DEVELOPMENTAL EXPECTATIONS FOR CHILD-LIKE SENTENCES

BY

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THESIS

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ABSTRACT

Purpose: The purpose of this project was to establish developmental sentence diversity expectations for children at 30 months of age. Two research questions were posed: (1) Is there a difference in the diversity of sentence subject types (i.e., first person singular, third person singular) at 30 months of age? (2) Is there a relationship between diversity of the selected sentence subject types and general measures of grammatical development? **Method:** Forty typically-developing toddlers at 30 months of age were selected from an existing database (Rispoli & Hadley, 2008) to develop sentence diversity expectations. Parent-child 30-min language samples were used to code sentence subjects for person (i.e., first person, second person, third person) and number (i.e., singular, plural). Sentence diversity was examined by converting coded sentences to unique subject-verb combinations (USVs). Mean length of utterance in morphemes (MLU; Brown, 1973) and *Index of Productive Syntax* (IPSyn; Scarborough, 1990) scores were calculated using 100 complete and intelligible utterances to determine the relationship between sentence diversity and general language measures. **Results:** There was not a significant difference between first person singular and third person singular USVs with the full sample, so a follow-up analysis was conducted by dividing the sample in half using the median MLU in morphemes at 30 months. This analysis revealed a significant difference between first person singular and third person singular USVs for the low MLU group, but not for the high MLU group. Low to moderate significant relationships were observed between first person USVs and both MLU and total IPSyn score at 30 months. A moderate to high significant correlation was observed between third person USVs and MLU, and a moderate significant correlation was observed with third person USVs and total IPSyn score. **Clinical Application:** Five at-risk 30-month-old toddlers were selected based on their 36 month scores on

the *Test of Early Grammatical Impairment* (TEGI; Rice & Wexler, 2001) to demonstrate the clinical usefulness of sentence diversity expectations. Criterion-referenced and norm-referenced cut-offs were presented to identify retrospective weaknesses in sentence production at 30 months of age. **Discussion:** Clinical usefulness of sentence diversity expectations and future research directions regarding sentence diversity are discussed.

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CHAPTER 1

INTRODUCTION & LITERATURE REVIEW

Most children develop language rapidly during the first few years of life. Children move from producing word combinations to producing simple, child-like sentences before graduating to the production of adult-like sentences. Although the production of word combinations and sentences in toddlers has been considered a developmental milestone, early language abilities continue to be characterized using very general measures such as mean length of utterance (MLU; Brown, 1973) that do not reflect specific elements of syntactic structure (Paul & Norbury, 2011).

Despite growing literature on vocabulary and grammatical development, little information is known about the development of sentences in young children. Sentences are an integral step in young children's language development and serve as the basic unit of syntactic analysis. The production of sentences made up of only lexical categories (e.g., *Baby sleep* or *Car go*) precedes the acquisition of sentences that include grammatical or functional categories (e.g., *The baby is sleeping* or *The car goes.)*. Although Radford (1990) characterized a period of child-like sentences that lack the functional categories exhibited in adult-like sentences, this linguistic characterization did not provide clear quantitative expectations that could be used to characterize differences between children in developmental rate. In the applied field of speech-language pathology, methods for quantifying rate of development are important to the diagnostic and treatment process.

Brown (1973) addressed this need by identifying several early stages of grammatical development. This popular framework categorized the grammatical development of typically developing children by MLU with corresponding age ranges and structural characteristics.

Brown calculated MLU by counting the number of morphemes in each utterance and dividing by the total number of utterances. MLU is a simple tool for the quantification and characterization of developmental change, and its simplicity contributes to its longstanding use. In addition to its ease, the typical structures characteristic of each stage assist in intervention planning and ongoing assessment.

The first three stages are applicable to the language growth focused on in this study. Stage I occurs between 12 and 26 months, when children reach an MLU of 1.00 to 2.00, and is characterized by the building of linear semantic relations. Stage II occurs from 27 to30 months, corresponding to MLU levels of 2.00 to 2.50. The start of morphological development is expected during Stage II, specifically the production of *–ing*, plural *–s*, and prepositions *in* and *on.* Stage III, occurring from 31 to 34 months and at MLU levels of 2.50 to 3.00, is characterized by question and negation sentence development and the emergence of tense and agreement structures. Although Brown's (1973) framework provides descriptive information about the development of an early grammatical system, Ingram (1989) argues that a great deal of development is not addressed, particularly in the first two stages. Because the focus of Stage I is semantic relations and the focus of Stage II is morphological development, Brown (1973) provides little detail about the substantial syntactic development that must occur in order to master morphology and, eventually, tense and agreement. While linguistic frameworks have moved on since the creation of Brown's (1973) stages, the incorporation of these new frameworks into clinical practice has not yet occurred.

Hadley (2006) recommended that we begin to recognize and include the crucial syntactic steps between word combinations and morphosyntactic development. To do this, Hadley (2006) suggested that we think of the developmental process as four stair steps, including words, verbs,

sentences, and tense. With the mastery of one developmental step, the child moves up the staircase to the next developmental accomplishment. These steps do not reflect discrete stages of development, but instead, the leading edge of language development. Children proceed through the steps by incorporating prior accomplishments into later-developing syntactic structures. This model indicates that verbs serve as the foundation for sentences, and child-like sentences serve as a foundation for adult-like sentences that are marked for tense and agreement.

Despite the recognition that sentence development is the foundation of the language development process, we still do not have an effective and efficient way to characterize children's early sentences for developmental description or clinical use. There is a lack of clear expectations for sentence development though sentences are identified as a critical language milestone. Identifying this milestone will not only assist in a better description of syntactic growth, but it could also serve to distinguish typical and atypical profiles from one another at younger ages.

The need for establishing a developmental sequence for sentence development in toddlers may also lead to earlier identification of language impairment. Although difficulties with tense and agreement marking are well-documented clinical markers of language impairment, these deficits in tense and agreement mastery are not recognized until the preschool years (Hadley & Short, 2005; Leonard, 1998; Oetting & Hadley, 2009; Rice, 2003; Rice & Wexler, 1996). However, because the development of sentences is a prerequisite to the subsequent development of grammar, it is possible that delays in sentence development foreshadow the well-established grammatical deficits with tense and agreement seen in preschoolers with language impairment. If clinically applicable expectations for sentence development are created, clinicians can assess children for deficits in their first sentences, an earlier indicator of grammatical vulnerability.

Documentation of sentence development expectations may assist in identifying indicators of language impairment at younger ages, before the onset of tense and agreement marking is expected (Hadley & Holt, 2006; Hadley & Short, 2005).

The remainder of this introduction is presented as follows. First, there will be an overview of the history and limitations of developmental sentence characterizations. Next, attempts at characterizing sentences for clinical purposes will be evaluated. Finally, a description of the type of sentence characterization that is still needed will be presented, followed by a summary of the project purpose and research questions.

Developmental Sentence Characterization

Within this section, information from Ingram's (1989) summaries of three developmental sentence characterization frameworks will be addressed. First, the work of Braine (1963) on pivot grammar as a method of sentence characterization will be highlighted. Next, the use of phrase structure rules by McNeill (1970) to characterize early sentences will be discussed. Then, the contributions of Brown (1973) on the use of semantic relations characterizations will be presented.

One method of sentence characterization proposed by Braine (1963) is pivot grammar. Pivot grammars are based heavily on distributional learning. Pivot grammar assumes that children learn language based on the input in their environment, with their first words and word combinations being those most frequent in the input. Common words in the input are referred to as pivot words, and they occur most often in the word combinations of young children. Children use these pivot words and attach other words to them, called open class words. Open class words are less frequent in the input, thus less common in children's word combinations. Over time, children begin to understand which pivot words and open class words can be put together, and

eventually begin to combine open class words as their understanding of these classes increases. Although pivot grammar can account for some of the earliest word combinations produced by children, it cannot account for all combinations. Ingram (1989) raises concerns about how a child makes the transition between producing word combinations with pivot grammar and producing unique sentences with an adult-like grammar.

McNeill's (1970) method of characterizing sentences using phrase structure rules assumed that children brought knowledge of language to the table, referred to as Universal Grammar. Universal Grammar was believed to equip children with a basic set of grammatical features and syntactic categories that are present in all languages. To develop a grammar, children use Universal Grammar and the input in their environment to assign syntactic categories to words, such as +VP for predicate or +NP for nominal. This categorization process results in the development of a grammatical system. Children assign categories in a predictable order, and phrase structure becomes evident in their early word combinations. With time, children acquire grammatical morphemes after the development of basic grammatical relations. Phrase structure rules accounted for the development of syntax and partly for the progression to an adult-like grammar. However, Ingram (1989) criticized the use of phrase structure rules to characterize early sentences because he believed the method assigned too much structure to children's earliest word combinations by using adult-like grammar to describe child-like productions.

Another method of sentence characterization, semantic relations (Brown, 1973), has also been used to characterize the sentences of young children. Brown (1973) claimed that children use the semantics, or meanings, of words to construct early word combinations. Semantic roles of words or primes provide tangible and more easily learned information to assist children in combining words into relations, such as *Agent* + *Action* or *Entity* + *Locative*. Brown (1973)

stated that eleven semantic relations are possible in early word combinations and that these relations serve as the foundation for the child to move toward grammatical development. Although semantic relations provide us with a descriptive framework for characterizing children's early sentences, the approach focuses only on semantic relationships between words without a mechanism for explaining how children arrive at the grammatical relationships present in syntactic structure. Additionally, there are no developmental expectations for semantic relations, which limit its usefulness for characterizing the severity of a child's language delay relative to typical developmental expectations.

The intended uses of these methods of sentence characterization were, in fact, to describe the nature of early grammar. All of the methods presented were appropriate for that purpose, but as the field of speech-language pathology has adopted these methods and attempted to apply them to clinical populations, there is a more pressing need for quantitative expectations. For example, to determine eligibility for early intervention services, percent delay must be quantified to identify the severity of early language deficits in children under age 3. To be clinically useful, it must be possible for a clinician to determine the severity of a language delay and monitor progress.

Clinical Attempts at Developmental Sentence Characterization

The clinical need for sentence development expectations is not new. Because of the issues with pivot grammar, phrase structure rules, and semantic relations pointed out by Ingram (1989), attempts have been made to establish sentence characterization methods that are more clinically useful. In fact, Lee (1966) was a pioneer who began working towards clinically relevant characterizations of early sentences. The attempt made by Lee (1966) was the creation of developmental sentence types (DST). DST was developed when Lee (1966) noted that

children with language impairments developed syntax not only at a slower rate, but in a qualitatively different fashion compared to their typically-developing peers. Using DST procedures, children's verbal productions were either labeled as one-word utterances or categorized into four levels. Level I - Two-Word Combinations included nouns produced with noun modifiers (e.g., *the, more, big*), possessive forms (e.g., *Mommy, Daddy*), designators (e.g., *there, here, that*), adjectives (e.g., *broken, tired, allgone*), or less occasionally, verbs (e.g., *eat, want*). Level II – The Noun Phrase included combinations of three nouns, which were viewed as the development of the grammatical category "noun phrase," or NP. Level III – Constructions included NPs joined to designative words, demonstrators, and identifiers as well as predicative constructions (e.g., *the car broken*), verb phrase constructions (e.g., *put on the hat*), and stereotyped constructions (e.g., *I don't know*). Level IV – Sentences included designative sentences (e.g., *This is a big house*), predicative sentences (e.g., *The doggie is there*), and actor-action sentences (e.g., *Mommy give some milk*).

Lee (1966) used these levels to document and compare the development of two toddlers. Results from analyses of a typically developing toddler (3;1) and a child with delayed language (4;7) indicated that their performances at each of the DST levels were differentiating. Although DST had obvious clinical potential to characterize children's early sentences, Lee (1974) refocused DST to examine only "pre-sentences," or words and word combinations that did not consist of a subject and verb. However, cross-sectional language samples from 40 typically developing children collected and analyzed in Lee (1974) indicated that even the youngest toddlers in the 2;0 to 2;2 age group were already producing numerous tokens of subject-verb combination, although it is not clear how many of these were different types of subject-verb combinations. Though the revised DST provided useful information for a variety of word

combinations, it no longer characterized early sentences that included both a subject and verb. Further development of grammatical measures began to wane when the semantic and pragmatic revolutions shifted the clinical focus of speech-language pathology away from syntactic structure and grammar (Launer & Lahey, 1981). Additionally, the development of DST came prior to legislation mandating early intervention services, so there was little pressure to refine measures for early grammatical development.

Another attempt to apply syntactic analysis to clinical assessment came with the creation of the *Language Assessment and Remediation Screening Procedure* (LARSP; Crystal, Fletcher, & Garman, 1976). LARSP was designed to profile syntax and morphological development by segmenting children's language systems into four levels including sentence, clause, phrase, and word types. Language data is collected and analyzed using a 30-min language sampling procedure, language transcription, and eight transcript scans to identify syntactic and grammatical structures of interest (Klee & Paul, 1981). After analyses are completed, children's language systems are assigned to age-referenced stages to determine what structures are mastered, emerging, and can be targeted in intervention.

Most recently, Scarborough (1990) developed the *Index of Productive Syntax* (IPSyn) to quantify the grammatical complexity of 2- to 4-year-old children based on Miller's (1981) *Assigning Structural Stages*. Scarborough (1990) developed the IPSyn as a way to quantify differences among children in grammatical complexity based on the morphological and syntactic structures in their spontaneous speech. The IPSyn score is calculated by identifying two sufficiently different exemplars of 56 structures. The items are part of one of four subscales – Noun Phrase, Verb Phrase, Questions/Negations, or Sentence Structure. Points are awarded

when an utterance contains the structure(s) of interest, and subscale scores and total scores can be compared to reported age equivalents (Scarborough, 1990).

Although LARSP and IPSyn are useful clinical tools to characterize language development in young children, they characterize language skills over years of development. As such, their broad focus makes them less useful for fine-grained assessment of emerging child-like sentences. DSTs and LARSP, while helpful with remediation planning, cannot be used to quantify the severity of language delays. Although the IPSyn can be used to quantify grammatical abilities or delays, only 2 of 56 items focus specifically on child-like sentences. Despite the existence of various analysis methods, these methods are not typically used in clinical practice, and even if they were, they do not lend themselves to providing expectations for developmental change in sentence diversity.

An alternative approach to characterizing early word combinations came with the rise of the semantic revolution. During this time, semantic relations analyses were incorporated into clinical practice (Bloom & Lahey, 1978; Retherford, 1987). Using this method, utterances produced by the child were characterized by the semantic roles of the words within word combinations. This produced an inventory of the semantic relations the child used in a given period of time. Although this method is useful for evaluating the presence and absence of semantic relations in order to identify treatment targets in clinical practice, there is still a lack of developmental expectations available to compare a child to his or her peers. Additionally, analyses based on semantic relations approach word combinations from a semantic perspective and do not provide an explanation as to how semantic combinations become re-organized into an adult-like, syntactically-based grammar (Ingram, 1989).

Ingram (1989) developed a syntactically-based method to quantify early sentences as children began combining words. Based on analyses of five young children, Ingram noted that children appear to experience a syntactic spurt, or a rapid growth of early child-like sentences, around the time when MLU (Brown, 1973) reaches 1.5 or the child produces 100 unique syntactic types (USTs). Ingram (1989) described USTs as novel, multi-word combinations. Using the concept of USTs, an attempt was made by Hadley (1999) to use USTs clinically as an alternative, rate-based measure of early grammatical development by assessing novel combinations and the diversity of early sentences. Hadley (1999) operationalized the measure of USTs to eliminate words that attached to the periphery of sentences (e.g. addressees, interjections, affirmation markers) to prevent the inflation of length-based measures of grammatical development, such as MLU. Repeated productions of the same word combinations were also eliminated.

To validate the measure of USTs, Hadley (1999) selected 20 children from an archival database of children with developmental language disorders between the ages of 19 and 31 months and used 100 spontaneous utterances from language transcripts of caregiver-child interaction. Analyses showed reliability and predictive validity of the UST measure, as well as its ability to measure syntactic abilities of children when compared to MLU (Brown, 1973) and IPSyn (Scarborough, 1990). These results indicated that the UST measure of sentences adequately assessed grammatical development in a valid and time-efficient manner. However, USTs were still difficult to interpret due to lack of developmental expectations of typically developing children (Hadley, 1999).

Using USTs as a starting point, Villa (2010) characterized developmental change in children's sentences by extending the methodologies of Hadley (1999). Villa (2010) focused on

sentence diversity, or the child's ability to combine a variety of sentence subjects with a variety of verbs, as means to evaluate the early sentences of children ages 21 to 27 months. Sentence diversity is hypothesized to be a more sensitive indicator of progress in early grammatical development and to be a precursor to the subsequent development of tense and agreement (Hadley & Rispoli, 2010; Villa, 2010). In Villa (2010), language sample analyses were used to characterize children's sentence diversity, calling these diverse sentences unique syntactic types - subject-verb combinations (UST-SVs), henceforth referred to as unique subject-verb combinations (USVs). To be defined as a USV, utterances had to contain sufficiently different combinations of an explicit subject and lexical verb.

Villa (2010) completed analyses on 20 typically developing children from an archival database to characterize sentence development by focusing on sentence subjects from spontaneous, complete and intelligible declarative sentences. Productivity of a grammatical subject type was operationally defined as the production of two or more USVs with a grammatical subject type. In other words, a subject type was productive if the same subject was used with more than one verb (e.g., *I want; I play*) or if two different subjects of a given type were used with the same or different verbs (e.g., *dog sit; he sit*). Grammatical subject types included: first person singular, third person singular, third person plural, etc. based on the grammatical features of person and number. Subject type productivity was determined when children produced two or more USVs with a specific grammatical subject type.

Villa (2010) found that the quantity of USVs increased with age for the majority of participants and a developmental sequence in the appearance of productive subject types emerged. First person subjects emerged first for 60% of participants at 21 months, and third person singular subjects types either appeared concurrently with or after first person subjects.

Second person, third person plural, and first person plural subjects appeared later. This information suggests that children follow a pattern of sentence subject expansion as the diversity of their sentences increases. This finding also indicates that the assessment of children's sentence development should capture diversity across grammatical subjects as well as diversity across lexical verb types.

Although more clinically relevant attempts to characterize sentences have been made, the field is still in need of quantitative expectations that can be applied to children to assess their development and monitor progress. Each of the aforementioned methods has demonstrated promise and clinical relevance for characterizing early language development. However, none of these methods have been readily adopted into clinical practice. For clinicians to adopt new clinical methods, the methods should be theoretically and empirically sound. The methods will also need to be time-efficient to be useful in clinical practice. Therefore, the methods must limit the amount of time required for language sampling, transcription, and analysis. Finally, the methods will result in quantitative expectations that can be used to identify the severity of an early language delay and to monitor progress over time.

The purpose of this project was to establish developmental sentence expectations using a time-efficient analysis approach that can be used by clinicians in an everyday clinical setting. Specifically, this project focuses on developmental sentence expectations for children at 30 months of age that could be used as part of initial assessment procedures. To establish these developmental expectations, the current study was designed to document the variability in early sentence development in a sample of 40 typically developing toddlers. To test specific hypotheses for a developmental sequence in early sentence development, the following research questions were posed:

1. Is there a difference in the diversity of sentence subject types (i.e., first person singular, third person singular) at 30 months of age?
2. Is there a relationship between diversity of the selected sentence subject types and general measures of grammatical development?

Predictions for the two proposed research questions are as follows. It is predicted that there will be a significant difference between the diversity of first person singular and third person singular sentence subject types. This prediction is based on findings of Villa (2010) and McKenna (2011) which indicate that children produce first person singular sentence subjects earlier than third person singular sentence subjects, and with greater productivity, from ages 21 to 27 months.

It is predicted that third person singular sentence subject diversity will be correlated with MLU and IPSyn scores, but the relationship between these measures and first person singular diversity will not be as strong. Stronger relationships are expected for third person singular sentence diversity and the existing measures of length and grammatical complexity because there are more opportunities for children to use or omit obligatory grammatical morphemes in sentences with third person subjects in comparison to sentences with first person subjects. For example, third person lexical noun subjects require determiners (e.g., *the, my*). In addition, sentences with third person singular subjects and lexical verbs always require some form of auxiliary or verb affix to mark tense and agreement (e.g., *he wants more; he's eating*) whereas this is not always true for first person sentence subjects (e.g., *I want more; I'm eating*). These additional morphemes can increase both MLU and IPSyn scores for children who are able to elaborate sentence subjects and mark subject-verb agreement. However, omissions will be

apparent for children who do not yet have these grammatical abilities. In first person sentences, these developmental differences among children would be less apparent.

CHAPTER 2

METHODS

Database

Data for the current study was obtained from an existing longitudinal database funded by the National Science Foundation (NSF; Rispoli & Hadley, 2008). The overarching purpose of the longitudinal study was to document the growth of tense and agreement between 21 and 36 months of age and the contribution of parent input to that growth. Each child and primary caregiver dyad visited the laboratory a total of seven sessions, once at ages 21, 24, 27, 30, and 33 months and twice at 36 months. Each session was audio and video recorded.

Participants for the study were recruited from the campus community and surrounding rural communities in Champaign, Vermillion, and Macon counties in Illinois through newspapers, campus listservs, and flyers distributed to daycare centers and community facilities for the 15 month longitudinal study. Interested parents contacted the researchers, and researchers conducted a phone interview to determine if the child was developing typically. Parents were questioned on general health of the child, pre-maturity or trauma at birth, prolonged hospitalization, otitis media, developmental milestones, talkativeness, and intelligibility. Children reported to have frank neurological or sensory impairments, repeated bouts of otitis media (i.e., 6 or more infections), the insertion of pressure equalization tubes, or delayed onset of walking or talking (i.e., after 15 months) were not invited to participate. All children selected for the study were from homes where English was the only spoken language. For their participation, families were compensated $20.00 for each of the seven measurement point visits. Children also received toys as incentives (i.e., teddy bear in Illinois shirt, wind-up toy) for the 24 and 36 month measurement points.

Information was gathered regarding the children's general developmental abilities at 21 and 24 months of age using the *Ages and Stages Questionnaire* (ASQ, Bricker & Squires, 1999). The ASQ screened five developmental domains, including communication, gross motor, fine motor, personal-social, and problem-solving. Information on the children's expressive vocabularies was obtained using a parent report tool called the *MacArthur-Bates Communicative Development Inventories* (CDI; Fenson et al., 2007). The CDI provides information about words produced, word combinations, early sentences, and grammatical complexity.

At each measurement point from 21 to 36 months of age, audio and video recordings of two 30-min language samples were completed and available in the database. Children were recorded with a primary caregiver for the first 30-min sample and instructed to "play as they would at home" with age-appropriate toys. For the second 30-min sample, an examiner joined the child and parent and led the child through various semi-structured play scenarios designed to elicit the tense and agreement morphemes of interest. These scenarios included completing puzzles, constructing Mr. Potato Head, acting out a care-giving scenario with dolls, or playing with wind-up toys. Examiners included three graduate research assistants and the primary and co-primary investigators. One examiner participated in each child's second 30-min play sample.

Participants

For the current study, 40 typically developing toddlers and their parents were selected from the existing database. The toddlers were recruited primarily from white, college-educated homes. Mothers' highest educational levels included completion of high school (n = 2), associate's degree or some college (n = 6), bachelor's degree (n = 17), and advanced degree (n = 13). Children were reported by their parents to be white (n = 31), African-American (n = 4), and white and African-American (n = 3).

Eligible toddlers were 30 months of age and had passed the communication portion of the ASQ (Bricker & Squires, 1999) at 21 and 24 months of age. The children were also reported to be producing words at a level greater than or equal to the 10th percentile on the CDI (Fenson et al., 2007) at 24 months. Although use of the 10th percentile to truncate the full range may produce a higher than true average mean (McFadden, 1996), this cut-off matches the CDI criterion used to identify children with typical language development in current research (cf. Heilmann, Ellis Weismer, Evans, & Hollar, 2005). CDI vocabulary at 24 months was chosen because the greatest range of variability occurs on the tool at this age. The mean CDI total vocabulary for the participants at 24 months was 347.20 (SD = 158.02) and ranged from 77 to 640 words. The mean CDI total vocabulary for the participants at 30 months was 560.20 (SD = 105.29) and ranged from 275 to 675 words. Therefore, 24 months was deemed the best age to select participants due to greater variability. Participants ranged from the 10th percentile to the 99th percentile on the CDI at 24 months of age. Eight participants ranged from the 10th to the 30th percentile, eight from the 30th to the 50th percentile, eight from the 50th to the 70th percentile, and sixteen from the 70th to 99th percentile. Participant CDI total vocabulary, verb vocabulary, and total vocabulary percentile at 24 months are reported in Table 1.

Children were also required to pass a phonology screening at 30 months of age. The phonology screening consisted of the production of at least two instances of /t/, /d/, /s/, and /z/ in the final position of different words. These criteria were selected because these are the sounds necessary for marking tense and agreement, particularly past tense *–ed* and present -3*s*. The phonology screening was included to ensure that children had the phonological capabilities to produce tense and agreement markers that could increase their MLU or gain points on the IPSyn. Together, the ASQ, CDI, and phonology criteria helped to ensure that the participating toddlers

were adequately identified as typically developing on measures of early communication, vocabulary, and phonology.

Procedures

Language Samples. Transcribed language samples of 30-min parent-child interaction from the existing NSF database (Rispoli & Hadley, 2008) were used. Parent-child samples were selected to properly follow the procedures to compute MLU and IPSyn, which were originally computed using parent-child samples. Each 30-min sample was transcribed in its entirety using the standard conventions for the Systematic Analysis of Language Transcripts (SALT; Miller & Iglesias, 2010). Transcription of adult and child utterances was completed by trained graduate and undergraduate research assistants or laboratory volunteers for the entire 30-min sample. Transcribers listened to each child utterance a maximum of three times to maintain conservative measures of each child's language abilities. When necessary for clarity, transcribers used available video recordings to add contextual notes to the transcripts.

Next, a second transcriber who had not completed adult or child transcription for the language sample completed a consensus pass by re-listening to all utterances on the audio recordings and referring to the video recordings for increased clarity of child productions when necessary. This consensus transcriber was allowed to add content words, delete morphemes, or change utterances to unintelligible if the original transcription could not be confirmed. In instances where the consensus transcriber heard an additional, un-transcribed tense/agreement morpheme, another laboratory transcriber was called in as a third party listener to confirm the decision. Consensus transcription procedures served as the transcription reliability procedures for the current study. Transcript coding for standard measures of mean length of utterance (MLU) was also completed following SALT procedures (Miller & Iglesias, 2010).

General Measures. Using the transcribed 30-min parent-child language samples, general language measures were calculated. Total number of utterances and number of complete and intelligible utterances was calculated on the entire 30-min language sample using SALT's "Standard Measures Report" function (Miller & Iglesias, 2010). MLU was calculated with the same SALT function, based on the 100 complete and intelligible utterances used for IPSyn calculation, described below. Table 1 provides information about participant language abilities, including number of total utterances, number of complete and intelligible utterances, and MLU.

Additionally, scores on the *Index of Productive Syntax* (IPSyn; Scarborough, 1990) were calculated using the same complete and intelligible 100 utterances for each child. Adapted scoring procedures were followed. An adequate warm-up period of 20 utterances was allowed, and answers to yes/no questions were excluded. These additional procedures were used to increase the number of utterances with grammatical constituents and give each participant as much credit as possible, regardless of variations in parent input (e.g., question-answer style interaction, directive interaction) or initial shyness. For children who did not reach a total of 100 utterances with these adapted scoring procedures, the 20 utterance warm-up period was not included (n = 7). Five of these seven children produced less than 100 utterances within the analysis set, but IPSyn scoring was still completed. This resulted in scores for four subscales (i.e. Noun Phrase, Verb Phrase, Questions/Negation, Sentence Structure) and one total score on the IPSyn for each participant. IPSyn total scores are reported for each participant in Table 1.

The author completed IPSyn scoring procedures using the selected utterances for nine participants. Then, computerized assistance was developed to improve speed and accuracy of IPSyn scoring. A list was created in SALT's "Word and Code List" function that extracted pertinent lexical items (e.g., articles *a, an,* and *the*; adverbs *too, just*, and *right*) and coded

grammatical constituents (e.g., */3s*, */ed*, copula forms). After the creation of these additional procedures, the author and a trained graduate student completed the remaining IPSyns. Each IPSyn was re-checked for scoring accuracy by the author, and all scoring differences were resolved by consensus or in consultation with a faculty mentor before completing planned analyses. IPSyn subscales and total scores were tabulated using a pre-made form then entered into a Microsoft Excel file for documentation.

IPSyn scores were interpreted compared to the Scarborough (1990) IPSyn database of 30 month-old typically developing toddlers. Recall that the IPSyn scoring adaptation that was used may have slightly inflated IPSyn scores due to the potential for an increased number of utterances with scorable grammatical constituents. Because this comparison is based on children developing typically and is unrelated to the identification of language impairment, using the Scarborough (1990) database is still appropriate for the purposes of this project.

Sentence Measures. With transcription procedures complete on all language samples, each sample was then coded for sentence diversity. Sentence diversity coding procedures were adapted from coding procedures used in previous studies. These previous sentence diversity coding procedures had been completed on transcripts of 37 of the current participants as part of two prior studies using the same database (Bahnsen, 2011; Hadley & Rispoli, 2011). Transcripts from Bahnsen (2011) included codes on declarative sentences with an explicit subject and verb in the full 60-min language sample (i.e., 30-min parent-child, 30-min examiner-child). Hadley and Rispoli (2011) also used 60-min samples, but both declaratives and questions with an explicit subject and an explicit verb were coded for sentence diversity. Both of these studies included five codes that represented subject person and number. To update the earlier coded transcripts, the author re-coded and/or re-analyzed each of the 37 transcripts to include questions

and two new codes. The remaining three 30-min parent-child transcripts were coded in their entirety for sentence diversity by the author, using this study's procedures. A summary of the evolution of past sentence diversity variables and coded utterances is presented in Appendix A. The 30-min parent-child language sample was used for all children, regardless of how many utterances they produced, to develop rate-based expectations in a time period that was more clinically reasonable.

Only spontaneous, complete, and intelligible sentences produced by the child were coded. For this study, sentences were required to have both an explicit subject and a lexical verb. Sentences with copula *be* as its main verb or copula *be* omissions were not included. These sentences were excluded from this study to maintain a distinction between the diversity of early subject-verb and subject-verb-object sentences and the emergence of tense and agreement encoded by copula *be*. Utterances that consisted of routine expressions from songs, stories, or games, imitations of prior adult utterances, and partially intelligible utterances were also eliminated. Additionally, routine questions (i.e., *Where* NP *going?*, *What* NP *doing?)* were excluded, as they are recognized as "routine forms" of *wh*- questions and are unlikely to be unique, novel productions (Miller, 1981). Excluded routine questions made up 0% to 4% of participants' complete and intelligible utterances.

To examine child sentence diversity, clausal level codes were inserted following all explicit sentence subjects (i.e., head nouns, subject pronouns). Sentences with explicit subjects were labeled [SV] and coded for grammatical features of person (i.e., first, second, third) and number (i.e., singular, plural). This resulted in five sentence subject codes; [SV:1] was used for first person singular (i.e., I, me, my, child's own name) subjects, [SV:2] was used for second person singular subjects (e.g., you), [SV:3] was used for third person singular lexical (e.g. baby,

Pooh) or pronominal (e.g. it, he, she) subjects, [SV:1P] was used for first person plural subjects (e.g., we), and [SV:3P] was used for third person plural lexical (e.g., blocks, bubbles) and pronominal (i.e., they) subjects. For example, a sentence with the first person singular subject *Me* was coded as *Me[SV:1] do it,* and the third person subject *Baby* was coded as *Baby[SV:3] eat it.* Additional coding examples are presented in Appendix B.

Two additional codes, [SV:P] and [SV:RQ], were also used. The [SV:P] code was applied to sentence subjects that were names of conversation partners in the data collection session (i.e., Mommy, Daddy). These subjects were coded separately from third person singular subjects because of their potential to be addressee terms. Recall that original and consensus transcribers used both audio and video recordings to determine accuracy of child productions when possible. However, although transcribers set off definite addressee terms with commas in the transcription and consensus passes, there was a possibility for ambiguity for these subjects, particularly if these subjects were providing the child with most of their sentence diversity (McKenna, 2011). By creating a separate code, these potentially problematic subject types were removed from analyses but still documented. The code [SV:RQ] was applied to the subjects of the routine do/go questions that were excluded from analyses, as these question forms are considered early, routine productions that may not be the result of grammatical encoding (Miller, 1981). Refer to Appendix B for brief descriptions and coding examples.

Coded transcripts were checked for missing codes using SALT (Miller & Iglesias, 2010). In addition to routine, imitative, unintelligible productions, and vocalizations, sentences already coded for sentence subject diversity were excluded in the analysis set. The remaining list of utterances was reviewed to ensure all utterances meeting the sentence subject criteria had indeed been coded. Errors of omission were corrected by adding codes when necessary. Then, all

utterances coded for sentence diversity were checked for accuracy. Utterances with sentence subject diversity codes were extracted and listed using SALT's (Miller & Iglesias, 2010) Word and Code Lists. Coded utterances were reviewed, and errors of commission were corrected when codes had been applied incorrectly.

After coding was completed and checked, sentences with sentence subject codes were extracted from the language samples using SALT's (Miller & Iglesias, 2010) Explore Word and Code List function. Utterances coded with [SV:1], [SV:3], and [SV:3P] were examined to determine the number of unique subject-verb combinations present in the language sample. Unique subject-verb combinations (USVs) were defined as utterances with either an original explicit subject or an original verb. In other words, coded sentences with both explicit subjects and lexical verbs reflect subject-verb *tokens,* and their reduction to USVs reflects subject-verb *types*. Coded sentences which met the definition of USVs were compiled into individual participant documents on Microsoft Excel to determine the diversity of each subject type. Sentences were entered into the document if they included a different verb and sentence subject than previous sentences. Sentences which repeated both the same verb and the same sentence subject were not counted twice. Appendix C presents examples of the sentence to USV conversion process.

Reliability

General Measures. An undergraduate student was trained by the author to complete independent reliability for IPSyn calculations. The author reviewed the IPSyn procedures from Scarborough (1990) with the student, provided a handout with tips for IPSyn completion, and supervised the student in the completion of three example IPSyns. After the independent completion and review of another practice IPSyn, the student completed independent reliability

on six (15%) randomly selected participant IPSyns. Reliability was calculated by dividing the number of agreements on the 56 categories by 56. This method of independent reliability calculation was used to be more conservative than dividing the total number of agreed exemplars by the total possible 112 exemplars. The desired overall reliability of IPSyn calculation was set at 90% or higher. The overall agreement for IPSyn calculation was 90.0% (82.1% - 96.4%). It was determined that the IPSyns with the lowest reliability were those that were originally completed without computerized assistance. Because of this, all IPSyns completed before computerized assistance were re-done and two additional IPSyns were added to compute independent reliability. Independent reliability remained at an appropriate 90.0% on eight (20%) randomly selected IPSyns.

Sentence Measures. Of the 37 participant transcripts coded for sentence diversity in previous studies, six transcripts (15%) were randomly selected for independent reliability. Codes were removed from the six transcripts on SALT and saved as reliability files in a separate location by the faculty mentor. The author re-coded the six transcripts for independent reliability. Inter-rater agreement was calculated using a Cohen's kappa. The desired overall reliability of sentence diversity coding was set at 90% or higher. The overall agreement for coding was 97.0% (92.0% - 100.0%).

Independent reliability was also completed on sentence to USV conversion. An undergraduate student was trained by the author to convert sentences coded for sentence diversity to USVs. Six transcripts (15%) were randomly selected, and the student was provided with an Explore Word & Code List of sentences coded for sentence diversity to convert to USVs. Reliability was calculated by dividing the number of USV vs. non-unique sentences agreed upon by the total number of sentences to be converted to USVs to find a percentage. The desired

overall reliability of USV conversion was set at 90% or higher. The overall agreement for USVs was 98.3% (94.1% - 100.0%).

CHAPTER 3

RESULTS

Recall that the purpose of this project was to establish developmental expectations for child-like sentences at 30 months of age using a time-efficient, rate-based approach for assessment. In addition, it was expected that children's diversity of sentences with third person subjects would be related to existing measures of utterance length and grammatical complexity. This chapter begins with a description of the participants' language abilities, in general, and sentence production, in particular, before addressing the two specific research questions. The first research question asked if there was a difference in the diversity of sentence subject types (i.e., first person singular, third person singular) at 30 months of age. The second research question examined the relationship between the diversity of these selected sentence subject types and general measures of grammatical development (i.e., MLU, IPSyn).

Descriptive Statistics

General Measures. Individual data, means, and standard deviations of total utterances, complete and intelligible utterances, MLU, and IPSyn total scores at 30 months are reported in Table 1. Participants produced an average of 324.57 (SD = 102.71) total utterances during the 30-min parent-child language samples, ranging from 153 to 585. When reduced to complete and intelligible utterances, the participants produced 215.28 (SD = 70.74) utterances, ranging from 103 to 359. The average MLU for 100 complete and intelligible utterances for the 40 participants was 3.25 (SD = .65) and ranged from 1.79 to 4.88. This mean was higher than the predicted MLU mean, 2.54 (SD = .57), reported in Miller (1981). Recall, however, that the 100 utterances selected for MLU and IPSyn scoring followed adapted procedures, namely the exclusion of yes/no answers to questions, which would systematically increase MLU values. This data is

depicted in a box and whisker plot in Figure 1. Box and whisker plots are useful for illustrating the distribution of scores above and below the median. In these figures, the box represents the middle 50% of the data, with the median at the center line of the box. The bottom edge of the box represents the 25th percentile, and the top edge of the box represents the 75th percentile. The whiskers extend from the 25th and 75th percentiles to the minimum and maximum, respectively, excluding outliers. Outliers are represented as asterisks outside of the box and whisker plot.

The mean total IPSyn score was 58.90 (SD = 10.90), ranging from 31 to 79, out of a possible 112. This mean score was similar to the mean IPSyn total score for 30-month-olds, 58.80 (SD = 10.67), reported in Scarborough (1990). The distribution of IPSyn total scores is presented as a box and whisker plot in Figure 2.

Sentence Measures. Recall that sentences, defined as utterances with an explicit subject and lexical verb, were coded for person and number before diversity was determined. Frequency counts for each sentence subject type are presented in Table 2. The mean number (and range) of sentences coded for [SV:1] was 30.53 (5 – 115), 8.70 (0 – 38) for [SV:2], 14.28 (2 – 67) for [SV:3], 3.38 (0 – 24) for [SV:1P], and 1.83 (0 – 12) for [SV:3P]. This indicates that first person singular sentences were the most frequently produced sentence type, followed by third person singular sentences. Second person singular, first person plural, and third person plural sentences occurred less frequently.

Table 2 also includes USV data to show the diversity of first person singular, third person singular, and the three other subject types combined (i.e., second person, first person plural, third person plural). The mean number of first person singular USVs was 10.70 (SD = 3.86), ranging from 4 to 17, and the mean number of third person singular USVs was 9.70 (SD = 6.39), ranging from 2 to 36. These ranges are represented in Figure 3. The mean number of all other USVs was

7.83 (SD= 6.63), with a minimum of 0 and a maximum of 32. The mean number of total USVs was 28.23 (SD = 13.83), with a minimum of 11 and a maximum of 76. Figure 4 illustrates the variability of the [SV:1] and [SV:3] frequency counts and how this variability is reduced when diversity (USVs) is used to illustrate sentence production abilities.

To illustrate the variability of participants on their production of USVs, six children from the 40 participants were selected, including two children who produced the lowest number of USVs (i.e., GTP01G, GTP45G), two children who produced USVs at about the 50th percentile (i.e., GTP33B, GTP44B), and two children who produced the most USVs (i.e., GTP46G, GTP49G). Appendix D displays the USVs produced by these six children, separated into the different sentence subject types, and five of their longest complete and intelligible utterances.

Research Questions

The first research question focused on determining the difference between the diversity of first person singular sentence subject types and third person singular sentence subject types at 30 months of age. To answer this question, a paired-samples t-test was used to compare first person singular USVs and third person singular USVs. There was not a significant difference between diversity of first person singular sentences (M= 10.70, SD= 3.86) and diversity of third person singular sentences (M= 9.70, SD= 6.39); $t(39)= 1.01$, $p= .32$.

Since the prediction that there would be a significant difference between the USV types with first person singular and third person singular sentence subjects was not supported, a median split was used to further analyze the data. The participants were divided into two groups based on their MLU in morphemes from the 30-min parent-child language samples, and the t-tests were conducted on low and high MLU groups separately. For children with MLU values in the lower 50% of sample, a significant difference was found for first person singular USVs (M =

10.60, *SD* = 4.36) and third person singular USVs (*M* = 7.25, *SD* = 3.92); *t*(19)= 3.25, *p*= .004. For children with MLU values in the upper 50% of the sample, a significant difference was not found between the first person singular USVs (*M* = 10.80, *SD* = 3.40) and third person singular USVs (*M* = 12.15, *SD* = 7.46); *t*(19)= -0.87, *p*= .395. Figure 5 depicts the differences between first person singular USVs and third person singular USVs for participants in the lower and upper 50% of MLU.

The second research question aimed to determine the relationship between the diversity of sentence subject types (i.e., first person USVs, third person USVs) and general measures of language development, MLU and IPSyn. Pearson correlation coefficients were computed to determine the strength of the relationship between the diversity of each sentence subject type with MLU, a measure of length often used as a morphological/syntactic measure, and IPSyn, the most frequently used measure of 2-year-olds' grammatical development. To characterize the strength of the relationships, the following descriptions were used: 1.00-.80 = high, .80-.60 = moderate to high, .60-.40 = moderate, .40-.20 = low to moderate, .20-.00 = low (Glasnapp & Poggio, 1985). Correlations between MLU and IPSyn with all USV categories (i.e., first person singular, third person singular, other, total) are reported in Table 3. Low to moderate significant relationships were observed between first person USVs and MLU at 30 months (*r* = .28, *p* = .04; Figure 6) as well as total IPSyn score at 30 months (*r* = .28, *p* = .04; Figure 7). A moderate to high significant correlation was observed between third person USVs and MLU (*r* = .66, *p* < .001; Figure 8) and a moderate significant correlation was observed with third person USVs and total IPSyn score (*r* = .45, *p* = .002; Figure 9). For third person singular USVs, MLU accounted for 44% of the variance of USVs and IPSyn total scores accounted for 20% of the variance of USVs.

Because a median split was performed for the first research question, the correlational analyses were also conducted with the two MLU groups (see Table 3). For the lower MLU group, a moderate significant relationship was found between first person singular USVs and MLU at 30 months ($r = .49$, $p = .015$), and a moderate to high significant relationship was observed for USVs with IPSyn total score at 30 months ($r = .61$, $p = .002$). Third person singular USVs produced by the participants in the lower MLU group demonstrated a moderate to high significant relationship with MLU at 30 months ($r = .53$, $p = .008$) and IPSyn total score at 30 months ($r = .42$, $p = .031$).

For children with high MLUs, significant relationships were not observed between first person singular USVs and MLU ($r = .32$, $p = .085$) or IPSyn total score ($r = -.035$, $p = .442$). When comparing the general language measures with third person singular USVs, a moderate to high significant relationship was found with MLU ($r = .72$, $p < .001$); however, a significant relationship was not found between third person singular USVs and IPSyn total score for participants in the high MLU group ($r = .25$, $p = .142$).

CHAPTER 4

CLINICAL APPLICATION

This chapter focuses on how clinicians can apply the assessment of sentence diversity to 30 month-old toddlers at-risk for language impairment. To evaluate the usefulness of the sentence diversity measures, the measures were applied to at-risk participants from the same archival database.

Participants

Five at-risk participants were selected from the existing longitudinal database described in the methods section (Rispoli & Hadley, 2008). The five at-risk participants were not part of the 40 typically developing participants used to create sentence diversity expectations at 30 months. Instead, the five at-risk participants were selected based on their poor grammatical outcomes on the *Test of Early Grammatical Impairment* (TEGI; Rice & Wexler, 2001) at 36 month of age. The TEGI is an assessment used to formally evaluate the productive use of grammatical knowledge for tense marking on children as young as three years of age. It contains probes to elicit the production of third person singular present tense, regular and irregular past tense, auxiliary *be*, and auxiliary *do* forms, as well as a total score called an elicited grammatical composite (EGC). By selecting the at-risk participants based on their 36 month TEGI scores, sentence diversity expectations could be applied retrospectively to examine whether the number of USVs at 30 months provided an early indicator of poor grammatical outcomes. Because tense is a property of sentences, it is reasonable to hypothesize that limited sentence diversity at 30 months may foreshadow poor outcomes in tense and agreement marking at 36 months.

To be identified as an at-risk participant based on their grammar outcomes at 36 months, the children had to pass the phonological probe on the TEGI, score at or above the 10th percentile

on the CDI at 30 months, and meet one of the following: (a) score less than or equal to the language-disordered mean on at least two individual TEGI probes (third person singular probe ≤ .29, past tense probe ≤ .36, be/do probe *be* score ≤ .23, be/do probe *do* score ≤ .14), indicating performance similar to peers with language disorders, (b) score less than or equal to the 44% criterion cut-off on the EGC, or (c) show limited ability to produce sentences in response to TEGI probes, demonstrating more serious grammatical limitations. Using these selection criteria, five children, all males, were identified. Three of the children had difficulty producing scorable responses on the TEGI probes. One participant produced scorable responses on the third person singular and past tense TEGI probes, but did not produce any correct forms for either probe. The final participant produced scorable responses for three probes but was below the language disordered mean for all three (i.e., 0%, third person singular, 7% past, 17% *be*).

Procedures

Measures of utterance length were then computed, following the same procedures described in Chapter 2 for 30-min parent-child language sample data obtained at 30 months of age. Table 4 presents descriptive data for the five at-risk children at 30 months of age, including CDI total words, CDI percentile, number of complete and intelligible utterances, and MLU in morphemes. For children whose MLU was below age expectations, a clinician might not view the additional analysis of sentence diversity as necessary. For three of the at-risk participants (i.e., GTP04B, GTP15B, GTP16B), MLUs were more than 1.5 standard deviations below the 30 month MLU mean of 2.54 (Miller, 1981). Therefore, the sentence diversity analyses were conducted only for the two children whose expressive vocabulary on the CDI and MLUs fell within the average range at 30 months, and yet scored poorly on the TEGI probes at 36 months.

The language samples for the two remaining at-risk participants were coded for subject-verb combinations, and then reduced to first person singular, third person singular, and total USVs following the procedures described in Chapter 2. Participant GTP22B produced 19 total USVs during his 30-min parent-child language sample, including 15 first person singular USVs and 2 third person singular USVs. Participant GTP52B produced 7 total USVs, including 3 first person singular USVs and 3 third person singular USVs during his language sample. Numbers of coded first and third person singular sentences as well as USVs are reported in Table 4. USVs for both GTP22B and GTP52B are listed in Appendix E.

Results

Table 5 summarizes the means, standard deviations, and cut-off criteria for first and third person singular USVs and total USVs based on the analyses of the 40 typically developing children from Chapter 3 along with the raw scores for the two at-risk participants. Given third person USVs had a stronger relationship with MLU and IPSyn total scores than first person singular USVs, the at-risk participants' production of third person USVs was examined and compared to the findings for the typically developing toddlers reported in Chapter 3. Dollaghan's (2007) criterion cut-off of 80% was used to determine the minimum number of USV combinations of third person singular sentence subject types produced by 80% of the typically developing children. Dollaghan (2007) suggested that this is the most accurate cut-off point and avoids under identification of deficits. The bottom 20% of the typically developing children produced five or fewer third person singular USVs. When this cut-off was applied, the two at-risk participants both fell below the criterion and in an at-risk range for sentence diversity.

In an effort to be more conservative in establishing an at-risk range, a cut-off criterion of 90% was also determined. The 90% cut-off for third person singular USVs was three USVs.

GTP22B fell below this 90% cut-off while GTP52B fell just at the cut-off. Thus, both at-risk participants also fell in the bottom 10% of the sample for on this measure of sentence diversity. Comparison of the at-risk participants' USVs to the sample mean and standard deviation indicates they fall 1SD below the sample mean for third person singular USVs, but not1.25 standard deviations below the mean (the score corresponding to the 10th percentile) with the production of two and three third person singular USVs.

Discussion

Although sentence diversity expectations alone do not indicate language impairment, they can be used as part of the diagnostic process and the creation of a risk-based profile when assessing toddlers' language development. Recall that the purpose of this section was to evaluate the clinical feasibility of incorporating the established sentence diversity expectations into the assessment process. As demonstrated, the use of USVs is a straightforward method for assessing early sentence diversity. In addition, it should be possible to compute estimates of sentence diversity in real time during the assessment process. Although the clinical application reported here used existing 30-min parent-child language samples, structure-specific language sampling in real time is possible when specific grammatical abilities are first emerging. Note that the remaining two at-risk participants produced only two or three third person singular USVs in 30 min. With such a limited number of sentences produced, a clinician could record all instances of third person singular sentences in real time while the client plays with a parent or caregiver. These sentences can then be reduced to USVs to compare them to the sentence expectations reported in this study.

CHAPTER 5

DISCUSSION

Previous methods have been developed that characterize children's early sentence development. Many of these methods have been successful in describing the sentences of young children; however, most of them do not quantify children's progress in a way that can be used clinically to determine severity of language delay relative to developmental expectations. This study aimed to establish quantitative expectations for early sentence diversity that could be used with 30-month-old toddlers in everyday clinical practice. The approach was to examine the diversity of children's sentences at 30 months of age and determine if there was evidence that sentence diversity related to existing measures of length and grammatical complexity.

Valuable information regarding the sentence diversity of typically-developing 30-month-old toddlers was presented. It was found that by this age, *all* 40 typically-developing participants were able to produce a variety of simple, child-like sentences. These productions included at least four sentences with first person singular subjects, two sentences with third person singular subjects, and eleven total unique subject-verb combinations (USVs). Given these results, it is clear that sentence diversity is an accomplishment that should be expected at 30 months of age; it is not outside of the boundaries of what children can do. When clinicians see a lack of sentence diversity, it needs to be investigated in the same ways low vocabulary, limited MLU, and the lack of tense/agreement marking is scrutinized. These findings indicate that sentence diversity, including the production of both first and third person sentence subjects, is an expected accomplishment at 30 months of age.

In addition to gathering descriptive data to develop sentence diversity expectations, two research questions were posed. The first question examined the significance of the difference

between the diversity of first person singular and third person singular sentence subject types at 30 months of age. Determining the difference in the diversity between the two sentence subject types provides additional information about the developmental sequence for early sentence development. The second question investigated the presence of a relationship between the diversity of first and third person singular sentence subject types and general measures of grammatical development, specifically MLU and IPSyn. The presence of a relationship between sentence diversity and MLU and IPSyn would indicate that increased sentence diversity co-occurs with increases in length and grammatical complexity, supporting the measure as a valid indicator of grammatical development. With this information, sentence diversity can be used with greater confidence to characterize the early grammatical abilities of toddlers.

Significance of difference between first person singular and third person singular sentence diversity

The first research question focused on differences in the diversity of two sentence subject types, first person singular and third person singular. It was predicted that there would be a significant difference between the diversity of the two sentence subject types. Villa (2010) and McKenna (2011) found that children demonstrate a clear pattern of sentence subject production in early sentence development. Both studies found that most children produce first person sentences before beginning to produce third person sentences. Villa (2010) also noted that when both sentence subject types are present, first person sentences continue to be more common in children's productions from 21 to 27 months of age.

Although the children in the current study produced slightly more 1st person USVs than 3rd person USVs, differences between first and third person singular sentences did not exist at 30 months of age for the sample as a whole. It is important to remember that the current study was

designed to focus on an age when all children would be expected to produce sentences so that a criterion-referenced cut-off could be established. However, in selecting 30 months of age for this purpose, developmental differences between the diversity of sentences with first person singular subjects and third person singular subjects were no longer apparent. However, when a median split was employed, children with MLUs in the lower 50% of the sample showed a significant difference between first person singular USVs and third person singular USVs. Children with MLUs in the upper 50% of the sample did not demonstrate a significant difference between the means of the two sentence subject type USVs. Based on this information, it is possible that children who have less-developed language skills, in this case characterized by MLU, are still producing a greater number of first person singular USVs like the 21 to 27 month old children in Villa (2010). However, as language abilities advance, children produce third person singular USVs at the same rate as first person singular USVs. In other words, toddlers eventually reach a level where their language abilities allow them to produce more novel sentences about a greater range of topics beyond their personal wants and needs. These findings suggest that sentences dominated by first person singular subjects are a characteristic of less advanced language development. In sum, this analysis indicated that developmental differences between the diversity of sentences with first person singular subjects and third person singular subjects varied based on MLU, or general language abilities.

Relationship between sentence diversity and general measures of length and complexity

The second research question addressed the relationship between the diversity of first person singular and third person singular sentences and more general measures of language development, specifically MLU and IPSyn. Recall that MLU is a measure of utterance length, often linked to syntactic and grammatical development. IPSyn is a commonly used measure for

early grammatical development. It was predicted that the number of USVs with third person singular subjects would have a stronger relationship with MLU and IPSyn total scores than the unique combinations with first person singular subjects. Low to moderate significant relationships were observed between first person USVs and both MLU and total IPSyn score at 30 months. A moderate to high significant correlation was observed between third person USVs and MLU, and a moderate significant correlation was observed with third person USVs and total IPSyn score.

Although both first person and third person sentence diversity was significantly related to MLU and IPSyn total score, third person singular sentence diversity had a stronger relationship with the two general measures. This stronger relationship could be explained by the nature of MLU and IPSyn measures. The use of third person subjects provides greater opportunities to increase length (i.e., MLU) and grammatical complexity (i.e., IPSyn) than the use of first person subjects. There are two reasons for these increases. First, sentences with third person singular subjects have the potential to include overt agreement marking in the present tense (e.g., *He likes pizza, Pooh looks hungry*), unlike sentence with first person singular subjects (e.g., *I like pizza*). This increases utterance length and can also add points to the IPSyn VP subscale. Second, subject noun phrase elaboration is possible with third person subjects, but never with first person subjects (e.g., *The baby* vs. *I*). Noun phrase elaboration also increases the length of an utterance, and can also add points to the IPSyn NP subscale.

Different results were obtained when the correlational analysis was conducted for the two MLU subsamples. For the low MLU group, the relationships between diversity (USVs), length (MLU), and complexity (IPSyn) remained significant. However, for the high MLU group, significant relationships only remained for third person singular USVs. This finding provides

more support for the use of third person singular USVs as the choice for developing a criterion-referenced cut-off as it remains sensitive even as children continue to develop their language skills at the age of 30 months.

Clinical Applications for Assessing Early Sentence Diversity

The findings of Chapter 4 revealed that sentence diversity expectations can be applied to 30-month-old toddlers to assist in determining the presence of sentence production difficulties. Dollaghan's (2007) suggested cut-off criterion of 80% of the normal range was applied to two 30-month-old children at-risk for language impairment based on their poor grammatical outcomes at 36 months. Using the 80% cut-off criterion, children should be expected to produce at least five different first person singular USVs and four different third person singular USVs by 30 months of age. Using a more conservative cut-off of 90%, children should be expected to produce at least five first person singular USVs and three third person singular USVs. To remain conservative when determining sentence production risk, it may be more appropriate to use the 90% cut-off as a general expectation to indicate clinical concern. For the two at-risk children, both the 80% and 90% cut-off criteria placed them in an at-risk range.

The quantitative approach to assessing sentence diversity developed in this study provides new expectations for clinicians to use when interpreting young children's early sentence abilities. Importantly, these measures are also related to existing measures of length and grammatical complexity. Sentence diversity expectations can be integrated into an initial assessment of a child in addition to parent report and language sample measures. Given the establishment of tense and agreement marking difficulties as a clinical marker of specific language impairment (Leonard, 1998; Oetting & Hadley, 2009; Rice, 2003; Rice & Wexler, 1996) and the knowledge that sentences are a critical foundation for the production of tense and

agreement morphemes, sentences should become a focus in the assessment process. As illustrated by the two at-risk participants who presented with typical expectations for expressive vocabulary and MLU at 30 months, their lack of sentence diversity foreshadowed their difficulties with tense and agreement marking at 36 months.

In addition to the assessment of young children at-risk for language impairment, sentence diversity expectations can also be valuable to intervention planning and progress monitoring while being sensitive to the demands of a clinical caseload. MLU in particular is a clinical tool that has stood the test of time and continues to be used as a way to characterize deficits and monitor progress. The fact that third person USVs, the subject types used to develop the cut-offs presented in this study, are most strongly related to MLU can provide support for the use of sentence diversity expectations in addition to or instead of MLU by clinicians. However, when thinking about clinical feasibility, sentence diversity expectations can be computed more quickly and easily than MLU. Because children on a clinician's caseload would most likely be those in the low average or impaired range, USVs with third person singular subjects would be rare enough in a language sample to be recorded in real time, unlike MLU. Additionally, sentence diversity expectations provide clinicians with a way to write simple, measurable intervention goals that directly reflect sentence development. For example, writing a goal that states, "The child will produce three unique subject-verb combinations with third person singular subjects during play activities" is much more easily measurable and reflective of sentence development than a goal written for increasing utterance length, which focuses more on stringing words together than on building a sentence.

Although sentence diversity measures alone certainly do not determine whether or not a child exhibits language production deficits, USVs may be a useful measure in the construction of

a risk profile. Measures of sentence diversity could also be combined with expectations for language growth over time. For example, children must produce verbs before they produce child-like sentences, and they must produce child-like sentences before they demonstrate tense and agreement marking. Over 75% of children are reported to produce at least some common verbs by 24 months of age (Dale & Fenson, 1996; Hadley, Rispoli, & Hsu, 2013). Children with or at-risk for language disorders, on the other hand, often have smaller and less diverse verb lexicons and produce fewer verbs than typically-developing peers (Olswang, Long, & Fletcher, 1997; Watkins, Rice, & Moltz, 1993). Research has also demonstrated that the onset of tense and agreement begins around 24 months of age, with all forms (i.e., copula *be*, third person singular present */3s*, past tense */ed*, auxiliary *be*, and auxiliary *do*) evident by three years of age for most children (Hadley & Short, 2005; Rispoli, Hadley, & Holt, 2009, 2012). Children at-risk for language impairment demonstrate marked difficulty with the production of tense morphemes at three years (Leonard, Camarata, Brown, & Camarata, 2004). This project provides evidence that typically developing children are capable of producing simple, child-like sentences with sentence subject diversity by 30 months of age. Monitoring the production of diverse child-like sentences can provide useful information in assessing risk for language impairment in the third year of life, especially when combined with the monitoring of limited verb lexicons prior to 30 months and emergence of tense and agreement morphemes from 30 to 36 months of age.

Limitations and opportunities for further research

This study aimed to develop early sentence expectations for 30-month-old toddlers. While the creation of these expectations can prove useful in the initial assessment, monitoring, and intervention planning to address young children's language skills, further research on these sentence diversity expectations is warranted. Although the sample size for this study contained

40 participants, it is important to note that the large majority of the participants came from white, middle class homes with college-educated mothers. English was the first and only language of all of the participants. Although this is a strength for the first study aiming to establish sentence diversity expectations, results need to be interpreted cautiously with children that are not from the same or similar backgrounds as the participants in the current study. Previous studies indicate that children's oral language skills are influenced by factors such as socioeconomic status, maternal education, and use of more than one language in the home (Hart & Risley, 1995; Hoff, 2006; Hoff, 2013; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010). Given this information, it is possible that sentence diversity may also vary in these populations. Although the homogeneity of the participant sample kept many factors controlled for a first look at sentence diversity expectations, further research with more racially, economically, educationally, and/or linguistically diverse participant samples is necessary. By examining sentence diversity expectations in various populations, it can be determined if sentence diversity varies substantially for children from different demographic groups.

Expectations of sentence diversity for children younger and older than 30 months would also be beneficial. Future studies could examine how general expectations and individual differences change during the third year of life and document growth expectations for sentence diversity during this early developmental period. Just as the development of lexical norms (Dale & Fenson, 1996; MacWhinney, 2000) and tense and agreement expectations (Hadley, Rispoli, Holt, Fitzgerald, & Bahnsen, 2013; Rispoli, Hadley, & Holt, 2009, 2012) have provided clinicians and researchers with a concept of what is typical in these areas, sentence diversity measures can do the same. This knowledge would aid clinicians in assessing clients of different ages as well as in monitoring progress. The opportunity to measure progress of clients while

continuing to compare them to typically-developing peers could assist in visualizing the late start and slow growth of language development that is characteristic of those with language impairment (Leonard, 1998).

In addition to examining sentence diversity expectations at different ages, sentence diversity expectations that focus specifically on the total production of USVs or the production of the "other" later developing sentence subject (i.e., second person, first person plural, third person plural) USVs may assist in determining the growth of sentence diversity in this early period of grammatical development. This study revealed that total USVs and other USVs have moderate to high significant relationships with MLU and IPSyn at 30 months of age. USVs with the other, later-developing subjects may be particularly helpful when examining sentence diversity expectations for older toddlers, as this later accomplishment may be more clinically feasible to assess when third person singular USVs become more frequent for children.

In conjunction with developing more sentence diversity guidelines at different ages and with different populations, sentence diversity could also be evaluated in terms of varied conversational partners. Recall that this study used 30-min parent-child language samples to develop the proposed sentence diversity expectations for children at 30 months of age. Using parent-child samples is particularly relevant for initial assessment when a child may be reticent to interact with an unfamiliar adult and/or be more likely to talk to an adult or caregiver. However, investigating examiner-child interactions may also be beneficial. Clinicians can strategically modify the discourse in ways to create opportunities to produce more diverse, third person sentences to assess the emergence of specific sentence and morphosyntacic structures (Oetting & Hadley, 2009). In particular, if a child appears to have limited sentence diversity in productions with a familiar partner, a clinician can attempt to alter the communicative context to

tease apart whether or not preference for interpersonal discourse is a stylistic choice for the child or a question of language competence.

Although clinicians can aid in determining whether or not a child has difficulty with the production of diverse, child-like sentences, the findings of this study suggest that if children *can* produce diverse sentences, they *will* produce diverse sentences. It is important for clinicians to recognize the ease with which so many of the typically-developing children produced diverse sentences in this study. And, again, of the 40 children in this study, each and every one of them was producing child-like sentences with varied sentence subjects. Although the field of speech-language pathology has lacked clear guidelines for sentences, we can now be quite confident that by 30 months of age, diverse, child-like sentences are an expectation, not a possibility.

Another area of clinical research could focus on what scenarios or materials best facilitate sentence diversity in toddlers' utterances. It is possible that certain toys or play scenarios are more likely to support different types of sentences. Although first person sentences are important for the development of interpersonal discourse and personal narrative skills, this study showed that toddlers with more advanced general language abilities produce a similar number of first person singular and third person singular sentences. Therefore, it is important for clinicians to consider how the play environment creates opportunities for the production of third person singular sentences with toddlers as they begin to produce diverse sentences. For example, a play set with a variety of characters, such as a small farm with animals, provides ample opportunity for referring to other objects as grammatical subjects. Activities such as blowing bubbles or playing with playdoh might be more limiting and result in uses of primarily first person subject sentences. In this study, all children had access to the same sets of toys, but the time spent playing with each toy set was not controlled, and therefore, it varied between participants.

Gaining more information about the influence of toys in the play environment on measures of sentence diversity could assist clinicians and parents in shaping their interactions to best assess and promote increased sentence diversity.

Conclusions

Although additional research is needed, this study demonstrated that typically-developing toddlers can produce diverse child-like sentences by 30 months of age, as demonstrated by at least 11 total USVs in 30-min of parent-child conversational language sampling. At this age, children should be able to produce both first and third person singular sentence types. The study also revealed moderate to high and moderate correlations between the number of unique third person singular sentence types with existing measures of utterance length and grammatical complexity, indicating that the new measures of sentence diversity are related to other indices of grammatical development. The expectations provided by this study can assist clinicians in differentiating between children's production of word combinations and simple child-like sentences and monitoring their ability to produce a diverse variety of child-like sentences in a short period of time. This foundation is an important developmental accomplishment for subsequent progress in grammatical development.

CHAPTER 6

TABLES

Table 1

Participant Language Abilities

ID	CDI 24	Verb 24	%ile 24	Total Utts	C&I Utts	MLUm30	IPSyn Total
GTP01G	406	70	60	206	118	1.84	31
GTP03G	325	40	45	210	176	3.24	49
GTP05G	445	73	70	196	122	3.51	55
GTP06B	102	8	35	393	283	3.88	46
GTP09G	528	91	85	264	179	2.41	59
GTP10G	110	7	10	291	143	2.56	45
GTP11B	640	101	99	280	219	3.83	75
GTP12G	600	95	90	244	192	3.69	65
GTP13B	135	11	25	302	155	2.57	52
GTP18B	235	15	45	275	164	3.11	63
GTP19G	366	44	50	299	247	3.60	67
GTP20G	439	63	65	361	230	3.83	65
GTP21B	362	34	65	267	179	3.15	62
GTP25G	380	60	55	377	319	3.79	67
GTP26B	436	65	80	338	227	3.19	57
GTP28G	280	32	35	204	103	3.54	69
GTP30B	399	64	75	453	318	3.56	59
GTP33B	326	55	60	386	275	2.47	63
GTP35G	331	65	50	329	298	3.25	78
GTP36B	447	60	80	243	141	3.00	52
GTP38G	603	101	90	257	178	3.52	73
GTP39B	434	78	75	493	318	2.69	53
GTP40B	184	16	35	527	327	2.84	43
GTP41G	323	51	45	291	219	2.99	57
GTP42B	433	75	75	159	129	3.25	75
GTP43B	578	91	90	205	164	4.15	68
GTP44B	134	13	25	261	186	3.52	55
GTP45G	162	18	20	397	198	1.79	38
GTP46G	404	64	60	397	290	4.88	79
GTP47B	118	16	20	450	327	2.90	61
GTP48B	420	63	75	263	186	3.38	54
GTP49G	450	71	70	585	359	4.60	69
GTP50B	574	80	90	153	103	4.08	64
GTP51G	133	12	15	305	219	2.26	42
GTP53G	478	67	75	309	223	3.66	64
GTP54B	77	12	10	370	155	3.53	62
GTP55G	141	10	15	475	275	2.94	57
GTP57B	206	28	40	413	265	2.90	54
GTP59B	421	71	75	206	145	3.09	55
GTP60G	323	49	45	449	265	3.16	56
Mean	347.20	50.98	N/A	324.57	215.48	3.25	58.90
SD	158.02	29.14	N/A	102.71	70.74	0.65	10.90

Note. ID = Participant identification number; CDI 24 = Total vocabulary reported on the MacArthur-Bates Communicative Development Inventories (MCDI) at 24 months; Verb 24 = Verb vocabulary reported on the MCDI

Table 1 (cont.)

Development at 24 months; %ile 24 = Total vocabulary percentile on MCDI at 24 months; Total Utts = Number of total child utterances in 30-min parent-child language sample at 24 months; C&I Utts = Number of complete and intelligible utterances, excluding abandoned, interrupted, nonverbal, imitative, and routine productions in language sample; MLU = Mean length of utterance in morphemes of 100 complete and intelligible child utterances in language sample; IPSyn Total = Total score on *Index of Productive Syntax* (IPSyn). $N = 40$

Table 2

Frequency of Coded Subject-Verb Combinations and Diversity of USVs

ID	[SV:1]	[SV:2]	[SV:3]	[SV:1P]	[SV:3P]	[SV:RQ]	[SV:P]	USV1	USV3	USV Other	USV Total
GTP01G	6	1	7	0	0	0	1	5	5	1	11
GTP03G	41	2	11	2	0	0	0	16	10	3	29
GTP05G	22	9	14	1	0	0	0	10	12	7	29
GTP06B	115	0	14	0	0	5	2	15	9	0	24
GTP09G	19	6	0	0	0	0	0	13	5	0	18
GTP10G	24	0	14	1	1	0	0	6	8	2	16
GTP11B	19	19	22	4	2	0	0	11	14	12	37
GTP12G	19	5	19	10	3	0	0	6	11	11	28
GTP13B	11	1	2	0	0	0	0	8	2	1	11
GTP18B	27	3	11	0	0	0	0	11	9	3	23
GTP19G	36	24	23	6	0	1	0	13	15	15	43
GTP20G	24	10	8	3	1	0	0	10	8	4	22
GTP21B	16	7	25	3	2	1	0	10	17	11	38
GTP25G	40	10	14	8	3	0	0	13	12	12	37
GTP26B	44	5	17	1	1	0	0	16	10	6	32
GTP28G	8	3	4	1	1	0	0	7	4	4	15
GTP30B	66	9	20	1	1	1	0	13	14	7	34
GTP33B	35	5	7	3	2	0	0	15	7	6	28
GTP35G	25	21	8	3	12	1	1	16	7	22	45
GTP36B	25	13	9	0	0	0	0	9	5	5	19
GTP38G	10	5	27	1	3	0	0	6	18	8	32
GTP39B	32	8	5	3	7	1	0	16	5	12	33
GTP40B	64	1	2	0	1	0	2	8	2	2	12
GTP41G	29	7	13	0	0	1	2	11	8	2	21
GTP42B	27	0	9	1	2	0	3	7	5	3	15
GTP43B	42	15	18	0	0	0	0	9	11	9	29
GTP44B	16	0	10	4	4	0	2	11	10	5	26
GTP45G	6	4	4	0	0	0	0	4	4	3	11
GTP46G	38	38	38	10	4	0	0	14	24	32	70
GTP47B	47	15	3	8	0	0	0	14	3	8	25
GTP48B	19	11	9	3	0	0	0	10	6	5	21
GTP49G	86	18	67	24	11	0	0	17	36	23	76
GTP50B	9	2	19	1	3	0	0	6	12	5	23
GTP51G	5	9	4	8	0	0	0	5	4	9	18
GTP53G	56	15	4	5	2	0	0	13	3	12	28
GTP54B	21	14	16	0	2	3	0	9	12	7	28
GTP55G	31	12	16	2	1	0	2	13	11	7	31
GTP57B	31	14	22	10	0	1	0	17	13	16	46
GTP59B	7	4	10	1	4	0	0	4	6	8	18
GTP60G	23	8	22	1	0	1	0	10	11	5	26
Mean	30.53	8.7	14.28	3.38	1.83	0.40	0.38	10.70	9.70	7.83	28.23
SD	22.45	7.95	11.78	4.54	2.75	0.96	0.81	3.86	6.39	6.63	13.83

Note. ID = Participant identification number; [SV:1] = Code for subject-verb combinations with a first person singular subject; [SV:2] = Code for subject-verb combinations with a second person subject; [SV:3] = Code for subject-verb combinations with a third person singular subject; [SV:1P] = Code for subject-verb combinations with a first person plural subject; [SV:3P] = Code for subject-verb combinations with a third person plural subject; [SV:RQ] = Code for subject-verb combinations that appeared in routine *do*/*go* questions and were eliminated from analyses; [SV:P] = Code for subject-verb combinations that included the name of a conversation partner as the

Table 2 (cont.)

sentence subject and were excluded from analyses; USV-1 = Number of unique subject-verbs combinations (USVs) with first person singular subjects; USV-3 = Number of USVs with third person singular subjects; USV Other = Number of USVs with second person, first person plural, and third person plural subjects combined; USV Total = Number of total USVs of all sentence subject types. $N = 40$

Table 3

Correlations of Diversity Measures and General Language Measures

Full Sample (N = 40)	IPSyn30	USV1	USV3	USVOther	USVTotal
MLUm30	.697**	.282*	.661**	.540**	.643**
IPSyn30		.276*	.454**	.572**	.561**
USV1			.329*	.418**	.631**
USV3				.638**	.859**
USVOther					.891**
High MLU Group (n = 20)					
MLUm30	.670**	.486*	.528**	.277	.556**
IPSyn30		.611**	.424*	.287	.574**
USV1			.382*	.364	.767**
USV3				.435*	.770**
USVOther					.779**
Low MLU Group (n = 20)					
MLUm30	.217	.320	.715**	.576**	.692**
IPSyn30		-.035	.252	.619**	.418*
USV1			.379*	.556**	.669**
USV3				.622**	.861**
USVOther					.908**

Note. MLUm30ID = Mean length of utterance in morphemes of listed complete and intelligible child utterances in 30 month language sample; IPSyn30 = Total score on *Index of Productive Syntax* (IPSyn) at 30 months of age; USV1 = Unique subject-verb combinations (USVs) with first person singular sentence subjects; USV3 = USVs with third person singular sentence subjects; USVOther = USVs with second person, first person plural, and third person plural sentence subjects combined; USVTotal = Number of total USVs of all sentence subject types.
** Correlation is significant at the 0.01 level (1-tailed)
*Correlation is significant at the 0.05 level (1-tailed)

Table 4

Language Characteristics of At-Risk Participants

ID	Vocab 30	%ile 30	C&I Utts	MLU	[SV:1]	[SV:3]	USV1	USV3	USV Other	USV Total
GTP04B	218	10	99	1.37	--	--	--	--	--	--
GTP15B	373	25	28	1.46	--	--	--	--	--	--
GTP16B	259	10	100	1.25	--	--	--	--	--	--
GTP22B	246	10	100	2.62	62	2	15	2	2	19
GTP52B	349	20	100	1.85	3	4	3	3	1	7

Note. ID = Participant identification number; Vocab 30 = Total vocabulary reported on the MacArthur-Bates Communicative Development Inventories (MCDI) at 30 months; %ile 30 = Total vocabulary percentile on MCDI at 30 months; C&I Utts = Number of complete and intelligible utterances, excluding abandoned, interrupted, nonverbal, imitative, and routine productions in language sample; MLU = Mean length of utterance in morphemes of listed complete and intelligible child utterances in 30 month language sample; [SV:1] = Subject-verb combinations with first person singular subjects; [SV:3] = Subject-verb combinations with third person singular subjects; USV = Unique subject-verb combinations. Criterion-referenced cut-off at 80% for first person singular USVS = 6, third person singular USVs = 5, total USVs = 18.
N = 5

Table 5

Norm-referenced and Criterion-referenced Sentence Diversity Cut-offs

	USV-1	USV-3	USV Total
Mean	10.70	9.70	28.23
(SD)	(3.86)	(6.39)	(13.83)
Normal distribution cut-off			
-1.25 SD below mean	5.88	1.71	10.94
Criterion-referenced cut-off			
80% cut-off	6	5	18
90% cut-off	5	3	12
At-Risk Participant Scores			
GTP22B	15	2	19
GTP52B	3	3	7

Note. USV-1 = First person singular unique subject-verb combinations (USVs); USV-3 = Third person singular USVs; USV Total = All USVs.

CHAPTER 7

FIGURES

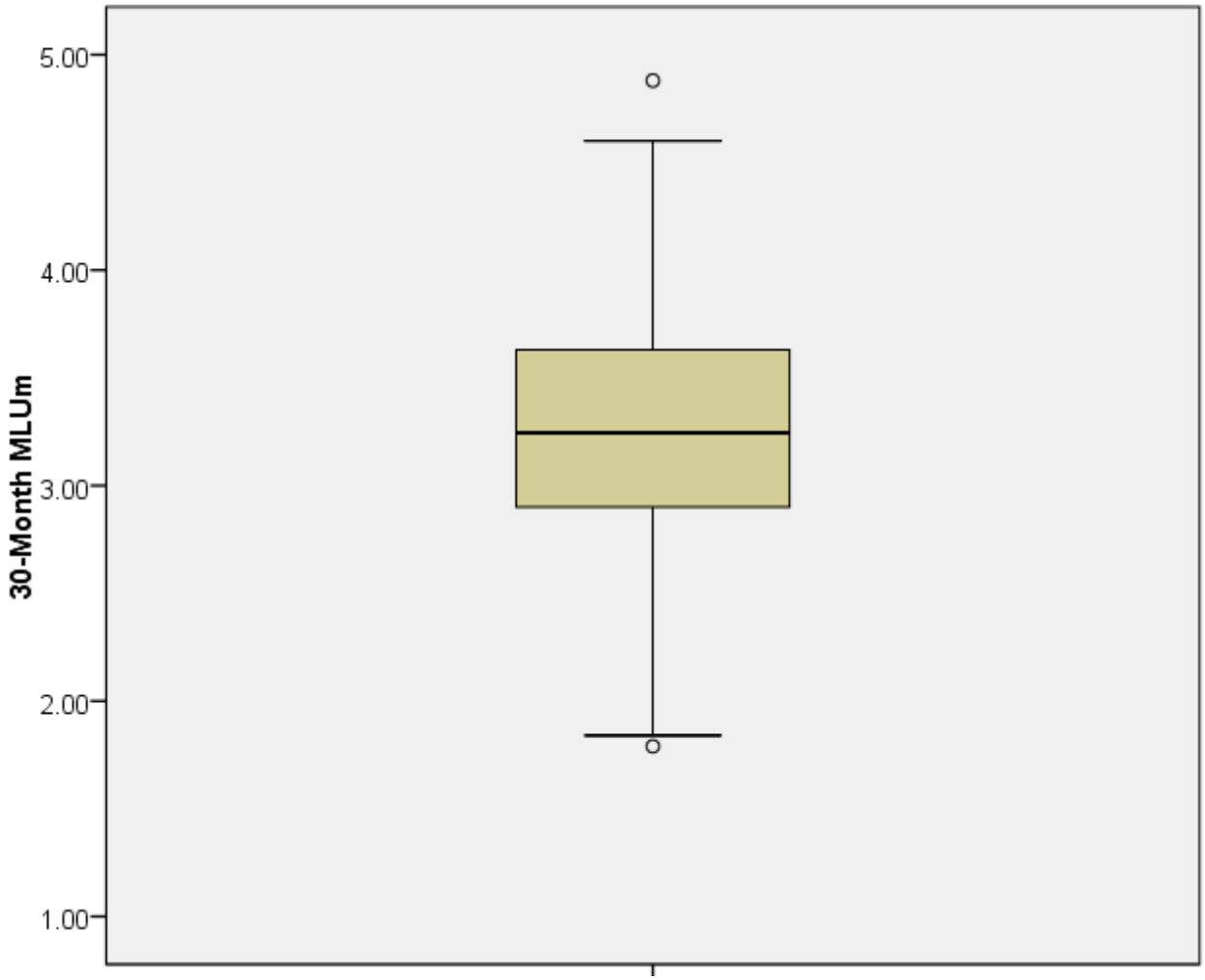

Figure 1. Mean length utterance in morphemes (MLUm) variability among participants from 30 month parent-child language sample.

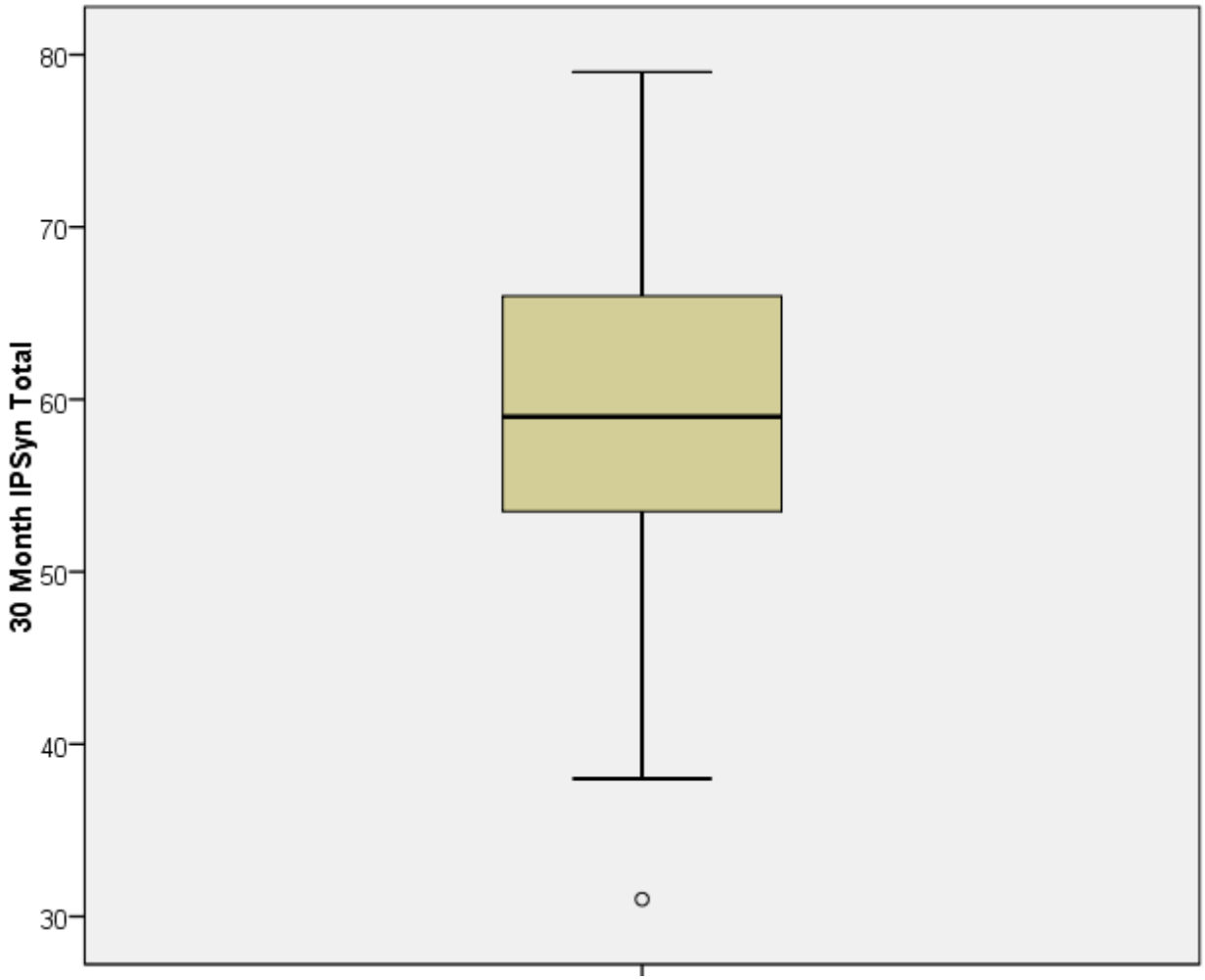

Figure 2. Variability of total scores on the *Index of Productive Syntax* (IPSyn) at 30 months.

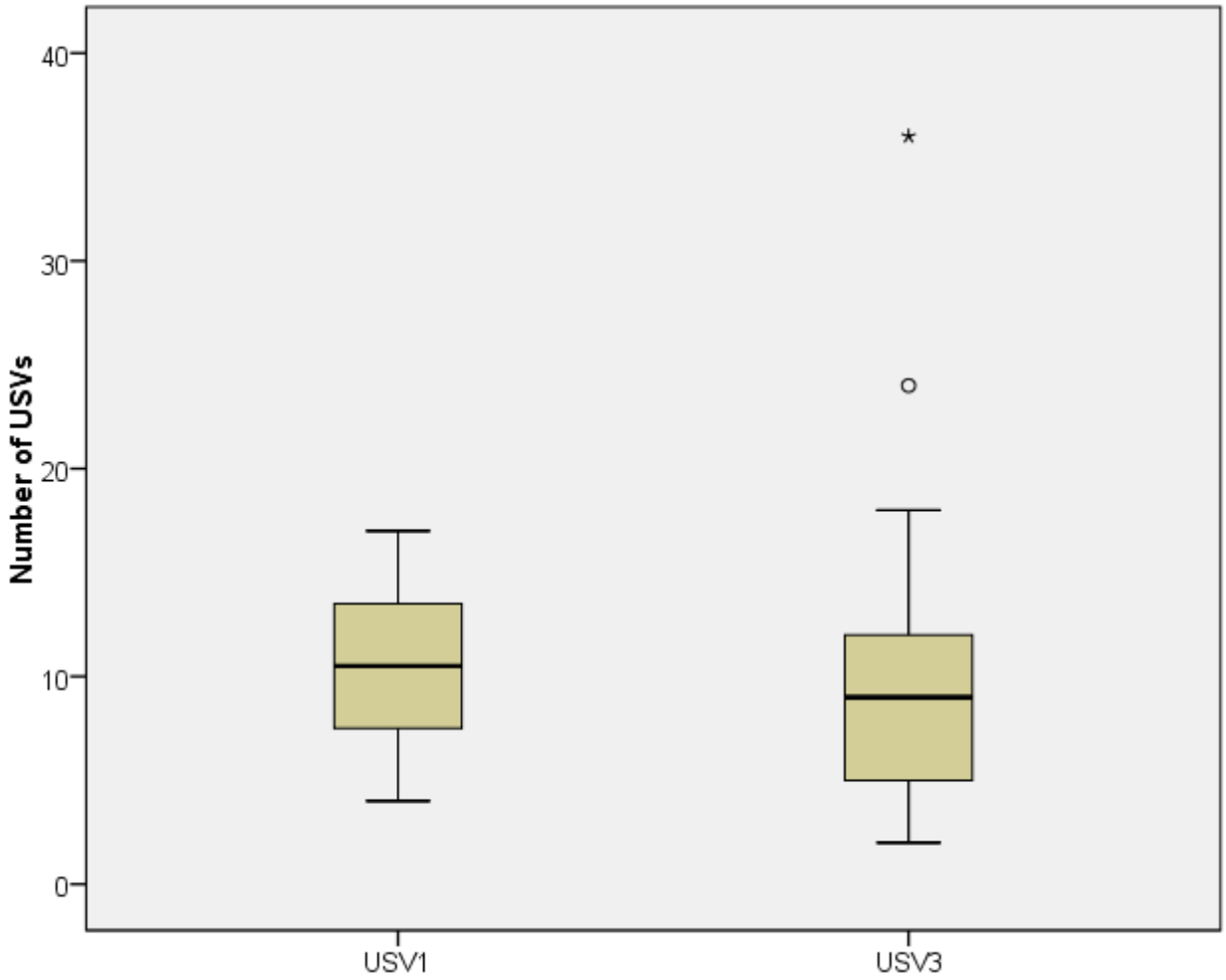

Figure 3. Variability of the diversity of first person singular (USV1) and third person singular (USV3) unique subject-verb combinations (USVs).

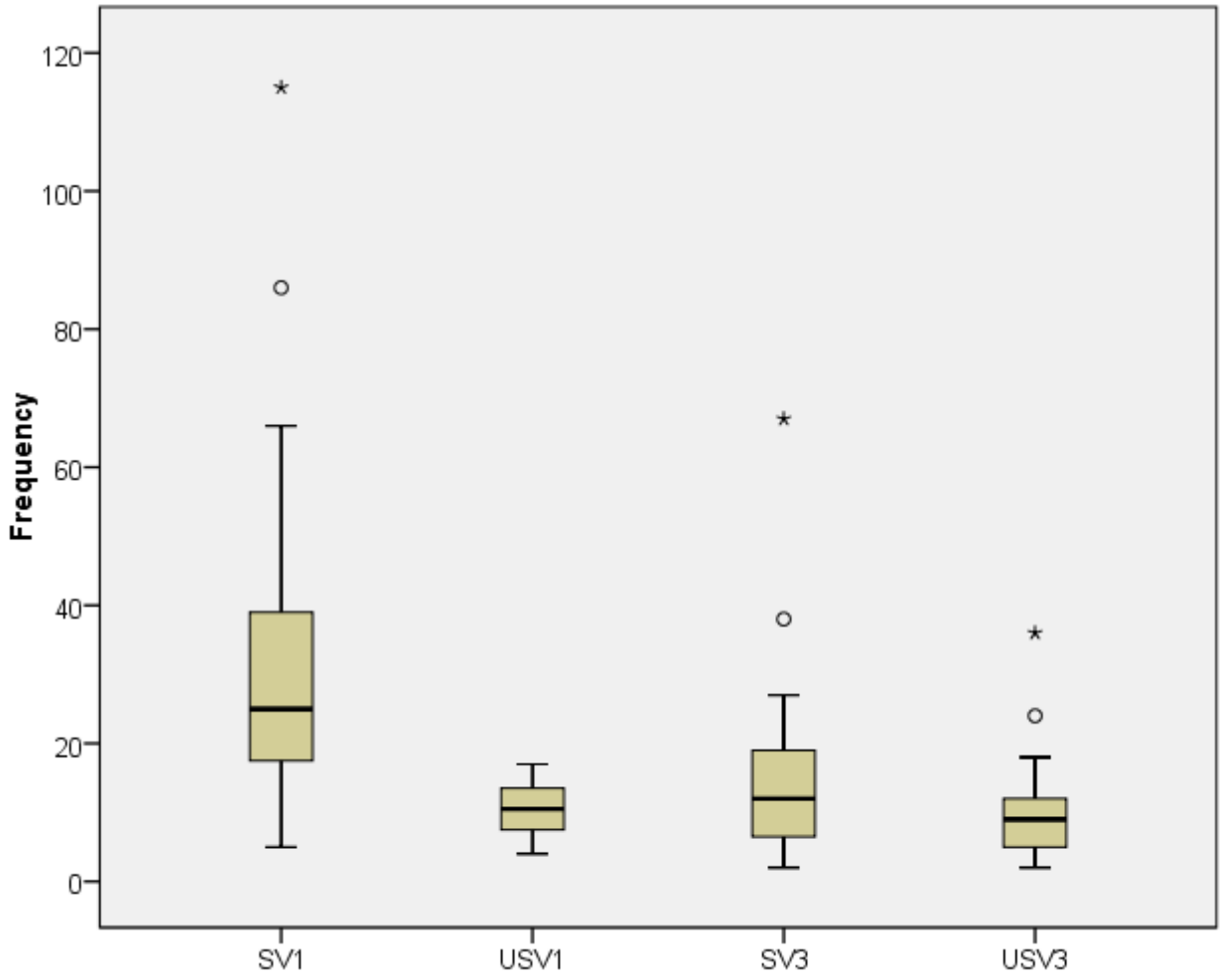

Figure 4. Difference in variability between frequency of subject-verb codes ([SV:1], [SV:3]) and diversity of unique subject-verb combinations (USV1, USV3).

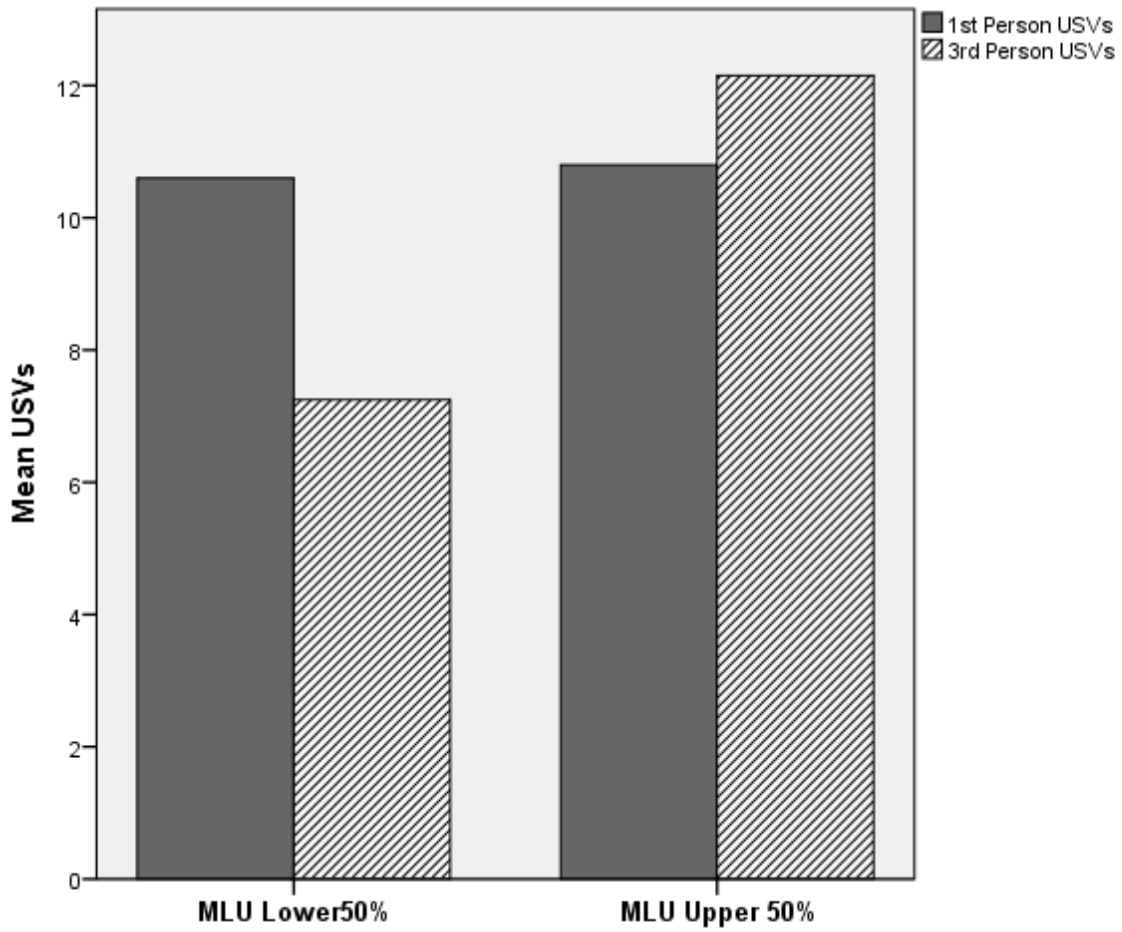

Figure 5. Significance of the difference between the mean of first person singular unique subject-verb combinations (USVs) and third person singular USVs for participants in the lower 50% of MLU values and upper 50% of MLU values.

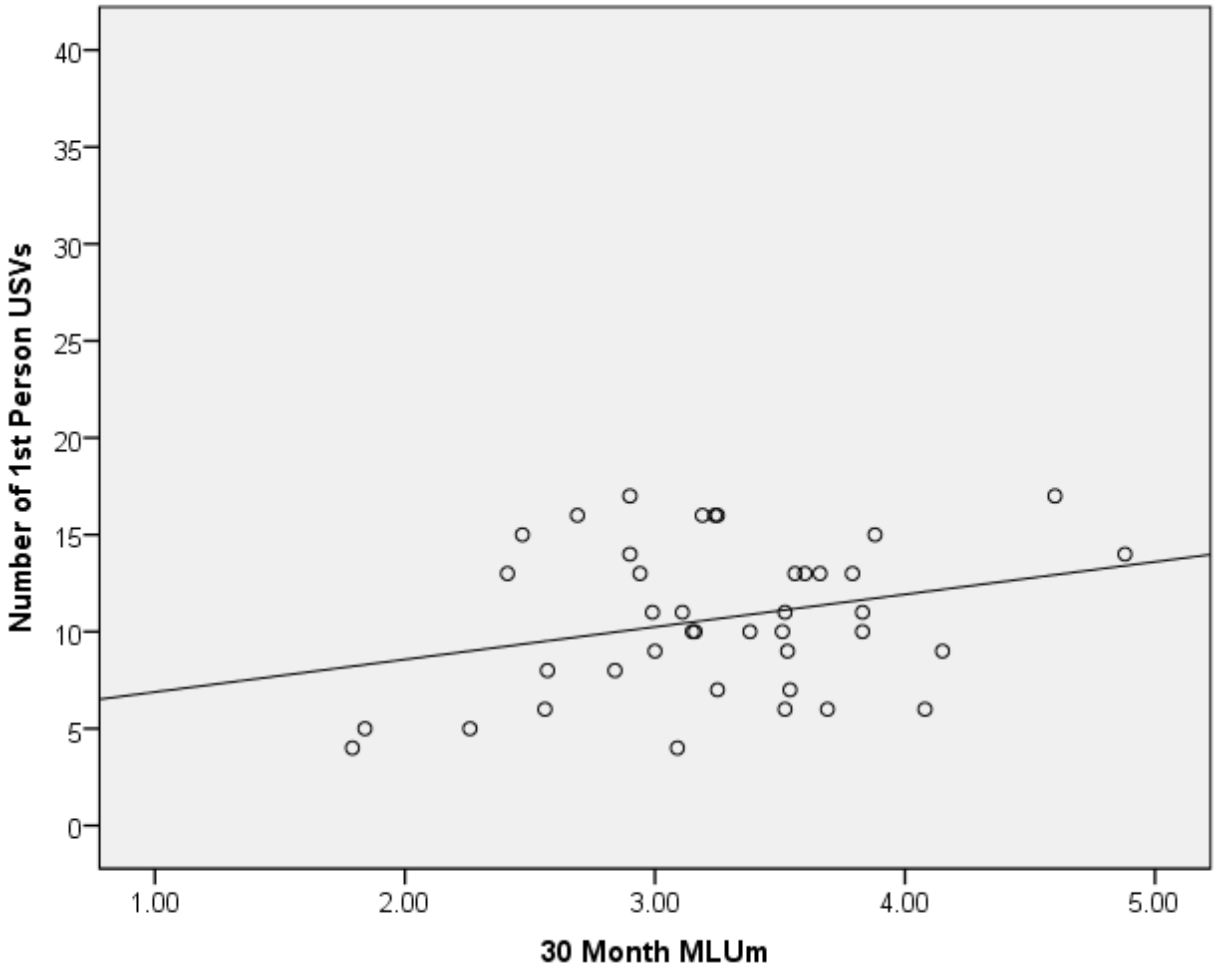

Figure 6. Relationship between first person singular unique subject-verb combinations (USVs) and mean length utterance in morphemes (MLUm) from 30 month language samples.
$r = .28$, $p = .04$

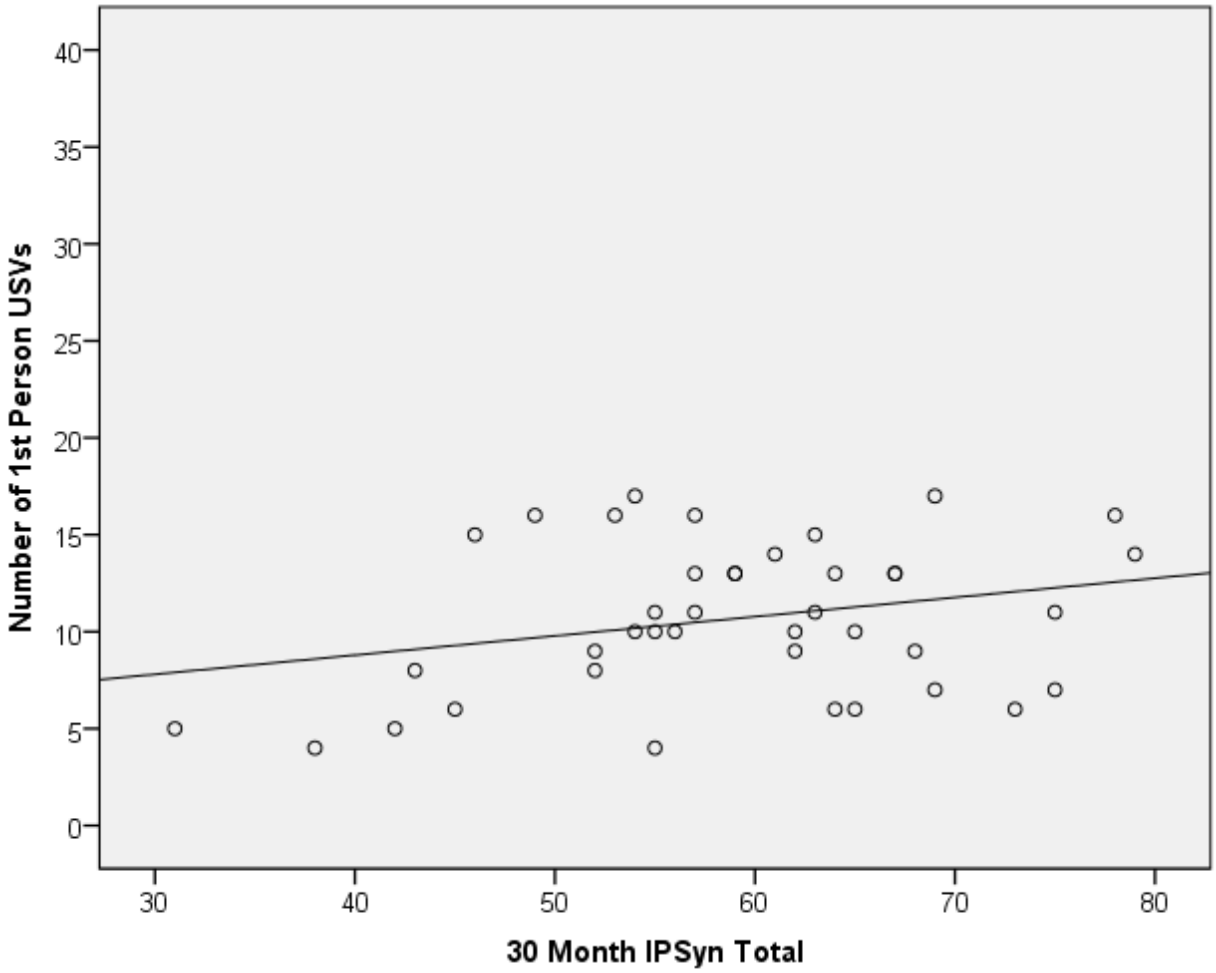

Figure 7. Relationship between first person singular unique subject-verb combinations (USV1) and *Index of Productive Syntax* (IPSyn) total scores at 30 months.
$r = .28$, $p = .04$

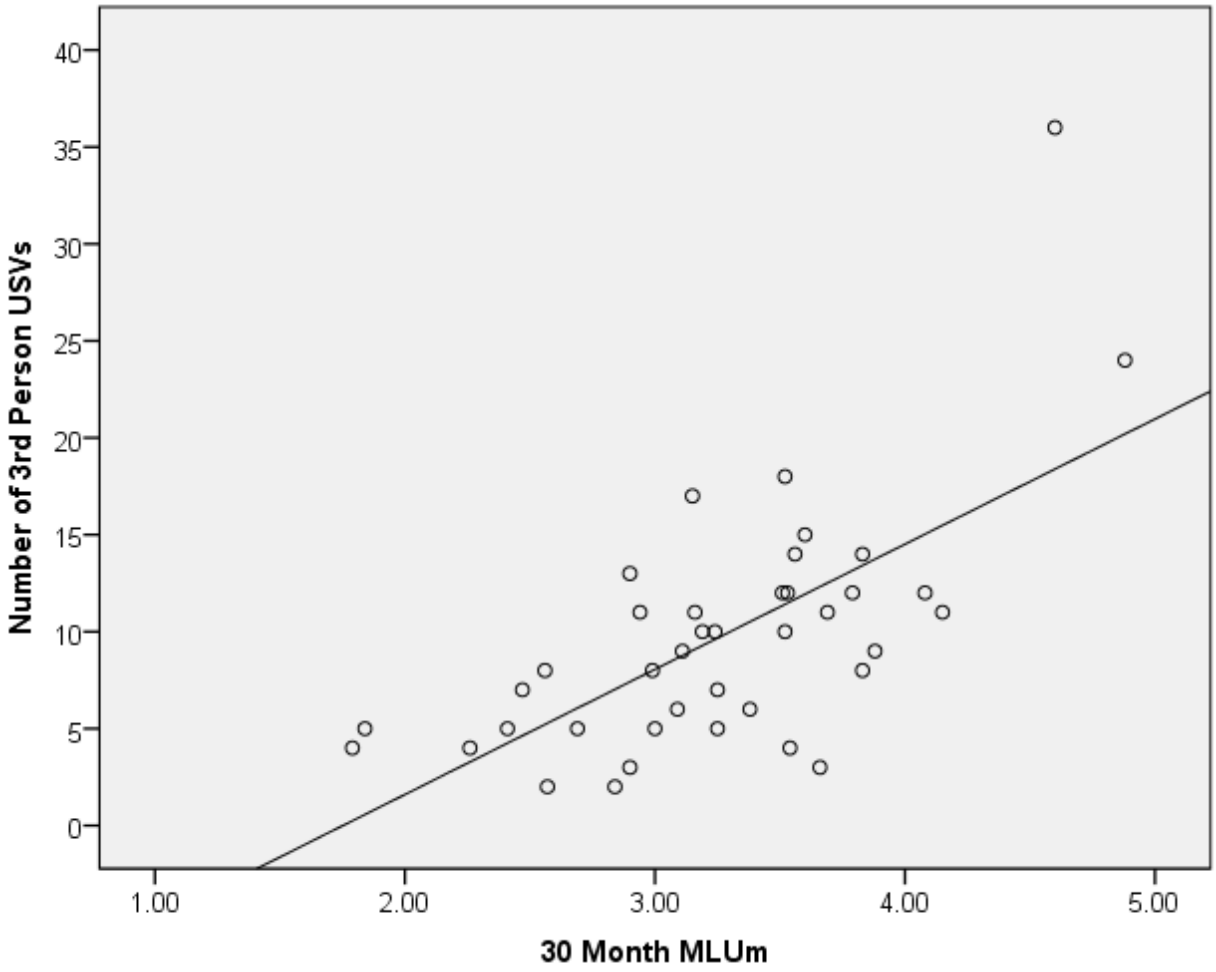

Figure 8. Relationship between third person singular unique subject-verb combinations (USVs) and mean length utterance in morphemes (MLUm) from 30 month language samples.
$r = .66$, $p < .001$

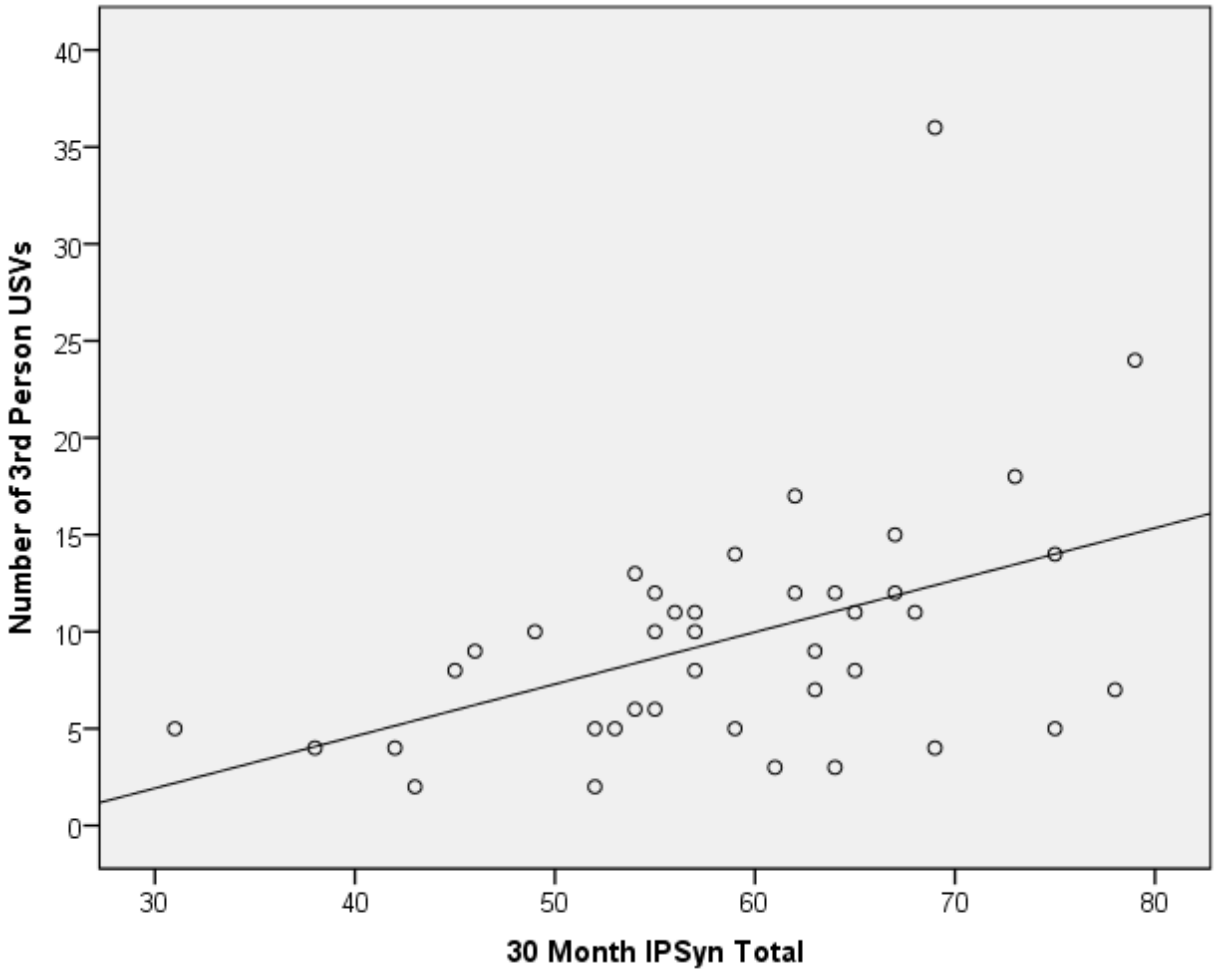

Figure 9. Relationship between third person singular unique subject-verb combinations (USVs) and *Index of Productive Syntax* (IPSyn) total scores at 30 months.
$r = .45$, $p = .002$

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APPENDIX A

Sentence Diversity Variable and Coding History

Study	Variable	Operational Definition	Exclusions
Hadley (1999)	Unique syntactic types (USTs)	Unique combinations of two or more words with syntactic status that could fit into the phrase structure of a more grammatically complete adult utterance; words without syntactic status include greetings (e.g., hi), social words (e.g., please), interjections (e.g., oops), addressees (e.g., mommy), and nonsyntactic markers of affirmation or negation	Imitations, partially unintelligible, interrupted, or abandoned utterances
Brinkmeier (2002)	UST and UST-Verb	UST – Same as Hadley (1999) UST-Verb - required explicit verb as one of the words	Followed Hadley (1999)
Villa (2010)	UST with a subject-verb combination (UST-SVs)	Active, declarative sentences with an explicit subject and lexical verb Began coding for sentence subject person and number	Followed Hadley (1999), also excluded questions and imperatives
Bahnsen (2011) McKenna (2011)	Unique subject-verb combination (USVs)	Same operational definition as Villa (2010), updated terminology	Followed Hadley (1999), same as Villa (2010)
Current study	USVs	Sentences with an explicit subject and a lexical verb Non-formulaic questions now coded	Followed Hadley (1999), also excluded imperatives, sentences with conversational partner names as explicit subjects, routine *do* and *go* questions

APPENDIX B

Sentence Diversity Codes: Descriptions and Examples

Code	Description	Examples from language samples
[SV:1]	Coded on explicit first person singular subjects of subject-verb combinations (i.e., *I, me, Cname*)	I[SV:1] want baby. I[SV:1] share with you. Me[SV:1] pick up. Cname[SV:1] washing it off.
[SV:2]	Coded on explicit second person subjects of subject-verb combinations (i.e., *you*)	You[SV:2] do it. Here you[SV:2] go. You[SV:2] open this? You[SV:2] could have this one.
[SV:3]	Coded on explicit third person singular subjects of subject-verb combinations (e.g., *baby, Pooh, it, he*)	Baby[SV:3] have pants. Pooh[SV:3] want some juice. It[SV:3] make noise. Now he[SV:3] stop.
[SV:1P]	Coded on explicit first person plural subjects of subject-verb combinations (e.g, *we, us*)	We[SV:1P] go a little walk. We[SV:1P] take a bath. We[SV:1P] get some glasses. Us[SV:1P] have to get chicken.
[SV:3P]	Coded on explicit third person plural subjects of subject-verb combinations (e.g., *cows, babies, they*)	Cows[SV:3P] are going in a rocketship. Babies[SV:3P] gonna come to sleep. They[SV:3P] both spinning together. They[SV:3P] gonna come out.
[SV:P]	Coded on names of conversation partners in the subject position of noun-verb combinations (e.g., *Mom, Mommy*)	Mom[SV:P] have pink. Mom[SV:P] scoot me. Mommy[SV:P] say it. Mommy[SV:P] don't like this.
[SV:RQ]	Coded on explicit subjects of simple *do* and *go* questions	Where apple[SV:RQ] go? What he[SV:RQ] doing? Where him mustache[SV:RQ] go? Where this one[SV:RQ] go?

APPENDIX C

Conversion of Coded Subject-Verb Combinations to Unique Subject-Verb Combinations (USVs)

	Subject-verb combination	Unique subject-verb combination (USV)	Rationale
1	I[SV:1] can carry Pooh.	I carry	USV-1: Unique verb and first person singular subject
2	I[SV:1] want that one.	I want	USV-1: Same first person singular subject as 1, but unique verb
3	Baby[SV:3] like the milk.	Baby like	USV-3: Unique verb and third person singular subject
4	He[SV:3] looking for that.	He look	USV-3: Unique verb and third person singular subject
5	I[SV:1] want a plate.	----	NONE: Same subject and verb as 2
6	This[SV:3] come off.	This come	USV-3: Unique third person singular subject and verb
7	Pooh[SV:3P] want food on plate.	They want	USV-3: Same verb as 2, but unique third person singular subject
8	I[SV:1] come with.	I come	USV-1: Same first person singular subject as 1 and 2 but unique verb; Same verb as 6 but unique subject

APPENDIX D

Unique Subject-Verb Combinations (USVs) and Longest Utterances of Typically-Developing Participants

GTP01G Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I do	You go	Baby fall		
I drop		Baby have		
I got		Pooh knock		
I switch		She got		
I want		She have		
5	**1**	**5**	**0**	**0**
Total UST-SV 11				

Longest Utterances	
1	Here you[SV:2] go, bear.
2	Mom, give me it.
3	She[SV:3] got my chair.
4	{Uhoh} I[SV:1] dropped my fork.
5	Baby[SV:3] fall down on me.

GTP45G Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I feed	You do	Baby want		
I try	You go	My ear hurt		
I want	You open	My tummy hurt		
I wash		This juice feed		
4	**3**	**4**	**0**	**0**
Total UST-SV 11				

Longest Utterances	
1	What's this, daddy?
2	I[SV:1] try find it.
3	The babies in there.
4	This juice[SV:3] feed her.
5	I[SV:1] want take the baby's bag.

GTP33B Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I build	You get	Something else go	We build	Those look
I eat	You have	The farmer feed	We got	
I forget	You want	He want		
I get		It got		
I go		Somebody come		
I have		He got		
I help		He take		
I know				
I like				
I need				
I open				
I see				
I spill				
I use				
I want				
15	**3**	**7**	**2**	**1**
Total UST-SV 28				

Longest Utterances	
1	And the farmer[SV:3] can feed the sheeps.
2	But I[SV:1] don’t need to cook it.
3	I[SV:1]’m gonna go make you something else.
4	You[SV:2] gotta use your little fingers.
5	This is some big chair for you.

GTP44B Unique Subject-Verb Combinations

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
Cname crack		Bear want	We get	They open
Cname drop		Egg come	We close	The cows go
Cname wash		He flip	We go	
I get		He march		
I have		He want		
I like		It march		
I need		It walk		
I take		The door close		
I turn		This guy ride		
I want		This have		
I/Cname put				
11	**0**	**10**	**3**	**2**
Total UST-SV 26				

Longest Utterances	
1	I[SV:1] need something to make me food.
2	Yes, and it's a fire oven.
3	The cows[SV:3P] go in here.
4	I[SV:1] need help get the animals out, mom.
5	We[SV:1P] gonna get WinniePooh pizza out.

GTP46G Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I cut	You call	He have	We babysit	Her things want
I did	You change	He like	We call	They go
I got	You close	He say	We go	They have
I love	You come	He want	We have	They need
I make	You do	It go	We pretend	
I need	You drink	It have	We put	
I put	You eat	It say	We see	
I want	You follow	It slide		
I wash	You forgot	It snap		
I/my have	You get	My baby have		
I bake	You go	My baby need		
I drive	You have	Poohbear go		
I go	You hold	She get		
I visit	You lost	She go		
	You mean	She has		
	You open	She like		
	You put	She poop		
	You share	She see		
	You take	She sleep		
	You tie	She want		
	You want	The farmer say		
		The girl go		
		The one have		
		Yours have		
14	**21**	**24**	**7**	**4**
Total UST-SV 70				

Longest Utterances	
1	I[SV:1]'m gonna have this too and I[SV:1]'m gonna have the green cup.
2	This is a cookie, so I[SV:1]'m gonna cook it in the stove.
3	Because she[SV:3] had a bad dream, and you[SV:2] were gonna be a mom.
4	Could you[SV:2] take her clothes on so I[SV:1} could make her pajamas on?
5	She[SV:3]'s gonna take some little medicine because she[SV:3] doesn't like medicine.

GTP49G Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I build	You do	He blow	We build	Little piggy come
I come	You go	He come	We came	The babies start
I find	You get	He decide	We do	The guys get
I get	You have	He do	We go	The mommy pig and the daddy pig come
I know	You open	He drink	We get	They go
I like	You push	He go	We have	They need
I make	You want	He get	We need	They play
I open		He have	We take	
I pop		He keep	We want	
I push		He knock		
I see		He like		
I sit		He love		
I take		He see		
I touch		He sit		
I use		He walk		
I want		He want		
I/Cname go		Nobody see		
		Piggy say		
		Pooh want		
		She build		
		She come		
		She go		
		She get		
		She have		
		She like		
		She need		
		She want		
		That guy get		
		That guy go		
		The fishy want		
		The friends		
		The mommy go		
		This one have		
		Who build		
		Wolf come		
		Wolf want		
17	**7**	**36**	**9**	**7**
Total UST-SV 76				

Longest Utterances	
1	I[SV:1]'m gonna open it up and put it on the stove.
2	And what are you[SV:2] gonna do with these blocks?
3	I[SV:1] gotta get the red blocks off of there, mommy.
4	I[SV:1]'m gonna pretend all these are the pigs.
5	And she[SV:3] came and the guys[SV:3P] got in the house because that wolf[SV:3] didn't want to come in.

APPENDIX E

Unique Subject-Verb Combinations (USVs) and Longest Utterances of At-Risk Participants

GTP22B Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
Cname bite	You eat	Chicken go		They eat
Cname sit		That go		
Cname/I try				
Cname/I cut				
Cname/I build				
I blow				
I eat				
I got/gotta				
I know				
I like				
I need				
I see				
I take				
I want/wanna				
I wash				
15	**1**	**2**	**0**	**1**
Total UST-SV 19				

Longest Utterances	
1	I[SV:1] wanna try chicken going in.
2	Mama, we're alldone with that, mama.
3	And taco and rice and hotdog and pizza and pizza.
4	I[SV:1] wanna go play puzzle.
5	I[SV:1] gotta put cup back.

GTP52B Unique Subject-Verb Combinations (USVs)

First person singular USVs	Second person USVs	Third person singular USVs	First person plural USVs	Third person plural USVs
I make	You eat	Chicken make		
I bring		Pizza come		
I know		Knife stir		
3	**1**	**3**	**0**	**0**
Total UST-SV 7				

Longest Utterances	
1	And chicken[SV:3] make.
2	{Hey} I[SV:1] make it.
3	Where my burger[SV:RQ] go?
4	You[SV:2] eat broccoli, Mom?
5	Pizza[SV:3] coming, Mom.