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The Effect of Questions in Caregiver Input to Infants on Later Vocabulary Development

by

Laila Samaha

A thesis to be

submitted in partial fulfillment

of the requirements for the degree of

Master of Science in the Department of Communication Science and Disorders

Idaho State University

Spring 2019

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Committee Approval

To the Graduate Faculty:

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

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September 17, 2018

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RE: regarding study number IRB-FY2019-67: The Effect of Questions in Caregiver Input to Infants on Later Vocabulary Development

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Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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The Effect of Questions in Caregiver Input to Infants on Later Vocabulary Development

Thesis Abstract—Idaho State University (2019)

Infant vocabulary development is influenced by caregiver language input. Numerous studies have investigated the quality of caregiver input relating to later infant vocabulary size; however, caregiver use of questions has not been investigated as a quality input measure. Accordingly, the purpose of this study was to determine how the quantity of caregiver input, caregiver use of wh-questions and other question forms, and caregiver use of statements presented to infants related to later vocabulary skill. Archived data from 14 caregiver-infant dyads were explored in this study. It was hypothesized that types of questions posed by caregivers to infants between 6 to 18 months of age would support later vocabulary development. Results indicated some statistical significance between groups, and effect size values suggested substantial clinical significance. Findings from the study can be used by speech-language pathologists to provide caregiver education regarding the impact of question forms on potential vocabulary development in infants.

Key Words: quantity and quality of caregiver input, question forms, infants, caregivers, vocabulary development, speech language pathology

The Effect of Questions in Caregiver Input to Infants on Later Vocabulary Development

Chapter 1 Introduction

Early measures of language skill, including rate of vocabulary growth and vocabulary use, have been identified as predictive measures of later school-age success (Hart & Risley, 2003). Children with more advanced language abilities, especially larger vocabularies, have better reading comprehension and decoding skills than children with weaker language abilities (Braze, Tabor, Shankweiler, & Mencel, 2007; Duff, Reen, Plunkett, & Nation, 2015). One study found that delayed vocabulary development and a family history of language or literacy deficits in 2-year-olds resulted in elevated risk for developing reading difficulties (Duff et al., 2015). Similar literature found that vocabulary deficits are often apparent in children who have language and reading difficulties including specific language impairment and poor reading comprehension (Catts, Adlof, & Ellis Weismer, 2006; McGregor, Oleson, Bahnsen, & Duff, 2013). Vocabulary deficits that are often apparent in children with language impairment and are characterized by an overall smaller vocabulary size and only surface knowledge (rather than deeper understanding) of the words that are within their lexicon (McGregor et al., 2013).

It is critical for children to develop vocabulary from an early age due to the fact that vocabulary growth trajectories decrease as children grow older. Jiang, Logan, and Jia (2018) followed a cohort of 420 children from prekindergarten until third grade. They investigated two important contributors to reading comprehension, grammar and vocabulary skill. The results showed that prekindergarten skill and growth trajectories in grammar and vocabulary are quite distinguishable. Preschool grammar indicators explained an average of 25% of the variance in third-grade grammar ability. Vocabulary differences, on the other hand, made up about 50% of the variance in third-grade vocabulary ability. Jiang and colleagues (2018) explained that

vocabulary skill becomes increasingly stabilized over time, even more so than grammar skill. Interestingly, the study revealed a close relationship between children's developmental trajectories in grammar and vocabulary. In other words, children with high levels of vocabulary at age 5 also tended to have high levels of grammar at age 5 (Jiang et al., 2018). As demonstrated by this study, children's vocabulary skills are closely related to other language skills, including grammar. Adding to the complexity of the relationship between vocabulary and language skill, Adlof and Patten (2017) found that nonword repetition and vocabulary knowledge explained up to 44% of the variance in word-learning abilities. Furthermore, vocabulary knowledge was a strong predictor of verbal semantic recall (Adlof & Patten, 2017).

In addition to academic success, vocabulary skill is related to social competence and social acceptance in children. Bornstein, Haynes, and Painter (1998) found that social competencies, such as saying "please," expressing feelings, and use of social skills when speaking with others, require higher levels of vocabulary ability. These findings suggest that a child's vocabulary plays an important role in global language skills. Gertner, Rice, and Hadley (1994) found that limited language ability is related to lower levels of acceptance among peers. Language ability served as a better predictor of peer status than measures of age and intelligence, meaning that communication abilities play an important role in the formation of peer relationships. These findings imply that children with limited language abilities are less adept at using language to establish and maintain friendships in early childhood than children with typically developing language (Gertner et al., 1994). Thus, understanding factors that influence vocabulary development is important to mediate children's academic, language, and social outcomes.

Determining predictors of language skill in development is challenging due to the substantial variability across children (Fenson et al., 1994). Many environmental factors including gender, maternal age at birth, behavioral problems, birth weight, and socioeconomic status (SES) can influence an infant's risk for being a late-talker (Hamer et al., 2017). Furthermore, research has documented a positive relationship between caregiver[1] linguistic input to children and vocabulary acquisition. Hart and Risley (2003) found that differences in SES impact the quantity of input (number of words) caregivers provide to children, which in turn, impacts vocabulary development. Other studies have begun to detail the relationship between the types of words spoken by caregivers to children and later vocabulary development (Rowe, 2012). Ultimately, we know that caregivers can support vocabulary development by altering their language use to children in the first years of life.

Further, speech-processing efficiency mediates the relationship between child-directed speech and vocabulary development. The influence of language input on infants' speech-processing skill serves as an essential link between early language experience and later vocabulary knowledge (Weisleder & Fernald, 2013). Sustaining infant attention is critical to increasing opportunities for language input. Research supports that infants have longer attention latencies for infant-directed (ID) singing in comparison to adult-directed speech or ID speech (Corbeil, Trehub, & Peretz, 2016; Tsang, Falk, & Hessel, 2012). Thus, caregivers who use speech imitating the rising and falling patterns of ID singing may have more success in sustaining infant attention. Question forms carry unique prosodic features, which are preferred by infants. However, parental use of questions posed to infants has not been investigated to its

[1] For the purposes of this study, *caregiver* is defined as an individual who spends a significant amount of time with the child and provides basic needs for the child. Primary caregivers participating in this study were mostly made up of mothers; however, fathers occasionally participated in the study as well as extended family members such as grandparents.

full extent as a quality input measure predictive of future vocabulary development. For example, given findings that ID singing preferentially sustains infant attention over ID and adult-directed speech, would the unique intonation/prosodic patterns of questions directed to infants also preferentially sustain infant attention over other question types directed to infants, and therefore support vocabulary development to a greater degree?

Caregiver Input Measures

Caregiver linguistic input to prelinguistic infants can support or hinder future language ability. Socioeconomic status is intricately linked to caregiver linguistic input; SES has been evidenced to play strong role in language development (Hammer et al., 2016; Hart & Risley, 2003; Hoff-Ginsberg, 1991; Rowe, 2012). Hart and Risley (2003) estimated that the average child from a higher SES was exposed to 215,000 words of language experience in a 100-hour week compared to 62,000 words for the average child in low-SES families. By age 4, this difference in language-rich exposure has been documented to render a difference of approximately 32 million words in vocabulary exposure. These large disparities in language exposure affect school readiness, given that vocabulary knowledge serves as a strong predictor for academic success. Hammer and colleagues (2016) found that children from a lower SES were seven times more likely to have low reading scores, nearly 15 times more likely to have low math scores, and almost four times more likely to have difficulties with approaches to learning.

Vocabulary differences in development may stem, at least to some degree, directly from differences in caregiver linguistic input to infants (Hammer et al., 2016; Hart & Risley, 2006; Rowe, 2012). For example, Hart and Risley (2003) found that caregivers from higher SES groups produced more affirmatives (encouraging words such as “Great job!”) and fewer prohibitions (prohibiting words such as “No”) when speaking to their children. Caregivers from

higher SES groups were more responsive to their children and produced more diverse input in terms of number of nouns and modifiers per hour (Hart & Risley, 2003). Similar findings from Hoff-Ginsberg (1991) indicated that upper-middle-class mothers talked more, produced longer utterances, used a richer vocabulary, and were more responsive conversational partners with their children than working-class mothers. These findings are clinically relevant as caregivers may not be in direct control of environmental factors influencing language development; however, if provided proper intervention by a speech-language pathologist, caregivers may be able to adjust their linguistic output to support early language success. The relationship between measures of linguistic input and vocabulary development are important because they may enable earlier identification of children at-risk for language disorders. Moreover, understanding specific features of caregiver input that influence vocabulary development may help clinicians understand the underlying mechanisms involved in vocabulary learning.

There are a number of ways caregiver linguistic input can be defined, and each influence vocabulary outcomes to differing degrees. To begin with, both the quantity and quality of caregiver linguistic input should be considered. Quantity can be defined as the number of words used by a caregiver when speaking to his/her child, and this can be further broken down into the number of words spoken directly to the child versus the number of words spoken in the child's presence (some directed and some not directed to the child). Quality, on the other hand, is more closely tied to specific elements of the linguistic input, such as the number of unique or novel words spoken to the child, the types of words spoken (e.g., adjectives, nouns, verbs, etc.), the types of sentence structures used, the types of morphemes used, and so forth. For example, one study including 12 children with expressive language delay found that mother's use of responsive language including imitation, interpreting, and expansion was positively correlated

with later measures of child language including number of different words used by the child and vocabulary size (Girolametto et al., 1990). The same study found that measures of maternal language complexity including mean length of utterance (MLU), or talkativeness (i.e., quantity) did not have an effect on later measures of child language (Girolametto et al., 1990). A similar study assessing caregiver input found that with quantity of caregiver input and SES controlled for, quality of input measures related to child vocabulary skills at different points in development (Rowe, 2012). Results from this study indicated that at 18 months, quantity of parent input was more strongly related to later vocabulary skill than quality of input. At 30 months, input rich in vocabulary diversity and sophistication was more strongly related to vocabulary skill 1 year later. At 42 months, parent's use of decontextualized language was related to later vocabulary skill. Per study design, decontextualized language included the use of narratives as events that happened in the past or will happen in the future (Rowe, 2012). These findings are important as they suggest that qualitative input plays an important role in language development. Furthermore, results from Rowe (2012) suggest that caregivers are able to support language growth by providing specific input to children at different stages of development.

Melodic Intonation

By adjusting the type of linguistic input they provide, caregivers can support language and vocabulary development resulting in greater academic success. However, more can be discerned to help determine what type of linguistic environment is optimal for vocabulary growth. Linguistic input that optimally sustains infants' attention may be key for caregivers, such as motherese (ID speech). Motherese is a type of speech that both mothers and fathers use when directing speech to infants. Its form is categorized by a higher mean pitch, wider pitch range, longer pauses, shorter phrases, and more prosodic repetition (Fernald & Simon, 1984). Prosodic

contours are defined as a specific contour type (i.e., rising, falling, flat), followed within the next two utterances by the same contour type, or a whispered utterance, followed within the next two utterances by another whispered utterance. This type of speech melody exemplifies language addressed to infants to a much greater degree than that addressed to adults (Fernald, 1989). Most importantly, when compared to the prosodic form of adult-directed speech, Fernald (1989) found that the prosodic form of motherese led infants to understand the communicative intention of the speaker to a great extent. For example, the high intensity and sudden rise time in prosodic cues are typical of prohibition vocalizations (i.e., instructing the infant to stop a behavior using spoken cues only). Such vocalizations tend to be assertive and interrupt infant behavior. As indicated by Hart and Risley (2003), prohibition vocalizations are more commonly used by caregivers from lower SES. Acoustic vocalizations for attention-bids (i.e., calling for the infant's attention using spoken cues only) and approval vocalizations (i.e., acknowledging positive behavior of the infant using spoken cues only) tend to be more exaggerated prosodic contours, which are more highly preferred by infants. Hart and Risley (2003) stated that the acoustic pattern of approval vocalization are more commonly used by caregivers from higher SES. Infants are predisposed to comforting vocalizations characterized by low frequency, continuous sounds in mothers' speech (Fernald & Simon, 1984).

Infants are naturally more responsive to certain prosodic features of mothers' speech, suggesting that certain prosodic features are more accessible to infants and differential in their effects on infant behavior (Fernald, 1989). These ideas are supported by a more recent body of evidence suggesting that speech addressed directly to the infant, and not speech overheard by the infant in adult conversations, facilitates vocabulary learning between 19 and 24 months (Weisleder & Fernald, 2013). The results of these two studies imply that caregivers who utilize

speech methods that sustain infant attention for longer periods (speech with distinct melodic contours) may facilitate vocabulary acquisition, because infants who engage with more ID speech orient toward familiar words more quickly and accurately when interpreting speech in real time.

Speech-processing efficiency mediates the relationship between child-directed speech and vocabulary development. A critical path from early language experience to later vocabulary knowledge is the influence of language exposure on infants' speech-processing skill (Weisleder & Fernald, 2013). Thus, infants who are better able to process speech learn new words faster, increasing their vocabulary growth more efficiently. In summary, ID speech is preferred by infants, sustains attention for longer periods of time, and has been attributed to later vocabulary ability. Further, it may be that the melodic intonation and prosodic cues of ID speech, specifically, mediate and guide language development.

A growing body of evidence suggests that ID singing is more effective in sustaining infant attention than adult-directed, or even ID speech (Corbeil, Trehub, & Peretz, 2016; Tsang, Falk, & Hessel, 2012). Infants not only prefer ID singing, but demonstrate higher engagement with maternal singing than maternal speech (Tsang, Falk, & Hessel, 2012). Similar to ID speech, ID singing is effective in sustaining infant attention due to the temporal aspects and prosodic cues. Jones and Boltz (1989) proposed that the temporal pattern of ID singing is enhanced by a regular beat, metrical organization (i.e., change in rate and/or pulse), and tempo. These characteristics facilitate predictive listening and allow infants to identify subsequent events. Infant-directed singing has been shown to have salient behavioral effects on infants as well. One study of premature infants found that infants who were provided with music therapy showed favorable vital signs, sleep patterns, and feeding behaviors as compared to infants who did not

receive music therapy (Loewy, Stewart, Dassler, Telsey, & Homel, 2013). These findings suggest that melodic input not only sustains infant attention for longer periods of time, but also serves to stimulate infant development during critical periods of growth. Furthermore, ID singing significantly improved the adverse environmental factors of low birth weight and premature birth, which are known risk factors for language impairment. When caregivers use ID speech or ID singing, they are able to sustain their infant's attention for longer periods of time, thus establishing better speech-processing skills, which leads to higher vocabulary knowledge. Caregivers should use ID speech and singing to sustain infants' attention for longer periods of time in addition to using language with natural melodic intonation.

Wh-Questions

Caregivers use a variety of question forms to communicate with their children. Question forms can be defined in a number of ways. Wh-questions, for example, are questions that are framed with who, what, where, when, why, or how. Such forms of questions are more demanding of children as they require more complex verbal responses than other types of question forms (Rowe, Leech, & Cabrera, 2016). Yes/no questions are defined as questions that elicit a yes or no response (i.e., Would you like some water?). Choice questions are defined as questions that offer a choice of two parts, which are connected by the conjunction "or" (i.e., Is your baby a boy or girl?). Finally, tag questions are defined as questions with two parts, where the first part is positive, and the second part is negative or vice versa (i.e., You are going to the movie, aren't you?; Rowe et al., 2016).

As previously stated, infants prefer exaggerated speech contours (Fernald, 1989). Normal intonation patterns of standard American English (SAE) are characterized by their rising patterns when posing questions (Levis, 1999; Liu & Xu, 2007; Hedberg & Sosa, 2015). Given the distinct

melodic intonation inherent to question forms, it can be hypothesized that infants prefer and are able to sustain attention for longer periods of time when caregivers' pose questions rather than statements. Caregiver use of questions mimic the infant-preferred prosodic elements of speech, while also supporting language development. For example, wh-questions may support vocabulary development as they require children to produce a more complex verbal response (e.g., greater MLU; Rowe et al., 2016). Therefore, it can be hypothesized that wh-questions may support language development to an even greater extent than other question forms.

Previous studies have investigated the relationship between caregiver use of wh-questions and infants' later vocabulary skill. Rowe and colleagues (2016) examined fathers' from low income homes use of wh-questions with their 24-month children. Evidence from the study suggested that fathers' use of wh-questions is positively and significantly related to children's concurrent vocabulary skill 1 year later. In addition, caregiver use of wh-questions was directly associated with later verbal reasoning skills at 36 months. Stronger verbal reasoning skills were found to be due, in part, to higher vocabulary skills. Given such evidence, Rowe and colleagues (2016) argued that children's ability to listen to salient attentional and non-verbal cues in the environment result in an efficient and rapid way to practice, thus verbally demonstrating ability to link referents to objects.

In similar literature, Goodwin, Fein, and Naigles (2014) found that caregiver use of wh-questions was significantly related to higher comprehension ability in children. These findings were significant after mother's general language complexity (MLU) and children's general language level (number of word types including types of wh-question used, presence of an auxiliary verb, subject question, object question, and/or complex questions) were controlled for. The researchers suggested that higher levels of comprehension may be associated with the

"movement" involved in wh-questions. Wh-question movement refers to a special type of word order when the wh-word (or phrase with the wh-word) appears at the front of the sentence, or clause instead of later in the sentence. In line with other studies of caregiver input measures, Rowland, Pine, Lieven, and Theakston (2003) found that acquisition of wh-questions could be predicted based on the frequency with which particular types of wh-words and verbs occurred in input. Again, these results suggest that language growth fluctuates in parallel with parental linguistic input; the greater and more diverse the input, the more sophisticated the language development. This study relied heavily on examining individual differences between mothers, and searching for corresponding differences between children. Limitations included failure to investigate the length of parent utterances, and how frequently caregivers produced declaratives, interrogatives, verbs, nouns, and pronouns in relation to child acquisition of wh-questions. These limitations warrant future research of individual differences in language acquisition as influenced by parent wh-question use. More specifically, future research should investigate vocabulary ability across children as related to parental use of wh-questions.

Purpose

Accordingly, the *long-term* goal of this research is to determine how various aspects related to the quantity and quality of caregiver input in infancy (e.g., the total number of words spoken to the infant, the number of different words spoken to the infant, the type of questions presented to the infant, etc.) impact later speech and language abilities. This will provide a means to educate families of children who are at risk in supporting language development and help clinicians to better counsel caregivers. The present proposal aims to explore the use of caregiver question type (wh- versus all other question forms) to infants who are typically developing in relation to later expressive and receptive vocabulary abilities in those same children. The

objective is to determine how caregiver use of wh-questions or other question forms relates to later vocabulary skill. The *central hypothesis* is that caregiver input measures (wh- and other question forms) with infants between 6 to 18 months of age will relate to later vocabulary development (expressive and receptive vocabulary size at 1 year of age and expressive vocabulary size at 2 and 3 years of age). This hypothesis was formulated based on research which suggests that caregiver input plays an important role in vocabulary acquisition. The *rationale* for the proposed research is that once we know how caregiver wh- and other question forms impact vocabulary development in children who are typically developing, we can explore the impact in children who are at risk and begin to develop a means for educating caregivers on components of vocabulary development that support future academic success. Clinicians who provide early intervention can use this knowledge in diagnosis and treatment to support families of children with delayed or disordered language development.

Chapter 2 Methods

Participants

Archived data for this project were obtained from 14 caregiver/infant dyads video/audio recorded monthly between 6 and 18 months of age in a longitudinal study conducted by Ramsdell-Hudock at East Carolina University (see Ramsdell-Hudock, Stuart, & Peterson, 2018 for additional detail). A cohort of 16 caregiver/infant dyads was recruited to participate in the original longitudinal research study. Recruitment guidelines specified that the primary language spoken in the home must be English. Two of the participants reported that they spoke a language other than English in the home setting. For the purposes of the present study, one of these infants will be excluded as the caregivers spoke primarily Arabic to the child throughout the recordings, and the other will be included as the caregivers spoke only English to the infant throughout the recordings. A second infant will be excluded from the present study due to atypical speech/language development.

In order to recruit participants, 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.

According to caregiver report, all families were of middle SES. 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 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, one male infant was Asian American (father of East Indian descent and mother of Vietnamese and Hawaiian descent), and the remaining 12 infants were Caucasian. One male infant was from a home where English, Indian, and Vietnamese were spoken (with English as the primary language spoken). 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. Regardless of language background or hearing status, all infants demonstrated typical speech and language development during the recording period, a point supported by speech and language abilities within normal limits at follow-up testing conducted with each child at 3 ½ years of age.

Materials and Procedure

Original study approval from the University and Medical Center Institutional Review Board at East Carolina University was collected prior to data collection. Each caregiver provided 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. Caregiver/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 once a month for hour-long recordings. Caregivers were instructed to interact and play with their infants as they typically would in a home setting during recordings. 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. Throughout 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. Caregiver utterances were located using a breath-group criterion (i.e., each vocalization occurred on a single egressive breath; Oller & Lynch, 1992). Caregiver utterances that were directed toward the infant were coded and orthographically transcribed for all recordings, for every infant, at every age. The middle 20-minutes of each 60-minute recording were used for transcription and analysis. In the event of hardware dysfunction or camera abnormalities, the first 20-minutes of a recording were used for analysis and transcription. Similarly, the last 20-minutes were used if both the middle and first portions of the recording were not functional. Once located, each utterance was coded as either directed toward the infant or not directed toward the infant. Utterances were coded as directed toward the infant when the caregiver spoke directly to the infant (i.e., response, request, or clarification), or nonverbally indicated directedness (through eye gaze). Utterances were coded as not directed to the infant when the caregiver spoke to someone else in the room (i.e., family members, researchers), to someone on the phone, or as indicated either verbally or nonverbally. To decrease subjectivity, lab assistants worked together to reach a consensus on coding of particularly challenging utterances.

Once coded, lab assistants orthographically transcribed each utterance directed to the infant. Utterances were transcribed orthographically into a Microsoft word document allowing researchers to determine the total number of utterances spoken by caregivers. This served as a measure of overall quantity in the transcripts. Questions were then categorized into two types: wh-questions and other question forms. A wh-question was coded only when the question contained a main (lexical) verb, copula verb, or object immediately following the wh-question.

Questions without a main verb, copula verb, or noun following the wh-question (i.e., what? who?) were excluded from data analysis based upon published methods that found these types of wh-questions do not initiate the same type of complex verbal response from infants as wh-questions attached to verbs (Rowe et al., 2016). Other question forms were defined as; questions that evoke a yes or no response (e.g., Do you want juice?), choice questions (e.g., Do you want this toy or that toy?), tag questions (e.g., You like animals, right?), and any other question forms.

Vocabulary ability. *The MacArthur-Bates Communicative Development Inventory* (CDI) was the parent report measure of vocabulary for the present study (Fenson et al., 1997). 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, expressive vocabulary was tallied 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. Further, receptive vocabulary was tallied at one year (15 to 18 months).

Design

Correlation and multiple regression analyses were conducted to examine the relationship between all criterion and predictor variables (shown 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 the total number of words spoken to the infant, the number and type of questions posed by caregivers to infants (wh-questions versus other question forms), the number of statements posed by caregivers to infants, and infant age from 6 to 18 months. A significance level (*p)* was set at 0.05 for the purpose of this study.

Chapter 3 Results

Caregivers produced a total of 8,341 words in the middle 20 minutes of 60-minute recordings with their 14 infants from 6 to 18 months of age. From these words, there were 1455 total statements directed to the infant, 735 total questions (258 wh-questions and 385 other question forms) directed to the infant. 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. Vocabulary scores for each infant as measured via the CDI are shown in Table 2. Descriptive statistics show an increase in vocabulary with an increase in infant age, which follows typical developmental patterns.

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 following variables were positively and significantly correlated with expressive vocabulary at 1 ½ years of age: total words at 8 and 17; total questions at 13 and 17; total wh-questions at 17; and other questions at 8, 9, 10, 12, 13, 15, and 17 months of infant age. Higher values at these ages were related to larger expressive vocabulary at 1 ½. Other questions at 18 months of infant age was negatively and significantly correlated with expressive vocabulary at 1 ½ years of age, indicating that the fewer other questions, the larger the 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 $R^2 = 0.328$, $F\ (5, 6) = 0.587$, $p = 0.712$, 7 months of age produced $R^2 = 0.409$, $F\ (5, 8) = 1.109$, $p = 0.426$, 8 months of age produced $R^2 = 0.593$, $F\ (5, 7) = 2.038$, $p = 0.190$, 9 months of age produced $R^2 =$

0.871, F (5, 5) = 6.776, p = 0.028, 10 months of age produced R^2 = 0.915, F (5, 2) = 4.283, p = 0.2, 11 months of age produced R^2 = 0.471, F (5, 5) = 0.891, p = 0.549, 12 months of age produced R^2 = 0.8, F (5, 3) = 2.406, p = 0.25, 13 months of age produced R^2 = 0.892, F (5, 8) = 13.239, p = 0.001, 14 months of age produced R^2 = 0.484, F (5, 7) = 1.311, p = 0.359, 15 months of age produced R^2 = 0.764, F (5, 5) = 3.23, p = 0.112, 16 months of age produced R^2 = 0.506, F (5, 7) = 1.432, p = 0.321, and 17 months of age produced R^2 = 0.885, F (5, 4) = 6.141, p = 0.52. Regression was not conducted at 18 months of infant age due to missing values; we only had data for 5 of 14 infants at 18 months.

As can be seen in Table 3, the total questions and total statements at 13 months of infant age had significant negative regression weights, indicating that caregivers who asked fewer questions and provided fewer statements directed to their infants at this age were expected to have children with larger expressive vocabularies at 1 ½ years of age, after controlling for other variables in the model. The total other questions at 13 months of infant age had a significant positive regression weight, indicating that caregivers who asked more other question forms of their infants at 13 months of infant age 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.

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, total questions at 7 months of age was positively and significantly correlated with receptive vocabulary at 1 ½ years of age. This indicates that higher values at this age were

related to larger receptive vocabulary. Total statements at 7 and 14 months of infant age were negatively and significantly correlated with receptive vocabulary at 1 ½ years of age, indicating that the more other questions, the larger the receptive vocabulary. Receptive 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 produced at: 6 months of age $R^2 = 0.459$, F (5, 6) = 1.017, $p = 0.482$, 7 months of age $R^2 = 0.369$, F (5, 8) = 0.936, $p = 0.506$, 8 months of age $R^2 = 0.651$, F (5, 7) = 2.617, $p = 0.121$, 9 months of age $R^2 = 0.534$, F (5, 5) = 1.144, $p = 0.443$, 10 months of age $R^2 = 0.528$, F (5, 2) = 0.447, $p = 0.798$, 11 months of age $R^2 = 0.555$, F (5, 5) = 1.246, $p = 0.407$, 12 months of age $R^2 = 0.938$ F (5, 3) = 0.9.101, $p = 0.049$, 13 months of age $R^2 = 0.424$, F (5, 8) = 1.179, $p = 0.397$, 14 months of age $R^2 = 0.684$, F (5, 7) = 1.228, $p = 0.387$, 15 months of age $R^2 = 0.496$, F (5, 5) = 0.985, $p = 0.506$, 16 months of age $R^2 = 0.731$, F (5, 7) = 3.806 $p = 0.055$, and 17 months of age $R^2 = 0.697$, F (5, 4) = 1.842, $p = 0.287$. Regression was not conducted at 18 months of infant age due to missing values; we only had data for 5 of 14 infants at 18 months.

As can be seen in Table 4, the total number of words produced by caregivers (quantity) at 8 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 receptive vocabularies at 1 ½ years, after controlling for other variables in the model. The total number of wh-questions at 12 months of infant age had significant positive regression weights, indicating that caregivers who asked more wh-questions of their infant were expected to have children with larger receptive vocabulary. Similarly, the total number of other questions at 12 months had significant positive regression weights, indicating that caregivers who asked more other question forms 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.

Expressive Vocabulary at 2 Years

Table 5 summarizes the statistically significant descriptive statistics and analysis results when examining the relationship between expressive vocabulary at 2 years with all potential predictor variables. As can be seen, the total number of wh-questions caregivers asked of their infants at 16 months of infant age was positively and significantly correlated with expressive vocabulary at 2 years of age, indicating that the more wh-questions asked of infants at 16 months of age, the larger the expressive vocabulary at 2 years of age. Total statements produced by caregivers and total number of other questions at 6 months of infant age, and total number of words produced by caregivers at 18 months of infant age were negatively and significantly related to expressive vocabulary at 2 years of age. This indicates that the more statements at 6 months, more other question forms at 6 months, and more words at 18 months, the larger the expressive vocabulary at 2 years of age.

The multiple regression model for all predictors produced at 6 months of age $R^2 = 0.419$, F (5, 6) = 0.864, $p = 0.554$, 7 months of age $R^2 = 0.592$, F (5, 8) = 2.320, $p = 0.139$, 8 months of age $R^2 = 0.642$, F (5, 7) = 2/515, $p = 0.131$, 9 months of age $R^2 = 0.390$, F (5, 5) = 0.639, $p = 0.682$, 10 months of age $R^2 = 0.914$, F (5, 2) = 4.255, $p = 0.201$, 11 months of age $R^2 = 0.521$, F (5, 5) = 1.087 $p = 0.465$, 12 months of age $R^2 = 0.872$, F (5, 3) = 4.088, $p = 0.138$, 13 months of age $R^2 = 0.529$, F (5, 8) = 1.795, $p = 0.220$, 14 months of age $R^2 = 0.378$, F (5, 7) = 0.853, $p = 0.554$, 15 months of age $R^2 = 0.449$, F (5, 5) = 0.814, $p = 0.587$, 16 months of age $R^2 = 0.422$, F (5, 7) = 1.021, $p = 0.472$, and 17 months of age $R^2 = 0.627$, F (5, 4) = 1.346, $p = 0.398$.

Regression was not conducted at 18 months of infant age due to missing values; we only had data for 5 of 14 infants at 18 months.

As can be seen in Table 5, the total number of other questions caregivers posed to their infants at 7 months of infant age had significant positive regression weight, indicating that caregivers who posed more other question forms 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.

Expressive Vocabulary at 3 Years

Table 6 summarizes the statistically significant 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 positively and significantly related to total statements produced by caregivers at 6 months of infant age, total other questions produced by caregivers at 15 months of infant age, and total number of words produced by caregivers 13 months of infant age. This indicates that the more statements to infant at 6 months of age, the more other question forms to infants at 15 months of age, and the more words to infants at 13 months of age, the larger the expressive vocabulary at 3 years of age. Total number of statements at 11 and 15 months, total other question forms at 6 months, and total questions at 7 and 17 months of infant age were negatively and statistically related to expressive vocabulary. This indicates that the more statements to infants at 11 and 15 months of age, the more other question forms at 7 and 15 months of age, and of the more total questions to infants at 7 and 15 months of age, the larger the expressive vocabulary at 3 years of age.

The multiple regression model for all predictors produced at 6 months of age $R^2 = 0.333$, F (5, 6) = 0.599, $p = 0.705$, 7 months of age $R^2 = 0.069$, F (5, 8) = 0.118, $p = 0.985$, 8 months of age $R^2 = 0.221$, F (5, 7) = 0.398, $p = 0.836$, 9 months of age $R^2 = 0.521$, F (5, 5) = 1.087, $p = 0.465$, 10 months of age $R^2 = 0.664$, F (5, 2) = 0.789, $p = 0.641$, 11 months of age $R^2 = 0.055$, F (5, 5) = 0.058, $p = 0.996$, 12 months of age $R^2 = 0.966$, F (5, 3) = 17.215, $p = 0.020$, 13 months of age $R^2 = 0.234$, F (5, 8) = 0.490, $p = 0.776$, 14 months of age $R^2 = 0.645$, F (5, 7) = 2.543, $p = 0.128$, 15 months of age $R^2 = 0.462$, F (5, 5) = 0.859 $p = 0.564$, 16 months of age $R^2 = 0.285$, F (2, 10) = 0.559, $p = 0.730$, and 17 months of age $R^2 = 0.543$, F (5, 4) = 0.952, $p = 0.534$. Regression was not conducted at 18 months of infant age due to missing values; we only had data for 5 of 14 infants at 18 months.

As can be seen in Table 6, the total number of wh-questions and other question forms posed to infants by their caregivers at 12 months of infant age and the total number of wh-questions posed to infants by their caregivers at 14 months of infant age were positively and statistically significantly related to expressive vocabulary size at 3 years of age. This indicates that caregivers who posed more wh-questions and other question forms to their infants at 12 months of age, and caregivers who posed more wh-questions to their infants at 14 months of age were related to larger expressive vocabulary size at 3 years of infant age. The total number of words and the total number of questions caregivers posed to their infants at 11 months of age were negatively and statistically significantly related to expressive vocabulary at 3 years of age. This indicates that caregivers who produced fewer words and questions to their infants at 11 months of age were related to larger expressive vocabulary sizes.

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 our hypotheses, when looking at all predictor variables, effect sizes were *largest* for total wh-questions asked by caregivers to infants at each month of age and all later vocabulary outcomes at each year. The only exception to this pattern was larger effect sizes for total words directed to infants from caregivers at each month of age and later expressive vocabulary at 1 year of age. The clinical importance of these results is that the more wh-question caregivers direct to infants, the greater contribution 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 caregiver/infant dyads in the present study obscured our ability to quantify statistically significant results, while the magnitude of the effect sizes observed shows that caregiver use of wh-questions (and to a lesser extent total words directed to infants), is exhibiting a strong influence over later vocabulary outcomes.

Chapter 4 Discussion

We aimed to determine the relationship between caregiver language input, specifically, the quality (wh-questions, other question forms, and statements) and quantity (number of words) of caregiver input presented to infants between 6 and 18 months of age as it relates to later vocabulary skill at 1, 2, and 3 years of age. The central hypothesis was that caregiver input measures (wh- and other question forms) with infants between 6 to 18 months of age would relate to later vocabulary development (expressive and receptive vocabulary size at 1 years of age and expressive vocabulary size at 2 and 3 years of age). By determining factors that influence vocabulary development, speech-language pathologists are more prepared to educate and counsel families of children who are at risk in supporting language development. In the present study, we looked at the middle 20-minute portions of hour-long recordings in 14 caregiver-infant dyads. These participants were recorded monthly between 6 and 18 months of infant age, and provided follow-up information on vocabulary abilities at 2 and 3 years of age. Previous research has indicated that both quality and quantity play a role in infant vocabulary development; however, quality has a greater impact (Rowe, 2012). While only some statistical significance was discovered between predictor and criterion variables, a great deal of clinical significance was observed through effect size.

The first aim was to determine the relationship between caregiver wh-questions posed to infants between 6 and 18 months of age and receptive vocabulary development at 1 year of age, and expressive vocabulary at 1, 2, and 3 years of age. A statistically significant positive correlation was found between caregiver use of wh-questions at 17 months of age and expressive vocabulary at 1 year, 12 months of age and receptive vocabulary at 1 year, 16 months of infant

age and expressive vocabulary at 2 years, and 12 and 14 months of infant age and expressive vocabulary at 3 years.

Aim 2 was to determine the relationship between other questions posed by caregivers to infants between 6 and 18 months of age and receptive vocabulary development at 1 year of age and expressive vocabulary at 1, 2, and 3 years of age. Descriptive statistics and analysis results indicated that caregiver use of other questions at 8, 9, 10, 12, 13, 15, and 17 months of infant age was positively and significantly correlated with expressive vocabulary at 1 year of age. Other questions at 18 months of infant age were negatively and significantly correlated with expressive vocabulary at 1 year. Further, regression analysis results demonstrated that caregiver use of other questions at 13 months of infant age was a significant predictor of expressive vocabulary at 1 year, 12 months of infant age was a significant predictor of receptive vocabulary at 1 year, 6 and 7 months of infant age was a significant predictor of expressive vocabulary at 2 years, and 12 and 15 months of infant age was a significant predictor of expressive vocabulary at 3 years.

Finally, aim 3 was to determine whether statements produced by caregivers to their infants between 6 and 18 months of age had an effect on receptive vocabulary development at 1 year of age and expressive vocabulary at 1, 2, and 3 years of age. Results indicated no relationship between statements produced by caregiver and expressive vocabulary at 1 year of age. A statistically significant negative relationship was observed, however, between caregiver use of statements at 7 and 14 months of infant age and receptive vocabulary at 1 year, 6 months of infant age and expressive vocabulary at 2 years, and 11 and 15 months of infant age and expressive vocabulary at 3 years. Finally, a statistically significant positive relationship was observed between caregiver use of statements at 6 months of infant age and expressive vocabulary at 3 years.

Beyond statistical significance, observed effect sizes would support the clinical importance of relationships between caregiver input and later vocabulary outcomes. In particular, the largest effect sizes were observed for total wh-questions asked by caregivers to infants at each month of age and all later vocabulary outcomes at each year. The only exception to this pattern was larger effect sizes for total words directed to infants from caregivers at each month of age and later expressive vocabulary at 1 year of age. In other words, wh-questions posed by caregivers to their infants consistently showed a large effect on future vocabulary ability in this group of children who are typically developing.

Findings from the present study add to the previous literature by supporting that question forms posed by caregivers to their infants are positively and significantly correlated with later vocabulary ability. It is worth noting that previous work investigating caregiver input measures lead to variation in types of input that were positively related to children's vocabulary outcomes. Rowe, Leech, and Cabrera (2016) found that father's use of wh-question in infants at 24 months of age was positively and significantly related to later vocabulary skill and verbal reasoning ability at 36-months of age. However, their findings suggested that other question forms posed by fathers to their infants did not have an effect on vocabulary skill and verbal reasoning ability. We found that both wh-questions and other questions influenced vocabulary skill at a later age.

Another distinctive difference between the present study and findings from Rowe and colleagues (2016) is that while we found a significant relationship between the quantity of caregiver input with later vocabulary outcomes, Rowe and colleagues (2016) did not. Differences in results may be attributable to the age differences of infants participating in both studies. The present study investigated infants between 6 and 18 months of age, whereas Rowe and colleagues (2016) studied infants at 24 months of age. As indicated by Rowe (2012), the quality

of caregiver input provided to infants influences infant vocabulary development throughout various developmental periods. For example, Rowe (2012) indicated that at 18 months of infant age, quantity of parent input was more strongly related to later vocabulary skill than quality of input. Input rich in vocabulary diversity and sophistication was most related to vocabulary skill at 30 months of age. At 42 months, caregiver use of decontextualized language, specifically narrative utterances, was most related to later vocabulary skill. The infants participating in the present study were more closely related to the age of infants participating in Rowe's (2012) study. Accordingly, it is possible that the age of infants participating in each study may account for some of the differences in findings between these studies.

Overall, the present study adds to the current literature by investigating quality of input measures for infants between 6 and 18 months of age. Previous research has investigated infants at 18, 24, and 36 months of infant age. Based on our understanding that specific features of caregiver input which contribute to vocabulary development are critical throughout different periods of infant age, the present study adds new features of input which may be important for the developing infant. As such, features of caregiver input investigated in the present study should be further investigated to determine their clinical utility of educating caregivers regarding question elements of language input that may lead to stronger vocabulary development in children.

Clinical Implications

Statistically significant results indicated some relationship between the quality of caregiver input to infants who participated in the study and later expressive and receptive vocabulary size. Of greater significance, however, clinical importance was demonstrated through effect sizes. The present study builds upon previous literature which indicates that while both

quantity and quality play an important role in vocabulary development, quality plays a more significant role during certain points in infant development (Rowe, 2012). In particular, we can infer that caregivers could promote vocabulary growth in their children by asking more wh-questions, and to a lesser degree, asking more other questions (e.g., yes/no, choice, and tag questions), and simply speaking more to their children.

Future studies should explore the utility of these activities on promoting language development. Caregiver education and counseling is an important role and responsibility that speech-language pathologists take on. Providing caregivers with education regarding the importance of the quality and quantity of linguistic input to infants as part of parent-focused intervemtion should increase awareness and influence linguistic input provided to children. For example, Girolamentto, Weitzman, Wiigs, and Pearce (1999) conducted a study including 12 mother-child dyads. Each child participant had an expressive language delay and was between 25 and 35 months of age. Each mother participant attended an 11-week parent-focused language intervention program. The program consisted of eight, 2.5-hour evening sessions and 3 home visits. Pre-intervention and post-intervention expressive vocabulary skills were measured using the MacArthur Bates Communicative Development Inventories (CDI; Fenson et al., 1993). Findings indicated that facilitating maternal responsive language input to children who are late talkers buffers weak language-learning strategies at a critical time in development. The present study may not be directly applicable to children who are late-talkers; however, the concept of implementing parent-focused intervention that may promote vocabulary development can still be applied especially if there are environmental risk factors that may inhibit vocabulary development. Thus, it is increasingly important for speech-language pathologists to counsel caregivers on the importance of providing a language-rich environment.

Children with more advanced language abilities, especially vocabulary abilities, have better reading comprehension and decoding skills than children with less advanced language abilities (Braze et al., 2007; Duff et al., 2015). Furthermore, vocabulary skill is related to social competence and social acceptance in children (Bornstein et al., 1998). Gertner and colleagues (1994) found that language ability served as a better predictor of peer status than measures of age or intelligence, hence communication abilities play an important role in the formation of peer relationships. These findings imply that children with limited language abilities are less adept at using language to establish and maintain friendships in early childhood than children with typically developing language (Gertner et al., 1994). Therefore, increasing caregiver awareness regarding the impact that vocabulary development has on academic, language, and social outcomes is critical.

Study Limitations

A first study limitation is related to an assumption; prior to data coding and analysis, it was assumed that wh-questions follow a rising intonation, whereas statements and yes/no questions follow a falling intonation pattern. Upon having a discussion pertaining to rising and falling intonation patterns, it became apparent that yes/no questions carry a rising intonation. Directed review of the literature regarding intonation patterns has shown that all question forms carry unique intonation (Levis, 1999; Liu & Xu, 2007; Hedberg & Sosa, 2015). Accordingly, a limitation of the present study pertains to the assumption that only wh-questions carry a rising intonation pattern. Specifically, the hypothesis that more wh-questions posed to infants would result in larger later vocabularies was founded on misguided idea that wh-question have a unique intonation pattern when compared to other question types. However, this misguided idea does not alter the results of the present study.

A second study limitation is related to the research design and participant sample. Longitudinal research designs are typically used to explore developmental trends. In exploring developmental trends for a subset of individuals, we may not be observing patterns in the population as a whole. The present study focused on qualitative and quantitative measures that appear to be beneficial in a subset of children who were typically developing. However, findings from the study do not generalize to children who are at-risk, disordered, or delayed. Further, the present study did not include infants from various socioeconomic status. Therefore, findings from this study do not generalize to all populations. Despite these limitations, it is not uncommon for developmental research to be conducted on children who are typically developing before moving on to explore children who are atypically developing or at-risk for difficulties/disorders.

A third study limitation is related to study methodology; each recording session was independently coded, orthographically transcribed, and analyzed for different values on different occasions by different laboratory staff. As a result, many individuals who have influenced the data collection. Laboratory staff were trained by two graduate students and followed the same coding procedure throughout each phase of data collection and preparation. While coding and transcribing the data, laboratory staff worked independently on each file, but were to consult with each other regarding questionable data to gain consensus and reduce the chance for human error. Although human error could still account for errors in data preparation, a variety of parameters were set to prevent or lessen the occurrence of human error.

Fourth, the aim of each infant recording was to collect data at every infant age for every infant. Unfortunately, there were a number of data points, or infant ages in months, that did not have data present. This was a result of two main issues: lack of a recording session for the

specific infant age during data collection in the longitudinal study, or technical difficulties from hardware or software malfunction. These data errors were not common, but did occur, and could have decreased the reliability of the results.

Fifth, central argument for the present study relates to the fact that wh-questions carry an intonation and prosody that is unique to English. Given that infants have been found to respond distinctively to speech and song with variable intonation and prosody (Corbeil et al., 2016; Fernald, 1989; Tsang et al., 2012), we hypothesized that infants would sustain their attention to wh-questions more than other question forms and statements that lack such intonation and prosody changes. One male infant in the study, however, was from a home where English, Indian, and Vietnamese were spoken (although English was the predominant language spoken in the home). Unlike English, where question forms are posed with rising intonation, Indian and Vietnamese languages do not use intonation to indicate questions. According to Nhung (2010), Vietnamese is a tonal language, meaning that changes in pitch level and/or contour signal result in a change of meaning. English intonation, on the other hand, reflects differences in the intention of the utterance and may act as the only means for distinguishing various types of sentences (i.e., declaratives, interrogatives, etc.). In Vietnamese, intonation is rarely used as a way to form questions (Nhung, 2010). Indian languages are considered phrasal languages, meaning they have no lexical stress and no pitch accent (Fery, 2010). Unlike the English language, Indian languages do not convey pragmatic meaning with stress. Accordingly, the child who was exposed to languages other than English presents a limitation to the study. Although a central argument was made that rising intonation may increase infants' attention, the present research study did not rely solely on intonation and prosody via acoustical analysis to indicate question forms. Rather, the present study focused on orthographic transcription completed by

laboratory staff to code question forms versus statements. Still, upon visual inspection of the data, there were no outliers associated with this particular caregiver-infant dyad, so it is not likely that language background influenced the results.

Future Directions

The present study has potential for expansion and further investigation. One major direction for future studies would be to look at specific types of wh-question forms (i.e., who, what, when, where, why, how) or other question forms (i.e., choice, tag) to determine unique influence on infant vocabulary development. Rowland and colleagues (2003) investigated the acquisition of wh-question forms in a group of children between 2 and 3 years of age. They found that caregivers tended to use early acquired wh+verb combinations (i.e., forms acquired during Brown's stages I and II) when speaking to their children, rather than later acquired wh+verb combinations (i.e., forms acquired during Brown's stages III and IV/V). Rowe and colleagues (2016) looked specifically at the types of wh-questions forms that caregivers posed to their infants at 24-months of age and found that caregivers posed more "what" questions than any other wh-question forms. In summary, future research could investigate specific types of other questions and wh-questions posed by caregivers to their infants.

Another factor to consider in regard to the types of questions posed by caregivers has to do with the complexity of question forms. This could further be investigated by determining whether caregivers' use nouns, verbs, adjectives, and adverbs within the sentence structure of questions posed is semantically general or complex. For example, Rowland and colleagues (2003) suggested that children acquire semantically general verbs (verbs that encode general meanings, such as no, go, do, etc.) more easily than semantically complex verbs (verbs that encode more abstract meanings, such as smell, see, etc.). The same concept of generality and

complexity applies to verbs, adjectives, and adverbs which could be used to analyze the complexity of questions posed by caregivers to their infants. Alternatively, it would be interesting to investigate the conversational aspect of question forms to see which question forms infants are likely to respond to, and how often infants respond to questions posed by caregivers. Rowe and colleagues (2016) noted that infants provided more verbally-complex responses when caregivers posed wh-questions as compared to other question forms. Therefore, future research could build upon current literature reflecting the conversational aspect of question forms.

Altering the participant sample is another direction for future research, and there are several factors to consider with respect to the sample. To begin with, a larger sample size would also increase the internal validity and lead to greater statistical significance, as well as a higher probability of generalization. Also, developmental research typically begins by exploring children who are typically developing and progresses to children who are at-risk. Expanding the participant sample to include children who are at-risk for language and/or speech disorders could provide more information and generalize to a larger number of children. Furthermore, socioeconomic status plays an important role in vocabulary acquisition. Therefore, it would be ideal to carry out similar studies in families from varying levels of socioeconomic status in order to include individuals who may benefit from increased caregiver education regarding quantity and quality of caregiver input. Another consideration would be language background; most of the families in the present study were from English-speaking homes. To determine whether intonation is a uniquely contributing factor, it would be beneficial to include infants from diverse language backgrounds. Lastly, the present study consisted of a within subjects, longitudinal investigation of infants between 6 and 18 months of age. Similar literature in the field has included infants between 14 and 54 months of age (Rowe, 2012), 25 and 35 months of age

(Girolamentto, Weitzman, Wiigs, & Pearce, 1999), and 2 and 3 years of age (Rowe et al., 2016). As indicated by Rowe (2012), the type of input provided to infants by their caregivers becomes increasingly important depending on a child's stage of development. Altering the age of participants may lead to further indications regarding specific ages where caregiver use of questions becomes increasingly important.

Beyond sample considerations, the present study relied on orthographic transcriptions to differentiate questions from statements. Future research could utilize instrumentation designed specifically for prosodic analysis in order to reliably code caregiver utterances. For example, PRAAT is a free tool used to conduct acoustic analysis of speech and voice samples (Van Lieshout, 2003). The Pratt program offers pitch analysis including measures for duration and amplitude of individual cycles. Using specific measures to determine rising and falling intonation could be implemented in future research to determine whether or not these prosodic features play a role in infant vocabulary development.

Conclusion

In conclusion, the results of this study suggest that caregivers can promote vocabulary growth in their children by asking more wh-questions, and to a lesser degree, asking more other questions (e.g., yes/no, choice, and tag questions), and simply speaking more to their children. Increasing caregiver awareness may result in increased quantity and quality of caregiver language input, and increase future vocabulary growth and development in infants.

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Tables and Figures

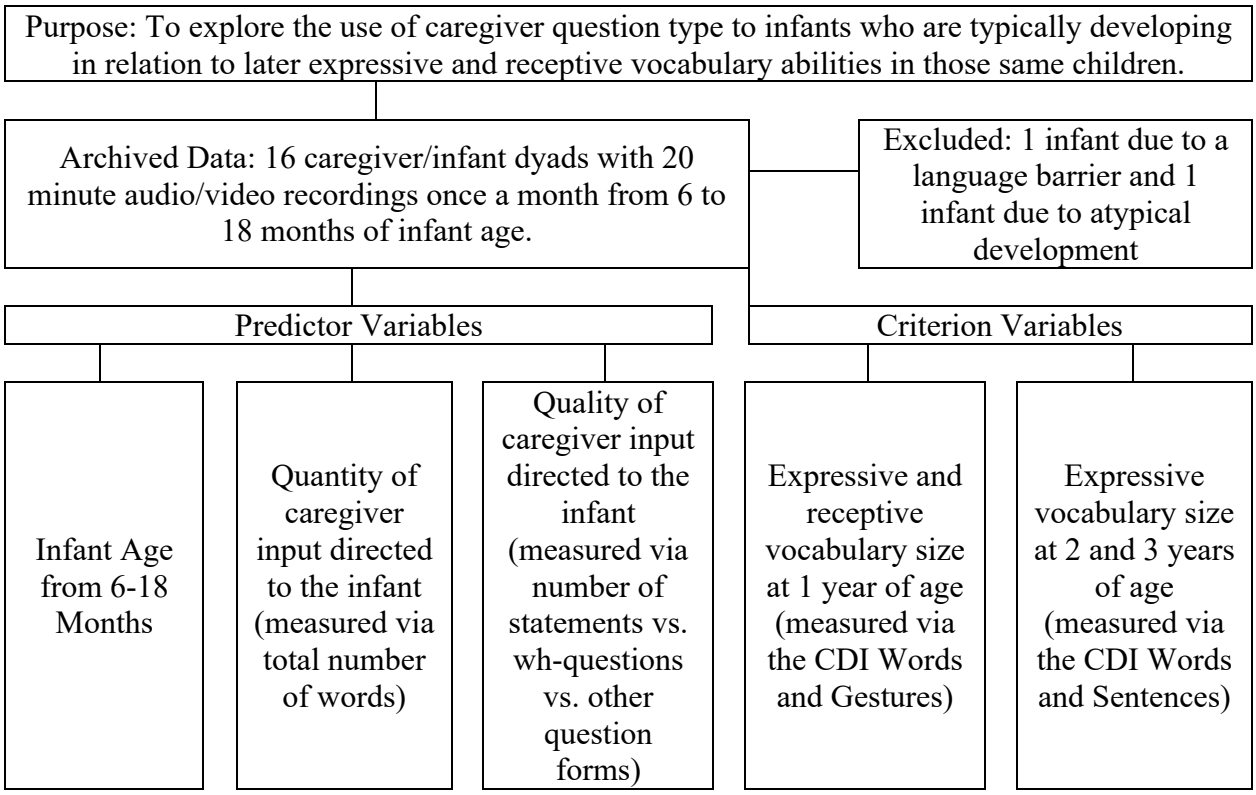

Figure 1. Study Purpose, participants, and variables of interest

Table 1 Predictor Variables of Interest

Infant Age (Months)	Words	Questions	Statements	Wh-questions	Other Questions
6	606.083	56.154	131.000	20.769	28.231
7	571.786	45.286	101.571	16.000	23.357
8	605.769	44.429	112.714	16.500	23.929
9	652.182	61.833	114.500	22.750	31.083
10	571.700	55.167	121.750	20.750	27.167
11	517.000	55.462	94.923	20.538	27.846
12	607.364	68.444	118.111	19.333	38.111
13	769.571	54.071	118.714	16.929	31.643
14	620.385	52.357	114.357	17.071	26.857
15	707.308	63.500	109.500	21.250	35.167
16	765.615	63.462	118.846	24.308	32.231
17	631.500	61.636	99.091	21.273	32.818
18	715.500	54.000	100.000	21.400	27.400
Total	8341.763	735.801	1455.078	258.871	385.839

Table 2 Vocabulary Size by Infants Across Ages

Infant	1 Year Expressive	1 Year Receptive	2 Years Expressive	3 Years Expressive
1	149	258	548	680
2	151	248	550	661
3	18	213	178	655
4	301	338	574	677
5	181	185	576	635
6	61	111	277	662
7	4	41	337	562
8	51	149	186	662
9	32	377	222	655
10	17	188	66	677
11	32	194	521	623
12	69	202	337	653
13	19	273	293	651
14	68	279	514	658
M	82	218	370	651
SD	84	87	174	30

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

Age (months)	Predictor Variables	*M*	*SD*	*r*	Multiple Regression Weights *B*	*β*	*t*	*p*
	Total Words	606.083	358.527	0.256	0.119	0.494	0.793	0.458
	Total Questions	56.154	29.314	-0.028	-8.803	-3.120	-1.309	0.239
6	Total Statements	131.000	60.054	0.130	-0.022	-0.016	-0.016	0.988
	Total Wh-questions	20.769	11.439	-0.042	9.515	1.319	0.963	0.373
	Total Other Questions	28.231	15.428	0.099	9.310	1.729	1.350	0.226
	Total Words	571.786	241.274	-0.124	-0.145	-0.414	-1.171	0.275
	Total Questions	45.286	14.231	0.023	-9.776	-1.652	-1.276	0.238
7	Total Statements	101.571	50.013	-0.086	-0.255	-0.151	-0.434	0.676
	Total Wh-questions	16.000	7.504	-0.213	9.631	0.858	1.018	0.339
	Total Other Questions	23.357	10.631	0.307	14.584	1.841	1.817	0.107
	Total Words	605.769	289.558	.578*	0.188	0.621	0.759	0.473
	Total Questions	44.429	25.690	0.355	3.085	0.942	0.751	0.477
8	Total Statements	112.714	43.569	0.332	-0.440	-0.211	-0.342	0.742
	Total Wh-questions	16.500	7.998	-0.027	-10.093	-0.958	-1.179	0.277
	Total Other Questions	23.929	14.258	.623*	-0.480	-0.081	-0.072	0.944
	Total Words	652.182	378.610	0.458	0.076	0.312	0.555	0.603
	Total Questions	61.833	34.659	0.323	-8.323	-3.282	-1.875	0.120
9	Total Statements	114.500	63.635	0.520	0.007	0.005	0.005	0.996
	Total Wh-questions	22.750	12.962	-0.074	5.217	0.765	0.814	0.452
	Total Other Questions	31.083	23.735	.606*	11.274	3.051	1.863	0.121
	Total Words	571.700	352.962	0.006	-0.057	-0.211	-0.873	0.475
	Total Questions	55.167	26.727	0.445	2.074	0.466	0.489	0.673
10	Total Statements	121.750	44.004	0.387	-0.318	-0.127	-0.304	0.790
	Total Wh-questions	20.750	11.355	0.253	-3.438	-0.349	-0.581	0.620
	Total Other Questions	27.167	14.090	.639*	6.184	0.818	1.988	0.185
	Total Words	517.000	279.558	0.262	0.110	0.348	0.374	0.723
	Total Questions	55.462	24.831	0.317	-7.270	-2.027	-1.089	0.326
11	Total Statements	94.923	44.371	0.303	0.371	0.189	0.252	0.811
	Total Wh-questions	20.538	12.319	0.105	3.784	0.578	0.575	0.590
	Total Other Questions	27.846	13.366	0.536	10.260	1.455	1.493	0.196
	Total Words	607.364	235.430	0.233	-0.158	-0.398	-0.751	0.507
	Total Questions	68.444	34.975	0.482	2.040	0.696	0.362	0.741
12	Total Statements	118.111	34.761	0.348	0.634	0.215	0.469	0.671
	Total Wh-questions	19.333	13.463	0.177	-6.785	-0.890	-0.697	0.536
	Total Other Questions	38.111	17.645	.756*	5.087	0.875	0.861	0.453
	Total Words	769.571	408.164	0.470	0.041	0.257	1.292	0.232
	Total Questions	54.071	30.547	.599*	3.334	-3.431	-2.836	0.022*
13	Total Statements	118.714	56.813	0.303	0.327	-0.518	-2.349	0.047*
	Total Wh-questions	16.929	11.276	0.333	3.826	1.054	2.058	0.074
	Total Other Questions	31.643	19.844	.758**	3.408	3.473	4.323	0.003**
	Total Words	620.385	325.449	0.374	0.066	0.244	0.703	0.505
	Total Questions	52.357	27.046	0.153	-5.722	-1.807	-1.918	0.097
14	Total Statements	114.357	53.190	0.115	-0.070	-0.041	-0.083	0.937
	Total Wh-questions	17.071	10.894	0.262	7.304	0.733	1.451	0.190
	Total Other Questions	26.857	16.454	0.296	7.302	1.427	1.845	0.108
	Total Words	707.308	420.767	0.401	-0.447	-2.239	-2.116	0.088
	Total Questions	63.500	42.924	0.568	-10.861	-5.377	-1.615	0.167
15	Total Statements	109.500	58.894	0.407	0.014	0.009	0.013	0.990
	Total Wh-questions	21.250	19.344	0.576	12.580	2.811	2.396	0.062
	Total Other Questions	35.167	23.151	.578*	20.985	5.645	2.201	0.079
	Total Words	765.615	316.718	-0.118	-0.107	-0.387	-0.547	0.601
	Total Questions	63.462	24.633	0.102	-5.443	-1.532	-1.248	0.252
16	Total Statements	118.846	37.826	-0.256	-0.650	-0.281	-0.573	0.584
	Total Wh-questions	24.308	12.358	-0.132	6.194	0.875	1.159	0.285
	Total Other Questions	32.231	13.621	0.376	11.289	1.757	1.987	0.087
	Total Words	631.500	457.238	.799**	-0.171	-0.851	-0.974	0.385
	Total Questions	61.636	39.427	.662*	-4.891	-2.140	-2.668	0.056
17	Total Statements	99.091	50.169	0.577	0.740	0.347	0.664	0.543
	Total Wh-questions	21.273	16.692	.769**	9.691	1.797	2.438	0.071
	Total Other Questions	32.818	20.454	.779**	7.300	1.699	2.393	0.075
	Total Words	715.500	423.270	-0.447	0.050	1.164		
	Total Questions	54.000	41.213	-0.850				
18	Total Statements	100.000	54.695	-0.847	0.224	0.638		
	Total Wh-questions	21.400	21.279	-0.766	1.401	1.550		
	Total Other Questions	27.400	17.785	-.900*	-4.506	-4.168		

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

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

Age (months)	Predictor Variables	*M*	*SD*	*r*	Multiple Regression Weights *B*	*β*	*t*	*p*
	Total Words	606.083	358.527	0.208	0.100	0.382	0.682	0.520
	Total Questions	56.154	29.314	0.362	-1.077	-0.349	-0.163	0.876
6	Total Statements	131.000	60.054	0.275	-1.178	-0.783	-0.896	0.405
	Total Wh-questions	20.769	11.439	0.189	-1.179	-0.149	-0.122	0.907
	Total Other Questions	28.231	15.428	0.535	8.260	1.402	1.220	0.268
	Total Words	571.786	241.274	0.457	0.219	0.603	1.650	0.137
	Total Questions	45.286	14.231	0.013*	-1.074	-0.175	-0.131	0.899
7	Total Statements	101.571	50.013	-0.014*	-0.563	-0.322	-0.895	0.397
	Total Wh-questions	16.000	7.504	-0.249	-1.674	-0.144	-0.165	0.873
	Total Other Questions	23.357	10.631	0.254	1.778	0.216	0.207	0.842
	Total Words	605.769	289.558	.720**	0.586	1.869	2.470	0.043*
	Total Questions	44.429	25.690	0.425	1.070	0.315	0.271	0.794
8	Total Statements	112.714	43.569	0.448	-1.339	-0.620	-1.086	0.314
	Total Wh-questions	16.500	7.998	0.276	-1.530	-0.140	-0.186	0.858
	Total Other Questions	23.929	14.258	.561*	-5.136	-0.833	-0.805	0.447
	Total Words	652.182	378.610	0.494	0.374	1.794	1.674	0.155
	Total Questions	61.833	34.659	0.197	-2.359	-1.084	-0.325	0.758
9	Total Statements	114.500	63.635	0.320	-0.619	-0.502	-0.290	0.783
	Total Wh-questions	22.750	12.962	0.080	-0.858	-0.147	-0.082	0.938
	Total Other Questions	31.083	23.735	0.258	0.838	0.264	0.085	0.936
	Total Words	571.700	352.962	0.231	0.052	0.245	0.432	0.708
	Total Questions	55.167	26.727	0.281	-3.030	-0.864	-0.386	0.737
10	Total Statements	121.750	44.004	0.158	-0.704	-0.357	-0.364	0.751
	Total Wh-questions	20.750	11.355	0.320	5.305	0.683	0.484	0.676
	Total Other Questions	27.167	14.090	0.400	6.587	1.106	1.143	0.371
	Total Words	517.000	279.558	0.506	-0.177	-0.501	-0.588	0.582
	Total Questions	55.462	24.831	0.530	6.135	1.530	0.895	0.412
11	Total Statements	94.923	44.371	0.380	-1.189	-0.541	-0.788	0.466
	Total Wh-questions	20.538	12.319	0.544	-1.303	-0.178	-0.193	0.855
	Total Other Questions	27.846	13.366	0.435	1.903	0.241	0.270	0.798
	Total Words	607.364	235.430	0.391	0.028	0.087	0.295	0.787
	Total Questions	68.444	34.975	0.477	-10.024	-4.227	-3.950	0.029
12	Total Statements	118.111	34.761	0.295	-0.910	-0.382	-1.498	0.231
	Total Wh-questions	19.333	13.463	0.333	15.067	2.446	3.437	0.041*
	Total Other Questions	38.111	17.645	.735*	14.150	3.010	5.323	0.013*
	Total Words	769.571	408.164	.582*	0.090	0.422	0.918	0.386
	Total Questions	54.071	30.547	.576*	3.319	1.160	0.415	0.689
13	Total Statements	118.714	56.813	0.472	-0.324	-0.210	-0.413	0.691
	Total Wh-questions	16.929	11.276	0.430	-3.418	-0.441	-0.372	0.719
	Total Other Questions	31.643	19.844	.588*	-1.498	-0.340	-0.183	0.859
	Total Words	620.385	325.449	0.238	-0.033	-0.117	-0.331	0.750
	Total Questions	52.357	27.046	0.310	-0.622	-0.189	-0.198	0.849
14	Total Statements	114.357	53.190	-0.015*	-1.141	-0.650	-1.274	0.243
	Total Wh-questions	17.071	10.894	0.387	7.422	0.718	1.399	0.205
	Total Other Questions	26.857	16.454	0.290	3.126	0.589	0.749	0.478
	Total Words	707.308	420.767	0.133	-0.220	-1.528	-0.989	0.368
	Total Questions	63.500	42.924	0.479	-8.305	-5.705	-1.174	0.293
15	Total Statements	109.500	58.894	0.408	0.422	0.388	0.388	0.714
	Total Wh-questions	21.250	19.344	0.408	6.812	2.112	1.233	0.272
	Total Other Questions	35.167	23.151	0.530	14.690	5.483	1.465	0.203
	Total Words	765.615	316.718	.568*	-0.041	-0.147	-0.281	0.787
	Total Questions	63.462	24.633	.787**	5.802	1.603	1.771	0.120
16	Total Statements	118.846	37.826	0.411	0.208	0.088	0.245	0.814
	Total Wh-questions	24.308	12.358	0.374	-4.811	-0.667	-1.198	0.270
	Total Other Questions	32.231	13.621	.766**	-1.997	-0.305	-0.468	0.654
	Total Words	631.500	457.238	0.502	0.520	2.910	2.055	0.109
	Total Questions	61.636	39.427	0.299	0.677	0.333	0.256	0.811
17	Total Statements	99.091	50.169	0.152	-2.862	-1.508	-1.781	0.150
	Total Wh-questions	21.273	16.692	0.436	-0.907	-0.189	-0.158	0.882
	Total Other Questions	32.818	20.454	0.279	-4.642	-1.214	-1.055	0.351
	Total Words	715.500	423.270	0.488	0.348	0.348	0.000	1.476
	Total Questions	54.000	41.213	0.448				
18	Total Statements	100.000	54.695	0.642	2.194	2.194	0.000	1.140
	Total Wh-questions	21.400	21.279	0.280	-11.782	-11.782	0.000	-2.382
	Total Other Questions	27.400	17.785	0.512	1.350	1.350	0.000	0.228

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

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

Age (months)	Predictor Variables	*M*	*SD*	*r*	Multiple Regression Weights *B*	*β*	*t*	*p*
	Total Words	606.083	358.527	0.299	0.517	1.043	1.799	0.122
	Total Questions	56.154	29.314	-0.105	-11.316	-1.944	-0.876	0.415
6	Total Statements	131.000	60.054	-0.010	-2.607	-0.919	-1.014	0.350
	Total Wh-questions	20.769	11.439	-0.110	11.672	0.785	0.616	0.561
	Total Other Questions	28.231	15.428	-0.014	15.322	1.379	1.158	0.291
	Total Words	571.786	241.274	0.274	-0.020	-0.028	-0.096	0.926
	Total Questions	45.286	14.231	0.062	-26.613	-2.177	-2.022	0.078
7	Total Statements	101.571	50.013	0.186	0.104	0.030	0.103	0.921
	Total Wh-questions	16.000	7.504	-0.337	22.667	0.978	1.395	0.201
	Total Other Questions	23.357	10.631	0.502	34.522	2.110	2.505	.037*
	Total Words	605.769	289.558	0.417	0.822	1.317	1.718	0.129
	Total Questions	44.429	25.690	-0.139	-8.488	-1.254	-1.068	0.321
8	Total Statements	112.714	43.569	0.212	-4.310	-1.003	-1.733	0.127
	Total Wh-questions	16.500	7.998	-0.367	3.398	0.156	0.205	0.843
	Total Other Questions	23.929	14.258	0.297	9.241	0.753	0.718	0.496
	Total Words	652.182	378.610	0.257	-0.136	-0.267	-0.218	0.836
	Total Questions	61.833	34.659	0.256	-11.090	-2.091	-0.548	0.607
9	Total Statements	114.500	63.635	0.340	0.238	0.079	0.040	0.970
	Total Wh-questions	22.750	12.962	-0.025	9.382	0.658	0.322	0.761
	Total Other Questions	31.083	23.735	0.438	17.330	2.243	0.629	0.557
	Total Words	571.700	352.962	-0.433	-0.276	-0.568	-2.346	0.144
	Total Questions	55.167	26.727	0.226	-0.173	-0.021	-0.022	0.984
10	Total Statements	121.750	44.004	0.248	0.373	0.082	0.196	0.862
	Total Wh-questions	20.750	11.355	0.171	0.151	0.008	0.014	0.990
	Total Other Questions	27.167	14.090	0.452	10.508	0.767	1.859	0.204
	Total Words	517.000	279.558	0.250	-0.132	-0.208	-0.236	0.823
	Total Questions	55.462	24.831	0.387	-17.343	-2.415	-1.362	0.231
11	Total Statements	94.923	44.371	0.301	1.139	0.289	0.406	0.701
	Total Wh-questions	20.538	12.319	0.371	21.148	1.612	1.687	0.152
	Total Other Questions	27.846	13.366	0.476	20.104	1.423	1.535	0.185
	Total Words	607.364	235.430	0.099	0.159	0.209	0.492	0.657
	Total Questions	68.444	34.975	0.095	12.328	2.193	1.425	0.249
12	Total Statements	118.111	34.761	0.180	0.745	0.132	0.360	0.743
	Total Wh-questions	19.333	13.463	-0.258	-36.083	-2.471	-2.415	0.095
	Total Other Questions	38.111	17.645	0.462	-0.755	-0.068	-0.083	0.939
	Total Words	769.571	408.164	0.518	0.129	0.303	0.728	0.487
	Total Questions	54.071	30.547	.541*	-23.796	-4.178	-1.652	0.137
13	Total Statements	118.714	56.813	0.468	-0.006	-0.002	-0.004	0.997
	Total Wh-questions	16.929	11.276	0.490	28.139	1.824	1.702	0.127
	Total Other Questions	31.643	19.844	.574*	26.566	3.030	1.804	0.109
	Total Words	620.385	325.449	0.401	0.277	0.499	1.311	0.231
	Total Questions	52.357	27.046	0.135	-5.751	-0.879	-0.851	0.423
14	Total Statements	114.357	53.190	0.326	2.362	0.676	1.226	0.260
	Total Wh-questions	17.071	10.894	0.051	-1.086	-0.053	-0.095	0.927
	Total Other Questions	26.857	16.454	0.218	3.135	0.297	0.350	0.737
	Total Words	707.308	420.767	0.300	-0.212	-0.502	-0.311	0.769
	Total Questions	63.500	42.924	0.313	-31.068	-7.264	-1.429	0.212
15	Total Statements	109.500	58.894	0.188	-1.752	-0.548	-0.524	0.623
	Total Wh-questions	21.250	19.344	0.305	25.376	2.678	1.494	0.195
	Total Other Questions	35.167	23.151	0.356	49.157	6.245	1.595	0.172
	Total Words	765.615	316.718	0.086	-0.032	-0.058	-0.076	0.942
	Total Questions	63.462	24.633	0.177	-14.980	-2.098	-1.580	0.158
16	Total Statements	118.846	37.826	-0.064	-1.224	-0.263	-0.497	0.634
	Total Wh-questions	24.308	12.358	0.045	16.964	1.192	1.460	0.188
	Total Other Questions	32.231	13.621	0.380	24.699	1.913	2.000	0.086
	Total Words	631.500	457.238	0.379	-0.620	-1.504	-0.957	0.393
	Total Questions	61.636	39.427	0.213	-13.461	-2.868	-1.989	0.118
17	Total Statements	99.091	50.169	0.290	3.239	0.739	0.787	0.475
	Total Wh-questions	21.273	16.692	0.416	30.717	2.773	2.093	0.105
	Total Other Questions	32.818	20.454	0.287	11.215	1.271	0.996	0.376
	Total Words	715.500	423.270	-0.009	1.098	9.391		
	Total Questions	54.000	41.213	-0.398				
18	Total Statements	100.000	54.695	-0.434	1.098	9.391		
	Total Wh-questions	21.400	21.279	-0.462	1.098	9.391		
	Total Other Questions	27.400	17.785	-0.358	1.098	9.391		

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

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

Age (months)	Predictor Variables	*M*	*SD*	*r*	Multiple Regression Weights *B*	*β*	*t*	*p*
	Total Words	606.083	358.527	0.100	0.017	0.191	0.307	0.769
	Total Questions	56.154	29.314	-0.157	0.992	0.945	0.398	0.705
6	Total Statements	131.000	60.054	0.039	0.103	0.201	0.207	0.843
	Total Wh-questions	20.769	11.439	-0.332	-3.663	-1.365	-1.000	0.356
	Total Other Questions	28.231	15.428	-0.005	-0.268	-0.133	-0.105	0.920
	Total Words	571.786	241.274	0.135	0.017	0.134	0.301	0.771
	Total Questions	45.286	14.231	-0.009	1.191	0.568	0.349	0.736
7	Total Statements	101.571	50.013	0.124	0.070	0.117	0.268	0.796
	Total Wh-questions	16.000	7.504	-0.144	-2.121	-0.533	-0.504	0.628
	Total Other Questions	23.357	10.631	0.076	-1.321	-0.470	-0.370	0.721
	Total Words	605.769	289.558	0.274	0.057	0.528	0.467	0.655
	Total Questions	44.429	25.690	0.435	0.261	0.225	0.130	0.900
8	Total Statements	112.714	43.569	0.131	-0.249	-0.337	-0.395	0.705
	Total Wh-questions	16.500	7.998	0.406	0.737	0.197	0.175	0.866
	Total Other Questions	23.929	14.258	0.305	-0.389	-0.185	-0.119	0.908
	Total Words	652.182	378.610	-0.119	0.046	0.997	0.917	0.401
	Total Questions	61.833	34.659	-0.425	-1.125	-2.329	-0.689	0.521
9	Total Statements	114.500	63.635	-0.122	-0.019	-0.070	-0.040	0.970
	Total Wh-questions	22.750	12.962	-0.357	0.278	0.214	0.118	0.911
	Total Other Questions	31.083	23.735	-0.268	0.725	1.030	0.326	0.758
	Total Words	571.700	352.962	0.535	0.025	0.684	1.428	0.289
	Total Questions	55.167	26.727	-0.190	0.486	0.803	0.425	0.712
10	Total Statements	121.750	44.004	-0.168	-0.169	-0.497	-0.600	0.609
	Total Wh-questions	20.750	11.355	-0.288	-0.671	-0.501	-0.421	0.715
	Total Other Questions	27.167	14.090	-0.153	0.163	0.159	0.194	0.864
	Total Words	517.000	279.558	-0.122	-0.049	-0.408	-0.329	0.756
	Total Questions	55.462	24.831	-0.122	1.002	0.734	0.295	0.780
11	Total Statements	94.923	44.371	-0.044	-0.010	-0.014	-0.014	0.990
	Total Wh-questions	20.538	12.319	-0.142	-1.072	-0.430	-0.320	0.762
	Total Other Questions	27.846	13.366	-0.073	-0.108	-0.040	-0.031	0.977
	Total Words	607.364	235.430	0.134	-0.129	-0.930	-4.273	0.024
	Total Questions	68.444	34.975	0.518	-4.856	-4.756	-6.023	0.009
12	Total Statements	118.111	34.761	0.241	0.045	0.044	0.233	0.831
	Total Wh-questions	19.333	13.463	0.542	9.646	3.637	6.927	0.006
	Total Other Questions	38.111	17.645	0.550	5.978	2.954	7.078	0.006
	Total Words	769.571	408.164	0.014	0.009	0.122	0.231	0.823
	Total Questions	54.071	30.547	0.064	-0.907	-0.928	-0.288	0.781
13	Total Statements	118.714	56.813	-0.136	-0.280	-0.533	-0.905	0.392
	Total Wh-questions	16.929	11.276	-0.086	0.186	0.070	0.051	0.960
	Total Other Questions	31.643	19.844	0.172	1.977	1.314	0.614	0.556
	Total Words	620.385	325.449	-0.141	-0.056	-0.586	-2.037	0.081
	Total Questions	52.357	27.046	0.062	-1.081	-0.962	-1.232	0.258
14	Total Statements	114.357	53.190	-0.145	-0.255	-0.425	-1.019	0.342
	Total Wh-questions	17.071	10.894	0.325	4.403	1.245	2.973	0.021
	Total Other Questions	26.857	16.454	0.063	1.366	0.752	1.173	0.279
	Total Words	707.308	420.767	-0.214	-0.109	-2.824	-1.769	0.137
	Total Questions	63.500	42.924	-0.032	-0.038	-0.097	-0.019	0.985
15	Total Statements	109.500	58.894	-0.005	0.394	1.348	1.305	0.249
	Total Wh-questions	21.250	19.344	-0.160	0.017	0.019	0.011	0.992
	Total Other Questions	35.167	23.151	0.025	1.126	1.564	0.404	0.703
	Total Words	765.615	316.718	0.192	-0.100	-1.026	-1.206	0.267
	Total Questions	63.462	24.633	0.333	-0.030	-0.024	-0.016	0.987
16	Total Statements	118.846	37.826	0.302	0.564	0.688	1.169	0.281
	Total Wh-questions	24.308	12.358	0.258	1.201	0.479	0.528	0.614
	Total Other Questions	32.231	13.621	0.297	1.214	0.534	0.502	0.631
	Total Words	631.500	457.238	0.381	-0.052	-1.438	-0.827	0.455
	Total Questions	61.636	39.427	0.519	-0.034	-0.081	-0.051	0.962
17	Total Statements	99.091	50.169	0.176	-0.046	-0.120	-0.116	0.913
	Total Wh-questions	21.273	16.692	0.460	0.893	0.915	0.624	0.567
	Total Other Questions	32.818	20.454	0.536	0.970	1.247	0.882	0.427
	Total Words	715.500	423.270	-0.755	-0.023	-2.082		
	Total Questions	54.000	41.213	-0.658				
18	Total Statements	100.000	54.695	-0.685	0.169	1.905		
	Total Wh-questions	21.400	21.279	-0.533	0.595	2.611		
	Total Other Questions	27.400	17.785	-0.728	-0.822	-3.014		

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

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

Age (months)	Variables of Interest	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	Total Words	2.011	1.486	0.838	0.176
	Total Questions	0.416	2.487	2.515	20.102
	Total Statements	0.665	1.164	1.836	10.961
	Total Wh-questions	1.025	3.169	2.832	27.875
	Total Other Questions	0.894	3.028	2.767	26.205
7	Total Words	2.709	1.948	0.960	0.460
	Total Questions	0.614	2.763	2.630	25.898
	Total Statements	0.277	1.639	2.097	13.336
	Total Wh-questions	1.110	3.261	2.874	29.171
	Total Other Questions	0.983	3.131	2.812	28.006
8	Total Words	2.455	1.811	0.987	0.219
	Total Questions	0.609	2.699	2.618	21.776
	Total Statements	0.453	1.529	2.028	14.409
	Total Wh-questions	1.101	3.251	2.870	29.031
	Total Other Questions	0.968	3.104	2.803	26.802
9	Total Words	2.078	1.579	0.958	0.005
	Total Questions	0.319	2.353	2.456	18.210
	Total Statements	0.431	1.358	1.950	10.790
	Total Wh-questions	0.990	3.130	2.814	27.296
	Total Other Questions	0.829	2.923	2.729	22.982
10	Total Words	1.907	1.375	0.725	0.316
	Total Questions	0.435	2.524	2.529	21.025
	Total Statements	0.586	1.395	1.956	14.071
	Total Wh-questions	1.026	3.170	2.832	27.902
	Total Other Questions	0.914	3.053	2.777	26.721
11	Total Words	2.105	1.442	0.632	0.673
	Total Questions	0.433	2.534	2.531	21.685
	Total Statements	0.187	1.780	2.166	14.701
	Total Wh-questions	1.027	3.168	2.833	27.604
	Total Other Questions	0.904	3.046	2.773	26.939
12	Total Words	2.970	2.191	1.147	0.259
	Total Questions	0.216	2.251	2.403	17.912
	Total Statements	0.555	1.506	2.007	16.442
	Total Wh-questions	1.045	3.182	2.841	27.274
	Total Other Questions	0.727	2.858	2.684	24.990
13	Total Words	2.332	1.868	1.274	0.410
	Total Questions	0.447	2.508	2.529	19.760
	Total Statements	0.506	1.351	1.941	11.725
	Total Wh-questions	1.089	3.231	2.863	28.096
	Total Other Questions	0.829	2.945	2.732	24.430
14	Total Words	2.263	1.687	0.960	0.132
	Total Questions	0.480	2.565	2.551	21.012
	Total Statements	0.454	1.437	1.987	12.438
	Total Wh-questions	1.088	3.231	2.863	28.207
	Total Other Questions	0.915	3.044	2.776	25.890
15	Total Words	2.060	1.609	1.048	0.189
	Total Questions	0.282	2.248	2.418	15.886
	Total Statements	0.374	1.460	2.005	11.594
	Total Wh-questions	1.000	3.113	2.817	25.032
	Total Other Questions	0.764	2.864	2.697	23.049
16	Total Words	2.948	2.356	1.549	0.510
	Total Questions	0.305	2.411	2.467	21.463
	Total Statements	0.559	1.477	1.994	15.613
	Total Wh-questions	0.965	3.108	2.802	27.427
	Total Other Questions	0.831	2.975	2.737	26.664
17	Total Words	1.670	1.255	0.756	0.060

	Total Questions	0.315	2.310	2.444	16.849
	Total Statements	0.241	1.673	2.115	13.365
	Total Wh-questions	1.006	3.131	2.821	26.034
	Total Other Questions	0.809	2.922	2.722	24.154
18	Total Words	2.078	1.630	1.068	0.216
	Total Questions	0.428	2.404	2.499	16.586
	Total Statements	0.249	1.622	2.093	12.501
	Total Wh-questions	0.993	3.095	2.812	24.283
	Total Other Questions	0.903	3.027	2.770	25.375

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.