proportion of her total word types than did that of the mother in Dyad 11. For the children at the Word Combinations phase, most of the word types produced by the children were also produced by their mothers.
Figure 3-23: Proportion of words in the shared lexicon out of the total word types produced by the child, and also out of the total word types produced by the mother, at the Word Combinations phase during the 60-minute natural language samples.

Figure 3-24 illustrates the proportion of word classes out of the total word types within the shared lexicons of the two dyads. For both dyads, nouns were the predominant word class expressed, although this pattern was more apparent for Dyad 9. The word class patterns in the shared lexicons were very similar to those depicted in Figure 3-19 for Child 9 and Child 11 as there was a high proportion of each child’s lexicon that was within the dyad’s shared lexicons (see also Figure 3-23). The shared lexicon of Dyad 9 is found in Table 3-11 (presented in the Case Study), and for Dyad 11 in Appendix M.
Shared Lexicons – Frequency of Words

The shared lexicon for each dyad with children at the Word Combinations phase was compared to the most frequently produced spoken word types of each child and each mother. Figure 3-25 illustrates the proportion of the words in the shared lexicon that were produced frequently by the child and the proportion of the words in the shared lexicon that were produced frequently by the mother during their natural language sample. The children produced less than .20 of the words in the dyad’s shared lexicon frequently (i.e., five or more times) in the language sample.

In contrast, the mothers produced more than .45 of the words in the dyad’s shared lexicon frequently. Many of the words that the children and mothers produced in

Figure 3-24: Proportion of word classes out of the total shared word types produced by the dyads of the children at the Word Combinations phase during the 60-minute natural language samples.
common were word types that were used frequently by mothers in the natural language samples.

Figure 3-25: The proportion of the words in the shared lexicon produced frequently by the children at the Word Combinations phase and the proportion of words in the shared lexicon produced frequently by the mothers during the 60-minute natural language samples.

**Shared Lexicons – Imitation**

Figure 3-26 shows the proportion of the children’s and the mothers’ imitations out of the total number of responses in the natural language samples of the dyads with children at the Word Combinations phase of spoken language development. As seen in Graph A, the proportions of imitative utterances out of the total number of responses produced by Child 9 and Child 11 were .21 and .13, respectively. In Graph B, the
proportions of imitative utterances out of the total number of responses produced by Mother 9 and Mother 11 were .26 and .19, respectively.

The proportions of exact imitation, expanded imitation, and reduced imitation (out of the total number of imitations per participant) for the mothers and children who were at the Word Combinations phase are depicted in Figure 3-27. Graph A indicates that both Child 9 and Child 11 engaged in proportionally more reduced imitations of their mothers’ utterances (i.e., .60 and .69 respectively), out of their total number of imitations compared to exact imitations of their mothers’ utterances: (i.e., .30 and .31 respectively).

For Child 9, expanded imitation of this mother’s utterances was proportionally very low (.10 of his total number of imitations); for Child 11, this type of imitation was not produced at all. Such low levels of expanded imitation by the children were not unexpected given their low mean lengths of utterance. Thus, the children at the Word Combinations phase were more likely to produce reduced imitations of one of their mothers’ prior utterances than other types of imitation.
Graph B in Figure 3-27 indicates that mothers tended to engage in proportionally more *exact* imitations of their children’s prior utterances than other types of imitation. Additionally, both mothers also produced *expanded* imitations of their children’s prior utterances. The proportion of reduced imitations was very low for both Mother 9 and Mother 11. Given the mean lengths of their children’s utterances, the mothers’ low
proportions of reduced imitations were not unexpected. Accordingly, the mothers with children at the Word Combinations phase were more likely to produce exact or expanded imitations of one of their children’s prior utterances than reduced imitations.

Figure 3-27: Proportion of the children’s (A) and the mothers’ (B) imitation types out of the total imitations for dyads with children at the Word Combinations phase during the 60-minute natural language samples.
Dyad 9

The pattern of results for Dyad 9 (Miranda and her son Adam) provides an example of the mothers and their children who were at the Word Combinations phase of spoken language development.

Miranda provided the following information about her son’s communication abilities in the initial interview. Adam was a 47-month-old boy with a diagnosis of ASD who lived at home with his mother and father. He was his mother’s second biological child and had three older, young adult siblings. Miranda self-identified as being of Asian ethnicity and indicated that Adam was of mixed Asian and Caucasian ethnicity. Miranda stated that she was employed as an executive assistant and had 17 years of education.

Adam’s mother reported that she first became concerned about her son’s development when he was 12 months old, at which time she felt that “something was not right.” He was not yet talking and banged his head. He was evaluated at 18 months of age and began receiving early intervention services which included speech therapy two times per week and behavioral therapy weekly. At 2 years 11 months, he was seen for a comprehensive developmental assessment and was diagnosed with ASD. At the time of enrollment in the current research study, Adam was attending day care 10 hours per day at a developmental laboratory school at a local community college. He was receiving ABA therapy 8 hours per week and 2 hours of speech and language therapy per week in his day care/preschool program and also was seen for an additional 2 hours per week of speech and language therapy separately. Miranda described the speech and language
therapy sessions as being “play-based” and focused on manipulation of toys. Miranda said that her son was spending one hour per day at the developmental laboratory school with children who were developing typically, and the family’s goal was for him to be “one hundred percent of the time with typical children.”

Miranda described her son as a child who “has a smile that could light up a room.” She stated that although he was able to say more than 50 words, he did not use more than 50 words with his mother and father. His mother indicated that Adam used speech primarily to label and make requests. For example, he might say “milk please” but required prompting to produce longer utterances. Miranda stated that her son did not use speech for commenting. Furthermore, she described Adam as being “a repeater.” He enjoyed playing with the family’s iPad and his mother said that this had been a “main learning tool” for him. Miranda also indicated that her son liked to sing along with the iPad and was “so clear,” but he “won’t talk” as clearly and his speech “gets jumbled up when repeating longer [phrases].” Adam was also reported to know the letters of the alphabet, numbers, and the names of vegetables. Furthermore, Miranda said that Adam did not like his mother to read to him or sing with him.

During the natural language sample, Adam and his mother engaged in several activities, but these activities were not as varied as many of the other dyads. The activities were: brushing teeth; eating breakfast; playing a naming routine with an electronic toy; caregiving; playing with Legos and other blocks; and singing a song. Like most of the families, Miranda recorded several sessions over more than one day and consequently, there was more than one episode of eating breakfast and playing with the electronic toy. Yet, despite the lack of diversity in activities, Adam engaged in a lot of
talking: he produced 6 utterances per minute, and 9 words per minute (see Table 3.9 for his total number of utterances and total word tokens in the 60-minute language sample). Miranda was also relatively talkative: she produced 19 utterances per minute, and 58 words per minute (see Table 3.10 for her total number of utterances and total word tokens in the 60-minute language sample).

It is also interesting to note that these analyses suggest that, if all of the children in the study are placed in rank order from lowest to highest values for each of the measures of spoken language, Adam had relatively more diverse vocabulary and more grammatically complex utterances than most of the children. On a similar rank order of maternal spoken language for all of the mothers in the study, Miranda had relatively less diverse vocabulary and less grammatically complex utterances than most of the mothers.

Figure 3.28 permits a closer look at the specific semantic categories of word types in Dyad 9’s language sample, elucidating the specific noun words types that Adam (Graph A) and his mother (Graph B) expressed during their interactions. Although the general pattern of the proportions of the noun types out of the total noun types produced in the child’s and mother’s vocabulary was very similar, it is apparent that Adam had a higher proportion of vehicle word types compared to his mother, who also had a substantial proportion of vehicle word types, both out of the total noun word types. The electronic toy with which Adam and Miranda played produced a very diverse assortment of vehicle names. Miranda often asked her son what he saw, Adam activated the toy,
the vehicle name was spoken aloud by the toy, and then Adam repeated the vehicle name.

For both mother and child, there were also relatively higher proportions of unspecified noun and toy word types. As shown in Figure 3-22, Miranda’s higher proportion of descriptive word types could have been related, in part, to her frequent praise of her son after he correctly named a vehicle or other entity, as well as to different adjectives and
adverbs she used to talk about the toys and objects with which the dyad interacted (see also Table 3-11). It is noteworthy that both Adam’s and Miranda’s lexicons had low proportions of word types for many semantic categories out of their total word types expressed. The topics they talked about appeared to be limited.

Examination of the dyad’s shared lexicon in Table 3-11 also reveals additional information about the types of words they used and what they talked about. The predominance of open class words, and particularly nouns, is apparent. In contrast to the amount and diversity of nouns, the number of action/state word types was very limited and not diverse. In fact, six of the 14 action/state word types were general all-purpose verbs. The dyad’s low verb diversity is in sharp contrast to the diversity of the noun and descriptive word types in their shared lexicon.

Only one-tenth of Adam’s total word types was not shared with his mother in the language sample. These words consisted of the following 18 word types: three social/interactive words (uhn, whoosh, wow), nouns (airplane, bicycle, ambulance, E_C, engine, fire, airline, fork, line, mag_laugh, pilot, power, way), and two action word types (excavate, hold).
Table 3-11: Word types \((n = 167)\) of the shared lexicon of Miranda and Adam (Dyad 9) and word tokens of Miranda produced during the 60-minute natural language sample.

<table>
<thead>
<tr>
<th>Token</th>
<th>Type</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 be</td>
<td>5</td>
<td>round</td>
<td>2 propeller</td>
<td>2</td>
<td>roller</td>
<td>79 a</td>
</tr>
<tr>
<td>83 good</td>
<td>5</td>
<td>square</td>
<td>2 roller</td>
<td>2</td>
<td>spill</td>
<td>78 be</td>
</tr>
<tr>
<td>77 want</td>
<td>5</td>
<td>star</td>
<td>2 spill</td>
<td>2</td>
<td>trecher</td>
<td>69 the</td>
</tr>
<tr>
<td>61 Child’s name</td>
<td>4</td>
<td>all</td>
<td>2 trecher</td>
<td>2</td>
<td>asphalt</td>
<td>63 that</td>
</tr>
<tr>
<td>39 block</td>
<td>4</td>
<td>book</td>
<td>1 angry</td>
<td>1</td>
<td>way</td>
<td>48 one</td>
</tr>
<tr>
<td>32 cereal</td>
<td>4</td>
<td>crane</td>
<td>1 asphalt</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>23 put</td>
<td>4</td>
<td>diamond</td>
<td>1 cement</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>21 Mommy</td>
<td>4</td>
<td>dump</td>
<td>1 concrete</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>21 play</td>
<td>4</td>
<td>hair</td>
<td>1 concrete</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>20 make</td>
<td>4</td>
<td>half</td>
<td>1 concrete</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>19 train</td>
<td>4</td>
<td>marshmallow</td>
<td>1 cream</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>16 get</td>
<td>4</td>
<td>plane</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>16 tiny</td>
<td>4</td>
<td>truck</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>16 triangle</td>
<td>3</td>
<td>air</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>15 hat</td>
<td>3</td>
<td>animal</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>15 see</td>
<td>3</td>
<td>blue</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>14 eye</td>
<td>3</td>
<td>car</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>13 circle</td>
<td>3</td>
<td>cargo</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>13 there</td>
<td>3</td>
<td>Daddy</td>
<td>1 cylinder</td>
<td>1</td>
<td>close</td>
<td>25 l</td>
</tr>
<tr>
<td>12 blueberry</td>
<td>3</td>
<td>excavator</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>12 little</td>
<td>3</td>
<td>excuse</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>11 big</td>
<td>3</td>
<td>floor</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>11 bit</td>
<td>3</td>
<td>green</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>11 yogurt</td>
<td>3</td>
<td>hand</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>10 milk</td>
<td>3</td>
<td>high</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>10 rectangle</td>
<td>3</td>
<td>loader</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>9 enough</td>
<td>3</td>
<td>sea</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>9 red</td>
<td>3</td>
<td>screw</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>9 small</td>
<td>3</td>
<td>speed</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>9 up</td>
<td>3</td>
<td>too</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>9 vehicle</td>
<td>3</td>
<td>tractor</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>8 iPad</td>
<td>3</td>
<td>water</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>8 jet</td>
<td>3</td>
<td>where</td>
<td>1 open</td>
<td>5</td>
<td>one</td>
<td></td>
</tr>
<tr>
<td>8 watch</td>
<td>2</td>
<td>backhoe</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 brush</td>
<td>2</td>
<td>balloon</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 closet</td>
<td>2</td>
<td>biplane</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 lego</td>
<td>2</td>
<td>blimp</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 tissue</td>
<td>2</td>
<td>build</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 tooth</td>
<td>2</td>
<td>cable</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>7 yellow</td>
<td>2</td>
<td>door</td>
<td>9 thank you</td>
<td>2</td>
<td>where</td>
<td>8 all done</td>
</tr>
<tr>
<td>6 aircraft</td>
<td>2</td>
<td>end</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>6 chair</td>
<td>2</td>
<td>game</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>6 loud</td>
<td>2</td>
<td>heart</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 bear</td>
<td>2</td>
<td>hot</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 bulldozer</td>
<td>2</td>
<td>human</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 find</td>
<td>2</td>
<td>jumbo</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 freight</td>
<td>2</td>
<td>mixer</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 locomotive</td>
<td>2</td>
<td>monorail</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 lot</td>
<td>2</td>
<td>plow</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
<tr>
<td>5 polar</td>
<td>2</td>
<td>private</td>
<td>2 oh</td>
<td>1</td>
<td>mixer</td>
<td>1 mm</td>
</tr>
</tbody>
</table>

Note. General all-purpose verbs are marked with underlined text. Word types that occur more than once belong to different semantic/syntactic categories.
Many of the words that were not shared were words for which Adam produced the incorrect noun or verb form; these are shown in bold text in the list above. Rather than repeating or imitating incorrect words, Miranda provided the correct word. For example, she said excavator in response to his incorrect production of excavate, or said jet airliner instead of jet airline. In most cases, she acknowledged his correct production of a spoken word by repeating or imitating what he said. However, in other instances she praised him instead, for example by saying, very good. In some instances, she provided a contingent response that did not involve an imitation of his spoken utterance. In other cases, Adam was singing along with the toy and his mother did not produce any response.

The word types and tokens from Table 3-11 demonstrate the frequency of many words that were repeated during the natural language sample by Adam’s mother. There were high numbers of tokens of the verb/state word types such as the copula be and the general all-purpose verbs; closed class words such as the question word what, the helping word be, and other grammatical words such as pronouns. It is also interesting to note that there are high tokens of the articles a and the, as well as the conjunction and; production of these words types could have been related to the high tokens of nouns. Twenty-four of these shared words were also produced five or more times by Adam in the language sample (want, block, cereal, play, train, tiny, hat, circle, big, rectangle, red, small, iPad, jet, yellow, car, what, be (auxiliary), no (quantitative), two, no, yes, it, I).

Imitation played a prominent role in the shared lexicon of Adam and Miranda. As depicted previously in Figures 3-26 and 3-27, Adam and his mother engaged in similar proportions of imitation. Furthermore, Adam engaged in proportionally more reduced and exact imitations out of his total responses, while Miranda engaged in proportionally
more exact and expanded imitations out of her total responses. Adam produced limited expanded imitations and Miranda produced limited reduced imitations, as would be expected given the limited grammatical complexity of Adam’s spoken language.

The relationship between the dyad’s shared lexicon and imitation is depicted by the following examples from the transcript. The first excerpt from lines 307 to 317 illustrates the naming routine that the dyad engaged in with the electronic toy in a game the mother called “aircrafts.”

307  *MOT: what’s that ?
308  *TOY: biplane .
309  *CHI: biplane .
310  *MOT: very good
311  *MOT: biplane .
312  *MOT: what about that one ?
313  *TOY: sea plane .
314  *CHI: sea plane .
315  *MOT: sea plane .
316  *MOT: (be)cause it lands in the sea .
317  *MOT: the ocean .

Here, the mother asked the child to identify what he saw on the game, and the child activated the toy, which spoke the label out loud, and then Adam imitated the label. His productions often closely matched the model provided by the toy. Then, Miranda produced an exact imitation of her son. In lines 316 and 317, Miranda produced two
contingent utterances that elaborated upon her son’s prior utterance, which provided more information.

Another example of imitation occurred during breakfast as Miranda tried to determine how much cereal to give her son.

136  *MOT: how much cereal?
137  *MOT: a little bit or a lot?
138  CHI: lot.
139  *MOT: a lot?
140  *MOT: okay.
141  *MOT: is that enough?
142  *MOT: or more?
143  *CHI: xxx.
144  *MOT: a little bit more?
145  *CHI: little more.
146  *MOT: little bit more?

In line 138, the child replied with a reduced imitation of his mother’s prior utterance, and Miranda then attempted to confirm his reply by producing a slightly expanded imitation by adding an article and using a rising intonation. When the mother asked two consecutive questions and the child replied with an unintelligible utterance, the mother elaborated upon her prior utterance. Adam’s reply this time was again a reduced imitation of his mother’s prior utterance. Miranda’s subsequent return imitation was an expanded imitation of her son’s prior utterance. In this exchange, there were many exemplars of concepts related to quantity.
A third example is taken from a block activity from lines 1119 to 1128:

1119  *MOT:  what are you doing with all the blocks ?
%com\(^6\):  sound of blocks being banged together

1120  *MOT:  that’s loud !

1121  *CHI:  that’s loud .

1122  *MOT:  it is loud .

1123  *MOT:  it’s loud when you hit the blocks together like that .

1124  *CHI:  xxx .

1125  *MOT:  what ?

1126  *CHI:  triangle .

1127  *MOT:  triangle .

1128  *MOT:  very good .

In line 1121 of this excerpt, Adam produced an exact imitation of his mother’s prior utterance. She, in turn, changed the pronoun and produced an uncontracted copula, which functioned to confirm the accuracy of his prior imitation. Miranda then expanded her own prior utterance by adding more information. Adam’s next utterance was unintelligible. When his mother requested clarification, he replied with a subsequent utterance that was intelligible. She then followed with an exact return imitation. There were four tokens of the word *loud* in this exchange, and two tokens of *triangle*.

These examples help to illustrate the shared words that Adam and Miranda used, and the role of frequency of production and imitation in their shared lexicon. When the

\(\text{\hspace{20pt}}^6\)  %com: is a comment line in the transcript, indicating an activity that is occurring. This is a CHAT transcription convention.
child and his mother imitated one another, the number of tokens of the imitated word types increased. Adam appeared to be a “repeater” as his mother described him to be, and his mother frequently provided a model for this imitative behavior. These examples also show that although Adam was able to closely reproduce a word or sometimes a few words or short phrases, his spontaneous utterances were often difficult for his mother to understand, and she needed to ask for clarification or confirmation by repeating his utterance with a rising intonation. At other times, his mother did not understand him. As this case study demonstrates, Adam was a beginning communicator with ASD at the Word Combinations phase who engaged in numerous spoken language interactions with his mother during their language sample.

Summary

The preceding descriptive analyses and case studies illustrate the patterns of children’s and mothers’ spoken language across the continuum of development in these 13 beginning communicators with ASD at the Intentional/Presymbolic, First Words, and Word Combinations phases. For the children at the earliest phase before linguistic symbols were produced consistently, their mothers reported that the children understood some spoken words. As spoken language emerged in the children at the First Words phase, there were decreases in unintelligible utterances, increases in intelligible utterances, and increases of many lexical characteristics: the number of word types and word tokens; the number of words spoken per minute; and lexical diversity. Their mean length of utterance in morphemes also increased across the phases of spoken language.
development. Changes were also apparent in the lexical and grammatical characteristics of the mothers’ language input to their young children with ASD. Mothers produced more utterances, more word types, more word tokens, and their lexical diversity, and mean length of utterances increased as their children’s spoken language developed.

However, there was variability across the dyads, as well, with some children and mothers being more talkative or less talkative than others, expressing more or less diverse vocabulary, and using more or less grammatically complex utterances. Additionally, there was overlap in characteristics across the phases of spoken language development. In all of the dyads with children who produced speech, mothers and children shared a common lexicon, which included the word types that they both produced during the 60-minute natural language sample. These shared words were often words mothers produced frequently in the samples. The number of words within the dyads’ shared lexicons also increased across the phases of spoken language development. Furthermore, their shared lexicons appeared to be related to their imitation of one another within their natural language samples. Mothers tended to produce more exact and expanded imitations of their children while the children tended to produce more reduced and exact imitations of their mothers. There were also differences in imitation across dyads, with some engaging in more imitation than others.

Although it is apparent that most of the beginning communicators with ASD in the present study were developing spoken language, it is important to recognize that all of the children were significantly limited in their receptive and expressive language abilities compared to their same-aged peers who were developing typically.
Chapter 4

Discussion

This chapter considers results in relation to prior research and theory, discusses clinical implications, notes limitations of the study, and discusses directions for future research.

Maternal and Child Spoken Language Interactions Across Dyads

This study of the characteristics of the spoken language interactions of young beginning communicators with ASD and their mothers is based on the social-interactionist theories of language development. These theories posit that children develop language through social interactions with their caregivers, who provide scaffolding to support their children’s acquisition of language content (semantics or meaning), form (syntax or grammar), and use (pragmatics or function). The scaffolds provided by caregivers are responsive to the developmental level of their children and change over time (Vygotsky, 1962, 1978).

In the earliest stages of language acquisition, social-pragmatic aspects of language are more prominent: caregivers are responsive to their children’s actions and vocalizations, follow into their children’s focus of attention, and map spoken words onto their children’s actions on objects and also onto their children’s non-symbolic communicative gestures (e.g., reaching, showing, giving, pointing). As children begin to
develop comprehension of words over time as their caregivers speak to them, the data-providing characteristics of caregivers’ speech assume greater influence. The data-providing characteristics include the mother’s and child’s general talkativeness and the lexical and grammatical complexity of their utterances (Hoff & Naigles, 2002; Rowe, 2012).

The young child’s active role in this process of language acquisition is emphasized in many of the social-interactionist theories: the child initiates communication through non-symbolic and/or symbolic means and caregivers respond, providing various types of linguistic feedback to the child. Children, in turn, respond by providing feedback to caregivers. Thus, children’s and caregivers’ influences on one another are bidirectional. The results of the present study of 13 dyads of children with ASD who were beginning communicators support the social-interactionist theories of spoken language development. As Vygotsky (1962, 1978; Zaretskii, 2009) proposed, caregivers provide different types of supports that help to move children from their Zone of Actual Development to the Zone of Proximal Development. The results of the current study suggest that mothers of children with ASD who are beginning communicators provide scaffolds via their spoken language to facilitate their children’s progression through the phases of spoken language development.

An important clarification is that these phases of spoken language development are not discrete and discontinuous. Rather, they represent the continuum of spoken language development from the phase when children are intentional communicators who are beginning to understand spoken words but are producing few to no spoken words; to the early symbolic phase when children first produce and then expand their lexicon of
spoken words; to the phase of using combinations of spoken words in order to communicate symbolically. The natural language samples obtained in the current research study provided only a sampling of the children’s and mothers’ communicative interactions for a brief, 60-minute block of time as these children were developing the ability to communicate via spoken language. The heterogeneity across these children reflects different developmental phases within this continuum as well as individual variation across children.

One of the difficulties in comparing the results of the current study to prior research on the characteristics of the spoken language interactions of young children with ASD and their mothers is that none of the prior studies provides a detailed analysis of comparable measures for both mothers and children. Consequently, it is necessary to draw on many studies across research with mothers and children with ASD, mothers of children with other developmental disabilities (e.g., Down syndrome) or delayed language, and mothers of children with typical development, all of whom were beginning communicators. Comparisons between the results for the children with ASD in the present study and children with typical development and other developmental disabilities are important. If it is determined that children with ASD and other developmental disabilities follow the same patterns as children who are developing typically, although at a delayed rate, then their behavior can be described by a developmental framework. This is important for intervention planning.

It is also challenging to compare these results to the prior research because many of the studies have different settings (i.e., home vs. lab); different types of interactions (i.e., structured play with an unfamiliar set of toys or free play or other activities);
different durations for the parent-child interactions (i.e., 10 minutes, 15 minutes, 60 minutes, 90 minutes); and different partners (i.e., mothers only, either mother or father, or both). Furthermore, in these prior studies, some of the measures were provided for one time only (e.g., at baseline), or for only the caregiver or the child. Adding to the challenge is the fact that different researchers define some of the parameters of spoken language interactions somewhat differently. Despite these challenges, the following sections discuss the results of the analyses of the general and specific lexical characteristics of the spoken language interactions for beginning communicators with ASD and their mothers in relation to the prior research with other children with ASD, typical development, and other developmental disabilities.

**General Characteristics of Children’s and Mothers’ Utterances**

The first research question addressed by the present study was: What are the general characteristics of the utterances children with ASD and their mothers are observed to produce during daily interactions at home? The general characteristics focused on measures of talkativeness (number of utterances and number of tokens) and complexity (lexical diversity and MLU$_m$) of the children’s and mothers’ spoken language.
Talkativeness

It was predicted that the beginning communicators in the present investigation would increase in measures of talkativeness across the three phases of spoken language development. At the Intentional/Presymbolic phase of spoken language development, the children with ASD produced much greater proportions of unintelligible utterances than intelligible utterances in the natural language sample. Additionally, the children produced a limited number of consonants and limited babbling. This finding supports research regarding the vocalizations of children with ASD at this early phase (Patten et al., 2014; Paul et al., 2011; Warlaumont et al., 2014; Wetherby et al., 2007). Several studies describing the early communication of young children with or at risk for autism have indicated that, at the Intentional/Presymbolic phase before children are producing words, infants and toddlers at risk for developing ASD, or those with ASD, produce fewer “speech-like” vocalizations (Leezenbaum et al., 2014; Northrup & Iverson, 2015; Warlaumont et al., 2014).

Relatively, several lines of research investigating social feedback as a form of maternal responsiveness in typically developing infants and young children with, or at risk for, ASD indicate that mothers respond with more speech to their children’s speech-like utterances (Gros-Louis et al., 2006; Leezenbaum et al., 2014; McGillion, Herbert, Pine, Vihman, dePaolis, Keren-Portnoy, & Matthews, 2017; Northrup & Iverson, 2015). The results of the present study appear to support previous research suggesting that mothers talk less to their children with ASD who produce utterances with less “speech-like” characteristics, particularly consonant sounds. Specifically, the mothers of the three
children at the Intentional/Presymbolic phase who did not produce spoken words were less talkative than the two mothers whose children did produce limited spoken words. This reduced talkativeness was apparent for the number of total utterances and the number of tokens. As Iverson and Wozniak (2007) suggested, this reduced amount of spoken language input to children who are at the Intentional/Presymbolic phase could potentially result in a cascading effect where children with ASD who produce limited utterances with spoken words elicit less spoken language from their caregivers over time.

Only two of the children at the Intentional/Presymbolic phase in this study produced a few spoken words or conventional vocalizations in the sample. It is interesting to note that their mothers tended to be more talkative than the mothers of the children who did not produce spoken utterances at this phase. This finding would also seem to support the literature on potentially diminished social feedback to children with ASD who have more limited speech as described above. However, due to the small number of participants in the present study, it is not possible to draw conclusions.

The results of the present study also indicated that the proportion of intelligible utterances out of the total number of utterances (i.e., unintelligible and intelligible combined) that were produced by the children during the 60-minute natural language samples increased from the earlier to later phases of spoken language development. Children were using more conventional spoken words and conventional vocalizations, and there was a corresponding increase in the total number of utterances and the total number of spoken word tokens they produced across the phases of spoken language development.
In the current study, the changes in mothers’ talkativeness did not appear to be related to changes in the children’s chronological ages for the most part because there were children of varying ages at each phase of language development. The mothers of the three oldest children were among the four least talkative mothers in terms of the number of word tokens. This is in contrast to the findings of Huttenlocher et al. (1991) and Rowe (2012), who found that, for parents and children who were typically developing and at the same phases of language development, caregivers’ talkativeness was generally stable as their children’s language developed; it changed in relation to the children’s age level.

There was variation across mothers and across children in the total amount of talkativeness. This variability in talkativeness is consistent with much of the research in child-directed speech for children with typical development and those with developmental disabilities (Hart & Risley, 1995; Rowe, 2008; Warren et al., 2010). In previous studies, numerous intrinsic factors (i.e., factors within the adult or child) and extrinsic factors (i.e., factors outside the adult or the child) account for this variation: caregiver socioeconomic status and education (Hart & Risley, 1995; Hoff-Ginsberg, 1991, 1994; Rowe, 2008); communication style (Lieven, Pine, & Barnes, 1992; Nelson, 1973; Nelson, Baker, Denninger, Bonvillian, & Kaplan, 1985; Pine, Lieven, & Rowland, 1997; Venuti, deFalco, Esposito, Zaninelli, & Bornstein, 2012); communication context (Bornstein, Haynes, & Paynter, 1998; Bornstein, Tamis-LeMonda, & Haynes, 1999; caregiver knowledge about child development (Bornstein et al., 1998; Rowe, 2008); linguistic and cultural background (Bornstein et al., 1992); child gender (Huttenlocher et al., 1991); and IQ (Huttenlocher et al., 1991).
Furthermore, in the present investigation, mothers who were more talkative did not tend to have children with more complex language as measured by MLU$_m$ or lexical diversity, $D$. These results are not consistent with previous research which indicated that mothers who are more talkative have children whose language abilities are more advanced, either for children with ASD (Bang & Nadig, 2015; Warren et al., 2010) or for children who are typically developing at comparable language levels (Hart & Risley, 1995; Rowe, 2012). This discrepancy may be due to the fact that other studies followed children over time and investigated the associations between earlier caregiver language characteristics and later child language characteristics (i.e., longitudinal and correlational studies); the current investigation looked only at the concurrent characteristics of mothers’ and children’s language.

**Complexity**

It was hypothesized that the spoken language produced by the beginning communicators in the present study would increase in complexity across the phases of spoken language development. The results of the current study indicate that the complexity of the children’s utterances, evidenced by the number of different word types produced during the natural language sample, increased across the language development phases. At the Intentional/Presymbolic phase, only two of the five children produced any word types, and they produced only a few (i.e., conventional words and conventional vocalizations). All of the children at the First Words phase produced spoken words; the number of different words (i.e., word types) they expressed was greater than the children
at the Intentional/Presymbolic phase. The two children at the Word Combinations phase had higher values for the number of different spoken words they expressed compared with the children at the First Words phase. These findings would be expected given that, in the current study, the children were categorized by phase of spoken language development based on these variables. However, other aspects of complexity such as lexical diversity as measured by $D$, and grammatical complexity as measured by mean length of utterance in morphemes were variable across the children at the different phases of spoken language development.

These results are not consistent with some of the previous research on the grammatical complexity and lexical diversity of the language of children with ASD, where increases in $MLU_m$ and lexical diversity, $D$, or type/token ratio were observed along with increases in the number of different words expressed. However, in many of these studies, the children with ASD appeared to be at the Word Combinations phase, a higher stage of grammatical and vocabulary development (Burgess et al., 2013; Bang & Nadig, 2015; Tager-Flusberg et al., 1990) than most of the children in the current study, with mean length of utterance greater than 2.0 for many participants, and/or higher frequencies of word types produced during language samples. In the current study, the differences in vocabulary development compared with grammatical complexity of utterances would not be unexpected given that the children were at the early phases of spoken language development; all but one of the 13 children had mean length of utterance in morphemes below 2.0. These differences may also reflect the uneven profile of spoken language that Tager-Flusberg et al. (2009) discussed, where children may have more advanced skills in one language domain (e.g., phonology, vocabulary,
grammar, or pragmatics) compared to others. Thus, when the 13 children are rank-ordered for each of these measures of language talkativeness and complexity, it appears that the number of different words the children produced increased in a similar way to increases in measures of talkativeness, such as the total number of utterances and the total number of word tokens, yet this was not apparent for the other measures of complexity.

Although it was predicted that there would be variability among mothers of children within the different phases of spoken language development, it was also hypothesized that the mothers’ spoken language interactions would increase in linguistic complexity with their children’s development. The mothers in the present study varied in all aspects of grammatical complexity and linguistic diversity measures across their children’s phases of spoken language development. When mothers were rank-ordered from most to least for each measure of lexical diversity and grammatical complexity, some mothers used more grammatically complex utterances with children who were at earlier phases of spoken language development (i.e., the Intentional/Presymbolic or First Words phases), and vice versa. These findings are also discrepant with those of previous research which indicated that caregivers with more grammatically complex and linguistically diverse language have children with ASD who have more advanced language skills (Bang & Nadig, 2015; Burgess et al, 2013; Swensen, 2007), as well as for children who are typically developing (Hoff & Naigles, 2002). These divergent findings may also be related to the earlier phases of spoken language development of the children with ASD in the current study. However, it is important to remember that the present investigation has a small number of participants.
Prior research on maternal spoken language interactions has been conducted with children with ASD who have been identified as being “minimally verbal” (Bottema-Beutel et al., 2014; Haebig et al., 2013a; McDuffie & Yoder, 2010). Much of this research has not reported measures of spoken language complexity such as MLU or lexical diversity for the children or caregivers. Perhaps because these children have so few words, detailed characterization of their semantic and early grammatical development has not been undertaken. Furthermore, the social-pragmatic features of maternal spoken language interactions rather than the lexical or grammatical aspects have been described instead.

Yet, the variability in the complexity of mothers’ spoken language observed in the present study is consistent with prior research, where variability is apparent across caregivers of children with typical development (Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007; Bornstein et al., 1998; Hoff & Naigles, 2002) and of children with ASD (Bang & Nadig, 2015; Burgess et al., 2013).

It appears that the measures of talkativeness and complexity are appropriate means by which to describe and compare the spoken language characteristics of beginning communicators with typical development and developmental disabilities, and their mothers’ language characteristics. If children with ASD who are beginning communicators are developing language more slowly but in ways that are similar to children with typical development, then the quantity and quality of maternal spoken language produced during interactions would be as important to the language development of children with ASD as they are for children who are developing typically.
As Rowe (2008) indicated, “more talk, more diverse and complex talk” (p. 199) relates to the size of children’s receptive and expressive vocabulary.

It is important to recognize that complexity refers to lexical diversity or richness as well as grammatical complexity. In this study, mothers of beginning communicators with ASD produced utterances that had greater lexical diversity than their children’s utterances as measured by $D$ as well as by the number of different words produced. This provided a rich array of vocabulary available for uptake by their children. In addition, the mothers produced utterances that were more grammatically complex than their children, but not too complex: only 2.6 morphemes longer on average (range = 1.55 to 4.14). From the results of this descriptive study it is not possible to determine whether this is optimal for the children.

**Semantic-Syntactic Characteristics of Children’s and Mothers’ Words**

The second research question was: What are the semantic-syntactic characteristics of the spoken words children with ASD and their mothers are observed to produce during daily interactions at home, and children are reported by mothers to produce and understand?

**Vocabulary Composition – Observed**

The present investigation described the semantic and syntactic characteristics of the words children with ASD and their mothers used during interactions at home, as well
as the characteristics of the words children were reported by mothers to produce and understand. It is important to emphasize that the types of activities varied across the dyads. Prior research has indicated that context influences the type and characteristics of spoken language that caregivers use with their young children (Hoff-Ginsberg, 1991). For example, Hoff-Ginsberg found that mothers’ vocabulary was more diverse and their language was grammatically more complex during book reading, while it was more directive during play with toys. Dressing and mealtime had higher rates of question asking than other contexts. One way to control context across families would be through the use of semi-structured activities, providing materials such as specific books, toys, or snacks to the families at home or in a laboratory setting. However, this would not reflect the activities that occurred naturally in the children’s homes. Consequently, in the present study, mothers were free to choose activities that represented their typical interactions with their children.

The mothers and their children who were beginning communicators in the present study talked as they engaged in daily activities together. The dyads shared a common focus of attention which was evident through the words they used. This is important to recognize because the concepts that were expressed represented the ideas that the children and their mothers shared during one hour of interaction. The words that the children spoke elicited more spoken language from their mothers, and at times the mothers responded through the shared words of their lexicon, providing scaffolds for language learning. Similarly, words that the mothers spoke also elicited spoken language from their children. The two children at the Intentional/Presymbolic phase produced action words and social-interactive words, while the children at the First Words and
Word Combinations phases produced these words in addition to words relating to nouns, descriptions, and closed class words that code grammatical concepts. Mothers provided temporally and linguistically responsive utterances to their children using words that were related to those used by their children. Although mothers and children used similar types of words, many of the specific words they used differed from those used by other dyads.

Mothers of children at all three phases of spoken language development produced utterances that were composed of all five semantic-syntactic classes: social-interactive, action/state, noun, descriptive, and closed class. Similar proportions were produced across most categories; however, some differences were found at the different phases of the children’s spoken language development. For example, mothers of the children at the Intentional/Presymbolic phase produced lower proportions of nouns than mothers at the later phases. The mothers of children at the First Words phase produced a greater proportion of nouns compared to social-interactive, action/state, descriptive, and closed class word types. Generally, the children at the First Words phase produced a greater proportion of nouns compared to social-interactive, action/state, descriptive, and closed class words. However, some children produced higher proportions of social-interactive words than nouns. This suggests that mothers talked more about nouns as their children began to talk more about them, and nouns continued to be the most prominent words for mothers when talking with their children who were at the Word Combinations phase. In addition to increased proportions of noun types, mothers and children produced decreased proportions of social-interactive word types with more advanced phases of children’s language development.
Individual differences between mothers were also apparent. In general, the differences in the composition of the mothers’ vocabulary seemed to be related to the unique interests and activities of the dyads. These differences may have also reflected the nature of the activities in which the mothers and children interacted: dressing, feeding, and caregiving, versus reading storybooks or playing. For example, one mother talked more about vehicles with her son, and another talked more about food/drink. These variations would be directly related to the different types of activities in which the mothers and children engaged, and the specific items involved in those activities. For this reason, the analyses focused on word classes rather than specific word types.

Interestingly, common nouns were not the types of early words spoken by the children who were Intentional/Presymbolic communicators in the present study. Instead, these early words were those that Gopnik (1988) referred to as social words and cognitive-relational words, or that Bloom, Tinker, and Margulis (1993) identified as relational words and socially mediated expressions. In the current study, these were identified as social-interactive word types consisting of animal sounds, sound effects, interjections, conventional meaningful vocalizations (i.e., *mm*, *yum* to indicate something that tastes good, or *unuh* to indicate “no,” etc.), and games and routines. These word types are among the earliest developing spoken language forms. Utterances with social-interactive words appear to be more prevalent in the early stages of language development in children who are developing typically (Ratner & Bruner, 1978; Ninio, 1993, 2016). Prior research on language acquisition in children with ASD who are beginning communicators has often excluded these types of words from analysis (e.g., Tager-Flusberg et al, 1990). The results of the current study suggest that these social-
interactive words were important in the spoken language of children who are at this emergent phase. In fact, as mentioned previously, there were only two children at the Intentional/Presymbolic phase who produced any spoken words during the natural language samples and all of these consisted of social-interactive word types and action words.

Ninio (1993) contended that vocatives, interjections, animal sounds, onomatopoetic words, and social words (e.g., hi, bye_bye, all_gone, etc.) were “individual linguistic signs that do not combine syntactically with other words within larger units” (p. 295). These words stand alone and thus are salient to beginning communicators at the earliest phase of spoken language development. These words appeared in the first words of the two children at the Intentional/Presymbolic phase, and they continued to be present in the lexicons of all the children and their mothers through all three phases of language development. However, the proportion of social-interactive words decreased as the phases of language development advanced. As with each characteristic of language investigated, there was variation across children and mothers. For some, social-interactive words comprised large proportions of their lexicons.

In the present study, there were changes in the proportions of the different word classes out of the total word types produced by the children over the three phases of spoken language development. In the First Words phase, the children produced a range of word classes, including nouns, social-interactive words, action/state, descriptive, and closed class words. Proportions varied across word classes across the children, with three of the children producing more nouns than other word classes, and one child producing more closed class words than other classes. Two children continued to produce a
significant proportion of social-interactive words compared to other word types. The children at the Word Combinations phase also produced a range of word classes. Although both children produced proportionally more nouns than other word classes, one child produced many more nouns than all other classes, while the other child also produced a high proportion of social-interactive words.

These proportions are generally consistent with prior research on the composition of early vocabulary of typically developing children between the appearance of first words and the vocabulary spurt which precedes the development of semantic relations and word combinations (Bates et al., 1988; Bloom et al., 1993; Masur & Eichorst, 2002).

Much of the prior research on observed vocabulary composition of maternal language input to children with ASD has concentrated on general lexical diversity measures such as the number of different words, type/token ratios, or the parameter $D$. The specific composition of vocabulary has not been addressed comprehensively. The results of the current investigation do seem to be consistent with some of this prior research, indicating the prominence of nouns in maternal language input to children with ASD and the relationship of nouns to the children’s subsequent vocabulary production (Naigles, 2013; Swensen, 2007). In contrast, prior research on vocabulary composition in beginning communicators with other types of developmental disabilities such as Down syndrome has found that mothers’ language input was characterized by “simpler” language that consisted of higher proportions of the social-interactive word types (i.e., onomatopoeic words and routines), and lower proportions of closed-class word types than the language directed to their two-year-old typically developing age-mates (Zampini et al., 2011). In the present study, the majority of mothers of children at all three phases of
spoken language development produced lower proportions of social-interactive word types compared with the proportions of the other word classes. As with other characteristics of maternal and child spoken language, there was considerable individual variability among the mothers, a finding that is consistently mentioned in the prior research.

**Vocabulary Composition - Reported**

An extensive body of research exists describing the results of parent report measures of the receptive and expressive vocabulary of children who are typically-developing, children with language delays or disorders, and children with developmental disabilities. Many of these studies have used the MCDI-WG or MCDI-WS. As seen with the other characteristics of children’s spoken language, there was a substantial amount of variability in the vocabulary composition that mothers reported for their children both between and within different phases of development. This pattern is consistently seen across the literature (Bates et al., 1988; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010). Overall, prior research indicated that on parent report measures, children with ASD followed the same developmental pattern of receptive and expressive vocabulary, although many children were significantly delayed in comparison with typically developing children (Charman et al, 2003; Ellis Weismer et al., 2011; Luyster et al., 2007; Rescorla & Safyer, 2013). These studies also report high correlations between observed and reported vocabulary utilizing checklists.
One of the challenges in comparing the present findings with prior research is that, although word classes and semantic-syntactic categories have comparable operational definitions, researchers group the categories differently (i.e., common nouns, predicates, and closed class), and omit categories such as proper names, animal sounds, and routines, etc. Another challenge is that different parent report measures are used across studies, and furthermore, different scoring methods are utilized (i.e., proportions of total vocabulary reported or opportunity scores, which appear to be calculated out of the total items within each semantic category).

Only one child at the Intentional/Presymbolic phase in the current investigation was reported by his mother to produce any spoken words and these 12 words were comprised of social-interactive words and nouns. In contrast, four of the five children were reported to understand words across all semantic-syntactic categories: social-interactive, noun, action/state, descriptive, and closed class word types. The fifth child, the youngest in the study, was reported to understand words in all categories except descriptive and closed class words. This pattern is consistent with prior research by Charman et al. (2003), which indicated low percentages of reported production of common nouns, predicates (i.e., actions and modifiers), and closed class words for children with ASD who had one to five words.

For all six of the children at the First Words and both children at the Word Combinations phases, nouns were the predominant class of words that mothers reported that their children understood. Nouns were followed by action/state, social-interactive, descriptive, and closed class words. For words that mothers reported their children produced, nouns were the predominant class of words. Social-interactive words were the
next highest proportion out of the total words reported by mothers that were produced by five of the six children at the First Words phase, and by both children at the Word Combinations phase, followed by action/state, descriptive, and closed class words. These patterns are consistent with parent report measures of receptive and expressive vocabulary for typically developing children of younger ages (Bates et al., 1988) with nouns greater than predicates, which are greater than closed class words. This pattern is apparent as well for children with ASD (Charman et al., 2003; Luyster et al., 2007).

However, the specific proportions for the noun class differed in the present study compared with the previous research on parent report of vocabulary composition for children with ASD as well as for younger children who were developing typically. In the current investigation, noun classes comprised between .68 and .88 of the children’s total reported expressive vocabulary, which is much higher than that reported in previous research. For example, Charman et al. (2003) indicated that children with ASD were reported by their caregivers to produce common nouns between .33 and .56 of their total reported vocabulary. Luyster et al. (2007) found that children with ASD were reported by caregivers to produce nouns at .34 and at .38 for children who were typically developing but younger. Somewhat higher levels were reported by Bates et al (1988) for typically developing 20-month olds: .56 of the total expressive reported vocabulary for nouns.

There was more similarity between the caregivers’ reported vocabulary measures for children’s production of predicates (i.e., actions and descriptive words) in the current study and that in prior investigations for children with ASD and younger children with typical development. For children at the First Words and Word Combinations phases in the current study, action/state and descriptive word classes combined were between 0
and .16 of the children’s total reported expressive vocabulary, compared with .08 to .13 for children with ASD (Charman et al., 2003; Luyster et al., 2007); predicates at .08 of the children’s total reported expressive vocabulary for children who were typically developing, but younger (Luyster et al., 2007); and a value of .16 specified by Bates et al. (1988) for reported expressive vocabulary for verbs and adjectives for typically developing 20 month olds.

In addition to the reasons specified earlier regarding the differences in how vocabulary on the MCDI-WG has been analyzed in these studies (i.e., including social-interactive words with other nouns, excluding proper nouns and other common nouns, among other issues), it may be that the beginning communicators with ASD in the present study were older than the children with ASD in the prior studies. For example, in the Charman et al. study, the mean chronological age of the sample was 3;2 years, and for Luyster et al., the mean chronological age was 3;0 years at the time the MCDI was completed by parents. The mean age of the children with typical development from Bates et al. (1988) was 20 months, much younger than the children with ASD in the current study. In the present study, the mean chronological age was 49.6 months, although there were two 2-year-olds, and two other children who were close to 3 years old. The children in the current investigation may have had many different life experiences than the younger children with ASD in the prior studies. Furthermore, the participant groups with ASD in both Charman et al. (2003) and Luyster et al. (2007) were much more heterogeneous: the researchers in both studies indicated that some of the children did not produce any speech, while other children had language skills that were within normal limits.
At all phases of spoken language development, the children in the current study were reported to understand a larger total number of words (i.e., frequency) than they were reported to produce across all semantic-syntactic classes, with the exception of one child whose mother completed the MCDI-WS version which does not have a separate method of indicating words understood. On the MCDI-WS, the mother indicated all of the words her child produced on the form, and these words were also counted as understood. In contrast, there could be words on the MCDI-WG that a child was reported to understand but not yet produce.

Many researchers have indicated that reported vocabulary measures were consistently higher than observed vocabulary measures (Bates et al., 1988; Bloom et al., 1993; Gopnik, 1988). For example, Bates et al. found that for typically developing children at 20 months (whose mean MLU$_m$ was 1.14, similar to many of the children in this study), the productive vocabulary composition reported by mothers was higher than the productive vocabulary composition observed for common nouns and for miscellaneous words, comparable for verbs and adjectives, and substantially lower for closed class word types.

In the current study, when the children’s reported spoken vocabulary was compared with their observed vocabulary obtained from the language samples, all of the children at the First Words and Word Combinations phases had higher reported proportions of noun word types than observed proportions of noun word types. For all

---

Bates, Bretherton, and Snyder (1988, p. 97) defined open and closed class word types in a similar manner as in the present study. Their definition of the *miscellaneous class* of words included proper names, routines (e.g., *hello*), and “a few adverbials and other items that were difficult to classify by an open-closed-class distinction.” Thus, it was somewhat different than the social-interactive class used in the present investigation.
but one child at the First Words phase, proportions of action/state word types were higher for observed vocabulary than reported vocabulary, and for that child and the two children at the Word Combinations phase, proportions of action/state words were comparable for reported and observed vocabulary. For all of the children at the First Words and Word Combinations phases, proportions of descriptive words were higher for observed vocabulary than reported vocabulary (except one child who was not reported or observed to produce any descriptive words). Furthermore, proportions of closed class words were higher for observed vocabulary than reported vocabulary for all but one child. These findings are generally consistent with the results of prior research (Bates et al, 1988). In contrast, all but two children had lower reported social-interactive vocabulary than observed vocabulary, and one child had comparable observed and reported vocabulary for that class. The lower proportions of social-interactive words in reported vocabulary compared to observed vocabulary are discrepant with the findings from Bates et al. (1988). This discrepancy may be due to the possibility that it may be easier for mothers to identify nouns versus other types of words, or it may actually reflect that the beginning communicators with ASD in the current study knew more nouns and fewer social-interactive words. Most of the children in the present study were observed to produce lower proportions of nouns and higher proportions of social-interactive words than mothers reported they produced in their natural language samples. Thus, it may be that the children knew more nouns but were not using them as much, and were using more social-interactive words than typically-developing children at the same language development level.
Bates et al. (1988) indicated that the largest differences between reported and observed vocabulary are in common nouns and, especially, closed class words:

In spontaneous conversation, we can produce only a limited sample of our large open-class vocabularies; however, we may well be called upon to use most if not all of our grammatical function words in order to produce well-formed speech. Nevertheless, this difference also has developmental implications: parental report is likely to reflect what the child knows, whereas free speech reflects those forms that she is more likely to use. (p. 99)

Some of the previous studies of vocabulary composition in children with ASD have investigated only reported vocabulary; and in other cases, both receptive and expressive reported vocabulary are described or, more often, only expressive reported vocabulary is studied. Often this is because the parent report questionnaire only measures expressive vocabulary, for example, as with the MCDI-WS or the Language Development Scale (LDS; Rescorla, 1989). The results of the present study appear to be generally consistent with this prior research with respect to the closed class category (Bates et al., 1998; Charman et al., 2003; Luyster et al., 2007). However, there are discrepancies with other word classes. Specifically, the ranges in proportions of nouns reported produced (out of the total words reported produced) for all of the children in the present study appeared to be higher compared to the mean value reported for the children with ASD in prior research (Charman et al., 2003; Luyster et al., 2007).

There are several potential explanations for the discrepancies in the results between the present study and the previous research by Charman et al. (2003) and Luyster et al. (2007). First, as mentioned previously, the children in the current study were older. Second, the greater heterogeneity of the participant samples in Charman et al. (2003) and Luyster et al. (2007) may be a factor. Third, in Luyster et al. (2007),
parents completed an earlier composite version of the MCDI which included both the Words and Gestures and Words and Sentences vocabulary; the authors did not indicate if the vocabulary was comparable between the two versions. Another explanation is that the mothers in the present study may have accurately identified that their children knew more nouns, actions, and descriptive words than other children with ASD in previous research studies. The participants in the current study may have had experiences with a wider repertoire of concepts due to their older chronological ages (Bruckner, Yoder, Stone, & Saylor, 2007; Ellis Weismer et al., 2011; Rescorla, Alley, & Christine, 2001).

Thus it appears that the results of the present study are generally consistent with the literature on observed and reported spoken vocabulary for most word classes for beginning communicators who are typically developing and who have ASD. This suggests that these children with ASD who were beginning communicators in this study were generally following the typical phases of vocabulary development, although they are much older than children who are typically developing and at comparable levels of language acquisition. Furthermore, parent report measures appear to be viable options for obtaining information about children’s vocabulary development, in conjunction with observed measures obtained via natural language samples. These are the recommendations for best practice when working with beginning communicators with ASD (Kasari et al., 2013; Tager-Flusberg, et al., 2009).
Shared Lexicon

The third research question was: Is there a relationship between the words a child with ASD produces and the words his/her mother produces during their daily interactions, such that the dyad produces a common set of spoken words (i.e., a shared lexicon)?

Discussion of the results of the analyses concerning the shared lexicon must be prefaced by the clarification that the spoken words the mother and child of each dyad produced in common were those that occurred as the mother and child were interacting during that specific 60-minute natural language sample recorded by the mother. It is important to keep in mind that this represents one block of time during which the dyads were interacting and communicating. At another day and time, during other activities, different words may be shared in common by the pair. Thus, there may be other shared words that were not observed given the contexts recorded in these samples.

The words that the dyads shared in common comprised a high proportion of the children’s total vocabulary, indicating that the children produced very few words in these samples that their mothers did not produce in these samples as well. In contrast, these shared words comprised much lower proportions of the mothers’ total vocabulary. The shared words reflected the individual interests and activities of the dyads, yet the word classes were similar across dyads within the three phases. There were individual differences across dyads, however, with some producing higher proportions of social-interactive words out of their total shared lexicon, and others producing higher proportions of nouns, for example. The dyads’ shared vocabulary appeared to be related
to both the frequency of the shared words in the mothers’ language input, and the proportion of imitation out of the mothers’ and children’s total responses to each other in their interactions.

**Frequency of Words**

The earlier discussion of vocabulary composition focused on the number of different words (i.e., word types) in the spoken language produced by both the mother and the child, as well as the different classes of word types. The number of times each word type was produced by the mother or the child was reflected in the number of tokens for each word type. Some word types were produced frequently, while others were produced infrequently. In the current study, *frequent* production of a word was defined as five or more tokens. Although this number was selected based on certain conventions in child language research as described earlier, the number 5 is essentially an arbitrary cutoff between words that are produced *frequently* and words that are produced *infrequently*.

Of all the words produced by a mother, there was a subset of words that was produced frequently in the language sample (i.e., five or more times), and another subset that was produced infrequently in the language sample (i.e., less than five times). Across the mothers of children who produced spoken language, between .19 and .57 of their total lexicon was comprised of words that mothers produced frequently. This indicates that for all but one of these mothers, most word types were produced less than five times in the language sample.
Another subset of each mother’s total lexicon was the words that the mother produced in common with her child (i.e., their shared lexicon for that language sample). Some of the words in the shared lexicon might be words that the mother produced frequently, and some might be words that she produced infrequently. The probability that a shared word would be produced five or more times in the sample versus the probability that a shared word would be produced less than five times in the sample was determined. The results of this analysis suggest that for seven of the ten mothers whose children produced some spoken language, there was a greater probability that the shared word was produced by the mother five or more times during the language sample (range = .53 to 1.00) than the probability that the shared word was produced less than five times during the language sample. For the other three mothers, the probability ranged between .38 and .50, suggesting that for these mothers, the shared words were as likely to be produced frequently or infrequently, or more likely to be used less than five times in the language sample than produced five or more times during the language sample.

The results of the current investigation suggested that the frequency of individual words produced by the mother in the language sample played a role in the shared lexicon of the majority of the mother-child dyads at the three phases of spoken language development. The dyad’s shared lexicon consisted of a group of words that the mother and child produced in common. Word types that mothers and children shared in common in the sample tended to be word types that were spoken more frequently by many of the mothers.

The frequency of words mothers use when talking with their young children has been shown to be correlated with the earlier achievement of language milestones by
children who are typically developing, such as first words, first imitations, first word combinations, and first talk about the past (Hart, 1991; Hart & Risley, 1995; Huttenlocher et al., 1991; Tamis-LeMonda et al., 2001). The results of the present study regarding frequency of shared words appears to be consistent with the research in language acquisition in typically developing children with respect to the words that caregivers produce more frequently tend to be the words that their children first learn to produce. Huttenlocher et al. (1991) determined that the relative frequency of occurrence of content words, particularly common nouns, within a parent’s speech was positively related with the age of acquisition of that word by the child within age group of 14- to 26-month-old toddlers. Words that were produced more frequently were learned earlier by the children.

Furthermore, Goodman et al. (2008) that indicated that, within lexical categories (i.e., common nouns, people words, verbs, adjectives, closed class, others), the higher the frequency of the word in the parental language samples, the earlier the word was acquired. Thus, it appears that the many of the words that the children heard being used frequently by their mothers during the language samples in the present study were also many of the same words that the children produced. As shown in the Tables 3-5, 3-8, and 3-11, as well as in Appendices I through N, the shared lexicon of each dyad contained word types across the range of semantic-syntactic categories.

It is important to note that there were many high-frequency words that mothers expressed that children did not produce. Many of these words belonged to the closed class: infinitives, auxiliary verbs (are, do, can, will), prepositions, pronouns, and quantifiers. In addition, there were many words that belonged to the open class which were also high frequency but were not produced by the child. That is, they were not in
the shared lexicon or produced spontaneously by the child. Numerous factors may account for this lack of uptake by the child. First, many of the closed class words are typically acquired at later stages of language development according to the theory of language acquisition described by Brown (1973), for example. The child’s mean length of utterance in morphemes would approach $MLU = 2.25$ at Brown’s Stage II before prepositions ($in$, $on$) are learned, or even later at $MLU = 3.50$ at Stage IV when articles are learned (Brown, 1973, p. 271). These stages are well beyond the phases of spoken language development of the beginning communicators in the present study.

Furthermore, many of the words that were produced by the children were related to things with which the child was playing, manipulating, touching, or looking at. Although it was not possible to visualize what was happening during the dyads’ interactions because only audio-recordings were obtained, it was apparent from the conversations that most talk revolved around what was in the immediate environment. Relatedly, it appears as though many of the high-frequency words that were produced by the children were words that referred to more familiar, concrete concepts; other words used frequently by the mothers that were less concrete or not present in the immediate environment were less likely to be produced by the children.

**Imitation**

The results of the present investigation indicated that imitation between the mothers and children appeared to be related to the words in the dyad’s shared lexicon. It is important to clarify that this type of imitation or overlap is related to what is referred to
as *immediate echolalia* in the literature. Prizant (1987) explained the differences between two forms of echolalia:

The clearest distinction that has been made differentiates two general categories of echolalic behavior based on temporal latency between the original production of an utterance and the subsequent repetition. Stated simply, *immediate echolalia* refers to utterances that are produced either following immediately or a brief time after the production of the model utterance. *Delayed echolalia* refers to utterances repeated at a significantly later time. (pp. 66-67)

In the context of the present study, the repetition of an utterance by either the mother or the child was classified as an imitation. This definition highlights the reciprocal nature of the behavior. Consideration of such reciprocity frames this behavior in a developmental perspective (Bloom et al., 1974; Olson & Masur, 2012).

In the mother-child interactions recorded in the present study, mothers’ and children’s imitations occurred in response to a prior utterance of their partner. Imitation is one type of responsive utterance; comments, questions, interjections (*wow, oh no*), and continuers (*uh huh, really*) are other types. Because imitations can only occur as a response to a prior utterance within a certain period of time or specified number of utterances, the proportion of the mother’s or child’s imitations out of their total *responses* was analyzed, rather than out of their total utterances during the natural language sample.

Using the same methodology as was used in the present study (i.e., the CHIP command of CLAN), Che et al. (2018) looked at the proportion of overlapping utterances out of the total number of children’s and mothers’ utterances, as well as the proportion of overlapping utterances out of the total number of their responses to each other. The children were typically developing, at three ages and levels of language development: 14
months (MLU = 0.98); 20 months (MLU 1.38); and 32 months (MLU = 2.60). As Che et al. (2018) indicated,

...mothers produce a far greater number of utterances than their toddlers at the outset of language development; that is, they produce multiple utterances in succession, without intervening child utterances. Hence, estimates of maternal overlap calculated as a function of maternal responses to child utterances tend to be considerably higher than estimates calculated as a function of the total number of utterances. (p. 76)

Che et al. (2018) confirmed that the proportions of mothers’ imitations out of their total responses were higher than the proportions of imitations out of total utterances.

As mentioned previously, the children in the present study increased the total number of intelligible utterances produced across the three phases of spoken language development. In addition, they increased the amount (i.e., the frequency) of their responses across the three phases of spoken language development. Specifically, at the Intentional/Presymbolic phase, the two children who produced spoken language produced 1 response and 23 responses, respectively. Child 4’s one response was an imitation (a proportion of 1.00), while seven of Child 12’s responses were imitations (.30). At the First Words phase, the children’s responses ranged from 38 to 264 responses, and the number of imitations ranged from 9 to 115 imitations. The proportions of imitations out of total responses ranged from .15 to .43. At the Word Combinations phase, one child produced 339 responses, with 70 imitations; the other child produced 481 responses with 62 imitations; proportions of imitations out of the total responses were .21 and .13, respectively. Although the frequency of responses increased across the phases of spoken language development, the proportion of imitative utterances out of the total number of child responses appeared to decrease over the phases of language development. This
suggests that with advancing spoken language abilities, the children’s responses to their mothers may have consisted of other types of linguistically contingent utterances in addition to imitations.

The trend indicated in the present study was consistent with the results of prior research on imitation in the language development of children who are developing typically, as well as children with other developmental disabilities or delays in language learning at similar phases of spoken language development as the beginning communicators with ASD (Bloom et al., 1974; Che, Alarcon, Yannaco, & Brooks, 2016; Che et al., 2018; Sokolov, 1993; Sokolov & Moreton, 1994; Tager-Flusberg & Calkins, 1990). These prior studies indicated that children who were at the earlier phase of grammatical development (i.e., 1.5 morphemes) had higher proportions of imitation than the children with more advanced language skills. The children in the present study appeared to have larger proportions of imitations out of their total responses than were indicated in these prior studies. Sokolov and Moreton (1994) reasoned, “As children’s linguistic skills increase, they are less likely to rely on lexical items produced by their parents to build contingent responses and are more likely to modify their speech according to their own communicative intent” (p. 192). It appears that the beginning communicators with ASD in the present study were using more imitation of their mothers at the First Words and Word Combinations phases than the typically developing children in prior research (Che et al., 2018; Sokolov & Moreton, 1994). As with other characteristics of children’s language interactions, there was individual variation, as well. For example, one child (Child 10) produced many more responses and many more imitations than the other children at the First Words phase of spoken language
development; and his proportion of imitation as a function of his responses was .43, which was much higher than the other children.

It appears that the proportion of imitation by the children with ASD who were beginning communicators in the present study was higher than that reported by Che et al. (2016; 2018) for typically developing children (proportion of imitation to total utterances, range = .12 to .18; proportion of imitation to total responses, range = .14 to .19). The proportion of imitation to total responses were also higher in the present study compared to Che et al. (2016) for children who were late talkers: at 30 months it was .21, and at 42 months it was .19. Furthermore, the proportion of imitation by children in the present study was higher than that by children with Down Syndrome and by younger children with typical development (.12, range = .06 to .18) as reported by Sokolov (1992). Hwang and Windsor (1999) indicated that the proportion of imitation was .21 for children with Down syndrome and .13 for peers with typical development matched for MLU (1.12-2.14).

In the present investigation, which considered only the early phases of spoken language development, the frequency and proportion of imitations mothers used during their interactions with their children also increased as the children’s phases of language development advanced. The mothers (Mother 4 and Mother 12) of the two children at the Intentional/Presymbolic phase who produced speech had six responses and four imitative utterances, and 92 responses and 21 imitations, respectively. The proportion of imitation out of the total responses was .67 and .23, respectively. Mothers of children at the First Words phase produced between 83 and 444 responses, and the number of imitations ranged from 13 to 178. The proportions of imitations out of total responses ranged from
.11 to .40 for these mothers. Mothers of the children at the Word Combinations phase produced substantially more responses and imitations: 866 responses with 222 imitations (.26), and 911 responses with 169 imitations (.19). As with their children, there was individual variation: Mother 10 also produced a higher proportion of imitations (.40) as did her son.

Overall, the results of the current study regarding mothers’ imitation appear to be both similar to and different from prior research on maternal imitation of children at comparable phases of spoken language development (Che et al., 2016, 2018). This is particularly true when mothers’ total responses were analyzed in prior research (Che et al., 2018) rather than total utterances (Che et al, 2016). The proportion of imitation out of total responses by mothers of their typically developing children in Che et al (2018) ranged from .16 to .25, which was similar to the mothers of children at the Word Combination phase and some of the mothers in the First Words phase in the current study. Proportions of imitation for mothers of children aged 30 months and 42 months who were late-talking (Che et al., 2016) were .22 and .24, respectively. Zampini et al. (2011) investigated imitation in mothers of children in three groups. The proportion of imitation out of total utterances for mothers of 2-year-old children with Down syndrome was .13 and for mothers of children who were typically developing and matched for vocabulary was .11; both of these values were lower than in the present study. However, the proportion of imitation out of total utterances by mothers of age-matched peers with

---

8 The typically developing participants appear to be from the same New England corpus from the CHILDES database for both Che et al. (2016) and Che et al. (2018).
typical development in Zampini et al. was .27, which was also closer to the values for some of the mothers in the present investigation.

Differences in imitativeness between the current study and prior research may have been related to different activities in the language sample corpora, including shorter length of interactions in prior research (10 to 25 minutes). An alternative explanation may be that the children with ASD in the present study did engage in higher proportions of imitation compared with children with typical development, those who were late-talkers, or children with other developmental disabilities.

The children in the current study often imitated their mothers: more frequently by producing reduced imitations, and less often, by producing exact imitations. Mothers also imitated their children by producing exact imitations, and generally less often, by producing expanded imitations. The literature on the role of imitation in language learning suggests that it is in the early stages of language learning when a child’s mean length of utterance is between 1.0 and 2.0 morphemes that mothers’ expansion of children’s utterances, and children’s subsequent exact imitations of those expansions appear to facilitate children’s vocabulary development and acquisition of semantic relations (Olson & Masur, 2012).

When the children in the study by Olson and Masur (2012) were in the earliest phase between 13- and 17-months of age, they were more likely to produce exact imitations because they typically produced single-word utterances, yet by the time they were 21 months, their production of exact return imitations decreased and expansions increased (Olson & Masur, 2012). Previous research also suggested that as children’s language expanded beyond this two-word phase, imitation and expansion played lesser
roles for typically developing children and their mothers. Children began to use
discourse elements such as pronouns to refer to people and objects that were talked about
in previous utterances rather than imitating or repeating words. Children learned to
provide semantically related utterances that did not necessarily share the same form of an
utterance (Clark & Bernicot, 2008). In the present study, the children in the Word
Combinations phase produced lower proportions of imitations (.21 and .13) compared to
five of the children at the First Words phase. A comparable decrease was not seen for the
mothers. Although the number of children’s and mothers’ responses to each other
increased from the First Words phase to the Word Combinations phase, children and
mothers were producing other types of contingent responses that did not involve
imitation. In addition, pronouns including demonstrative pronouns (i.e., this, that) were
emerging in the dyads’ shared lexicons for children at the First Words and Word
Combinations phases.

In the present study, mothers sometimes imitated or repeated their children’s
utterances as a way of confirming what they said. The following exchange between
Child 10 and his mother is an example of such a confirmation.

781   *MOT:  what’s that?
782   *CHI:  sun.
783   *MOT:  sun?
784   *CHI:  yyy [+! yes].
785   *MOT:  you drawin(g) a picture with the sun?

Mother 10 repeated the word sun with a rising intonation contour after her son produced
it to confirm that she had understood him correctly. He responded affirmatively. The
mother then expanded her imitation of the child’s production of the word *sun*. At other
times, mothers may have used imitation to signal that they did not understand what a
child said. In addition, it may have been that the mother interpreted the child’s
subsequent imitation of her prior utterance as a way to confirm that she understood the
child’s message.

For the mother-child dyads in the current study, the proportion of mothers’
imitations that asked questions to seek confirmation was analyzed. The results of this
analysis suggest that some mothers used imitation sometimes as a means for
confirmation. For example, the proportion of imitations that were used for confirmation
by the mothers of Dyads 2, 4, 8, 9, and 11 ranged between .22 and 1.0. However, there
was substantial variability among the mothers, with not all mothers using imitation for
confirmation frequently, and some not using imitations in this way at all.

Hwang and Wior (1999) found that mothers of children with Down syndrome and
those with typical development varied in the amount of immediate, spontaneous imitation
in which they engaged. The children with Down syndrome were preschoolers with
MLU between 1.12 and 2.34. Hwang and Windsor determined that the children with
Down syndrome and the children with typical development primarily imitated words in
the utterance-final position of their mothers’ utterances, and more than one-third of the
imitations they produced were imitations of nouns. Mothers’ imitations typically
involved reduced imitation of their former, or model message. Often, the mother’s
imitation was shorter than their typical mean length of utterance. Hwang and Windsor
(1999, p. 323) suggested that, “mothers may have interpreted imitation as a result of
children’s incomplete comprehension.”
The children in the present study tended to imitate words that occurred in utterance final position, but most did so infrequently. There were several instances of this in the case studies reported previously in the current investigation. Word-final position is highly salient and it may help the word stand out for the child. On the other hand, as noted by Hwang and Windsor (1999), nouns tend to occur more frequently in word final position, so it may not be unexpected that the children in their study imitated more nouns. The mothers in the current study used short utterances with their children. If the mothers produced utterances consisting of three words, and if all factors were equal, the probability of imitating an utterance in first position would be .33; in middle position it would be .33; and in final position it would be .33. Nine of the 10 children in the current study appeared to imitate words that occurred in final position of their mother’s prior utterance. The children’s actual probabilities of imitating words in final position ranged from .17 to .71 of children’s imitations, with four of the nine exceeding chance levels. As with other measures, there was variability among the children.

Because the current study was descriptive in nature, it is only possible to say that the shared lexicon of each dyad was comprised of words that both mother and child produced. Some of these shared words were produced frequently by the mothers, and many of the words may have been words that occurred in mothers’ and children’s imitations of one another.

In summary, across the three phases of language development, the spoken language interactions of young beginning communicators with ASD and their mothers were characterized by utterances that were produced spontaneously as well as in response to one another. Mothers varied in the proportion of their utterances that were
“responsive” in this way: for some, less than .10 of their total utterances were responses, and for others up to .85. For the children, the proportion of responses out of their total utterances was .50 to 1.0. Three of the beginning communicators who were at the Intentional/Presymbolic phase did not produce any spoken language during their interactions with their mothers. The ten children who did speak produced utterances that were unintelligible as well as intelligible, and the proportion of intelligible utterances increased across the phases of spoken language development. In addition, the number of utterances and the number of word tokens that children produced tended to increase across the continuum of spoken language development, as did the number of different words produced by the children. However, other characteristics of lexical and grammatical complexity of children’s utterances did not increase systematically in a similar manner. There was a substantial amount of overlap between the phases of development, with children at a more advanced phase producing less grammatically complex utterances than children at earlier phases, and children with longer mean lengths of utterances producing utterances with lower lexical diversity values than children with shorter mean lengths of utterances.

Mother-child dyads talked about a wide range of concepts during the 60 minutes of social interactions at home while engaged in daily activities. Their shared lexicons consisted of words that both mother and child produced, and these words were coded as different semantic-syntactic categories. At the earliest Intentional/Presymbolic phase, only two of the children produced spoken words and these were social-interactive and relational words such as actions. At the First Words and Word Combinations phases, the categories expanded to include nouns, descriptive words, and more actions/states.
Closed class words with grammatical functions increased as children began to combine words together, and social-interactive words became less prominent.

Mothers often produced words frequently in their interactions with their children, so children heard many words multiple times. The spoken words children produced included those words their mothers produced frequently, so children seemed to build their lexicons with the words they heard their mothers express during their daily interactions.

In addition, mothers reported words that their children understood and produced. This reported vocabulary reflected the words that the children knew, while the observed vocabulary reflected the words that the children used in the language samples. The children’s reported vocabulary consisted of larger proportions of nouns compared to their observed vocabulary, and smaller proportions of other semantic-syntactic categories.

When the children produced utterances with words or conventionally meaningful vocalizations, mothers responded at times to those utterances by imitating them. For mothers of children at the First Words phase, the proportion of mothers’ imitative utterances out of their total responses ranged from .11 to .40. For mothers of children at the Word Combinations phase, the proportion was .19 to .26. Sometimes these imitations were exact repetitions of what their children said, and sometimes they were expansions. Children also often responded to their mothers by imitating them. Sometimes these imitations were reduced imitations of what their mothers said, and sometimes they were exact repetitions. In this way, mothers’ and children’s imitations appeared to influence the words in the dyads’ shared lexicons.
Across all parameters of talkativeness, utterance complexity, lexical diversity, vocabulary composition, shared lexicon, and imitation there was variability across mothers and their children, which reflected individual differences.

**Clinical Implications**

The results of this descriptive investigation of the characteristics of the spoken language interactions of young beginning communicators with ASD and their mothers have several clinical implications for assessment and intervention. The clinical implications relate to: (a) broadening the scope of language samples that clinicians and researchers include in their analyses; (b) targeting vocabulary in intervention; (c) increasing lexical frequency in mothers’ spoken language interactions; (d) reconsidering the term *echolalia*; (e) considering imitation and expansion as intervention strategies; and (f) using augmentative and alternative communication (AAC) for children who are not producing spoken language.

**Broadening the Scope of Language Samples**

Routines, songs, stories, interjections, and other social-interactive words and phrases are often excluded from analysis in spontaneous language samples. Yet the results of the current study suggest that these types of words appear to be prominent and important in the natural language samples of mother-child interactions for beginning communicators with ASD and should be included in language sample analyses. These
types of words were the ones that appeared in the limited lexicons of the children at the
Intentional/Presymbolic phase, and were part of the shared lexicons of most, if not all, of
the dyads in the current study. Certainly, the goals of obtaining the language sample will
determine whether these types of words will be analyzed (e.g., calculation of MLU); however, by automatically excluding them from analysis, important information about
the child’s communication may be unavailable. For example, children’s knowledge
about and active participation in routines and familiar songs can facilitate their awareness
of predictable words and conventional vocalizations, helping them anticipate the words
that come next in the dyadic interaction. Production of social-interactive words can
provide clues to the sounds that a child can make so that other words with similar sounds
can be targeted.

A related clinical implication is that one of the goals of obtaining a broader
language sample is to analyze a child’s spoken language output in order to assign a child
to a phase of spoken language development. This is a task that can be very challenging.
The phases of spoken language development are a continuum that ranges from early
Preintentional/Presymbolic behaviors to Intentional/Presymbolic to the symbolic phases
of First Words, Word Combinations, and Sentences. Multiple domains of language need
to be considered: the child’s production of speech sounds (phonology), vocabulary
development (semantics), grammatical development (syntax and morphology), as well as
the child’s use of language (pragmatics).

Although published benchmarks have been proposed to assist in this process
(Tager-Flusberg et al., 2009) and were adapted for use in the current investigation, some
of the children seemed to be closer to the earlier segment of one phase or the later
segment of another. The concept of a “mixed phase profile” was helpful in determining the appropriate phase for some of the children. In addition, it allows the researcher or clinician to better understand the variability in behaviors that was widespread across the three phases of development in this study. Rather than finite characteristics, considering ranges in behaviors at each phase facilitated assignment to the different phases. In research, assigning children to different phases would be helpful to determine the differential effects of an intervention. Furthermore, nuanced intervention approaches can be targeted for different phases of spoken language development. This spoken language benchmark approach is also useful clinically for helping to understand which language milestones have been achieved and which should be targeted in the future.

**Targeting Vocabulary**

The current study has potential implications for determining what vocabulary to target in interventions with children with ASD who are beginning communicators. As was previously mentioned, social-interactive words including animal sounds, sound effects, and games and routines were prominent in the language samples of the dyads in this study. Social-interactive language may be particularly important for children who produce little to no spoken language, as it is for infants and toddlers at the early stages of language development (Ratner & Bruner, 1978; Ninio, 1993). For children with ASD who are at these early phases of spoken language development, these types of words should be included and not excluded when language samples of these mothers and children are analyzed. Targeting these types of words for children at the
Intentional/Presymbolic phase is an important intervention strategy. They are often produced in isolation and thus can be more salient to children. Animal sounds, onomatopoeic words, and conventionally meaningful vocalizations (uh oh, mm) often comprise vowel sounds, early developing consonants, and reduplicated consonant-vowel combinations that may be within the speech sound inventory of young children at this early phase. In addition, many of these games and routines consist of high affect and turn taking which can promote social closeness in mother-child dyads.

In the present investigation, the shared vocabulary that the dyads used in their natural daily interactions also involved nouns, general all-purpose verbs, more specific verbs/states, and descriptive words. Furthermore, children and mothers talked about different people in their lives; such proper nouns are also often eliminated in the analyses of spontaneous language samples in the literature.

These findings have additional implications for vocabulary selection for children with ASD at early phases of spoken language development. First, the use of the MacArthur-Bates Communicative Development Inventories (MCDI) appears to be supported for children with ASD who are beginning communicators. The present study utilized the Words and Gestures (MCDI-WG) form with all but one child. This is a common practice within much of the research with young children with ASD, and one reason is that this form enables caregiver report of both receptive and expressive vocabulary. Although the children’s ages fell outside the range of the Words and Gestures subtest for all of the children in the current study, the developers of the MCDI-WG indicate that it is appropriate to use with children whose language development is within the range of 8 months to 18 months of age. However, it may be that the use of the
MCDI-WG *underestimates* the expressive vocabulary of children who are chronologically older. For example, spoken words that were commonly used by the children in the present investigation related to colors, numbers, foods, and other word types that were not on the Words and Gestures form but were on the Words and Sentences form. Thus, it may be that the Words and Sentences form (MCDI-WS) can also be used with children who are older than 18 months but whose expressive language developmental level is below 30 months, especially those involved in early intervention targeting concepts such as common nouns, actions, descriptive words, quantities, prepositions, and other semantic/syntactic categories. Although the Words and Sentences form expands the number of lexical items in each semantic-syntactic category, it does not provide separate data on a child’s vocabulary comprehension. This is particularly important for children who produce few spoken words. Furthermore, the Words and Sentences form is lengthy and may be time-consuming for caregivers to complete.

The shared lexicon of each dyad included the words that both the mother and child used in common. This is different than the concept of *core vocabulary* that is prevalent in the research in linguistics, education, and augmentative and alternative communication (Banajee, DiCarlo, & Stricklin, 2003; Beukelman, Jones, & Rowan, 1989). The term has been used to refer to the common vocabulary that is produced by nondisabled peers of a particular age and/or diagnostic group. For example, core vocabularies have been identified for toddlers (Banajee et al., 2003), preschoolers (Beukelman et al., 1989), and children with Down syndrome (Deckers, Van Zaaken, Van Balkom, & Verhoeven, 2017). Young children who are beginning communicators depend on adults (i.e., therapists, teachers, caregivers, etc.) to provide vocabulary for
them, particularly at early phases of language development. Thus, the purpose of identifying core vocabulary is to assist in vocabulary selection for individuals who exhibit delays in receptive or expressive vocabulary development. In the resulting core vocabulary lists that have been developed for young children, the majority of the most frequent words are function or closed class words (Banajee et al., 2003; Beukelman et al., 1989; Deckers et al., 2017), with nouns not being included or being very few in number (van Tilborg & Deckers, 2016).

The proportions of word classes in such core vocabularies differ substantially from the shared lexicons of the mother-child dyads in the present study. For example, in the list of words for preschoolers developed by Beukelman et al. (1989), there were no nouns in the 50 most commonly used words produced by all six children, and the only verbs were general all-purpose verbs that do not carry specific meaning. Social-interactive words were also absent from the list other than yes, no, hey, and okay. The list of core words developed by Banajee et al. (2001) reflected the similar predominance of closed class words and the lack of nouns, specific verbs/states, descriptive words, and social-interactive words. In contrast, the types of words in the shared vocabulary of the dyads in the present study were very different. The shared lexicons mirrored concepts that were interesting and motivating to the individual dyads. Their shared lexicon reflected words that the pair were currently using in common during the particular 60-minute interaction chosen by the mother.

Those intervention approaches that base vocabulary selection on a list of core vocabulary items would not reflect the types of words that mothers and children in the present study used in daily interactions. Furthermore, such lists of core vocabulary items
would not reflect the word types that the mothers reported their children understood and produced on the parent report measure. Therefore, the results of this study suggest that the use of words from developmental checklists such as the MacArthur-Bates Communicative Development Inventories (Fenson et al., 2007) or the Language Development Survey (Rescorla, 1989) would be a more appropriate means of selecting target vocabulary for young children with ASD who are beginning communicators. Appropriate vocabulary targets should be selected for beginning communicators with ASD who are in all three phases of spoken language development across daily interactions in natural contexts (home, school, daycare, etc.)

Furthermore, the results of this investigation suggest that natural language samples of caregiver-child interactions provide a rich source of the words that are used by the dyads during naturally occurring contexts such as toy play, daily routines, and caregiving activities. Although it is a very time-consuming process to audio- or video-record and then transcribe these natural language samples, research has shown that such contexts provide more complete information about a child’s spoken language abilities than more structured language-elicitation tasks (Kover, Davidson, Sindberg, & Ellis Weismer, 2014). The vocabulary obtained from these natural language samples (observed vocabulary) could then be combined with the reported vocabulary to yield a comprehensive lexicon for the child. This lexicon could then be used for intervention planning.

For children with ASD who are at the Intentional/Presymbolic phase of spoken language development and who produce few if any spoken words, the MCDI-WG form may be particularly useful because caregivers can provide information on words that the
child understands. For children with ASD who are at the First Words or Word Combinations phase and are older than 18 months and produce some words, the MCDI-WS may be more useful since there may be vocabulary words on it that are more appropriate for their age levels, experiences, and interests.

**Increasing Frequency of Specific Words in Maternal Language Input**

The current study underscored that many of the word types in the dyad’s shared lexicon were those that the mother produced five or more times in her language interactions with her child. The mother’s more frequent use of specific word types appeared to be a factor in the child’s word use. The increased frequency of word tokens of specific word types in caregivers’ spoken language interactions with their children who are beginning communicators has several clinical implications.

First of all, increasing the frequency of word tokens in spoken language interactions is a strategy that has been used effectively in several intervention approaches. *Focused stimulation* is one type of intervention that has been used successfully with children who have a variety of communication disorders (Girolametto, Pearce, & Weitzman, 1996a, 1996b; Girolametto, Weitzman, & Clements-Baartman, 1998; Lederer, 2014). In this approach, new vocabulary words are identified and targeted in intervention, and the interventionist, either a speech-language pathologist or a caregiver (in the case of caregiver-mediated intervention), provides numerous exposures to the target word(s) during a session. In some intervention research, single words have been targeted (Girolametto, Pearce, & Weitzman, 1996; Lederer, 2014), while in other
research, word combinations or specific semantic-syntactic relations have been targeted (Wolfe & Heilman, 2010).

Reconsidering Echolalia

As previously discussed, echolalia is frequently identified as a common characteristic of individuals with ASD and it is defined as the repetition of previously heard speech. The results of the present study suggest that all of the beginning communicators who produced spoken language engaged in various forms of repetition or imitation of their mothers’ previous utterances. These children engaged primarily in two different types of imitation: reduced and exact. It is clear from the current study that the child and mother of each dyad imitated one another. In this regard, it appears that the term imitation may be preferable to the term echolalia. Imitation describes the interactive nature of these behaviors that occur during mother-child conversations, rather than a one-sided behavior that the term echolalia connotes.

Thus, one important clinical implication of the current investigation concerns the use of the term echolalia to describe the spoken language behaviors of children with ASD who are beginning communicators. The term imitation may be more appropriate to describe a mother’s or child’s repetition of the prior speech of his or her communication partner, and self-imitation may be used to describe a mother’s or child’s repetition of his or her own prior speech. A differentiation can also be made of immediate versus deferred imitation, which has traditionally been viewed within a certain amount of time (Prizant, 1983) or a specific number of prior utterances. In the current study, a window of seven
utterances (the response plus six prior utterances) was selected to examine imitation consistent with prior research (Che et al., 2016, 2018; Sokolov & Moreton, 1994); other researchers have used five prior utterances (Bloom et al., 1974). *Deferred* imitation could be used to describe imitation of spoken language at further time distances. Imitation could also be used to describe repetition of speech from stories, movies, or other electronic media. *Non-speech* imitation could be used to describe the repetition of non-speech sounds produced by others or oneself.

The importance of changing the terminology is that imitative utterances could then be viewed as meaningful communicative behaviors, as they were found to be in the current study. All of the mothers appeared to respond to their children’s imitations by acknowledging them, imitating them themselves, or asking a question in order to clarify or confirm the child’s utterance. Judging from the mothers’ responsivity toward their children in these natural language samples, it appears that they viewed their children’s imitative utterances as communicative and meaningful.

Another important clinical implication of the results of the present study relates to how the spoken language development of these beginning communicators with ASD is described, and what types of utterances constitute spoken language. This is important for both assessment and intervention, as well as for research in intervention. In the analysis of a language sample, many research studies and evaluation protocols (e.g., Condouris, Meyer, & Tager-Flusberg, 2003) have excluded imitations, self-repetitions, and echolalic utterances when obtaining spontaneous language samples of young children with ASD. For example, in the article proposing the spoken language benchmarks framework, Tager-Flusberg et al. (2009) stated:
Many children in the process of acquiring language use imitation and repetition of spoken language, especially during the early states, to serve some functional communicative goals. Echolalia and stereotyped language, consisting of scripts heard in previous contexts repeated in a noncommunicative way, are atypical imitation behaviors that are part of the symptom pattern of ASD.... During the early stages of language acquisition, it may be difficult to discriminate typical from atypical verbal repetition in young children.... Nevertheless, when characterizing the complexity of children’s language, we recommend that echolalic (and imitative) language be omitted from analyses, as well as from speech samples used to classify children according to the benchmarks described later in this article. (p. 646)

This practice may omit important information about how the child and his or her communication partner engage in interactions, and information about the words and grammatical morphemes that the child is in the process of learning. The results of the present study suggest that another clinical implication is that it may be important to include rather than exclude such utterances in order to obtain a more complete sample of children’s spoken language development. One possibility would be to conduct two types of analyses: one that includes imitation and another one that excludes imitation. When including imitation, the child’s spontaneous and emerging imitative productions would be described. When excluding imitation, only spontaneous productions would be described. Similarities and differences between the two analyses could then be ascertained.

**Considering Imitation and Expansion**

The results of the current study highlighted the potentially important role of imitation and expansion, which also has clinical implications. Again, for children with ASD and limited spoken language, imitation may be an important strategy for acquiring spoken language.
Many of the intervention approaches that have been developed to increase caregivers’ responsiveness toward beginning communicators with ASD have targeted imitations and expansions, which are one type of imitation (Haebig et al., 2013a, 2013b; McConachie et al., 2005; McDuffie & Yoder, 2010; Scherer & Olswang, 1989). The impact of the mothers’ imitations generally and expanded imitations specifically cannot be determined from the results of this study; further research is needed to determine this. However, the results of this study do suggest that valuable information can be obtained from language samples that include children’s and mothers’ spontaneous imitation. This information can potentially inform intervention. For example, it is not known whether mothers’ use of expanded imitations (also referred to as “expansions” in the literature) was related to their children’s production of exact, expanded, or reduced imitations. From the research on typical language development, mothers’ expansions of their infants’ exact imitations of mothers’ prior single word utterances were associated with their children’s larger vocabularies several months later, as well as with increases in the children’s production of related words (Masur & Olson, 2008). Thus, expansions by mothers of typically developing infants’ imitations seem to pave the way toward word combinations.

As mentioned in the literature review, some of the intervention research with children with ASD that has targeted caregiver responsivity (i.e., use of responsive strategies such as follow-in commenting, linguistic mapping, etc.) has reported mixed results (Aldred et al., 2004; Carter et al., 2011; Haebig et al., 2013a, 2013b; McDuffie et al., 2013). That is, children with lower language abilities (described as “prelinguistic,” “minimally verbal,” or “nonverbal,” and who appeared to be at the
Intentional/Presymbolic phase), benefitted more from the social-pragmatic strategies, while children with more advanced abilities (potentially at the First Words, Word Combinations, or Sentences phases) did not benefit from such an intervention approach.

The results of the present study suggest that targeting caregivers’ linguistic responsiveness to their children’s phase of spoken language development may be a more appropriate avenue for research. Perhaps different types of imitation and expansion affect children with ASD differentially at different phases of spoken language development; research is required to investigate the effects at the different phases of spoken language development. Perhaps children who are at the First Words phase would benefit from strategies to increase the shared lexicon with their caregivers, targeting imitation and expansion of children’s single-word utterances to two-word semantic relations. Additionally, perhaps children at the Word Combinations phase would benefit from strategies to increase spoken language production targeting expansion of agent-action-object and other three-term semantic relations and the use of grammatical morphemes.

**Using Augmentative and Alternative Communication**

Finally, another clinical implication of the results of the current research pertains to the children at the Intentional/Presymbolic phase who produced little to no spoken language. These children provided few “speech-like” targets upon which their caregivers could provide responsive spoken language input that was temporally and linguistically contingent. Augmentative and alternative communication (AAC) with speech output
may provide another means for the children to participate in daily interactions with their mothers. There is evidence of the positive benefits of AAC for children with ASD (DiStefano, Shih, Kaiser, Landa, & Kasari, 2016; Kasari et al., 2014). Future research is needed to investigate the impact of AAC on mother-child language interactions and children’s language at the early stages of language development.

For children who require AAC, an intervention approach similar to focused stimulation involves repeated exposure to target word(s) or word combinations via natural speech in combination with graphic symbols with speech output from an AAC device, or without speech output. Research suggests partner use of aided AAC may positively impact comprehension and expression of vocabulary (Drager et al., 2006) and early semantic relations (Binger & Light, 2007).

**Contribution of the Current Study**

The present investigation adds to the literature on maternal spoken language interactions with young children with ASD who are beginning communicators in several ways. One way is by describing in detail the semantic-syntactic characteristics of both children’s and mothers’ spoken language. Previous research studies have looked at more general characteristics only, such as the overall number of utterances, word types, word tokens, lexical diversity, and mean length of utterance of communication partners and children with ASD (Bang & Nadig, 2015; Burgess et al, 2013; Warren et al, 2010). Prior research has not examined the specific types of words produced by both mothers and children with ASD who are beginning communicators.
The current study identified the different word classes within the mothers’ and children’s lexicons. There were different types of words produced at different phases of spoken language development, which paralleled the types of words produced by younger, typically developing children at comparable phases of language development. Thus, it appears that the young children with ASD who were beginning communicators at early phases of spoken language development were following a delayed but typical progression, rather than a fundamentally different pattern of development. As a result, this typical pattern of development may be helpful to inform intervention to build future phases of spoken language development. However, it should be noted that some of the children were older chronologically; future research should consider the implications of adopting a developmental model, modifying a developmental approach, or adopting a more functional approach (e.g., Gerber & Kraat, 1992).

In addition, the current investigation obtained and analyzed natural language samples of spoken language interactions of dyads in conjunction with mothers’ reports of their children’s receptive and receptive language as measured by the MacArthur-Bates Communicative Development Inventories. This combination of observed and reported vocabulary yielded a more detailed picture of children’s knowledge and use of spoken language (Bates et al., 1988) in spontaneous interactions with their mothers. This procedure is consistent with the recommendations of investigators for assessment of preschool (Tager-Flusberg et al., 2009) and school-aged children with ASD (Kasari et al., 2013) or other developmental disabilities who have limited spoken language. The utilization of both reported and observed vocabulary in the current study yielded a more complete lexicon than the more common approach of using only reported vocabulary.
(Charman et al., 2003; Ellis Weismer et al., 2011; Haebig et al., 2013a, 2013b; Luyster et al, 2007, 2008) or only natural language samples (Warren et al., 2010). This study offers a more comprehensive assessment of the children’s lexicon. By identifying the specific words a child currently uses, and words that he or she knows but does not yet use frequently, the child’s progress in language development can be monitored and guided. Vocabulary can be targeted that is relevant to the child’s interests and experiences and relevant to the appropriate phase of language development.

Another strength of the current study is that it described the shared lexicon of dyads: word types that both mother and child produced in common during the specific natural language samples. Prior research has not addressed the concept of a shared lexicon of mothers and their children with ASD. The current study looked at all word classes that were produced by the mother and the child of each dyad within their total 60-minute interaction, and then identified the words that both mother and child produced in common during the shared activities.

The importance of identifying the words that a mother and child produce in common is that this may help determine which words are emerging and/or mastered in a child’s lexicon. Words that occur frequently in the shared lexicon (e.g., five or more word tokens produced by the child) would appear to be words that the child has mastered. Furthermore, determining the less frequently produced words among the shared lexicon (e.g., less than five word tokens produced by the child) may help identify the words that are just emerging in the child’s lexicon. Thus, attention to the dyad’s shared and individual lexicons would facilitate a more systematic, and individualized approach to language learning.
Another contribution of the present investigation is the identification of imitation as a means by which a mother and her child with ASD develop a shared lexicon of common words. Although children with ASD are frequently identified as producing echolalia, the current study provided a detailed analysis of imitation by both mothers and their children who were beginning communicators. This adds to the literature that explores the role of imitation in language learning by dyads of mothers and their young children who are typically developing, and those with developmental disabilities including ASD.

**Limitations of the Current Study**

The current study has a number of limitations that should be considered when interpreting results. First of all, there was a small number of participants. Although 13 dyads were involved, and this number of participants is similar to other research studies that described language characteristics of comparable populations, a larger number of participants would permit greater generalization of the results. Furthermore, the group of participants was heterogeneous; children were described within three phases of early spoken language development. Consequently, there were very few dyads within each phase. Furthermore, there was overlap in specific measures across phases of language development. As noted earlier, these phases are by no means discrete; rather, they are continuous. In addition, there may be challenges assigning children with ASD to phases such as Intentional/Presymbolic, First Words, and Word Combinations.
Second, the mothers who participated in this study had previously subscribed to a research database and thus expressed an interest in participating in research studies. They had high levels of education and the majority was employed outside the home in professional occupations. As a result, they may not be representative of all mothers who have children with ASD who are beginning communicators at the early phases of spoken language development.

Furthermore, although the families who participated in the study were from diverse geographic locations across the U. S. and involved a range of ethnic backgrounds, this group of participants may not be representative of the diversity of the population of families with children with ASD who are beginning communicators. Related to this is another limitation of the study, which is that only mothers were recruited to participate. Families have other individuals who may be the primary caregivers of young children and engage in spoken language interactions with them. Therefore, broadening the range of family members and others who serve in the role of primary caregiver may have an impact on the results.

An additional limitation involves the use of digital audio recordings only. The mothers were instructed to conceal the recording devices so that they would not attract their children’s attention, and the dyads were able to successfully record during naturally-occurring activities. Mother-child speech interactions were transcribed in detail and these transcriptions captured the spoken words that mothers and children used in their interactions. As a result, analyses in the study were limited to spoken language. Children’s and mothers’ non-symbolic gestures (pointing, showing, reaching, etc.) were not captured via the audio recordings, nor was it possible to identify the mothers’ or
children’s use of manual signs and other forms of augmentative and alternative communication. Video recordings would have provided additional information on the behaviors and non-verbal communication modalities used by mothers and children. These might include facial expressions, pointing, referents in the environment, etc. Furthermore, there was limited access to the context through the audio recordings. As a result, it was not possible to determine, for example, whether children responded behaviorally to language from their mothers or vice versa. These limitations were particularly salient for the interactions that included children at the Intentional/Presymbolic phase where most children did not produce spoken language and may have used communicative gestures and facial expressions.

A further limitation involves the types of activities in which the dyads engaged. A wide range of activities was chosen by most mothers: although the families were in their ‘natural environment’ and their interactions with their children were representative of ‘naturally occurring’ interactions, this did not permit researcher-control over the specific activities. By not restricting the activities to a predetermined set of toys, books, or snacks, there was limited overlap in noun, verb, and other open-class vocabulary across dyads. However, in the present study, the wider range of activities selected by the mothers insured that mother and child spoken language interactions were reflective of naturally occurring events and routines in their homes and were not influenced by the restrictions imposed by the researcher.

A final limitation is related to the descriptive design of the study. This type of research design provided a rich source of information about the lexical characteristics of maternal and child spoken language interactions, and certain trends were observed.
However, it was not possible to determine any causal relationships between mothers’ and children’s behaviors. A related limitation is that this investigation involved a cross-sectional study of children at one point in time. It was not possible to determine the impact on language learning outcomes.

**Future Directions for Research**

The results of the present study lead to the following future directions for research. It will be particularly important to replicate this study using a larger sample in order to explore further the patterns that were observed in the current investigation and to assess the validity of these patterns. There is also a need to include a greater number of children at each phase. In addition, it will be important to expand the participant group to include caregivers having more diverse educational and ethnic backgrounds, which should also involve expanding primary caregivers to include fathers and grandparents, for example.

Furthermore, future research is needed to systematically explore the bidirectional relationships between caregivers’ and children’s utterances in dyadic interactions, particularly with respect to their imitations of one another. This will help to elucidate the role of imitation in language development. Additionally, it will be important to explore the changes in children’s utterances over the phases of spoken language development. Longitudinal research is needed to determine the impact of caregivers’ linguistic responsivity on children’s lexical and grammatical development over time.
Another area to pursue would be to expand the pilot study conducted by Breakstone (2016) that explored the semantic relations expressed by the mothers in Dyads 1 through 6 to the additional mothers in the current study. This analysis could also be extended to the semantic relations expressed by the children, and then further to determine whether there were any relationships between mothers’ and children’s spoken language interactions beyond the lexical characteristics. In particular, an important area of investigation would be the role of children’s and mothers’ imitations in the development of semantic relations across the phases of spoken language development.

In addition, future studies should use video to record caregiver-child interactions in order to obtain a more complete picture of caregiver-child interactions, the context, and caregivers’ and children’s use of non-speech communication such as the use of AAC, manual signs, gestures, facial expressions, etc.

Replication and validation of the patterns in the current study through future research could then lead over time to the development of pilot intervention studies for children with ASD who are beginning communicators at different phases of spoken language development. The development of pilot intervention studies is critical in order to investigate the effectiveness of caregivers’ use of strategies to increase lexical frequency, target vocabulary, consider utilizing imitations and expansions, and use AAC with children who have limited or no spoken language in order to expand vocabulary development and the development of semantic relations.
Conclusion

The current study described the spoken language of mothers and their young children with ASD who were beginning communicators as they engaged in daily interactions at home. Some of the children at the earliest phase of spoken language development produced no spoken language while children at the more advanced symbolic phase produced some multiword combinations. Children and mothers varied considerably in how much they talked and in the complexity of their utterances and the diversity of their vocabulary. The children’s spoken vocabulary was similar to that of younger, typically developing children, as well as that of children with ASD and other developmental disabilities at similar phases of spoken language development as described in the research literature. Their mothers used the same types of responsive language strategies, specifically, imitation and expansion of child utterances that are used by the mothers of typically developing children at comparable phases of spoken language development. Mother-child dyads shared a common lexicon of frequently used words that related to the objects with which they engaged during their one hour of social interactions. Their shared lexicon included words that were produced during mothers’ and children’s mutual imitations of their spoken utterances. Beginning communicators with ASD and their mothers engaged in social interactions that scaffolded and supported spoken language learning.

The findings from this descriptive study have several clinical implications for service providers of young children with ASD who are beginning communicators: (a) broadening the scope of language samples that clinicians and researchers include in their
analyses; (b) targeting vocabulary in intervention; (c) increasing lexical frequency in mothers’ spoken language interactions; (d) reconsidering the term *echolalia*; (e) considering imitation and expansion as intervention strategies; and (f) using augmentative and alternative communication (AAC) for children who have limited or no spoken language.

Future research is required to replicate the present study with a larger, more diverse sample in order to further investigate the patterns that were identified in this study and assess their validity. The ultimate goal is to inform intervention research to improve spoken language outcomes for young children with ASD who are beginning communicators.
REFERENCES


Breakstone, B. E. (2016). Quantity and quality of maternal language input to minimally verbal young children with autism spectrum disorders. Unpublished manuscript, Department of Communication Sciences and Disorders, Penn State University, State College, PA.


doi:10.1044/jshd.4603.241

doi: 10.1044/jshr.2702.183


https://doi.org/10.1007/BF02284756


**Appendix A**

**Institutional Review Board Research Approval Letter**

**Date:** August 25, 2015  
**From:** Courtney Whetzel, IRB Analyst  
**To:** Beth Breakstone

<table>
<thead>
<tr>
<th>Type of Submission</th>
<th>Initial Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title of Study</td>
<td>Maternal language input to young children with autism spectrum disorders: Supporting the transition from first words to word combinations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principal Investigator</th>
<th>Beth Breakstone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study ID</td>
<td>STUDY00003184</td>
</tr>
<tr>
<td>Submission ID</td>
<td>STUDY00003184</td>
</tr>
<tr>
<td>Funding</td>
<td>The Pennsylvania State University</td>
</tr>
<tr>
<td>INDI, IDE, or HIDE</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

**Documents Approved:**  
- Supplemental Material - Recruitment Advertisement - PAtTAN - Breakstone - Maternal Language Input to Young Children with ASD (August 5, 2015), Category: Recruitment Materials  
- Supplemental Material - Interview Questions - Breakstone - Maternal Language Input to Young Children with ASD (August 5, 2015), Category: Data Collection Instrument  
- Supplemental Material - Telephone or Email Script - Breakstone - Maternal Language Input to Young Children with ASD (August 5, 2015), Category: Recruitment Materials  

---

265
Recruitment Materials
* Supplemental Material – Recruitment Letter – PaTTAN
* Breakstone – Maternal Language Input to Young Children with ASD (August 5, 2015), Category: Recruitment Materials
* HRP-888 – Breakstone – Maternal Language Input to Young Children with ASD-8.15.15 revised (8/19/15), Category: Consent Form

Review Level: Expedited

On 8/20/2015, the IRB approved the above-referenced Initial Study. This approval is effective through 8/24/2016 inclusive. You must submit a continuing review form with all required explanations for this study at least 45 days before the study’s approval end date. You can submit a continuing review by navigating to the active study and clicking ‘Create Modification / CR’.

If continuing review approval is not granted before 8/24/2016, approval of this study expires on that date.

To document consent, use the consent documents that were approved and stamped by the IRB. Go to the Documents tab to download them.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-100), which can be found by navigating to the IRB Library within CATS IRB (http://irb.psu.edu). These requirements include, but are not limited to:
- Documenting consent
- Requesting modification(s)
- Requesting continuing review
- Closing a study
- Reporting new information about a study
- Registering on applicable clinical trial
- Maintaining research records

This correspondence should be maintained with your records.
Appendix B

Telephone/Email Script

Participant Code: Date:

I want to thank you for your interest in participating in our research study.

Let me tell you a little bit about our study.
The title of the project is, “Maternal language input to young children with autism spectrum disorders: supporting the transition from first words to word combinations.” We will be recording how mothers talk to their young children with autism.

To find out if you qualify to participate in the study, I will need to ask you a few questions. Are you ready?

YES NO

Are you the mother of a child with autism or autism spectrum disorder? Or has your child received a best clinical estimate of autism spectrum disorder?

YES NO

Are you the child’s primary caregiver?

YES NO

Is your child between the ages of 2;0 years and 6;0 years of age?

YES NO child’s age: __________

Is English the primary language you speak at home?

YES NO

Does your child have a vocabulary of 0 to 50 different words (spoken, written, signed, photos, or pictures)?

YES NO Does your child use single words or combine words in sentences?

Does your child use behaviors, gestures, words (spoken, written, signed, photos, or pictures) to make requests?

YES NO

Does your child have adequate vision?

YES NO Does he or she wear glasses?

YES NO

Does your child have adequate hearing?

YES NO Does he or she wear a hearing aid?

YES NO

You answered YES to all of the main questions, so you qualify to participate in the study. Would you like to participate?

YES NO

Since you said that you do want to participate in the study, I would like to meet with you at your home to go over the details of the study and if you want to participate, we will go over the consent form. At that time if you still want to participate, you will sign the consent form and then we can schedule the dates for the study.

Since you said you do not want to participate in the study, would like to thank you for taking the time to speak to me. Good-bye.

When would be a good time to meet with you at your home?

Date: Time:

Detach lower portion here; file with master list

Participant Code:
Appendix C

Instructions for Digital Voice Recording

Instructions for Digital Voice Recording

1) Here is the recording equipment that I talked about in our phone conversation. I will describe how to use it to record yourself while you and your child interact at home. Some of the things you said you and your child usually do together at home are: getting dressed, eating meals, playing, and reading books together.

2) Open the plastic box and you will see a leather case with a carabiner and a metal loop attached, and inside the case are the Sony digital voice recorder with a lapel microphone attached.

3) Attach the leather holder to your belt or belt loop, depending on which you prefer.

4) Now, attach the microphone clip to your shirt so that it is close to your mouth.

5) Next, hide the cable under your shirt so that your child doesn’t pull on it.

6) Make sure that the microphone is pushed into the microphone jack (the red hole on the top of the recorder).

7) HOW TO RECORD: (a) Slide and hold this switch until the recorder turns on; you will see “SONY” appear on the screen. (b) Next, push the red circle on the front of the recorder. (c) Then slide the recorder into the holder and close the flap so that the recorder doesn’t fall out.

8) You can go about your usual activities with your child. You can interact with your child while he’s getting dressed, eating meals, playing, and while reading books with you or anything else that is typical for you to do together.

9) After 2-3 hours, (d) turn off the recording by pressing the white square. (e) Then, take the recorder out of the holder and turn it off by sliding and holding the on/off switch on the side. When the display reads, “Power Off,” the recorder is off. You can leave the recorder in the leather case with the microphone attached. You can then detach the case from your belt or belt loop and put the recorder and accessories aside. I will pick everything up when I return later today.

10) If you need to talk on the phone or have to pause the recording for any reason, press the red record button again to pause recording; press the red record button again to resume recording.

11) Please fill out the “MacArthur-Bates Communication Development Inventories” questionnaire.

12) I will make arrangements to pick up the recording equipment and the questionnaire.

11) If you have any problems, please call me at (973) 985-4341 or email me at beb210@psu.edu.

Remember, please interact with your child as you normally would when you are home together.
Appendix D

Instructions for Completing MacArthur-Bates Communicative Development Inventories

This is a checklist for you to fill out that will show me the ways that your child communicates with you. There are several different parts:

Words and Gestures

I. Early Words
II. Actions and Gestures

- Please fill out the information on page 1.
- Try to fill out the form during a quiet time away from your child, maybe when he or she is napping or asleep.
- There are instructions for each section; please read them carefully!
- Please remember—there are no right or wrong answers!
- Children develop at different rates and have different words that they understand and express.
- On the vocabulary checklist in Part D. [Part A of the Words and Sentences form], I am interested in finding out what your child either “understands only and does not yet say” or “understands and says.” If your child only understands a word, mark “understands;” if your child understands AND says the word, mark “understands and says.”
- Some children are not able to use spoken words yet. If your child is not able to say a particular word, he/she may have a sign for it, or may use a picture symbol, photo, or printed word. If so, please make that down next to the word on the vocabulary checklist.
  - If he/she uses a sign, write SIGN next to the word
  - If he/she uses a picture symbol, write PICTURE SYMBOL
  - If he/she uses a photo, write PHOTO
  - If he/she uses a printed word, write PRINT
- I want to know what your child says or expresses without you asking him/her to imitate you. Try to think about whether he or she understands or has said these words; please don’t say to him/her, “Say, ‘jacket’?”
- You can give your child credit for mispronounced words or “baby talk” (for example, saying “nana” for “banana” or “banky” for “blanket.”)
- You and your child may have your own special words for things or people. You can write these words in on the vocabulary checklist.
- If your child understands or says a word that is similar to one on the vocabulary checklist, please write it in and give your child credit for it!
- Please complete all pages (1-10). I will complete p. 11.
- If you have any questions, you can contact me by email or by phone (see below), or you can skip over that section and we can talk about it when I return to pick up the questionnaire.

Thank you so much!

Beth E. Breakstone, M.S., M.Ed., CCC-SLP
Doctoral Candidate
Communication Sciences and Disorders
Penn State University
308L Ford Building
University Park, PA 16802
(973) 985-4344
beb210@psu.edu

1 These instructions are taken from the MacArthur-Bates Communicative Development Inventories User’s Guide and Technical Manual (Fenson et al., 2007), p. 16-17.
## Appendix E

### Parent Interview Questions

**Title of Project:** Maternal language input to young children with autism spectrum disorders: Supporting the transition from first words to word combinations

<table>
<thead>
<tr>
<th>Participant Code:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

| 1 | I want to thank you for participating in our study. Before we begin, do you have any questions for me? |
| 2 | First, I’d like to tell you a little bit about myself. I am a doctoral student at Penn State University and I am conducting this research study to find out about how mothers communicate with their young children with autism during typical daily activities in their home. I’ve been a speech-language pathologist for more than 20 years and I have worked with many families over the years. I have 4 children of my own and two young grandchildren. I’ve lived in NJ and NY for a very long time and moved to PA three years ago to go back to school. Once I graduate I plan to move back to NJ and work at a university to do research and teaching. |
| 3 | Next, I’d like to find out more about you and (child’s name) and your family. Remember, you do not have to answer any question that you do not wish to. We can stop at any time and that will be fine. |
| 4 | Please tell me a little about yourself. |
| 5 | I’d like to know more about your family. |
| 6 | Now let’s talk about (child’s name)? |
| 7 | What is (child’s name)’s typical day like? |
| 8 | What do you and (child’s name) like to do together? |
| 9 | Does (child’s name) go to childcare or preschool? |
| 10 | Does (child’s name) have any therapies? |
| 11 | Is there anything that your child doesn’t like or like to do? |
| 12 | Do you have any questions for me? |
Appendix F

Adapted CHAT Manual

Maternal Language Input to Young Children with Autism

Adapted from: Ratner, N. B. & Brundage, S. B., A clinician’s complete guide to CLAN and

1) Go to the CHILDES website: childes.psy.cmu.edu/
2) Make sure you have the most current version of QuickTime on your computer
3) Download CLAN from “Programs” section under “program”

4) Download the manual cited above, SLP’s Guide to CLAN in the line below
5) When you open CLAN you will see subfolders: CLAN, LIB, MOR, and WORK. When you
   save a file, make sure you save it to the WORK folder. Also store audio files there.
6) Download audio files to the computer.
7) Copy file and paste into the CLAN work folder. The file will be named with the year
   month day_00X.
8). In the CLAN work folder, create a subfolder for the participant (for example, create a new folder called C1M1)

9). Rename the file by removing the year and replacing it with the participants’ code and an underscore. For example, 16131_001 would be renamed C1M1_131_001.

IMPORTANT: Be sure to use this name to name your CHAT file when the time comes (see step b. 2) below.

10). How to transcribe:

a). Create a new CHAT file.
   1). Open the CLAN application
   2). Go to File > New. A new file.cha window appears
   3). If a Commands window appears, close it by clicking on the red circle.

b). Create a HEADER:
   1). Type in the following header, with which EACH file must begin:
      @Begin [Press Return key to advance to the next line]
      @Languages: eng [Press Return key to advance to the next line]
      @Participants: CHI Child’s code Role [i.e., child, therapist, father, mother. etc.]
                    MOT Mother’s name Role [mother]. Note: separate each participant with a
                    comma. [Press Return key to advance to the next line]
      @Media: filename, audio [example: @Media: C1M1_131_001, audio] Press
                    return key to advance to the next line
      @End   [This is the very last line in the transcript; after @Media there will be the
                   main lines, and dependent tiers (explained below).

   2). Save as: Save the file to the subfolder you created (Step 8 above) within the
                  work folder in CLAN. It MUST match the audio file name EXACTLY. CLAN
                  will automatically add the .cha extension to the filename. In the example above,
                  the file would be named, C1M1_131_001.cha.

   c). Reopen the file you just created by going to your subfolder (for example, C1M1) in
      the work folder in CLAN and opening that file (for example, C1M1). Now you are
      reading to set up the CHAT file to begin transcribing.

   d). At the top of the screen, go to Menu > Windows. Select Walker Controller.
      1). Walk length refers to the amount of speech you will hear when you listen to
          the file as you transcribe. The default is 8000 msec; if you do not hear enough of
          the person’s speech, increase the number (PI set Walk length to 60000).
      2). Loop number refers to the number of times the selected segment will play
          (PI set Loop number to 3).
      3). Playback speed refers to the rate of the speech you will hear; default is
          100%. Increasing the number will make the speed faster; decreasing the number
          will make the speed slower (PI set Playback speed to 110%).
      4). Click on red circle to close Walker Controller window.
e). **Definition of an utterance or C-unit.**

(1). Operational definition of C-Unit or utterance: According to Bernstein Ratner and Brundage (2015) and MacWhinney, a C-unit has the following 3 features:

(a). Silence or pause of more than 2 seconds  
(b). Terminal intonation contour.  
(c). Syntax that makes a complete sentence, or word(s) that make a complete, appropriate contribution to a conversation, as in,  
MOT: where are you going?  
CHI: home (one word, but an utterance).

Using the convention identified by Ratner Bernstein and Brundage (2015, p. 13), a C-unit or utterance has two out of the three features above. If you have only one feature, place the verbalization in question within the following C-unit or utterance (i.e., both parts would be on the same line of the transcript.)

(2). “Each Main line of the transcript should contain only 1 C-unit” (Bernstein Ratner & Brundage, 2015, p. 13).  

f). **Transcribing utterances.**

(1). At the top of the screen, go to **Menu > Mode.** Select **Transcribe sound or movie.**  
(2). Once you select **Transcribe sound or movie,** the MP3 file plays.  
(3). Each time you hear the end of a C-unit or utterance, press the space bar to add a bullet to the line.  
(4). Bullet 20-25 utterances at a time. The transcript will look like the screenshot below (Ratner Bernstein & Brundage, 2015, p. 11):

---

1 A C-unit is a conversation unit.
(5). Place your cursor to the left of a bullet. Press F6 to start playing the audio file. Transcribe 2-3 lines at a time. Place your cursor to the left of a subsequent bullet and continue the transcription process.

**g). Create MAIN LINES:**

(1). Each line of what was said by the participant begins with an *

(2). Only one utterance is coded in each main line. When a participant speaks more than one utterance during a speaking turn, each utterance is coded on its own line.

(3). Place your cursor to the left of the first bullet in the transcript (see screenshot on p. 3).

(4). After the asterisk, type a 3-letter code with UPPERCASE LETTERS for the participant followed by a COLON and a TAB [*CHI: or *MOT:].

(5). When you use the asterisk, three-letter code, colon, and tab this brings you to the ninth space in the line. Begin the transcription of what was actually said by the participant.

**NOTE:** A shortcut for steps 3) and 4) is to go to **Menu > Tiers** and then select #1, #2, #3, etc. that corresponds to the speaker of that utterance. You can also use keyboard shortcuts to select the appropriate tier or speaker. It is important to realize that these shortcuts will automatically use the correct formatting (i.e., the 3-letter code will be in UPPERCASE LETTERS, a colon will be inserted, and a TAB will be inserted. *(Using the keyboard shortcuts or TIER is the preferred method to avoid formatting errors)*.

(6). Each utterance transcribed ends with an **utterance terminator.** Use either a period(,), question mark (?), or an exclamation point (!). Insert a space in-between the last letter of the utterance and the utterance terminator.

Example:

```
*MOT: please give me a hug *•
↑ TAB space
```

(7). Each utterance begins with a lowercase letter.

(8). Capitalize only the first letter of proper names, days of the week, months. Capitalize the pronoun “I” and all related forms (“I’m,” “I’ll,” “I’ve,” etc.)

(9). Unintelligible utterances:

(a). Children’s unintelligible utterances should be transcribed in the following way: using a zero (0) followed by a space left bracket equal sign exclamation point space **written description** right bracket space utterance terminator.
Example (a):

```
*CHI:  0 [=! unintelligible utterance] .
       ↑  ↑
       spaces  space and utterance
terminator
```

Other descriptions in the written description could be “high-pitched vocalization,” “low-pitched vocalization, echolalia, singing intonation, humming, etc.

**NOTE:** Children’s unintelligible utterances may predominate a child’s conversation with a parent and when coded this way can be counted as a conversational turn within CLAN.

(b). When an adult produces an unintelligible utterance use xxx followed by an utterance terminator.

(c). When there is an unintelligible string within an otherwise intelligible utterance of a child or an adult, indicate the unintelligible part with xxx followed by a space and an utterance terminator.

Example (b):

```
*MOT: xxx .
```

Example (c):

```
*CHI:  xxx xxx track .
```

**d). Babbling:** If the child is babbling and you can try to write what you heard use yyy bracket equals exclamation mark space gloss right bracket space utterance terminator.

Example d):

```
*CHI:  yyy [=! ba ba] .
```
9). **Sound effects:** If a speaker makes a sound effect, indicate this with the following notation: 0 [=! car noises].

Example:

*MOT: 0 [=! laughs].

10). **Numbers:** Write out words for numbers.

Example:

*MOT: one two three •
*MOT: twenty+one candles •

11). **Words that “hang together”:** These should be transcribed by connecting the words with an underscore (_). These may be a familiar toy such as Mickey_Mouse or a brand name such as Chuck_E_Cheese. Note the use of a Capital letter for proper names.

Example:

*MOT: do you like Thomas_the_Tank_Engine ?*

12). **Compound words:** In adult transcripts, compound words should be written as they normally would be.

*MOT: that's my sweatshirt .

13). **Phonological fragments:** Sometimes a speaker begins to say a word and then changes it; this can be referred to as a “false start.” To indicate a phonological fragment, use the ampersand followed by the sounds:
Example:

* MOT: that's a &tr bus.

According to the online CHAT manual. The ampersand can also be used to indicate a phonological string in an unintelligible utterance, as in & digida

14). Assimilations: For adults, indicate that nonstandard assimilations such as “wanna,” “gonna,” “lemme,” etc. equal the standard expressions by using left bracket colon space words right bracket.

Example:

* MOT: wanna [: want to] take turns.

↑↑

Colon Space

Frequent assimilations

<table>
<thead>
<tr>
<th>Nonstandard word</th>
<th>Standard words</th>
<th>Nonstandard word</th>
<th>Standard word</th>
</tr>
</thead>
<tbody>
<tr>
<td>coulda(ve)</td>
<td>could have</td>
<td>lotsa</td>
<td>lots of</td>
</tr>
<tr>
<td>dunno</td>
<td>don’t know</td>
<td>mighta</td>
<td>might have</td>
</tr>
<tr>
<td>you</td>
<td>do you</td>
<td>need(t)a</td>
<td>need to</td>
</tr>
<tr>
<td>gimme</td>
<td>give me</td>
<td>oughta</td>
<td>ought to</td>
</tr>
<tr>
<td>gonna</td>
<td>going to</td>
<td>posta</td>
<td>supposed to</td>
</tr>
<tr>
<td>gotcha</td>
<td>got you</td>
<td>shoulda(ve)</td>
<td>should have</td>
</tr>
<tr>
<td>gotta</td>
<td>got to</td>
<td>sorta</td>
<td>sort of</td>
</tr>
<tr>
<td>hadta</td>
<td>had to</td>
<td>wanna</td>
<td>want to</td>
</tr>
<tr>
<td>hasta</td>
<td>has to</td>
<td>wassup</td>
<td>what’s up</td>
</tr>
<tr>
<td>hafta</td>
<td>have to</td>
<td>whaddya</td>
<td>what did you</td>
</tr>
<tr>
<td>kinda</td>
<td>kind of</td>
<td>whyntcha</td>
<td>why didn’t you</td>
</tr>
<tr>
<td>lemme</td>
<td>let me</td>
<td>whatcha</td>
<td>what are you</td>
</tr>
</tbody>
</table>

---

9 [www.chides.psu.cmu.edu/manuals/CHAT.pdf](http://www.chides.psu.cmu.edu/manuals/CHAT.pdf) (p. 21)
10 From Ratner and Brundage (2015, p. 22). “Whatcha” was added by Beth E. Breakstone.
15). **Exclamations:** Use the following spellings to keep constant the use of exclamations in the transcripts as well as to allow comparison with transcripts referenced in the literature or in transcriptions archived in CHILDES\(^1\).

Frequent exclamations:

<table>
<thead>
<tr>
<th>Exclamation</th>
<th>Meaning</th>
<th>Exclamation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>*ah</td>
<td>relief, joy</td>
<td>*pst</td>
<td>listen here</td>
</tr>
<tr>
<td>*ahhah</td>
<td>discovery</td>
<td>sh</td>
<td>silence</td>
</tr>
<tr>
<td>aw</td>
<td>sympathy</td>
<td>*tsk</td>
<td>shame</td>
</tr>
<tr>
<td>golly</td>
<td>gee whiz</td>
<td>tut</td>
<td>pity</td>
</tr>
<tr>
<td>gosh</td>
<td>gee whiz</td>
<td>ugh</td>
<td>disgust, effort</td>
</tr>
<tr>
<td>ha(h)</td>
<td>triumph</td>
<td>*uhoh</td>
<td>trouble</td>
</tr>
<tr>
<td>*haha</td>
<td>amusement</td>
<td>vroom</td>
<td>car noise</td>
</tr>
<tr>
<td>*heehee</td>
<td>amusement</td>
<td>whee</td>
<td>exuberance</td>
</tr>
<tr>
<td>*mmm</td>
<td>tasty, good</td>
<td>wow</td>
<td>amazement</td>
</tr>
<tr>
<td>*num</td>
<td>tasty</td>
<td>yea</td>
<td>a cheer</td>
</tr>
<tr>
<td>*nummy</td>
<td>tasty</td>
<td>(y)eeek</td>
<td>fear</td>
</tr>
<tr>
<td>*numnum</td>
<td>tasty</td>
<td>y(0)ikes</td>
<td>mild fear</td>
</tr>
<tr>
<td>ouch</td>
<td>sudden pain</td>
<td>*yum</td>
<td>tasty</td>
</tr>
<tr>
<td>ow</td>
<td>hurt</td>
<td>yummy</td>
<td>tasty</td>
</tr>
<tr>
<td>oy</td>
<td>dismay</td>
<td>yumyum</td>
<td>tasty</td>
</tr>
</tbody>
</table>

* Denotes words that are not included in Webster’s Third New International Dictionary. Do not include the * in the transcript when using these spellings.

---

\(^1\) From Bernstein Ratner and Brundage (2015, p. 20).
16). **Communicators:** *Communicators* are sounds that children or adults will make to mark a turn in a conversation or other functions (also referred to as *markers*). Use the following standard spellings in order to keep constant the use of communicators in the transcripts as well as to allow comparison with transcripts referenced in the literature or in transcriptions archived in CHILDES.

Frequent Communicators:

<table>
<thead>
<tr>
<th>Marker</th>
<th>Function</th>
<th>Marker</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ahem</td>
<td>ready to speak</td>
<td>nah</td>
<td>no</td>
</tr>
<tr>
<td>*emem</td>
<td>I don't know</td>
<td>uhhuh</td>
<td>yes</td>
</tr>
<tr>
<td>*er</td>
<td>pause</td>
<td>*uhhum</td>
<td>yes indeed</td>
</tr>
<tr>
<td>*hunmmmm</td>
<td>no</td>
<td>*uhuh</td>
<td>no</td>
</tr>
<tr>
<td>*hunhunh</td>
<td>no</td>
<td>*uh</td>
<td>pause (any vowel)</td>
</tr>
<tr>
<td>huh</td>
<td>questioning</td>
<td>um</td>
<td>pause (any vowel)</td>
</tr>
<tr>
<td>hmm</td>
<td>thinking, waiting</td>
<td>ye(a)h</td>
<td>yes</td>
</tr>
<tr>
<td>hmm?</td>
<td>questioning</td>
<td>*yeahhuh</td>
<td>yes (contradicting)</td>
</tr>
<tr>
<td>*mhmhm</td>
<td>yes</td>
<td>yup</td>
<td>yes</td>
</tr>
<tr>
<td>nope</td>
<td>no</td>
<td>yup</td>
<td>yes</td>
</tr>
<tr>
<td>*nuhuh</td>
<td>strong no</td>
<td>whoops</td>
<td>blunder</td>
</tr>
</tbody>
</table>

* Denotes words that are not included in Webster’s Third New International Dictionary. Do not include the * in the transcript when using these spellings.

17). **Letters:** Indicate when a speaker says a letter by using the following notation: `a@l` (no spaces between these symbols); if this is the end of the utterance, add the appropriate utterance terminator.

Example:

```
*MOT: w@l.
*MOT: x@l.
*MOT: y@l.
*MOT: and z@l.
```
18). **Strings of letters:** Indicate when a speaker says a string of letters by using the following notation: $abc@k$

*MOT: let's sing the abc@k song.

19). **Trailing off:** Sometimes a speaker will not finish an utterance. Indicate this by using +…

Example:

*MOT: fix the paper so it doesn't +…

20). **Trailing off with a question:** Sometimes a speaker will not finish question. Indicate this by using +..?

Example:

*MOT: do you want a yogurt or a +..?

21). **Interruption:**

a). **Interruption by other speaker:** Sometimes one speaker will interrupt another speaker. Indicate this by using plus forward slash period: +/-.

Example a):

*MOT: we don't have to go out this way so I would let +/.
*MOT: what if the front door's that way?

b). **Self-interruption:** Sometimes a speaker will interrupt him or herself. Indicate this by using plus forward slash forward slash period: +/-/

Example b):
22). **Retracing without correction:** Sometimes a speaker will repeat a word or phrase in the middle of an utterance without producing a correction. Indicate this by using angle brackets with the first use of the repeated word(s) followed by [/] and the part that is repeated followed by the remainder of the utterance.

Example:

```
*MOT: <which> [/] which book do you want to read?
```

23). **Retracing with correction:** Sometimes a speaker will repeat a word or phrase in the middle of an utterance and produce a correction. Indicate this by using angle brackets with the first part that is repeated followed by [//] with the part that is corrected and then the remainder of the utterance.

Example:

```
*MOT: <he went> [/] he wanted to say bye
Thomas .
```

24). **Pausing within an utterance:** Sometimes a speaker will pause briefly in the middle of an utterance before completing it. Indicate this with the following notations: a very brief pause (.); a slightly longer pause (..); a little longer pause (…)

Example:

```
*MOT: and (…) this ?
```

25). **Overlaps:** Sometimes two speakers will say something at the same time. You may either not be concerned about this and transcribe them on subsequent lines, or if you feel that this is important, you can indicate the overlapping turns with the following notation:

first speaker: <utterance> [>].
second speaker: <utterance> [<].

Those parts of the utterances that overlap go in the angle brackets.
26. Quotations: Sometimes individuals speak direct quotations from storybooks, movies or videos, or storybooks are read during caregiver-child interactions.

a). When the individual quotes something from a book, movie, or video, etc., indicate this by using the following notation +” sentence.

Example a).

*MOT: +” they stopped at Hackensack.
*MOT: +” people got on.
*MOT: +” and people got off.

b). When the individual begins to speak about the book with one utterance and on the next line he or she begins to read or quote, use the following notation - first line: and she says +”/ . This is followed by the second line, which begins with the notation +” followed by the quotation.

Example b).

*MOT: it says +”/.
*MOT: +” I am going to go from the start of the line to the end of the line without stopping.

Each subsequent line quoted will begin with the +” notation.

c). When the quotation precedes the utterance spoken by the individual, use the following notation: first line: +” followed by the character who spoke the quotation on the second line, ending with +”.

Example c).

*MOT: +” I’m tired of making stops.
*MOT: the little engine said +”.

d). A single quoted word can use the notation: word@q for quote.

Example d).

*MOT: what did the old lady say?
*MOT: she said hush@q.
27). **Shortenings**: Sometimes individuals leave out part of a word but it is still understandable, which often happens in running speech. To indicate this, use the following notation: place the omitted part of the word in parentheses (x).

Example:

*MOT: what are you doin(g) ?

Frequent shortenings:

<table>
<thead>
<tr>
<th>(a)bout</th>
<th>don('t)</th>
<th>(h)is</th>
<th>(re)frigator</th>
</tr>
</thead>
<tbody>
<tr>
<td>an(d)</td>
<td>(e)nough</td>
<td>(h)isself</td>
<td>(re)member</td>
</tr>
<tr>
<td>(a)n(d)</td>
<td>(e)spress(o)</td>
<td>-in(g)</td>
<td>sec(ond)</td>
</tr>
<tr>
<td>(a)fraid</td>
<td>(e)spresso</td>
<td>nothin(g)</td>
<td>s(up)pose</td>
</tr>
<tr>
<td>(a)gain</td>
<td>(es)presso</td>
<td>(i)n</td>
<td>(th)e</td>
</tr>
<tr>
<td>(a)nother</td>
<td>(ex)cept</td>
<td>(in)stead</td>
<td>(th)em</td>
</tr>
<tr>
<td>(a)round</td>
<td>(ex)cuse</td>
<td>Jag(uar)</td>
<td>(th)emselves</td>
</tr>
<tr>
<td>ave(nue)</td>
<td>(ex)cused</td>
<td>lib(r)ary</td>
<td>(th)ere</td>
</tr>
<tr>
<td>(a)way</td>
<td>(e)xcuse</td>
<td>Mass(achusetts)</td>
<td>(th)ese</td>
</tr>
<tr>
<td>(be)cause</td>
<td>(e)xcused</td>
<td>micro(phone)</td>
<td>(th)ey</td>
</tr>
<tr>
<td>(be)fore</td>
<td>(h)e</td>
<td>(pa)jamas</td>
<td>(to)gether</td>
</tr>
<tr>
<td>(be)hind</td>
<td>(h)er</td>
<td>(o)kay</td>
<td>(to)mato</td>
</tr>
<tr>
<td>b(e)long</td>
<td>(h)ere</td>
<td>(o)ver</td>
<td>(to)morrow</td>
</tr>
<tr>
<td>b(e)longs</td>
<td>(h)erself</td>
<td>(po)tato</td>
<td>(to)night</td>
</tr>
<tr>
<td>Cad(illac)</td>
<td>(h)im</td>
<td>prob(ab)ly</td>
<td>(un)til</td>
</tr>
<tr>
<td>doc(tor)</td>
<td>(h)imself</td>
<td>(re)corder</td>
<td>wan(t)</td>
</tr>
</tbody>
</table>
28). Backchannel: Sometimes an individual will make a comment aloud that is not addressed to the child, but may be being said to the investigator. To indicate this so that the utterance is excluded from the corpus of child-directed language, add the following as a post code following the utterance terminator: left bracket plus sign space bch right bracket [+ bch]

Example:

*MOT: he’s taking a little break from me. [+ bch]*

h). Transcribing Dependent Tiers: Dependent tiers come after a main line. It begins with a % symbol followed by the type of dependent tier being used.

1). Comments: Sometimes it may be important to make a comment that pertains to a preceding or following utterance. To indicate this, use the following notation for a dependent tier for comments: %com:
(Like a main tier, use a colon after the type of tier it is followed by a TAB (not a space); use a space followed by an utterance terminator (a period) at the end of the comment.

Example:

%com: sounds of someone walking .

NOTE: There can be only one comment following or preceding a main line.

2). Other codes: There are other codes that have been devised for CHAT. Consult the manual on the website for these:
(www.childes.psy.cmu.edu/manuals/CHAT.pdf  (p. 77- 84.)

i). CHECK: You should use the command, CHECK, to check the accuracy of your transcription frequently. Do not wait until you have finished transcribing to do this.
(1). Go to Menu > Windows > Commands. The Command window will open.
(2). In field with the blinking cursor, type CHECK.
(3). The “File In” button appears; click on it.
(4). Select the file you want to CHECK in the left panel; select “Add” button and the file will be added to the panel on the right.

(5). Select “Done.”

(6). The window closes and the @ appears next to CHECK. (i.e., CHECK@).

(7). Click on the blue “Run” button.

(8). If there are errors, you will see a message in the CLAN Output Window.

(9). Triple click on a line number and you will be brought to that line in the transcript where you can view and correct the error.

(a). Common errors are that utterance delimiters are missing.

(b). Another common error is that spaces are missing; brackets are missing; etc.

(10). After making corrections, repeat CHECK until you see the message in the CLAN Output window:

First pass DONE.
Second pass DONE.
Success! No errors found.

(j). MOR: The next step is to run the MOR command, which puts a dependent tier in the transcript with the morphology of each utterance.

(1). Go to Menu > Windows > Commands. The Command window will open.

(2). In field with the blinking cursor, type MOR.

(3). The “File In” button appears; click on it.

(4). Select the file you want to “morphemicize” in the left panel; select “Add” button and the file will be added to the panel on the right.

(5). Select “Done.”

(6). The window closes and the @ appears next to CHECK. (i.e., CHECK@).

(7). Click on the blue “Run” button.

(8). You will receive a message indicating the name of the Output file (it will be located in your Work folder and the participant subfolder. (CLAN runs a second program automatically called POST.).

For example, the message may say:

Your transcript(s) have 686 words with 24 that MOR does not recognize.
To fix these, please run this command: mor +xb *.cha
Then open the resultant file and triple-click to go to the place of each error.
After fixing the errors, please run MOR again.
If you choose to work with incomplete data, you can skill all these steps.

(9). After completing this step, run CHECK again.
## Appendix G

### Operational Definitions of Semantic/Syntactic Categories

<table>
<thead>
<tr>
<th>Mother and child language measures</th>
<th>Operational definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transcript</td>
<td>The total number of all words spoken in the language sample transcript by the participant. This variable is automatically calculated by the KIDEVAL command in CLAN.</td>
</tr>
<tr>
<td>Word tokens</td>
<td>The total number of different words spoken in the language sample transcript by the participant and is one measure of lexical diversity. The variable is automatically calculated by the KIDEVAL command in CLAN</td>
</tr>
<tr>
<td>D</td>
<td>A measure of lexical diversity developed by David Malvern and Brian Richards. It is automatically calculated using vocd by the KIDEVAL command in CLAN.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semantic Category (MCDI)</th>
<th>Operational definition(^2)/(Part of speech(^1)/(MOR CODE tag))</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common noun</td>
<td>“a noun that is used with limiting modifiers (as a or an, some, every, my) and that designates a being or thing of which more than one specimen exists” (N)</td>
<td>animal, dog</td>
</tr>
<tr>
<td>Proper noun</td>
<td>“a noun that designates a particular being or thing, does not take a limiting modifier, and is usually capitalized in English” (N:PROP)</td>
<td>Donald_Duck, Peppa_Pig</td>
</tr>
</tbody>
</table>

### OPEN-CLASS WORDS

<table>
<thead>
<tr>
<th>Animal Names</th>
<th>Common noun: Basic level, superordinate, and subordinate (N)</th>
<th>animal, dog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Characters</td>
<td>Proper noun: names of pets or fictional characters that are animals (N:PROP)</td>
<td>Donald_Duck, Peppa_Pig</td>
</tr>
<tr>
<td>Vehicles</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>airplane, car</td>
</tr>
<tr>
<td>Toys</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>Thomas, Buzz</td>
</tr>
<tr>
<td>Food and Drink</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>apple, cookie,</td>
</tr>
<tr>
<td>Clothing</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>coat, pants,</td>
</tr>
<tr>
<td>Body Parts</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>arm, hair,</td>
</tr>
<tr>
<td>Furniture and Rooms</td>
<td>Common noun: Basic level, superordinate, and subordinate (N)</td>
<td>bed, kitchen,</td>
</tr>
</tbody>
</table>

---

\(^1\) From MacArthur-Bates Communicative Development Inventories (MCDI; Fenson et al., 2007)

\(^2\) From the online Unabridged Webster-Merriam Dictionary unabridged.merriam-webster.com

### Appendix G (cont’d).

<table>
<thead>
<tr>
<th>Semantic Category (MCDI)</th>
<th>Operational definition(^2)/Part of speech(^3)(MOR CODE tag)</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Small Household Item</strong></td>
<td><strong>Common noun:</strong> Basic level, superordinate, and subordinate (N)</td>
<td>Missus Potts, Backpack, Map</td>
</tr>
<tr>
<td><strong>Outside Things and Places to Go</strong></td>
<td><strong>Common noun:</strong> Basic level, superordinate, and subordinate (N)</td>
<td>flower, school</td>
</tr>
<tr>
<td><strong>Proper noun:</strong> names of places (N:PROP)</td>
<td>The Bronx Zoo, bath, hello, goodbye, high five, bring, drink, p.</td>
<td></td>
</tr>
<tr>
<td><strong>People</strong></td>
<td><strong>Common noun:</strong> Basic level, superordinate, and subordinate (N)</td>
<td>Mommy, grandma</td>
</tr>
<tr>
<td><strong>Proper noun:</strong> names of fictional characters that are people (N:PROP)</td>
<td>Dora, Christopher Robin</td>
<td></td>
</tr>
<tr>
<td><strong>Games</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Words that are linked together are capitalized (tagged as Communicator, CO)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Action Words</strong></td>
<td><strong>Verb:</strong> &quot;a verb that expresses action&quot; (V)</td>
<td>morning, day, tonight</td>
</tr>
<tr>
<td><strong>Words about Time</strong></td>
<td>Common nouns (N)</td>
<td>tomorrow</td>
</tr>
<tr>
<td><strong>Descriptive Words</strong></td>
<td><strong>Adjective:</strong> “a word belonging to one of the major form classes … typically used as a modifier of a noun to denote a quality of the thing named” (ADJ)</td>
<td>hot, yucky</td>
</tr>
<tr>
<td><strong>Descriptive Words</strong></td>
<td><strong>Adverbs:</strong> “a word belonging to one of the major form classes…typically used as a modifier of a verb, an adjective, another adverb, a preposition, a phrase, a clause, or a sentence and typically expressing some relation of manner or quality…place…time…degree…number…but otherwise uninflected, and frequently formed with a characteristic derivative affix” (ADV)</td>
<td>now, later, quickly, very, here,</td>
</tr>
<tr>
<td><strong>Descriptive Words</strong></td>
<td></td>
<td>all gone</td>
</tr>
<tr>
<td><strong>Words that “link together” and are not used as separate morphemes in the child’s language; another term for this is “frozen phrases” (ADV or ADJ)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

\(^1\) From MacArthur-Bates Communicative Development Inventories (MCDI; Fenson et al., 2007)

\(^2\) From the online Unabridged Webster-Merriam Dictionary unabridged.me

## Appendix G (cont’d.)

<table>
<thead>
<tr>
<th>Semantic Category (MCDI)</th>
<th>Operational definition/Part of speech/(MOR CODE tag)</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED-CLASS WORDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question Words</td>
<td>Interrogative pronouns: a pronoun “used in a question” (WH)</td>
<td>what, who, ho</td>
</tr>
<tr>
<td>Prepositions</td>
<td>Preposition: “a linguistic form that combines with a noun, pronoun, or noun equivalent to form a phrase that typically has an adverbial, adjectival, or substantival relation to some other word” (PREP)</td>
<td>in, on, up,</td>
</tr>
<tr>
<td>Locations</td>
<td>Adverb: “a word belonging to one of the major form classes in any of a great many languages typically used as a modifier of a verb, an adjective, another adverb, a preposition, a phrase, or a sentence and typically expressing some relation of manner or quality…place…time…degree…number…cause…opposition…affirmation…or denial…” (ADV)</td>
<td>here</td>
</tr>
<tr>
<td>Infinitive</td>
<td>Infinitive: “an infinite verb form normally identical in English with the first person singular that performs certain functions of a noun and at the same time displays certain characteristics (as association with objects and adverbial modifiers) of a verb and is used with to” (INF)</td>
<td>to + verb</td>
</tr>
<tr>
<td>Articles</td>
<td>Article: “a word belonging to a group of limiting noun modifiers that in English consists of a, an, any, each, either, every, neither, no, one, some, the, that, those, this, these, what, whatever, which, whichever, possessive adjectives (as my), and possessive-case forms (as Joe's) and is characterized by occurrence before descriptive adjectives modifying the same noun” (Tagged as Determiner, DET)</td>
<td>a, any, each,</td>
</tr>
<tr>
<td>Pronouns</td>
<td>Pronoun: “a word belonging to one of the major form classes in any of a great many languages that is used as a substitute for a noun or noun equivalent, takes noun constructions and is declined, refers to persons or things named, asked for, or understood in the context, and has little or no fixed meaning except one of relation or limitation” (PRO)</td>
<td>I, you, his</td>
</tr>
<tr>
<td>Helping Verbs</td>
<td>Auxiliary Verb: “accompanying a nonfinite verb form that expresses the main verbal meaning of its clause, expressing typically such things as person, number, mood, and tense, and finite in form unless accompanied by another auxiliary verb, in which case only one is finite…” Includes modals (V:AUX)</td>
<td>am, gonna, dc.</td>
</tr>
<tr>
<td>Connecting Words</td>
<td>Conjunction: “a linguistic form … that joins together words or word groups such as sentences…” (CONJ)</td>
<td>but, so, if, although, until, and, or because,</td>
</tr>
<tr>
<td></td>
<td>Coordinator: “a coordinating conjunction” (CONJ)</td>
<td></td>
</tr>
</tbody>
</table>

---

1. From MacArthur-Bates Communicative Development Inventories (MCDI; Fenson et al., 2007)
2. From the online Unabridged Webster-Merriam Dictionary unabridged.merriam-webster.com
<table>
<thead>
<tr>
<th>Semantic Category (MCDI)</th>
<th>Operational definition / Part of speech / (MOR CODE tag)</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTHER CLASS WORDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound Effects and Animal Sounds</td>
<td>Includes <strong>onomatopoeia</strong>: “formation of words in imitation of natural sounds; the naming of a thing or an action by a more or less reproduction of the sound associated with it (such as buzz, hiss, or bobwhite); the imitative or echoic principle in language” tagged as **Communicator, CO; onomatopoeia tagged as **Onomatopoeia, ON)</td>
<td><strong>meow, choo choo, bow wow</strong></td>
</tr>
<tr>
<td>Communicators or Interjections</td>
<td><strong>Interjection</strong>: “The art of uttering exclamations” (Tagged as <strong>Communicator, CO</strong></td>
<td><strong>uh oh, hey, goodbye</strong></td>
</tr>
</tbody>
</table>

---

1 From MacArthur-Bates Communicative Development Inventories (MCDI; Fenson et al., 2007)
2 From the online Unabridged Webster-Merriam Dictionary unabridged.merriam-webster.com
Appendix H

Normative Data on Lexical Diversity (D)

Lexical diversity (D) as measured by vocd.

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Median</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>14.80</td>
<td>10.31</td>
<td>13.60</td>
<td>1.48</td>
<td>36.99</td>
</tr>
<tr>
<td>21</td>
<td>20</td>
<td>21.49</td>
<td>16.70</td>
<td>19.09</td>
<td>2.60</td>
<td>67.24</td>
</tr>
<tr>
<td>24</td>
<td>28</td>
<td>27.44</td>
<td>20.52</td>
<td>25.41</td>
<td>2.50</td>
<td>84.64</td>
</tr>
<tr>
<td>27</td>
<td>29</td>
<td>34.77</td>
<td>17.70</td>
<td>31.16</td>
<td>7.48</td>
<td>65.76</td>
</tr>
<tr>
<td>30</td>
<td>29</td>
<td>41.53</td>
<td>16.93</td>
<td>45.59</td>
<td>4.05</td>
<td>69.67</td>
</tr>
<tr>
<td>33</td>
<td>29</td>
<td>43.67</td>
<td>15.45</td>
<td>45.47</td>
<td>10.38</td>
<td>73.88</td>
</tr>
<tr>
<td>36</td>
<td>29</td>
<td>47.83</td>
<td>13.97</td>
<td>47.14</td>
<td>13.26</td>
<td>69.95</td>
</tr>
<tr>
<td>39</td>
<td>30</td>
<td>49.48</td>
<td>15.41</td>
<td>49.08</td>
<td>11.22</td>
<td>80.78</td>
</tr>
<tr>
<td>42</td>
<td>29</td>
<td>53.12</td>
<td>13.55</td>
<td>53.80</td>
<td>10.57</td>
<td>73.54</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td>64.02</td>
<td>8.46</td>
<td>63.48</td>
<td>50.83</td>
<td>83.30</td>
</tr>
</tbody>
</table>

| Adult academic writing | 23 | 90.59| 10.70 | 69.74 | 119.20 | |

Note. Table adapted from the data presented in Durán, Malvern, Richards, & Chipere (2004, pp. 231) and p. 234 for adult academic writing samples.
Appendix I

Shared Lexicon for Dyad 3 (40 shared word types)

<table>
<thead>
<tr>
<th>Open class</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td><em>be</em></td>
<td></td>
</tr>
<tr>
<td>62</td>
<td><em>want</em></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td><em>Pet’s name</em></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td><em>Mommy</em></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td><em>down</em></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td><em>do</em></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><em>help</em></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><em>lay</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><em>egg</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><em>help</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><em>ketchup</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><em>need</em></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><em>nose</em></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><em>there</em></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><em>so</em></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><em>wipe</em></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><em>phone</em></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><em>show</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>fix</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>letter</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>zebra</em></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>love</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Closed class</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>194</td>
<td><em>you</em></td>
<td></td>
</tr>
<tr>
<td>89</td>
<td><em>to</em></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td><em>your</em></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td><em>I</em></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td><em>a</em></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td><em>the</em></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td><em>that</em></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td><em>one</em></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td><em>this</em></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><em>more</em></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><em>down</em></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><em>five</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>one</em></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>much</em></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td><em>please</em></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td><em>all_done</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>moo_moo</em></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>ow</em></td>
<td></td>
</tr>
</tbody>
</table>

Note. *Token = Mother’s token values. General all-purpose verbs are marked with underlined text. Word types that occur more than once belong to different semantic/syntactic categories. Word types not shared: uhuh, school*
Appendix J

Shared Lexicon for Dyad 7 (47 shared word types)

<table>
<thead>
<tr>
<th>Token</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>179</td>
<td>be</td>
<td>129</td>
<td>it</td>
<td>67</td>
<td>oh</td>
</tr>
<tr>
<td>46</td>
<td>want</td>
<td>13</td>
<td>one</td>
<td>30</td>
<td>yeah</td>
</tr>
<tr>
<td>44</td>
<td>here</td>
<td>9</td>
<td>two</td>
<td>29</td>
<td>no</td>
</tr>
<tr>
<td>33</td>
<td>Child’s name</td>
<td>6</td>
<td>three</td>
<td>8</td>
<td>hey</td>
</tr>
<tr>
<td>29</td>
<td>popcorn</td>
<td>2</td>
<td>one</td>
<td>6</td>
<td>e</td>
</tr>
<tr>
<td>25</td>
<td>Mom</td>
<td>5</td>
<td></td>
<td>5</td>
<td>v</td>
</tr>
<tr>
<td>20</td>
<td>there</td>
<td>4</td>
<td></td>
<td>4</td>
<td>n</td>
</tr>
<tr>
<td>15</td>
<td>cone</td>
<td>4</td>
<td>please</td>
<td>3</td>
<td>i (letter)</td>
</tr>
<tr>
<td>14</td>
<td>bubble</td>
<td>3</td>
<td></td>
<td>3</td>
<td>k</td>
</tr>
<tr>
<td>8</td>
<td>puzzle</td>
<td>6</td>
<td></td>
<td>3</td>
<td>s</td>
</tr>
<tr>
<td>6</td>
<td>milk</td>
<td>5</td>
<td></td>
<td>2</td>
<td>y</td>
</tr>
<tr>
<td>5</td>
<td>bus</td>
<td>5</td>
<td></td>
<td>2</td>
<td>yes</td>
</tr>
<tr>
<td>5</td>
<td>pop</td>
<td>4</td>
<td></td>
<td>1</td>
<td>a (letter)</td>
</tr>
<tr>
<td>5</td>
<td>train</td>
<td>3</td>
<td></td>
<td>1</td>
<td>b</td>
</tr>
<tr>
<td>4</td>
<td>gummy</td>
<td>2</td>
<td></td>
<td>1</td>
<td>c</td>
</tr>
<tr>
<td>3</td>
<td>iPad</td>
<td>2</td>
<td></td>
<td>1</td>
<td>d</td>
</tr>
<tr>
<td>2</td>
<td>pink</td>
<td>1</td>
<td></td>
<td>1</td>
<td>f</td>
</tr>
<tr>
<td>2</td>
<td>shake</td>
<td>1</td>
<td></td>
<td>1</td>
<td>j</td>
</tr>
<tr>
<td>1</td>
<td>puff_puff</td>
<td>1</td>
<td></td>
<td>1</td>
<td>l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>z</td>
</tr>
</tbody>
</table>

Note. 'Token = Mother’s token values. General all-purpose verbs are marked with underlined text. Word types that occur more than once belong to different semantic/syntactic categories. Word types not shared: red, r, g, h, q
Appendix K

Shared Lexicon for Dyad 8 (33 actual shared word types/34 extrapolated)

<table>
<thead>
<tr>
<th>Open class</th>
<th>Closed class</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Token</strong></td>
<td><strong>Type</strong></td>
<td><strong>Token</strong></td>
</tr>
<tr>
<td>34</td>
<td>want</td>
<td>111</td>
</tr>
<tr>
<td>13</td>
<td>not</td>
<td>29</td>
</tr>
<tr>
<td>11</td>
<td>apple</td>
<td>28</td>
</tr>
<tr>
<td>10</td>
<td>eat</td>
<td>8</td>
</tr>
<tr>
<td>6</td>
<td>Yo (name of toy)</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>chicken</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>dinner</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>iPad</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>cookie</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>P_E</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>bar</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>dinosaur</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>love</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Teacher’s name</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>bean</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dad</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Friend’s name</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>green</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mother’s name</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>night</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>party</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>stop</td>
<td></td>
</tr>
</tbody>
</table>

Note. *Token = Mother’s token values. Data for Dyad 8 has been extrapolated to 60-minutes. General all-purpose verbs are marked with underlined text. Word types that occur more than once belong to different semantic/syntactic categories. Word types not shared: *mm, nah.*
Appendix L

Shared Lexicon for Dyad 10 (61 actual shared word types/74 extrapolated)

<table>
<thead>
<tr>
<th>Token</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Mommy</td>
<td>5</td>
<td>mouth</td>
</tr>
<tr>
<td>39</td>
<td>tickle</td>
<td>5</td>
<td>ready</td>
</tr>
<tr>
<td>28</td>
<td>foot</td>
<td>4</td>
<td>head</td>
</tr>
<tr>
<td>27</td>
<td>baby</td>
<td>4</td>
<td>monster</td>
</tr>
<tr>
<td>27</td>
<td>Child's name</td>
<td>4</td>
<td>sing</td>
</tr>
<tr>
<td>27</td>
<td>sweet</td>
<td>4</td>
<td>water</td>
</tr>
<tr>
<td>19</td>
<td>up</td>
<td>3</td>
<td>again</td>
</tr>
<tr>
<td>16</td>
<td>go</td>
<td>3</td>
<td>birthday</td>
</tr>
<tr>
<td>15</td>
<td>green</td>
<td>3</td>
<td>button</td>
</tr>
<tr>
<td>15</td>
<td>love</td>
<td>3</td>
<td>November</td>
</tr>
<tr>
<td>14</td>
<td>nose</td>
<td>3</td>
<td>smiley</td>
</tr>
<tr>
<td>13</td>
<td>not</td>
<td>3</td>
<td>stomp</td>
</tr>
<tr>
<td>13</td>
<td>read</td>
<td>2</td>
<td>Sister A</td>
</tr>
<tr>
<td>12</td>
<td>eye</td>
<td>2</td>
<td>sun</td>
</tr>
<tr>
<td>9</td>
<td>ear</td>
<td>1</td>
<td>Cheez_it</td>
</tr>
<tr>
<td>8</td>
<td>come</td>
<td>1</td>
<td>Christ</td>
</tr>
<tr>
<td>7</td>
<td>face</td>
<td>1</td>
<td>banana</td>
</tr>
<tr>
<td>7</td>
<td>hair</td>
<td>1</td>
<td>mind</td>
</tr>
<tr>
<td>7</td>
<td>have</td>
<td>1</td>
<td>Sister B</td>
</tr>
<tr>
<td>6</td>
<td>red</td>
<td>1</td>
<td>Sister C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>83</td>
<td>you</td>
<td>34</td>
<td>what</td>
</tr>
<tr>
<td>12</td>
<td>I</td>
<td>7</td>
<td>do</td>
</tr>
<tr>
<td>5</td>
<td>of</td>
<td>2</td>
<td>that</td>
</tr>
<tr>
<td>1</td>
<td>five</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>up</td>
</tr>
<tr>
<td>16</td>
<td>go</td>
</tr>
<tr>
<td>15</td>
<td>love</td>
</tr>
<tr>
<td>14</td>
<td>nose</td>
</tr>
<tr>
<td>13</td>
<td>not</td>
</tr>
<tr>
<td>13</td>
<td>read</td>
</tr>
<tr>
<td>12</td>
<td>eye</td>
</tr>
<tr>
<td>9</td>
<td>ear</td>
</tr>
<tr>
<td>8</td>
<td>come</td>
</tr>
<tr>
<td>7</td>
<td>face</td>
</tr>
<tr>
<td>7</td>
<td>hair</td>
</tr>
<tr>
<td>7</td>
<td>have</td>
</tr>
<tr>
<td>6</td>
<td>red</td>
</tr>
</tbody>
</table>

Note. 'Token = Mother's token values. Data for Dyad 10 has been extrapolated to 60-minutes. General all-purpose verbs are marked with underlined text. Word types not shared: hah, eieio, hey, meow, rawr, ruff, what (determiner).
Appendix M

Shared Lexicon for Dyad 11 (100 shared word types)

<table>
<thead>
<tr>
<th>Token</th>
<th>Type</th>
<th>Token</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>109</td>
<td>go</td>
<td>5</td>
<td>book</td>
</tr>
<tr>
<td>81</td>
<td>do</td>
<td>5</td>
<td>dog</td>
</tr>
<tr>
<td>54</td>
<td>not</td>
<td>4</td>
<td>bunny</td>
</tr>
<tr>
<td>49</td>
<td>want</td>
<td>4</td>
<td>Dad/Daddy</td>
</tr>
<tr>
<td>46</td>
<td>get</td>
<td>4</td>
<td>drink</td>
</tr>
<tr>
<td>38</td>
<td>there</td>
<td>4</td>
<td>dunk</td>
</tr>
<tr>
<td>36</td>
<td>good</td>
<td>4</td>
<td>school</td>
</tr>
<tr>
<td>33</td>
<td>bean</td>
<td>3</td>
<td>again</td>
</tr>
<tr>
<td>32</td>
<td>Mama/Mom</td>
<td>3</td>
<td>bubble</td>
</tr>
<tr>
<td>28</td>
<td>soup</td>
<td>3</td>
<td>Daisy</td>
</tr>
<tr>
<td>23</td>
<td>here</td>
<td>3</td>
<td>jelly</td>
</tr>
<tr>
<td>20</td>
<td>right</td>
<td>3</td>
<td>person</td>
</tr>
<tr>
<td>18</td>
<td>bread</td>
<td>3</td>
<td>tired</td>
</tr>
<tr>
<td>15</td>
<td>in</td>
<td>3</td>
<td>truck</td>
</tr>
<tr>
<td>15</td>
<td>toast</td>
<td>2</td>
<td>art</td>
</tr>
<tr>
<td>15</td>
<td>up</td>
<td>2</td>
<td>baby</td>
</tr>
<tr>
<td>14</td>
<td>tiger</td>
<td>2</td>
<td>Goofy</td>
</tr>
<tr>
<td>13</td>
<td>bear</td>
<td>2</td>
<td>light</td>
</tr>
<tr>
<td>13</td>
<td>juice</td>
<td>2</td>
<td>potato</td>
</tr>
<tr>
<td>13</td>
<td>know</td>
<td>2</td>
<td>ring</td>
</tr>
<tr>
<td>13</td>
<td>strawberry</td>
<td>2</td>
<td>spin</td>
</tr>
<tr>
<td>11</td>
<td>sleep</td>
<td>2</td>
<td>Teacher’s name</td>
</tr>
<tr>
<td>10</td>
<td>cold</td>
<td>2</td>
<td>tummy</td>
</tr>
<tr>
<td>9</td>
<td>eat</td>
<td>2</td>
<td>yucky</td>
</tr>
<tr>
<td>9</td>
<td>plate</td>
<td>1</td>
<td>bike</td>
</tr>
<tr>
<td>7</td>
<td>work</td>
<td>1</td>
<td>turn</td>
</tr>
<tr>
<td>6</td>
<td>game</td>
<td>1</td>
<td>turtle</td>
</tr>
<tr>
<td>5</td>
<td>blue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>269</td>
<td>you</td>
<td></td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>do</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91</td>
<td>a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>what</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>two</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>this</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>three</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>one</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>eight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>four</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>one</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>want</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>oh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>okay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>no</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>yeah</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>hm/hmm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>huh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>byebye</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>uhh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>that</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>two</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>whoa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>all_done</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>blech</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>alright</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>help</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>heyo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>hi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>nope</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>ah</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>brr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>tee_tee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>yay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>grr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>nana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ribbet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>roar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>welcome</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. ^1Token = Mother’s token values. General all-purpose verbs are marked with underlined text above. Word types that occur more than once belong to different semantic/syntactic categories. Word types not shared: all_gone, eh, five, kitty, mine, ugh
## Appendix N

### Shared Lexicon for Dyad 13 (15 shared word types)

<table>
<thead>
<tr>
<th>Open class</th>
<th>Closed class</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Token</strong></td>
<td><strong>Type</strong></td>
<td><strong>Token</strong></td>
</tr>
<tr>
<td>34</td>
<td>say</td>
<td>42</td>
</tr>
<tr>
<td>18</td>
<td>play</td>
<td>26</td>
</tr>
<tr>
<td>13</td>
<td>dog</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>cup</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>ball</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>cat</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>cap</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>newt</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* 'Token = Mother’s token values. General all-purpose verbs are marked with underlined text. Word types not shared: oo.
### Appendix O

#### Steps for Determining Child’s Phase of Spoken Language Development

<table>
<thead>
<tr>
<th>STEPS</th>
<th>Child’s values</th>
<th>Intentional/Presymbolic</th>
<th>First Words</th>
<th>Word Combin.</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Determine phonemes produced in language sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Determine syllable types produced in language sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Determine child’s word types produced in 60-minute language sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Calculate child’s number of word types produced in 20 minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Determine child’s word tokens produced in 60-minute language sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Calculate child’s number of word tokens produced in 20 minutes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** If # of word tokens in #6 is ≥ 100, go to #7 to determine if ≥ 92 word types in 20 minutes. If < 92, select Word Combinations phase; if ≥ 92, select Sentences phase.

| 7.    | Determine the number of word types produced in 65 utterances | | | | |
| 8.    | Determine child’s number of words reported produced by parent on MCDI | | | | |
| 9.    | Determine Age Equivalent Score using MCDI User’s Manual – Words and Gestures form (50% rank) | | | | |

**Note:** If AE score is > 18 months, go to #10 instead.

| 10.   | Determine Age Equivalent Score using MCDI User’s Manual – Words and Sentences form (50% rank) | | | | |

**Note:** If AE score is > 18 months, go to #10 instead.

| 11.   | Determine mean length of utterance in morphemes (MLU/m) | | | | |
| 12.   | Tally the number of checkmarks in each phase | | | | |
| 13.   | Determine phase with the most language characteristics | | | | |
VITA

Beth Ellen Davidoff

EDUCATION
Ph.D. 2018 Communication Sciences and Disorders
The Pennsylvania State University, University Park, Pennsylvania
M.S 1979 Speech and Language Pathology
M.Ed. Teachers College, Columbia University, New York, New York
B.A. 1977 Honors in Linguistics, Brown University, Providence, Rhode Island

SELECTED RESEARCH FUNDING AND SCHOLARSHIPS
2017 Summer 2017 Research Award, Center for Research, William Paterson
2016 Emerging Researcher Travel Award, International Society for
Augmentative and Alternative Communication (ISAAC)
2014 – 2016 AAC Leadership Project, U.S. Department of Education Grant
#H325D110008
2013 Communication Sciences and Disorders Graduate Research and
Teaching Assistantship, The Pennsylvania State University
1977 Phi Beta Kappa

SELECTED PUBLICATIONS
Caron, J., Light, J., Davidoff, B. E., & Drager, K. D. R. (2017). Comparison of
The effects of mobile technology AAC apps on programming visual
Scene displays. Augmentative and Alternative Communication, 33, 239-248.
22(1), 48-53. Invited article

SELECTED SCIENTIFIC AND PROFESSIONAL PRESENTATIONS
Davidoff, B. E.
Earlier intervention for nonspeaking children with complex
communication needs. Annual Conference of the American Speech-
Language-Hearing Association (ASHA), Los Angeles, CA.
Flash Technical Session.
Davidoff, B. E.
Mothers’ language input to young children with ASD and limited to no
speech: lexical characteristics. Annual Conference of the American
Speech-Language-Hearing Association (ASHA), Los Angeles, CA.
Flash Technical Session.
Davidoff, B. E.
Quantity and quality of mothers’ language input to their minimally
verbal young children with ASD. Annual Conference of the American
Speech-Language-Hearing Association (ASHA), Philadelphia, PA.
Poster presentation.
Davidoff, B. E.
Symbol-infused play for young children with complex communication
needs. 2016 Conference of the International Society of Augmentative