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The Effect of Quality and Quantity in Caregiver Input on Vocabulary Development

by

Caryn M. Lake

A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Science in the Department of Communication Sciences and Disorders

Idaho State University

Summer 2018

Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Caryn Lake find it satisfactory and recommend that it be accepted.

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September 8, 2017

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RE: regarding study number IRB-FY2018-53: The Effect of Quality and Quantity in Caregiver Input on Vocabulary Development

Dear Ms. Lake:

I agree that this study qualifies as exempt from review under the following guideline: Category 4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.
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Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Dedication

This thesis is dedicated to my selfless mother. Thank you for all of your love and support throughout the many smiles, laughs, tears, and stress. I could not have done it without you.

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The Effect of Quality and Quantity in Caregiver Input on Vocabulary Development

Thesis Abstract—Idaho State University (2018)

Caregiver language input, specifically quality and quantity of input, is one key factor related to vocabulary growth in children. In this study we have addressed how the quality and quantity of caregiver input from 6 to 18 months of infant age is related to vocabulary development at 18, 24, and 36 months of age in 14 parent - child dyads. It was hypothesized that increased quality and quantity of caregiver language input was related to increased expressive and receptive vocabularies. Some statistically significant results indicated differences between groups, and effect size values suggested substantial clinical significance. Quantity and quality of caregiver language input appeared to have considerable practical influence over expressive and receptive vocabularies. By finding the clinical significance of these variables, we can now explore how increased caregiver education is related to the quantity and quality of infant input and how it may influence vocabulary development.

Key Words: caregiver input, quality of caregiver language input, quantity of caregiver language input, vocabulary development, expressive language, receptive language, infant, toddler

The Effect of Quality and Quantity in Caregiver Input on Vocabulary Development

Vocabulary development is intricately linked with language acquisition and academic success. A well-developed vocabulary is necessary for literacy comprehension and communication as a whole (Moghadam, Zainal, & Ghaderpour, 2012). The rate of growth and size of vocabulary varies dramatically for toddlers (Cartmill et al., 2013; Mayor & Plunkett, 2011; Rowe, Özçalişkan, & Goldin-Meadow, 2008). According to normative data, children in the 10th percentile for vocabulary have developed an average of 560.2 words by 30 months of age, while children in the 90th percentile display a drastically larger vocabulary of 2032.9 words by 30 months (Mayor & Plunkett, 2011). Many aspects of an infant's development are responsible for this variability in vocabulary development and can be indicators of vocabulary size in childhood, including: parental interaction, gender, mobility during the first year of life, and non-verbal communication (Mayor & Plunkett, 2011; Rowe et al., 2008). For speech-language pathologists, increasing the evidence-based knowledge available regarding factors that contribute to vocabulary size could lead to earlier identification of language delay/disorder as well as more comprehensive early intervention approaches.

There are several aspects of a child's environment associated with vocabulary acquisition, some of which hold greater significance than others. Some items that influence vocabulary development include the amount and type of caregiver language input, toys, books, and caregiver response to infant vocalizations (Rowe, 2012; Sosa, 2016). Evaluating and determining the importance of each component of vocabulary development will assist both speech-language pathologists (SLPs) and caregivers in knowing which techniques and tools should be implemented to best support the vocabulary growth of their child (Rowe, 2012).

Previous studies have shown the significant relationship language presented from a parent can have with a child's vocabulary growth (Leffel & Suskind, 2013). Specifically, it has been indicated that quantity and quality of caregiver language input are significant factors contributing to an infant's vocabulary development. For the purpose of this study, quantity is defined as the total number of words directed to the infant, and quality is defined as the total number of different words directed to the infant. Information relating to previous studies on these two elements will follow. Complex language use by caregivers is another element that is positively related to later vocabulary size in children (Newman, Rowe, & Ratner, 2016). Along with quantity, quality, and complex language, vocabulary acquisition has also been linked to language and literacy preparedness in the school setting (Leffel, & Suskind, 2013).

Quantity and Quality

Researchers have determined that the quantity and quality of caregiver linguistic input contribute to language development, specifically under the domain of vocabulary (Cartmill et al., 2013). Quantity refers to the number of tokens, or words, presented to the infant (Rowe, 2012). Quality of language input refers to the types of words presented to an infant, -the number of different words that are offered (Olson & Masur, 2015; Rowe, 2012). Number of different words, rare words, words associated with decontextualized language, and other differing and unique lexical productions, are all included in the quality of language.

Rowe (2012) defined rare words as unique words that are not common and are not always used in regular conversation, decontextualized language as any utterance used when referencing ideas outside of the here and now (such as ideas relating to the past, future, or even an outside environment), and lexical productions as the specific words that are produced. She conducted a longitudinal study involving 50 parent/infant dyads who participated in recorded play sessions.

During these play sessions, the caregiver utterances were recorded. Recordings were transcribed and analyzed. Analysis of utterances determined the total number of words (quantity) and the total number of different words (quality) that were presented to the child. Quality of caregiver utterances was further evaluated by dividing the utterances into three sections, vocabulary diversity, vocabulary sophistication, and decontextualized utterances. Results from this study determined that at 2 ½ years of age, increased sophisticated language from the caregiver was a predictor of increased child vocabulary one year later. It was also determined that at 3 ½ years of age, decontextualized language from the caregiver was a predictor for increased child vocabulary one year later. The study concluded that vocabulary diversity and sophistication was most important during the third year of life and decontextualized language was most important during the fourth year of life. The study also found that quantity (total number of token words) was important throughout development, especially at 18 months of age, but not as important as quality. Overall, parents who spoke to their infants more often, and who presented a greater number of different words, had a positive significance related to larger and more complex vocabularies (Rowe, 2012).

Goodman, Dale, and Li (2008) investigated how quantity, or more specifically, frequency of exposure, affects infant vocabulary development. By studying a total sample size of 562 words produced by caregivers, they discovered that the frequency of specific words or utterances presented was directly related to expressive vocabulary growth. Target words were chosen from the *MacArthur-Bates Communicative Development Inventory* (CDI; Fenson et al., 1997), and parental frequency of use was determined via a search through 28 CHILDES (*Child Language Data Exchange System* database; MacWhinney, 2000) corpora containing a total of 3.8 million word tokens. It was determined that the closed-class words caregivers expressed more

frequently, such as “hat” and “in”, were not acquired as early as rare words. This was due to the fact that the rare words, more specifically, nouns such as “ball” and “drum” were more significant and took less time to comprehend, resulting in faster acquisition (Goodman et al., 2008). The researchers also found that words presented most frequently in each lexical category (noun, verb, etc.) were acquired earlier. These results suggest that the quality of linguistic input had a more significant relationship with vocabulary development than the quantity, but that quantity was still important, especially when related to specific lexical categories.

Decontextualized language is also positively related to vocabulary growth in children. Rowe (2013) conducted a study in which she examined the effects of decontextualized language presented by parents to their toddlers. During the study, 50 parent and child dyads were observed at 18, 30, and 42 months. The *Peabody Picture Vocabulary Test* (PPVT: Dunn & Dunn, 1997) was administered at both 42 and 54 months to evaluate child vocabulary growth. It was determined that parents who provided more decontextualized language input was related to children with larger vocabularies (Rowe, 2012 and 2013). Decontextualized language is a complex form of language; other complex language forms are positively related to vocabulary as well.

Presenting the same, or common words, is not as likely to increase development as compared to presenting different, or rare words to children. Presenting language containing lexical diversity as well as word segmentation has been shown to be advantageous for facilitating vocabulary development (Newman, Rowe, & Ratner, 2016). Segmentation refers to breaking down words into sound segments. An example of segmentation would include a child breaking down the word “Saturday” to the syllables - “Sa-tur-day”. The skill of segmenting is a form of phonological awareness, which pertains to the sound system of speech. The ability to segment

sentences into words and words into syllables and sounds will help toddlers to better build their sound inventory, resulting in more diverse language acquisition. By following a total of 121 mother and infant dyads, Newman and colleagues (2016) were able to determine that the segmentation skills of the children were positively correlated with increased vocabulary. Researchers have found that lexical diversity and segmentation have varying levels of effectiveness for supporting vocabulary growth when used individually. However, when the two elements are combined they have been found to be considerably more effective in scaffolding vocabulary development (Newman et al., 2016).

Along with segmentation and lexical diversity, verb acquisition can be linked to vocabulary development. In a study conducted by Hsu, Hadley, and Rispoli (2015), researchers evaluated how parents' use of verbs affected vocabulary development in their children. Following 20 parent and child dyads, researchers found that verbs used by parents were later identified in the vocabularies of their children (Hsu et al., 2015). More revealing was the finding that a diversity in verbs used by parents proved to be even more advantageous to vocabulary growth (Hsu et al., 2015). This relates to the concept that the quality of words, or the diversity of words, is extremely important for facilitating vocabulary growth.

Similar to segmentation and lexical diversity, complex language facilitates larger lexical inventories (Fernald, Marchman, & Hurtado, 2008). Complex language is rich in lexical diversity and decontextualized language, and contains rare and novel words. Researchers have discovered that when parents use complex language, their children are more likely to develop faster processing times, which result in greater acquisition and comprehension of new words (Fernald et al., 2008).

Not only does the type of language presented to children matter, but also the type of questions presented has been related to vocabulary development. Complex questions include *wh*-questions. Rowe, Leech, and Cabrera (2016) found that by introducing *wh*-questions to toddlers, the children were more likely to produce *wh*- questions as their vocabularies and language use increased. Questions beginning with *wh*- require critical thinking skills to produce, as well as to answer. As reported by the researchers, increased exposure to and experience with *wh*- questions resulted in more appropriate vocabulary use and comprehension.

Complex semantic and temporal responses from caregivers have also been shown to be beneficial to vocabulary development (McGillion et al., 2013). Semantic responses refer to those in which the parent comments on what the child is doing or involved with in that moment. Temporal responses refer to those in which a parent responds to a child's utterance within a specific time frame. An example of a semantic utterance would be a parent talking about how the child is driving a toy car, whereas a temporal response would be the parent responding positively, in a designated amount of time, in a reinforcing manner, to a child identifying the correct name of a toy. McGillion and colleagues (2013) studied 46 parent and infant dyad interactions. Dyads were recorded in their home environments each month from the infant ages of 9 to 18 months. Interactions, specifically caregiver responses, were used from two sessions, one at 9 ½ months, and the other at 18 months. Semantic and temporal responses were evaluated to determine if one or both was most beneficial to vocabulary development. Researchers determined that while both response types are individually significant with regards to vocabulary inventories, a combination of the two was most advantageous. Caregiver responses to child utterances and actions expose children to more contextualized language and is related to the development of increased language skills by the child (McGillion et al., 2013).

During each stage of development, infants and toddlers have varying needs across domains, whether it be physical, emotional, cognitive, or speech and language. Language development, specifically with regard to vocabulary development, is a domain that sees growth spurts at different ages, with varying contributors at each stage. Researchers found that while there are general needs such as verbal and physical input and feedback, there are specific elements and combinations of elements that will lead to more significant gains in vocabulary development (Vallotton, Mastergeorge, Foster, Decker, & Ayoub, 2017). Combining tools such as types of caregiver input, caregiver response, and physical responses, along with toys or books, to promote language development can be effective, depending on the needs of the child. Rowe (2012) stated, "that specific measures of input quality relate to child vocabulary skill at different points in development" (p. 1771).

Both quality and quantity have been shown to be important in vocabulary acquisition. However, it has been found that the quality of parental input is more valuable with regards to vocabulary growth (Rowe, 2012). Presenting a greater number of different words, and more lexically complex utterances is most advantageous and will result in larger toddler vocabularies. While quality has shown to hold a more significant role in vocabulary acquisition, quantity is still important. Quantity provides children with a number of exposures to language, and even to certain types of language, when incorporated with quality. All of these key factors contribute to the development of vocabulary, which holds exceptional importance in a child's life.

Educational Significance

Vocabulary growth is important in development because of the role it plays in relation to education. Duff, Reen, Plunkett, and Nation (2015) looked at the effect vocabulary development has on literacy and language skills. Their study included 300 infants who were evaluated at one

time between 16 and 24 months of age and once again after about 5 years. As infants, the children's vocabulary inventories were assessed. Once school-aged, not only were their vocabularies assessed, but also their phonological awareness, reading accuracy, reading comprehension, and nonverbal ability. Researchers found that vocabulary was positively related to literacy skills. As long as a strong vocabulary is acquired at some point in development, the child will likely have increased literacy skills (Duff et al., 2015). Literacy is of course, very significant for a successful education; therefore, it is important for clinicians and parents to recognize this factor in order to promote vocabulary development and provide opportunities for academic success.

Researchers have discovered that children who acquire vocabulary at a faster rate will be more successful in using their vocabulary in the future. Sixty-two dyads of parents and children were evaluated in one study (Rowe, Rudenbush, & Goldin-Meadow, 2012). Over the span of 32 months, the toddlers and parents were recorded during several home visits. Visits occurred every 4 months beginning at the age of 14 months, lasting until the children reached 46 months. The children were evaluated for their vocabulary growth by determining the word types they produced in each session. The children were also administered the *PPVT* (Dunn & Dunn, 1997) at 54 months of age. Researchers discovered that faster vocabulary acquisition was correlated with academic success, along with the idea that caregivers who facilitate more language production greatly aid their child's vocabulary development (Rowe, Raudenbush, & Goldin-Meadow, 2012). Clinically, this information is key in order for caregivers to provide effective interactions to promote faster vocabulary acquisition.

Moghadam, Zainal, and Ghaderpour (2012) synthesized a collection of studies examining the relationship between vocabulary size and reading comprehension. Through their review, they

determined that increased vocabulary size is positively and strongly correlated with reading comprehension. Reading comprehension is related to education, and specifically, educational success (Moghadam et al., 2012). Errors in reading and general comprehension tasks (lexical understanding, syntactic meaning, etc.) are often made as a result of a misunderstanding instructions (Moghadam et al., 2012). Academic performance is related to many different skills. It is important for teachers and professionals to recognize the significance of vocabulary and facilitate vocabulary growth.

Parental Education/Early Intervention

Studying quality and quantity of caregiver input provides critical information related to vocabulary development, especially in determining what is most effective for fostering vocabulary growth. Knowledge gained from studying language input provides insight and promotes awareness amongst caregivers (Leffel & Suskind, 2013). Rowe (2012) found that it was necessary to challenge children with complex and decontextualized language, in order to assist them in developing greater vocabularies. Caregiver input is a determining factor that can have a strong relationship with vocabulary development.

For most children, their first and most significant teachers are their caregivers. Children grow to become similar to their parents, especially through their language, grammar, and speech characteristics. Vocabulary acquisition functions the same way (Hart, & Risley, 2003). It would be beneficial for caregivers to understand the relationship language input can have on their child's vocabulary development. Such knowledge would enable caregivers to place more emphasis on their verbal productions in an attempt to encourage vocabulary growth (Leffel & Suskind, 2013).

Researchers reference the need for parent-directed intervention and the strong, lasting relationship it can have on the child. Leffel and Suskind (2013) state, “This research clearly shows that a qualitatively and quantitatively rich early language environment is critical for a child to reach not only his or her linguistic potential but ultimate life-course potential as well” (p. 268). Incorporating caregivers into therapy and developing that knowledge base related to the importance of language input will assist in vocabulary development. Ensuring that children reach their linguistic potential is important for language development and educational success.

Understanding that early language input forms foundations for later success throughout all aspects of life (including academic, employment, social, and psychological wellbeing) will increase caregiver awareness and aid in improved outcomes for children. Clinicians also need to understand the importance of language in development, and that the quantity and quality of language input has the potential to affect children for the rest of their lives (Rowe, 2012). Providing this insight to caregivers will increase knowledge and advocacy for positive development.

Purpose

If caregivers are aware of how their language input is related to their child’s language development, they may be more conscientious of the language they are using during interactions. They may also be better able to identify the need for early intervention (Leffel & Suskind, 2013). The *long-term goal* of this project is to aid in raising parental awareness of the effects that language input (specifically the quality and quantity of words spoken) has on vocabulary development. Doing so may promote expressive and receptive vocabulary growth and support earlier identification of children at risk for future speech and/or language disorders. The study looked to evaluate the quality and quantity of caregiver input to infants from 6 to 18 months of

age as it related to expressive and receptive vocabulary development in those same children at 1 ½, 2, and 3 years of age. The *objective* is to determine the relationship between caregiver input on expressive and receptive vocabulary acquisition in this cohort of children. The *central hypothesis* is that greater quality and quantity of parental input at 6 to 18 months will be related to larger expressive and receptive vocabularies at 1 ½, 2, and 3 years of age. The *rationale* for the proposed project is to validate gathering of caregiver/infant data under the current study design. If caregiver input in the current design is positively related to vocabulary development, we can continue to use this design confidently, and begin to develop methods for educating caregivers about the importance of caregiver input. Such methods for education could aid in the translation from basic research to clinical practice.

Methods

Participants

Participants came from a cohort of 16 caregiver/infant dyads, who participated in a longitudinal research study (at East Carolina University) from 6 to 18 months of infant age under the direction of Dr. Heather L. Ramsdell-Hudock. One of the infants was excluded from the study due to a language barrier. While the family did report English as the primary language spoken in the home, the caregivers spoke mostly Arabic during recordings. This made transcription too difficult so the infant was excluded from the present study. A second infant/caregiver dyad was excluded due to atypical development which resulted in a final sample size of 14 parent/infant dyads. For the purpose of this study, caregivers were defined as individuals who spent a significant amount of time with the child and provided basic needs and nurtured the child. Caregivers who participated in these recordings were primarily mothers, some fathers, and on occasion an extended relative like a grandmother.

Research advertisements were sent to addresses (obtained from publicly available Register of Deeds records at the Pitt County Court House, Greenville, NC) of families with infants born between November, 2010 and March, 2011. Interested families were interviewed, and details of the study, along with informed consent, were discussed. Inclusion criteria for the study consisted of caregivers who experienced normal pregnancies and no significant history of prenatal or perinatal problems; infants not at risk for developmental disorders; families where English was the primary language spoken in the home; families who were able to travel to the laboratory monthly; and families who did not expect to move away from the surrounding area within 2 years of beginning participation in the study. Families received $98.00 in the form of mercantile gift cards as incentive for every 2 months of participation in the study.

All families were of middle socioeconomic status according to caregiver report. There were no infant participants born to single parent homes, and both mothers and fathers participated in the study. Seven of the infants were first born, five had one older sibling, one had two older siblings, and one had three older siblings. Siblings ranged in age from 2 years to 12 years at the time of the infants' births.

Of the 14 infant participants, five were male and nine were female. One female infant was African American, and one male infant was Asian American (father of East Indian descent and mother of Vietnamese and Hawaiian descent). One male infant was from a home where English, Indian, and Vietnamese were spoken. The remaining 12 infants were Caucasian. All infants were normal hearing: they all passed an automated auditory brainstem response newborn screening (ALGO 3 or ALGO 5 Newborn Hearing Screener System) to click stimuli presented at 35 dBHL. In addition, full hearing evaluations including tympanometry, transient evoked otoacoustic emissions, and visual reinforcement audiometry were conducted at 7 and 18 months

of infant age, with follow-up testing as needed for instances where results were abnormal (i.e., infants presented with middle ear dysfunction) or testing was incomplete. Two of the infants received bilateral myringotomy and pressure equalization tubes during enrollment in the study.

Materials and Procedure

The University and Medical Center Institutional Review Board at East Carolina University approved the study prior to data collection. All caregivers gave voluntary informed consent for participation in the study. Exemption was also obtained from the Human Subjects Committee at Idaho State University, as the study purpose was covered in the original consent. Parent/infant dyads were followed over a 12-month longitudinal period through weekly interviews and monthly recordings.

Laboratory setting. Infants and caregivers came to the lab at East Carolina University once a month for hour-long recordings. During recordings, caregivers were instructed to play with their infants, and interact as they would typically do in a home setting. The lab was designed to simulate a natural environment, such as a nursery in a home; it included stuffed animals, toys, and various objects that would allow both parent and child to feel comfortable. This setting attempted to encourage natural interactions between caregivers and infants, to facilitate capture of a representative sample of the infant's vocal abilities.

The lab was equipped with both video and audio recording capabilities. For video data, the recording room contained eight Sony EVI-D70/W wall-mounted cameras with pan and tilt capabilities. Further, three walls contained three by four-foot mirrors to optimize camera angles in recordings. For audio data, an infant vest housed a high fidelity wireless microphone to control mouth-to-microphone distance (Buder & Stoel-Gammon, 2002). A signal-to-noise ratio of up to 96 dB was made possible with 16-bit quantization, and with signals digitized at

sampling rates of 44.1 or 48 kHz. All video and audio from the recording playroom was relayed to an adjacent control room. During recordings, laboratory staff would attempt to record two of the eight available camera angles, choosing those with the best view of the infant's face and the best view of the interaction between caregivers and infants.

Caregiver input. Utterances were located using a breath-group criterion (i.e., each vocalization occurred on a single egressive breath; Oller & Lynch, 1992). Caregiver utterances that are directed to the infant were transcribed orthographically for all recording sessions across infant and age. Due to time constraints, only a 20-minute portion of each recording session was used for transcription and analysis. The middle 20 minutes of each 60-minute session was used, with the exception of instances in which there was hardware or software issues. If this occurred, the first 20 minutes of the 60-minute session was coded, transcribed, and analyzed. Lab assistants coded, transcribed, and analyzed caregiver utterances independently. In order to decrease subjectivity a method of consensus coding was implemented. In the event that a lab assistant had a question regarding a specific utterance, they were able to ask another lab staff who was also working. Caregiver input was judged to be directed when their utterances were directed to the infant (e.g., a response, request, or clarification) as indicated verbally (by semantic content), or nonverbally (through eye gaze). Conversely, caregiver input was not directed when their utterances were not directed to the infant, but rather to someone else in the room, or to someone on the phone, as indicated verbally, or nonverbally. Following the coding and transcription, each 20-minute session was analyzed to determine the exact quantitative and qualitative values of the caregiver utterances. Each transcription was entered into Microsoft Word where they were edited to determine the total number of words (quantity). Caregiver utterances such as animal noises, imitating infant vocalizations, and other non-words were not

included in the analysis. Information from the files was then entered into Microsoft Excel in order to determine the exact number of different words (quality).

Vocabulary. Parent report has been recognized as both a reliable and valid means of determining speech language development in infants and toddlers (Feldman *et al.*, 2005; Fenson *et al.*, 1994; Heilmann, Ellis Weismer, Evans, & Hollar, 2005; Korkman, Jaakkola, Ahlroth, Pesonen, & Turunen, 2004; Oller, Eilers, & Bassinger, 2001; Rescorla & Alley, 2001). *The MacArthur-Bates Communicative Development Inventory* (CDI) was the parent report measure of vocabulary for the present study (Fenson et al., 1994). The CDI in particular has several studies to back up its concurrent and predictive validity as a measure of vocabulary (Feldman *et al.*, 2005; Heilmann *et. al.*, 2005). In a study by Feldman and colleagues in 2005, the CDI was shown to have positive and statistically significant concurrent validity when compared to three standardized accepted measures of infant language and cognition (e.g., *McCarthy General Cognitive Index*, the *McCarthy Verbal Scale*, and the *Peabody Picture Vocabulary Test-Revised*) and when compared to number of different words and mean length of utterance determined by recording parent to child conversations. A study by Heilmann and colleagues (2005) found the CDI to be positively correlated with the *Preschool Language Scales* III, the number of different words produced by the child according to the *Systematic Language Transcription Analysis* (SALT), and the child's mean length of utterance. Results of these studies indicate that the CDI is a valid measure of vocabulary and expressive language in toddlers.

Caregivers completed the CDI *Words and Gestures* bi-monthly from 10 to 18 months of infant age, and *Words and Sentences* in follow-up studies at 2 and 3 years of age. From the inventories, we tallied expressive and receptive vocabulary at three points in time (ranges

presented because the individual infants varied in age at each point in time): one year (15 to 18 months), two years (23 to 27 months), and three years (37 to 40 months) of infant/child age.

Design

Correlation and multiple regression analyses were conducted to examine the relationship between all criterion and predictor variables. Variables of interest are presented in Figure 1. The criterion variables of interest were expressive and receptive vocabulary at 1 ½ years of age, and expressive vocabulary at 2 and 3 years of age. The predictor variables of interest were caregiver input quantity, caregiver input quality, and infant age from 6 to 18 months. A significance level (*p)* was set at 0.05 for the purpose of this study.

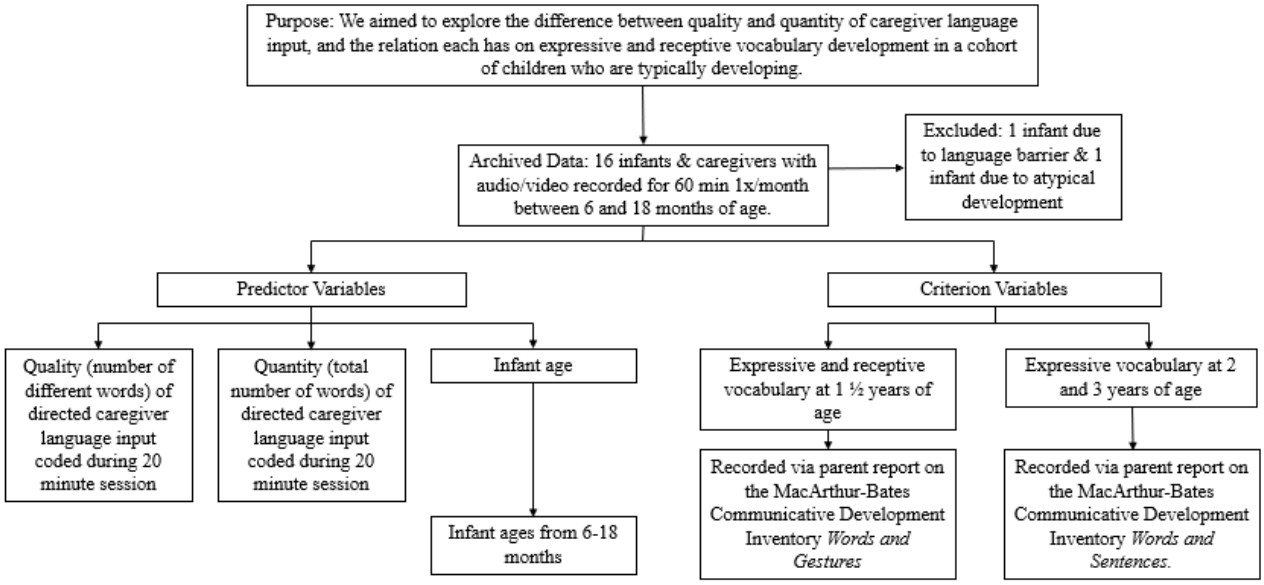

Figure 1. Purpose, Participants, and Variables of Interest

Results

Caregivers produced a total of 34,523 utterances in the middle 20 minutes of 60-minute recordings with their 14 infants from 6 to 18 months of age. From these utterances, there were 97,007 *total* words directed to the infant (quantity), and 26,447 *different* words directed to the

infant (quality). The raw number of predictor variables (quantity and quality of caregiver utterances from 6 to 18 months of infant age) are shown in Table 1.

Table 1
Number of Utterances per Predictor Variable across Infants

Age in Months	Caregiver Input	
	Quantity	Quality
6	7273	1961
7	8005	2315
8	7875	2174
9	7174	1779
10	5717	1622
11	5687	1567
12	6681	1890
13	10774	3278
14	8065	2082
15	9195	2329
16	9953	2575
17	6315	1688
18	4293	1187
Total	97007	26447

The MacArthur Bates Communicative Development Inventory was administered to determine vocabulary level. Caregivers completed the *Words and Gestures* response sheet for expressive and receptive vocabulary at 1 ½ years of age and *Words and Sentences* response sheet for expressive vocabulary at 2 and 3 years of age. Expressive and receptive vocabulary size per parent report for each child are displayed in Table 2.

Table 2
Vocabulary Score per Parent Report on the MacArthur Bates Communicative Development Inventory

	Vocabulary Size on MacArthur Bates CDI			
Infants	Expressive Vocabulary 1 ½ Years	Receptive Vocabulary 1 ½ Years	Expressive Vocabulary 2 Years	Expressive Vocabulary 3 Years
1	149	283	548	680
2	151	275	550	661
3	18	213	178	655
4	301	365	574	677
5	1181	301	576	635
6	61	130	277	662
7	4	57	337	652
8	51	177	186	662
9	32	405	222	655
10	17	216	66	677
11	32	215	521	623
12	69	230	337	653
13	23	274	293	651
14	68	307	514	658

Expressive Vocabulary at 1 ½ Years

Table 3 summarizes the descriptive statistics and analysis results when examining the relationship between expressive vocabulary at 1 ½ years with all potential predictor variables. As can be seen, the total number of words produced by caregivers (quantity) at 8 and 17 months of infant age was positively and significantly correlated with expressive vocabulary at 1 ½ years of age, indicating that higher values at these ages were related to larger expressive vocabulary. Expressive vocabulary at 1 ½ years of age was not significantly correlated with any of the other predictor variables.

The multiple regression model for all predictors at 6 months of age produced $R^2 = 0.272$, F (2, 9) = 1.682, $p = 0.240$, at 7 months of age produced $R^2 = 0.027$, F (2, 11) = 0.153, $p = 0.860$, at 8 months of age produced $R^2 = 0.504$, F (2, 10) = 5.082, $p = 0.030$, at 9 months of age produced $R^2 = 0.476$, F (2, 8) = 3.631, $p = 0.075$, at 10 months of age produced $R^2 = 0.275$, F (2, 7) = 1.327, $p = 0.325$, at 11 months of age produced $R^2 = 0.081$, F (2, 8) = 0.354, $p = 0.712$, at 12 months of age produced $R^2 = 0.096$, F (2, 8) = 0.424, $p = 0.668$, at 13 months of age produced $R^2 = 0.307$, F (2, 11) = 2.440, $p = 0.133$, at 14 months of age produced $R^2 = 0.206$, F (2, 10) = 1.300, $p = 0.315$, at 15 months of age produced $R^2 = 0.359$, F (2, 10) = 2.806, $p = 0.108$, at 16 months of age produced $R^2 = 0.024$, F (2, 10) = 0.124, $p = 0.885$, at 17 months of age produced $R^2 = 0.703$, F (2, 7) = 8.272, $p = 0.014$, and at 18 months of age produced $R^2 = 0.805$, F (2, 3) = 6.212, $p = 0.086$.

As can be seen in Table 3, the total number of words produced by caregivers (quantity) at 8, 9, 13, 15, and 17 months of infant age had significant positive regression weights, indicating that caregivers who produced more utterances directed to their infants at these ages were expected to have children with larger expressive vocabulary at 1 ½ years, after controlling for

other variables in the model. All other predictor variables from 6 to 18 months of age did not significantly contribute to the multiple regression model for expressive vocabulary at 1 ½ years.

Table 3
Summary Statistics, Correlations, and Results from the Regression Analysis (Dependent Variable = Expressive Vocabulary at 1 ½ years)

Predictor Variables					Multiple Regression Weights			
Age in Months	Utterances	M	SD	r	B	β	t	p
6	Quantity	606.083	358.527	0.257	0.383	1.598	1.802	0.105
	Quality	163.417	65.038	0.098	-1.870	-1.416	-1.596	0.145
7	Quantity	571.786	241.274	-0.119	0.018	0.053	0.980	0.924
	Quality	165.357	57.89	-0.162	-0.299	-0.206	-0.380	0.711
8	Quantity	605.769	289.558	0.581*	0.378	1.255	2.920	0.015*
	Quality	167.231	53.153	0.285	-1.295	0.789	-1.834	0.096
9	Quantity	652.182	378.61	0.462	0.319	1.317	2.644	0.030*
	Quality	161.727	68.68	0.133	-1.330	-0.997	-2.001	0.080
10	Quantity	571.70	352.962	0.373	0.199	0.766	1.628	0.148
	Quality	162.20	48.826	0.020	-1.014	-0.538	-1.145	0.290
11	Quantity	517.000	279.558	0.269	0.138	0.439	0.628	0.547
	Quality	142.455	54.564	0.190	-0.313	-0.194	-0.278	0.788
12	Quantity	607.364	235.430	0.235	0.177	0.446	0.916	0.386
	Quality	171.818	57.252	0.030	-0.478	-0.292	-0.600	0.565
13	Quantity	769.571	408.164	0.468	0.140	0.679	2.206	0.050*
	Quality	234.143	190.772	0.030	-0.160	-0.364	-1.182	0.262
14	Quantity	620.385	325.449	0.380	0.227	0.846	1.417	0.187
	Quality	160.154	65.052	0.217	-0.708	-0.528	-0.885	0.397
15	Quantity	707.308	420.767	0.403	0.232	1.120	2.329	0.042*
	Quality	179.154	66.185	0.109	-1.112	-0.843	-1.753	0.110
16	Quantity	765.615	316.718	-0.113	-0.100	-0.364	-0.457	0.657
	Quality	198.077	72.160	-0.062	0.331	0.274	0.343	0.738
17	Quantity	631.500	457.238	0.801**	0.251	1.254	2.902	0.023*
	Quality	168.800	46.053	0.587	-1.024	-0.515	-1.192	0.272
18	Quantity	715.50	423.270	-0.464	0.280	5.648	2.766	0.070
	Quality	197.83	87.703	-0.556	-1.476	-6.160	-3.017	0.057

*p < .05, **p < .01, ***p < .001

Receptive Vocabulary at 1 ½ Years

Table 4 summarizes the descriptive statistics and analysis results when examining the relationship between receptive vocabulary at 1 ½ years with all potential predictor variables. As can be seen, the total number of words produced by caregivers (quantity) at 8, 9, and 13 months of age was positively and significantly correlated with receptive vocabulary at 1 ½ years of age, indicating that greater quantity in directed utterances at these ages was related to larger receptive vocabulary. The number of different words produced by caregivers (quality) at 8 months of age was positively and significantly correlated with receptive vocabulary at 1 ½ years of age, indicating that greater diversity in directed utterances at this age was related to larger receptive vocabulary.

The multiple regression model for all predictors at 6 months of age produced $R^2 = 0.063$, F (2, 9) = 0.301, $p = 0.747$, at 7 months of age produced $R^2 = 0.141$, F (2, 11) = 0.901, $p = 0.434$, at 8 months of age produced $R^2 = 0.602$, F (2, 10) = 7.561, $p = 0.010$, at 9 months of age produced $R^2 = 0.395$, F (2, 8) = 2.610, $p = 0.134$, at 10 months of age produced $R^2 = 0.284$, F (2, 7) = 1.391, $p = 0.310$, at 11 months of age produced $R^2 = 0.214$, F (2, 8) = 1.089, $p = 0.382$, at 12 months of age produced $R^2 = 0.139$, F (2, 8) = 0.646, $p = 0.550$, at 13 months of age produced $R^2 = 0.409$, F (2, 11) = 3.813, $p = 0.055$, at 14 months of age produced $R^2 = 0.199$, F (2, 10) = 1.242, $p = 0.330$, at 15 months of age produced $R^2 = 0.049$, F (2, 10) = 0.258, $p = 0.778$, at 16 months of age produced $R^2 = 0.235$, F (2, 10) = 1.535, $p = 0.262$, at 17 months of age produced $R^2 = 0.294$, F (2, 7) = 1.458, $p = 0.296$, and at 18 months of age produced $R^2 = 0.186$, F (2, 3) = 0.342, $p = 0.735$.

As can be seen in Table 4, the total number of words produced by caregivers (quantity) at 8 and 13 months of age had significant positive regression weights, indicating that caregivers who produced more utterances directed to their infants at these ages were expected to have children with larger receptive vocabularies at 1 ½ years, after controlling for other variables in the model. All other predictor variables from 6 to 18 months of age did not significantly contribute to the multiple regression model for receptive vocabulary at 1 ½ years.

Table 4
Summary Statistics, Correlations, and Results from the Regression Analysis (Dependent Variable = Receptive Vocabulary at 1 ½ years)

Predictor Variables					Multiple Regression Weights			
Age in Months	Utterances	M	SD	r	B	β	t	p
6	Quantity	606.083	358.527	0.194	0.178	0.660	0.656	0.528
	Quality	163.417	65.038	0.133	-0.732	-0.492	-0.489	0.636
7	Quantity	571.786	241.274	0.375	0.148	0.394	0.773	0.456
	Quality	165.357	57.89	0.307	-0.035	-0.022	-0.044	0.966
8	Quantity	605.769	289.558	0.774**	0.278	0.856	2.223	0.050*
	Quality	167.231	53.153	0.637*	-0.169	-0.096	-0.248	0.809
9	Quantity	652.182	378.61	0.628*	0.008	0.039	0.073	0.943
	Quality	161.727	68.6797	0.463	0.696	0.594	1.111	0.299
10	Quantity	571.70	352.962	0.337	-0.025	-0.104	-0.222	0.831
	Quality	162.20	48.826	0.529	1.060	0.604	1.293	0.237
11	Quantity	517.000	279.558	0.463	0.170	0.471	0.729	0.487
	Quality	142.455	54.564	0.402	-0.018	-0.010	-0.015	0.988
12	Quantity	607.364	235.430	0.354	0.078	0.231	0.486	0.640
	Quality	171.818	57.252	0.337	0.236	0.170	0.359	0.729

13	Quantity	769.571	408.164	0.615*	0.164	0.740	2.604	0.025*
	Quality	234.143	190.772	0.213	-0.102	-0.216	-0.759	0.464
14	Quantity	620.385	325.449	0.272	-0.112	-0.386	-0.645	0.533
	Quality	160.154	65.052	0.407	1.080	0.747	1.249	0.240
15	Quantity	707.308	420.767	0.153	-0.023	-0.104	-0.178	0.862
	Quality	179.154	66.128	0.214	0.431	0.303	0.518	0.616
16	Quantity	765.615	316.72	0.462	0.035	0.120	0.170	0.868
	Quality	198.077	72.160	0.482	0.476	0.372	0.527	0.610
17	Quantity	631.500	457.238	0.514	0.036	0.194	0.292	0.779
	Quality	168.800	46.053	0.534	0.659	0.363	0.546	0.602
18	Quantity	715.50	423.270	0.429	0.173	0.770	0.184	0.866
	Quality	197.83	87.703	0.420	-0.373	-0.344	-0.082	0.940

*p < .05, **p < .01, ***p < .001

Expressive Vocabulary at 2 Years

Table 5 summarizes the descriptive statistics and analysis results when examining the relationship between expressive vocabulary at 2 years with all potential predictor variables. As can be seen, expressive vocabulary at 2 years of age was not significantly correlated with any of the predictor variables.

The multiple regression model for all predictors at 6 months of age produced $R^2 = 0.168$, F (2, 9) = 0.906, $p = 0.438$, at 7 months of age produced $R^2 = 0.086$, F (2, 11) = 0.519, $p = 0.609$, at 8 months of age produced $R^2 = 0.178$, F (2, 10) = 1.083, $p = 0.375$, at 9 months of age produced $R^2 = 0.090$, F (2, 8) = 0.396, $p = 0.685$, at 10 months of age produced $R^2 = 0.105$, F (2, 7) = 0.410, $p = 0.679$, at 11 months of age produced $R^2 = 0.233$, F (2, 8) = 1.213, $p = 0.347$, at 12 months of age produced $R^2 = 0.025$, F (2, 8) = 0.101, $p = 0.905$, at 13 months of age produced $R^2 = 0.320$, F (2, 11) = 2.585, $p = 0.120$, at 14 months of age produced $R^2 = 0.187$, F (2, 10) = 1.148, $p = 0.356$, at 15 months of age produced $R^2 = 0.205$, F (2, 10) = 1.288, $p = 0.318$, at 16 months of age produced $R^2 = 0.073$, F (2, 10) = 0.395, $p = 0.684$, at 17 months of age produced $R^2 = 0.188$, F (2, 7) = 0.813, $p = 0.482$, and at 18 months of age produced $R^2 = 0.079$, F (2, 3) = 0.128, $p = 0.884$.

As can be seen in Table 5, the total number of words produced by caregivers (quantity) at 13 months of age had significant positive regression weight, indicating that caregivers who produced more utterances directed to their infants at this age were expected to have children with

larger expressive vocabularies at 2 years, after controlling for other variables in the model. All other predictor variables from 6 to 18 months of age did not significantly contribute to the multiple regression model for expressive vocabulary at 2 years.

Table 5
Summary Statistics, Correlations, and Results from the Regression Analysis (Dependent Variable = Expressive Vocabulary at 2 years)

Predictor Variables					Multiple Regression Weights			
Age in Months	Utterances	M	SD	r	B	β	t	p
6	Quantity	606.083	358.527	0.299	0.558	1.126	1.188	0.265
	Quality	163.417	65.038	0.193	-2.388	-0.874	-0.921	0.381
7	Quantity	571.786	241.274	0.274	0.082	0.113	0.215	0.833
	Quality	165.357	57.89	0.287	0.579	0.193	0.367	0.721
8	Quantity	605.769	289.558	0.417	0.193	0.309	0.557	0.590
	Quality	167.231	53.153	0.391	0.431	0.127	0.229	0.824
9	Quantity	652.182	378.61	0.257	0.262	0.516	0.786	0.454
	Quality	161.727	68.6797	0.141	-0.846	-0.302	-0.460	0.658
10	Quantity	571.70	352.962	0.306	0.103	0.193	0.370	0.722
	Quality	162.20	48.826	0.296	0.596	0.155	0.296	0.776
11	Quantity	517.000	279.558	0.250	-0.313	-0.494	-0.774	0.461
	Quality	142.455	54.564	0.419	2.760	0.851	1.332	0.220
12	Quantity	607.364	235.430	0.099	-0.021	-0.027	-0.053	0.959
	Quality	171.818	57.252	0.155	0.565	0.175	0.346	0.738
13	Quantity	769.571	408.164	0.518	0.290	0.679	2.226	0.048*
	Quality	234.143	190.772	0.115	-0.254	-0.279	-0.914	0.380
14	Quantity	620.385	325.449	0.401	0.056	0.101	0.167	0.871
	Quality	160.154	65.052	0.430	0.947	0.341	0.565	0.585
15	Quantity	707.308	420.767	0.300	0.364	0.847	1.581	0.145
	Quality	179.154	66.128	0.077	-1.758	-0.643	-1.201	0.258
16	Quantity	765.615	316.72	0.086	-0.286	-0.516	-0.664	0.522
	Quality	198.077	72.160	0.180	1.594	1.893	0.842	0.419
17	Quantity	631.500	457.238	0.379	0.317	0.769	1.077	0.317
	Quality	168.800	46.053	0.232	-1.819	-0.444	-0.622	0.554
18	Quantity	715.50	423.270	-0.009	0.334	2.224	0.500	0.651
	Quality	197.83	87.703	-0.043	-1.631	-2.250	-0.506	0.648

*p < .05, **p < .01, ***p < .001

Expressive Vocabulary at 3 Years

Table 6 summarizes the descriptive statistics and analysis results when examining the relationship between expressive vocabulary at 3 years with all potential predictor variables. As can be seen, expressive vocabulary at 3 years of age was not significantly correlated with any of the predictor variables.

The multiple regression model for all predictors at 6 months of age produced $R^2 = 0.147$, F (2, 9) = 0.778, $p = 0.488$, at 7 months of age produced $R^2 = 0.021$, F (2, 11) = 0.117, $p = 0.891$, at 8 months of age produced $R^2 = 0.080$, F (2, 10) = 0.435, $p = 0.659$, at 9 months of age produced $R^2 = 0.259$, F (2, 8) = 1.396, $p = 0.302$, at 10 months of age produced $R^2 = 0.352$, F (2,

7) = 1.900, p = 0.219, at 11 months of age produced R^2 = 0.016, F (2, 8) = 0.064, p = 0.939, at 12 months of age produced R^2 = 0.018, F (2, 8) = 0.074, p = 0.929, at 13 months of age produced R^2 = 0.000, F (2, 11) = 0.002, p = 0.998, at 14 months of age produced R^2 = 0.041, F (2, 10) = 0.216, p = 0.809, at 15 months of age produced R^2 = 0.059, F (2, 10) = 0.314, p = 0.738, at 16 months of age produced R^2 = 0.037, F (2, 10) = 0.191, p = 0.829, at 17 months of age produced R^2 = 0.151, F (2, 7) = 0.623, p = 0.563, and at 18 months of age produced R^2 = 0.600, F (2, 3) = 2.246, p = 0.253.

As can be seen in Table 5, no significant positive or negative regression weights were obtained between the criterion and predictor variables. Predictor variables from 6 to 18 months of age did not significantly contribute to the multiple regression model for expressive vocabulary at 3 years.

Table 6
Summary Statistics, Correlations, and Results from the Regression Analysis (Dependent Variable = Expressive Vocabulary at 3 years)

Predictor Variables					Multiple Regression Weights			
Age in Months	Utterances	M	SD	r	B	β	t	p
6	Quantity	606.083	358.527	0.100	0.107	1.194	1.245	0.245
	Quality	163.417	65.038	-0.024	-0.570	-1.155	-1.204	0.259
7	Quantity	571.786	241.274	0.135	0.007	0.058	0.106	0.917
	Quality	165.357	57.89	0.141	0.048	0.092	0.170	0.868
8	Quantity	605.769	289.558	0.274	0.042	0.393	0.671	0.517
	Quality	167.231	53.153	0.197	-0.082	-0.140	-0.239	0.816
9	Quantity	652.182	378.61	-0.119	0.033	0.707	1.193	0.267
	Quality	161.727	68.6797	-0.356	-0.245	-0.962	-1.625	0.143
10	Quantity	571.70	352.962	-0.261	0.014	0.306	0.689	0.513
	Quality	162.20	48.826	-0.555	-0.266	-0.778	-1.750	0.124
11	Quantity	517.000	279.558	-0.122	-0.021	-0.174	-0.240	0.816
	Quality	142.455	54.564	-0.093	0.036	0.059	0.081	0.937
12	Quantity	607.364	235.430	0.134	0.018	0.126	0.249	0.810
	Quality	171.818	57.252	0.103	0.007	0.012	0.023	0.982
13	Quantity	769.571	408.164	0.014	0.002	0.022	0.058	0.955
	Quality	234.143	190.772	0.000	-0.002	-0.013	-0.035	0.973
14	Quantity	620.385	325.449	-0.141	-0.040	-0.415	-0.634	0.540
	Quality	160.154	65.052	-0.054	0.149	0.311	0.476	0.645
15	Quantity	707.308	420.767	-0.214	-0.029	-0.399	-0.685	0.509
	Quality	179.154	66.128	-0.122	0.102	0.217	0.372	0.717
16	Quantity	765.615	316.72	0.192	0.017	0.174	0.220	0.831
	Quality	198.077	72.160	0.179	0.008	0.019	0.025	0.981
17	Quantity	631.500	457.238	0.381	0.019	0.527	0.722	0.494
	Quality	168.800	46.053	0.297	-0.060	-0.167	-0.228	0.826
18	Quantity	715.50	423.270	-0.755	0.007	0.605	0.207	0.850
	Quality	197.83	87.703	-0.771	-0.072	-1.371	-0.468	0.672

*p < .05, **p < .01, ***p < .001

Effect Size

While many of the analyses conducted resulted in statistically nonsignificant findings, large effect sizes were found between most criterion and predictor variables, as can be seen in Table 7 (with criterion variables listed horizontally and predictor variables listed vertically). This means that the majority of the differences between variables were large, implying strong relationships and suggesting clinical importance. In line with past statistically significant findings in the literature, while effect sizes were only small to medium for the quantity variable across all ages and expressive vocabulary at 3 years of age, effect sizes were profoundly large for the quality variable across all ages and expressive vocabulary at 3 years of age. The clinical importance of these results is that larger variety in vocabulary produced by caregivers directed to infants is related to future vocabulary ability in this group of children who are typically developing.

Significance tests can be confounded by sample size, while effect size simply quantifies the difference between two groups. As such, it could be that the small sample size of 14 infants in the present study obscured our ability to quantify statistically significant results, while the magnitude of the effect sizes observed shows that caregiver input quantity, and to an even greater extent, caregiver input quality, are exhibiting a strong influence over later vocabulary outcomes.

Table 7
Effect Sizes (Cohen's d) between Criterion and Predictor Variables

Age in Months	Utterances	Expressive Vocabulary at 1 Year of Age	Receptive Vocabulary at 1 Year of Age	Expressive Vocabulary at 2 Years of Age	Expressive Vocabulary at 3 Years of Age
6	Quantity	2.010	1.376	0.838	0.176
	Quality	1.076	1.052	1.572	9.632
7	Quantity	2.708	1.787	0.960	0.460
	Quality	1.147	1.066	1.578	10.540
8	Quantity	2.454	1.676	0.987	0.219
	Quality	1.204	1.066	1.576	11.218
9	Quantity	2.077	1.475	0.958	0.005
	Quality	1.031	1.053	1.574	9.236
10	Quantity	1.906	1.263	0.725	0.316
	Quality	1.158	1.157	1.626	12.074
11	Quantity	2.104	1.303	0.632	0.673
	Quality	0.845	1.390	1.764	11.559
12	Quantity	2.969	2.025	1.147	0.259
	Quality	1.241	0.984	1.530	10.491
13	Quantity	2.331	1.770	1.274	0.410

	Quality	1.028	0.081	0.744	3.052
14	Quantity	2.263	1.566	0.960	0.132
	Quality	1.032	1.093	1.597	9.695
15	Quantity	2.059	1.515	1.048	0.189
	Quality	1.277	0.847	1.450	9.193
16	Quantity	2.948	2.230	1.549	0.510
	Quality	1.474	0.589	1.290	8.199
17	Quantity	1.670	1.169	0.756	0.060
	Quality	1.272	1.080	1.581	12.421
18	Quantity	2.074	1.533	1.068	0.216
	Quality	1.342	0.544	1.249	6.915

A Cohen's d of 0.2 is interpreted as a small effect size, of 0.5 as medium, and of 0.8 as large.

Discussion

Through this study, we aimed to evaluate the relationship between directed caregiver language input, specifically quantity (total number of words) and quality (total number of different words) and expressive and receptive vocabulary development in toddlers. Previous research has indicated that both quantity and quality of caregiver language input has a significant relationship with vocabulary development, but quality is more significant (Rowe, 2012). Through a correlation and multiple regression analysis, a cohort of 14 parent and infant dyads were evaluated to determine the role quantity and quality play in vocabulary development for these specific children. While only some statistical significance between the predictor and criterion variables was found, there was a great deal of clinical significance as observed through the large effect sizes.

Significant correlation results showed a relationship between the quantity of caregiver input at 8 and 17 months, expressive vocabulary at 1 ½ years of age increased. A relationship between caregiver input at 8, 9, and 13 months and receptive vocabulary size at 1 ½ years of age. No significant correlation results were found between quantity and quality of caregiver input and vocabulary size at 2 or 3 years of age. Multiple regression results showed significant and positive results between the quantity of caregiver input at 8, 9, 13, 15, and 17 months of age and expressive vocabulary at 1 ½ years of age; the quantity of caregiver input at 8 and 13 months of age and receptive vocabulary at 1 ½ years of age; and the quantity of caregiver input at 13

months of age and expressive vocabulary at 2 years of age. Multiple regression results also showed significant and positive results between the quality of caregiver input at 8 months of age (and) receptive vocabulary at 1 ½ years of age. No significance was found for expressive vocabulary at 3 years of age. This information suggests that there is a relationship between the quantity and quality of caregiver input across some infant ages and early expressive and receptive vocabulary development (prior to 3 years of age). This information follows similar findings in previous research in that quantity and quality are related to vocabulary development (Rowe, 2012).

Beyond statistical significance, however, effect sizes demonstrated substantial clinical relevance for caregiver input on later vocabulary size. Practical significance was seen between all variables across ages through large effect sizes. Especially notable were results at 3 years of age. Here, the quality of caregiver input across all infant ages consistently showed a large effect on later expressive vocabulary; while the quantity of caregiver input never exceeded a medium effect. These findings follow the trend found in previous research in that quality of caregiver input to infants has proven to have a stronger relationship than quantity. This information supports the notion that if caregivers produce a greater number of different words, their child is likely to have a larger vocabulary.

There are several factors that could be related to the statistical and clinical significance of the results. One thing to consider was the fact that all of the children in this study were typically developing. As a result, we observed what may be considered a ceiling effect with results on the CDI at 3 years of age, where all children were reported to produce all words on the inventory. Therefore, we may not have observed true expressive ability at 3 years of age. Another consideration is the presence of caregivers at each recording; was the father present, was the

mother present, were both the father and mother present? All of these questions could have altered the values for quantity and quality of caregiver input. Finally, we can consider the fact that there were no measures of receptive language ability at 2 and 3 years of age. We may have found more significant results if we were able to incorporate such a measure.

As seen in the data, quantity is important and does play a role in vocabulary development across infant ages, although the clinical significance that quality of caregiver input appears to be more important. For quantity and quality across infant ages, effect sizes were within similar ranges at 1 ½ and 2 years of age, suggesting both played an equally important role, with the exception of some months at 2 years of age. However, given smaller effect sizes and statistical significance with expressive vocabulary at 3 years of age, we can conclude that quality plays a more important role on later vocabulary skills as children age.

Another aim of this study was to determine if our data collection and analysis methods were appropriate. Using our methods, would we find results similar to those in published research? Through this research study, we have been able to determine that the data collection methods were appropriate as our results relating to clinical significance were in line with published research.

Clinical Implications

Statistically significant results indicated some relationship between the quality of caregiver input to these infants and later expressive and receptive vocabulary size. More considerable, however, was the clinical significance observed through effect sizes. The current study is more or less in line with previous research showing that while total number of words directed to the infant (quantity) is important, the total number of different words directed to the infant (quality) is more significant at some ages. Clinically, this notion is important as we know

that environmental factors are significantly related to infants' vocabulary development. It is imperative to consider which environmental factors are most significant with regards to language development so that we can focus on conveying that information to caregivers.

Caregiver education is a major component to the roles and responsibilities of a speech-language pathologist. Providing caregivers with information on the importance of quality and quantity of directed language input is likely to increase their awareness and potentially increase the qualitative and quantitative aspects of their language input. As the qualitative and quantitative aspects of directed caregiver utterances increases, it has been shown that later toddler vocabulary sizes will increase as well (Rowe, 2012).

Increasing caregiver awareness is also related to the occurrence of early intervention. If clinicians are able to provide accurate information on the clinical importance of expressive and receptive vocabulary development, caregivers may be better able to look for indicators of a need for early intervention. If early intervention is provided sooner, children may be able to develop appropriate vocabularies sooner rather than later, which may be significant for future literacy skills.

Larger vocabularies are related to increased literacy skills (Leffel, & Suskind, 2013). Providing caregiver education regarding what factors are related to language development may result in increased vocabulary size, and therefore increased literacy skills. As reported by Duff, Reen, Plunkett, and Nation (2015), increased literacy skills may better prepare children for academic success. As larger vocabularies can be associated with increased literacy skills, and further with academic success, it is imperative to consider the role caregiver language input plays on vocabulary development and increase caregiver awareness of these findings.

Study Limitations

While we have observed clinical significance, this study does have a number of limitations. The small sample size is one major limitation. A sample size of 14 infants is small and may have contributed to the lack of statistical significance found within the study. We did have a great deal of data after coding and analyzing the audio recordings, however, we were mostly only able to establish clinical significance from the information. Because of this, further research is needed with a greater number of participants in order to determine statistical significance and be able to generalize the information found in the study.

A second limitation was the fact that we did not assess inter-rater reliability within the study. Each recording session was evaluated by a trained lab assistant; however, the recordings were not reanalyzed a second time to determine inter-rater reliability. This is a threat to the internal validity of the study in that we cannot establish the validity of the values as they were only evaluated on one individual occasion. In future studies, inter-rater reliability should be assessed in order to increase reliability, and as a result be able to generalize the information found in the study.

Each recording file was coded, transcribed, and analyzed for different values on different occasions by different lab assistants. A study limitation is the potential occurrence of human error during the data analysis. While each lab assistant followed the same instructions and guidelines, there was still a possibility for individual human error. However, all lab assistants were trained by three graduate students in similar, if not the same manner. Additionally, while coding, transcribing, and analyzing the data, the lab assistants worked independently on each file, but brought any questions or concerns about particular files to other lab assistants in order to gain a second opinion, gaining consensus for questionable data. The potential for human error is

present, however, many parameters were in place in order to lessen or prevent the occurrence of human error.

While data at each month of age for every infant was to be evaluated, there were a number of data points, or infant ages in months, that did not have actual data present. This was a result from two main issues: lack of recording session for the specific month during the collection of data in the longitudinal study or technical difficulties either from hardware or software malfunction. These data errors were not common, but did occur, and could have decreased the reliability of the results.

One final limitation of this study centers on the notion that the sample population was not diverse making it difficult to generalize. Data was collected from only children who were typically developing and had no indicators for potential speech or language problems. Also, infants from various socioeconomic status were not included. For these reasons, the information generated from the study cannot be generalized to all populations. However, it is not uncommon for studies to first be conducted on children who are typically developing before progressing to children who are at risk for developmental difficulties/disorders.

Future Directions

This study has the potential for great expansion and investigation. One major direction for future studies would be to look at quality or caregiver input in greater detail. This could specifically include various parts of speech and how the implementation of them, by the caregiver, could be related to vocabulary development. Future authors could investigate how nouns, verbs, auxiliaries, etc. relate to vocabulary development and at what age we begin to see a significant difference. Furthermore, it could be advantageous to investigate the use of different morphemes as presented by the caregivers. It may be valuable to determine at which age the use

of grammatical morphemes are most significant and if certain morphemes are related to greater, or even earlier vocabulary growth. Another way to explore the quality of caregiver input in greater detail would be to include the type of questions presented to the infants. As previously referenced, wh- questions can be helpful in development of greater vocabulary (Rowe, Leech, & Cabrera, 2016). It would be interesting to see how not only wh- questions, but even simple yes/no questions are related to vocabulary development.

Another aspect that could be included in a future study is to look at what caregiver is providing the language input. It would be worth investigating whether input from mothers or fathers has a significant difference relating to vocabulary development of their children. Also noteworthy would be other types of caregivers, whether grandparents, nannies, day care providers, etc. In this study, a majority of the recording sessions took place with the mother, a number included the father, and an even smaller number included an extended relative such as a grandmother. Due to time constraints, we were unable to differentiate between the utterances provided by the different caregivers. However, this could be an area of interest for a future study.

Altering the participant sample is another direction this study could explore. Changing the participant sample increases external validity allowing for greater generalization to a larger population of people. Expanding the participant sample to include a more diverse group of infants and caregivers could provide more information and generalize to a larger number of people. Increasing the sample size to increase the internal validity is a central concept that could lead to greater statistical significance as well as higher likelihood of generalization. Although not considered in this study, socioeconomic status (SES) can be a major factor that is related to vocabulary development. Considering SES by including individuals from varying economic backgrounds could increase awareness for individuals who may benefit from increased caregiver

education regarding quantity and quality of the caregiver language. Including a more diverse population based on number of languages spoken may also be an area of interest. Bilingual upbringings are beneficial to vocabulary development, but it would be interesting to see if quantity and quality play a different role in this population than they do in the primarily monolingual population of the current study.

Each of these future directions can provide greater insight into the roles that caregivers play in the development of their child's vocabulary. Our variables, specifically the quality of caregiver language input, can be broken down into much smaller and specific aspects, which may further increase caregiver awareness. By increasing caregiver awareness, children may be more likely to develop larger vocabularies, which can lead to educational preparedness and support literacy skills.

Conclusion

Through correlation and multiple regression analysis we demonstrated that the total number of words and the total number of different words directed to an infant is related to vocabulary development for this cohort of children who were typically developing. While there are limitations to this study, clinical significance is still a major component. From this information, caregiver education can be implemented. Increasing caregiver awareness may result in increased quality and quantity of caregiver language input and larger vocabularies. Toddlers with increased vocabularies will have the potential for increased literacy skills leading to better preparation for school and academic success in their futures.

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