HHS Public Access

Author manuscript

Ear Hear. Author manuscript; available in PMC 2016 November 01.

Published in final edited form as:

Ear Hear. 2015 ; 36(0 1): 48S–59S. doi:10.1097/AUD.0000000000000209.

Quantity and Quality of Caregivers' Linguistic Input to 18-month and 3-year-old Children who are Hard of Hearing

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Abstract

Objectives—The primary objective of this study was to examine the quantity and quality of caregiver talk directed to children who are hard of hearing (CHH) as compared to children with normal hearing (CNH). For the CHH only, the study explored how caregiver input changed as a function of child age (18 months versus 3 years), which child and family factors contributed to variance in caregiver linguistic input at 18 months and 3 years, and how caregiver talk at 18 months related to child language outcomes at 3 years.

Design—Participants were 59 CNH and 156 children with bilateral, mild-to-severe hearing loss. When children were approximately 18-months and/or 3-years of age, caregivers and children participated in a 5-minute semi-structured, conversational interaction. Interactions were transcribed and coded for two features of caregiver input representing quantity (number of total utterances and number of total words) and four features representing quality (number of different words, mean length of utterance in morphemes, proportion of utterances that were high-level, and proportion of utterances that were directing). Additionally, at the 18-month visit, parents completed a standardized questionnaire regarding their child's communication development. At the 3-year visit, a clinician administered a standardized language measure.

Results—At the 18-month visit, the CHH were exposed to a greater proportion of directing utterances than the CNH. At the 3-year visit, there were significant differences between the CNH and CHH for number of total words and all four of the quality variables, with the CHH being exposed to fewer words and lower quality input. Caregivers generally provided higher quality input to CHH at the 3-year visit, as compared to the 18-month visit. At the 18-month visit, quantity variables, but not quality variables, were related to several child and family factors. At the 3-year visit, the variable most strongly related to caregiver input was child language. Longitudinal analyses indicated that quality, but not quantity, of caregiver linguistic input at 18

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Conflicts of Interest

The authors have no conflicts of interest to declare.

See Supplemental Digital Content, Appendix A List of Acronyms used throughout Outcomes in Children with Hearing Loss Study.

months was related to child language abilities at 3 years, with directing utterances accounting for significant unique variance in child language outcomes.

Conclusions—Although caregivers of CHH increased their use of quality features of linguistic input over time, the differences as compared to CNH suggest that some caregivers may need additional support to provide their children with optimal language learning environments. This is particularly important given the relationships that were identified between quality features of caregivers' linguistic input and children's language abilities. Family supports should include a focus on developing a style that is conversational-eliciting as opposed to directive.

INTRODUCTION

Extensive research demonstrates that children's early language environments play a critical role in shaping their linguistic, academic, and cognitive outcomes (Huttenlocher et al. 1991; Hart & Risley 1995; Weizman & Snow 2001; Hoff & Naigles 2002). Potentially the most important element of children's early language environments is the linguistic input provided by their caregivers. The success of children's early language learning is dependent upon this input being of adequate quantity and quality. However, exposure to high rates of quality linguistic input alone is not sufficient for age-appropriate language development; children must also be able to attend to and process the linguistic input to which they are exposed. As noted earlier in this monograph, a variety of factors may influence the potential for children who are hard of hearing (CHH) to attend to, or uptake, the linguistic input in their environments. These include factors discussed in other manuscripts in this monograph, such as audibility, perception, and characteristics of the auditory environment. These factors may interfere with CHH's consistent access to the linguistic input in their environments, thus limiting their cumulative uptake of linguistic information and, consequently, their success with language development.

Snow (1994) suggested that children with hearing loss (HL) are at risk for delayed language development because they miss potential learning experiences presented in the environment. She concluded that children with HL may be considerably more dependent than their typical peers on the availability of optimized language input. Early intervention for children at risk of language delays, including those with HL, is predicated on the notion that optimizing the language environment will provide protection against communication delays. Given the potentially heightened importance of caregiver talk for CHH, this manuscript compares characteristics of caregiver talk addressed to children with normal hearing (CNH) to characteristics of talk addressed to CHH. Changes in caregiver input over time, relationships of child and family factors with caregiver talk, and influences of caregiver input on child language are explored within the CHH.

There are two main characteristics of linguistic input to consider: quantity and quality. Quantity refers to how frequently caregivers speak to children and is often represented by the number of utterances or the number of words caregivers use in interactions with children. In Hart and Risley's (1995) landmark study of children's early language learning environments, they found that quantity of caregiver talk was a better predictor of children's linguistic outcomes than any other feature of their early language experiences. Other studies

also support this conclusion; children who are exposed to higher amounts of linguistic input demonstrate stronger vocabulary growth and faster lexical processing than children who are exposed to lower rates of linguistic input (Huttenlocher et al. 1991; Hoff & Naigles 2002; Hurtado et al. 2008). When children are exposed to high amounts of linguistic input, they are provided with frequent opportunities to learn about the phonemes that make up their language, the boundaries between words and sentences, the words that correspond to the objects and events in their surroundings, and syntactic patterns of sentences (Huttenlocher et al. 1991; Kuhl 2004, 2010).

Quality can refer to a wide range of linguistic characteristics, including the richness of the vocabulary, the complexity of utterances, use of techniques designed to engage the child in conversational interactions, and verbal interaction style (e.g., directive versus responsive). Vocabulary and utterance complexity have been explored most thoroughly in the literature, with numerous studies indicating that the number of different words and the complexity of utterances (represented by the average length of utterances) used by parents are positively associated with children's language outcomes (Hurtado et al. 2008; Rowe 2008). Studies have also examined parental use of high-level vocabulary, including mental state or desire terms (e.g., 'believe," "think," "love," and "want"). Findings have indicated that more frequent use of these terms is positively associated with children's later social understanding (Taumoepeau & Ruffman 2006). In other studies, researchers have investigated parental use of techniques to engage children in conversational interactions, such as asking open-ended questions. Findings from this work indicate that use of open-ended questions and frequency of conversational interactions are both positively associated with children's language outcomes (Hoff-Ginsberg 1985; Zimmerman et al. 2009). Another quality feature of linguistic input is the parent's verbal interaction style, which can be conceptualized in a number of ways. In their study of maternal interaction style, McDonald and Pien (1982) reported that there were two predominant intentions mothers had when participating in conversational interactions with their children: to control the child's physical actions and to converse with the child. Other studies have focused on whether a parent's input within interactions tends to be contingent upon the child's behaviors (i.e., a responsive style) or whether the parent frequently attempts to direct the child's behaviors and attention (Hoff-Ginsberg 1991; Masur et al. 2013). Previous studies have consistently found overly directive styles to be associated with negative child language outcomes, especially when the parent's directives are not related to the child's focus of attention (Akhtar et al. 1991; Rowe 2008).

Variability in Quantity and Quality of Caregiver Linguistic Input

Interestingly, quantity, but not quality, of talk appears relatively stable over time for individual parents (Cohen & Beckwith 1976; Olsen-Fulero 1982; Huttenlocher et al. 1991; D'Odorico et al. 1999). For example, Cohen and Beckwith (1976) found that parents provided their children with similar amounts of input from before their children were learning words to when they had acquired expressive vocabularies. Similarly, a parent's tendency to be talkative or taciturn appears to be stable across conversational partners; parents who are highly voluble when interacting with their own child are also likely to be highly voluble when interacting with other children and adults (Olsen-Fulero 1982; Smolak & Weinraub 1983; Huttenlocher et al. 1991). With regard to quality, however, parental

communication style appears to be less stable. As children get older and become more capable communicators, parents tend to increase the complexity of the language they use when interacting with their children (Kavanaugh & Jirkovsky 1982; Bornstein et al. 1999). This includes use of more mental state terms (Jenkins et al. 2003) and fewer directive utterances (Pan et al. 1986; Smolak 1987). However, this does not mean that child language alone drives the relationship between parent talk and child language outcomes. Although children with more advanced language abilities may indeed elicit more talk or higher quality talk from their parents (Hoff-Ginsberg 1994), evidence also indicates that parent talk predicts child language outcomes even after controlling for children's earlier language abilities (Hurtado et al. 2008; Rowe 2008). Thus, the relationship between parent talk and child language is likely bi-directional.

Given the contributions of quantity and quality of linguistic input to children's language outcomes, it is of interest to examine which factors are associated with variability in linguistic input. One of the most-explored factors is socioeconomic status (SES). Hart and Risley (1995) found that parents from professional families directed thousands more words each day to their children than did parents from working-class and welfare families. Similarly, parents from professional families were more responsive to children's contributions in interactions than were parents from working-class and welfare homes. The authors indicated that these were meaningful differences because exposure to more words and higher parental responsivity were associated with stronger child language outcomes. This fits with the findings of work indicating that the speech of working-class mothers more frequently served the purpose of directing their children's behavior than the speech of upper-middle-class mothers (Hoff-Ginsberg 1991). In addition to SES, other studies have found relationships between parent talk and the children's development, with parents being more directive and less responsive to children with disabilities (Kim & Mahoney 2004; Marfo 1990).

Caregiver Input to CHH

Literature on the characteristics of caregiver talk to CHH and the relationship between caregiver talk and CHH's communication outcomes is limited. In part, this is because most research on caregiver input to children with HL has focused on dyads in which the child is deaf, as opposed to hard of hearing. Findings generally indicate that hearing parents are more directive, use less complex language structures, and less high-quality talk, including mental state talk, in interactions with their deaf children than parents who share the same hearing status as their child (Cross et al. 1980; Nienhuys et al. 1984; Nienhuys et al. 1985, Spencer et al. 1992; Moeller & Schick 2006; Morgan et al. 2014). There is some evidence, however, that differences are less apparent or non-existent when the control group is language-matched to the child with HL, as opposed to age-matched, thus indicating that children's language abilities influence quality of caregiver input (Gallaway & Woll, 1994).

Several recent studies have documented relationships between quality of linguistic input and the language outcomes of children with cochlear implants. DesJardin and Eisenberg (2007) found that the complexity of mother's utterances and maternal use of two facilitative language techniques (recasts and open-ended questions) were positively related to children's

language outcomes. Similarly, Cruz and colleagues (2013) reported that maternal use of higher-level strategies such as recasts and open-ended questions predicted growth in the expressive language abilities of pediatric cochlear implant users. Additionally, the number of different words mothers used was predictive of the same children's growth in receptive language. In another report from the longitudinal study that yielded the Cruz et al manuscript, Quittner and colleagues (2013) found that for pediatric cochlear implant users, the strongest language outcomes were achieved by children whose mothers demonstrated high levels of maternal sensitivity and provided their children with above-average amounts and quality of language stimulation. It is unclear whether this work documenting the importance of quality language input for children with cochlear implants, or previous work documenting differences between parent talk to CNH and children who are deaf, are applicable to CHH who use hearing aids (HAs), as the early auditory-linguistic experiences of these groups naturally differ.

More recent studies have focused on linguistic input to groups of children with a range of HL (both deaf and hard of hearing), with findings indicating that parents of toddlers and preschoolers with HL expose their children to similar amounts of linguistic input as parents of CNH (Nittrouer 2010; Aragon & Yoshinaga-Itano 2012). However, Nittrouer (2010) found differences between the groups in quality of linguistic input, with parents of children with HL being less verbally responsive to their children's communicative attempts than parents of CNH. Importantly, children with HL who had more verbally responsive parents generally developed stronger language skills than children with HL who had less verbally responsive parents. Further work is needed to better understand how a child's hearing status may influence various qualitative aspects of parental linguistic input and whether variability in quality of linguistic input is related to language outcomes for CHH.

The only recent reports on parent input exclusively to CHH have come from the Outcomes of Children with Hearing Loss (OCHL) investigative team (VanDam et al. 2012; Ambrose et al. 2014). In this work, the team utilized automated technology to examine linguistic input in full-day recordings of CHH's natural environments. This technology allows for collection of quantitative information about the amount of linguistic input in children's everyday environments, but is limited in the information it can provide about quality of caregiver linguistic input, such as information about content and complexity. No differences were identified in the number of adult words or the number of adult-child conversational interactions in recordings of CHH's environments as compared to CNH's environments (VanDam et al. 2012). However, substantial variability was identified between families of CHH on these measures. Interestingly, the number of adult words in recordings was not significantly related to CHH's language outcomes (Ambrose et al. 2014). It is possible that the lack of a relationship was due to methodological issues; the automated technology did not allow for a differentiation of words directed toward the child versus overheard by the child. At least one recent study found that high quantities of adult words were only beneficial for toddlers' language development when the words were directed to the toddler as opposed to overheard by the toddler (Weisleder & Fernald 2013). This may also explain why the Ambrose et al. (2014) study found a positive relationship between frequency of conversational interactions and children's language outcomes; the parent talk that occurs within conversational interactions is likely to be child-directed and thus supportive of the

child's language learning. Given the potential importance of child-directed linguistic input for the language development of CHH, further investigations of caregiver linguistic input to CHH are needed.

The current study seeks to expand on our previous work by examining caregiver talk in caregiver-child interactions in a laboratory setting, thus allowing for more detailed analyses of the quantity and quality of caregiver talk. This work addresses four research questions:

1. Does the quantity or quality of caregiver linguistic input directed to CHH differ from that directed to CNH at 18 months or 3 years? *It is predicted that quantity of caregiver talk will not differ between groups, but that quality of caregiver talk will differ at both time points.*
2. How do the quantity and quality of linguistic input provided by caregivers to CHH change over time? *It is hypothesized that quantity of caregiver talk will remain stable across the two time points. Additionally, it is predicted that quality of caregiver talk will change over time in the same ways as identified for CNH in previous studies; caregivers will use more different words, longer utterances, more high-level utterances, and fewer directing utterances at the later time point.*
3. What factors contribute to variability in the quantity and quality of linguistic input directed to CHH? *It is hypothesized that higher SES will be associated with caregivers providing children with higher quantity and quality linguistic input. Additionally, it is predicted that stronger child language abilities will be related to higher quality caregiver linguistic input. No hypotheses are outlined regarding relationships between caregiver talk and children's audiologic characteristics or gender, as previous literature is less definitive with regard to these relationships.*
4. How does caregiver linguistic input at the 18-month visit relate to CHH's language outcomes at the 3-year visit? *It is predicted that both quantity and quality of caregiver linguistic input at 18 months will be related to children's communication outcomes at 3 years, with language abilities being more strongly associated with quality as opposed to quantity of input.*

MATERIALS AND METHODS

Details regarding general methods for the OCHL study, including subject recruitment, are described in detail in the beginning of this supplement (Tomblin et al. this issue, XXXX).

Participants

Participants from the larger OCHL sample were included if they completed the Art Gallery task with a caregiver at the 18-month or 3-year visit (see Procedures). Inclusion criteria for CHH were (1) chronological age between 6 months and 7 years of age at the time of recruitment, (2) better-ear pure tone average (BEPTA) between 25 and 75 dB HL[1], (3) no

[1]Although eligibility criteria for the HH group included a better-ear three- or four-frequency pure-tone average no better than 25 dB HL and no poorer than 75 dB HL, exceptions to this criterion were made to allow for inclusion of children with bilateral, high-frequency HL (n = 3). In addition, children that initially fit this eligibility criterion but that later progressed beyond 75 dB HL were retained in the study (n = 4), unless they received a cochlear implant.

cochlear implant, (4) from a home where English was the primary language, and (5) no significant cognitive or motor delays. The latter two criteria also applied to CNH, along with the additional criterion of a four frequency PTA of 20 dB HL or less in both ears.

Participants for the current study were 59 CNH (31 male, 28 female) and 156 children (85 male, 71 female) with bilateral, mild-to-severe HL (CHH). For the cross-sectional analyses, children who contributed data at both time points (CNH $n = 12$, CHH $n = 37$) are only represented in the 18-month data. The longitudinal analyses include repeated measures for 26 CHH who contributed data at both time points and who interacted with the same caregiver in both samples. Demographic characteristics for the CNH and CHH at each time point, including numbers of participants in each group, are displayed in Table 1 and audiologic characteristics for the CHH at each time point are displayed in Table 2.

Procedures

Audiologic Assessment—Audiologic evaluations were completed by a certified audiologist with pediatric experience and a test assistant. The audiologist attempted to obtain air conduction and bone conduction thresholds at 500, 1000, 2000, and 4000 Hz at a minimum by using visual reinforcement audiometry or conditioned play audiometry, depending on the age of the child. All attempts were made to obtain ear-specific thresholds by using insert earphones, circumaural headphones, or the child's own earmolds paired with insert earphones. If testing could not be completed, the child's audiologist provided a copy of the most recent reliable audiogram. To estimate the proportion of the amplified speech spectrum that was audible to the children when they were wearing their HAs, real ear speechmapping measurements were completed using the Audioscan Verifit. The aided Speech Intelligibility Index (ANSI S3.5, 1997) for the standard male speech signal (carrot passage) at an input level of 65 dB SPL was calculated for both right and left ears, and the higher of these values is considered the better-ear Speech Intelligibility Index.

Caregiver-Child Interaction—At the 18-month and 3-year visits, caregivers and children spent approximately 5 minutes engaged in the Art Gallery task, which has been used with CNH (Adamson et al. 2004) and children with HL (Quittner et al. 2004). Parents were given the following instructions, "You will notice that there are several pictures in the room. Try to attract your child's attention to and talk about each of the pictures. After looking at all of the pictures, return to his/her favorite picture and to the picture that he/she seemed to like the least." The majority of child-caregiver interactions (79%) included the mother as the sole caregiver. Fathers served as the sole caregiver in 13% of interactions and grandmothers served as the sole caregiver in 1% of interactions. For the remaining 7% of the samples, 2 caregivers interacted with the child, either the mother and father (5%) or the mother and grandmother (2%).

Research assistants transcribed video recordings of the caregiver and child utterances in the Art Gallery interactions. Transcribers followed conventions that would allow for analysis of utterances using the Systematic Analysis of Language Transcripts software (Miller & Chapman 1998). The software was used to calculate the number of utterances, number of total words, number of different words, and mean length of utterances in morphemes for

caregiver talk in the samples. A second research assistant independently transcribed 15% of samples for each group (CNH, CHH) at each time point (18-month visit, 3-year visit) so that inter-judge reliability could be calculated. Intra-class correlation coefficients were computed separately for each of the four variables of interest to assess the absolute agreement between independent raters. For the 18-month samples, the estimated coefficient was 0.98 for number of utterances, 0.99 for number of total words, 0.99 for number of different words, and 0.96 for mean length of utterances in morphemes. For the 3-year samples, results indicated a coefficient of 0.85 for number of utterances, 0.97 for number of total words, 0.97 for number of different words, and 0.93 for mean length of utterances in morphemes. These values are considered to be acceptable and they suggest that the largest part of the variability in the scores is related to differences between subjects rather than to systematic differences between judges or interactions between judges and subjects.

Using procedures designed for the OCHL project, each caregiver utterance that was fully intelligible and complete (M = 93.78, SD = 22.81) was coded as serving 1 of 10 mutually exclusive functions: basic acknowledgements, clarification questions, informative statements, informative questions, simple social phrases, test questions, directing utterances, conversational-eliciting utterances that were open-ended, conversational-eliciting utterances referencing topics outside the immediate context, and real utterances.[2] The latter four types of utterances (directing, two conversational-eliciting types, and real utterances) were chosen for analysis in this manuscript because previous literature has indicated that these may specifically serve to hinder or support language development (Hoff-Ginsberg 1985; Taumoepeau & Ruffman 2006; DesJardin & Eisenberg, 2007; Rowe 2008; Zimmerman et al. 2009; Cruz et al. 2013). Directing utterances served to direct the child's attention, behavior, or actions (e.g., "Look right here." "No, don't touch that." "Count the bugs." "Say elephant."). Conversational-eliciting utterances comprised two separate codes: open utterances, which invited the child to talk, and outside utterances, which required the child to think outside the immediate context to respond (e.g., "Can you tell me a story?" "What is fishing?" "Do you have a toy like this at home?"). Real utterances were either sincere requests for information to questions for which the caregiver did not know the answer (e.g., "Why do you think that?" and "Which one is your favorite?") or questions or statements with internal state words, such as "want," "believe," and "dream" (e.g., "You think that is funny."). Conversational eliciting utterances (open or outside) and real utterances were considered high-level functions based on findings from previous literature (e.g., DesJardin & Eisenberg, 2007; Cruz et al. 2013), thus the counts for these utterance types were added together to calculate the number of high-level utterances.

Inter-judge reliability was examined by having a second research assistant use the ten-level coding system to code caregiver utterances in 20% of the samples for each group and time point. For the 18-month visits, percent agreement ranged from 87% to 100% (M = 94%). For the 3-year visits, percent agreement ranged from 83% to 97% (M = 91%).

Language Outcomes—At the 18-month visit, parents completed the Communication and Symbolic Behavior Scales – Developmental Profile, Caregiver Questionnaire (Wetherby &

[2]For additional information on the 10-level coding system, contact the first author.

Prizant 2002). The Caregiver Questionnaire queries the parent about the child's abilities in seven areas within three domains: social communication (emotion and eye gaze, communication, gestures), expressive speech and language (sound, words), and symbolic functioning (understanding, object use), yielding a total standard score with a normative mean of 100 and standard deviation of 15. The manual for the test reports correlations of 0.55 and 0.63 with the receptive and expressive language scores of the Mullen Scales of Early Learning (Mullen, 1995), a commonly used measure of communication abilities in infants and toddlers.

At the 3-year visit, children's communication abilities were assessed via the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk 1999). The CASL is a clinician-elicited standardized test that assesses children's lexical/semantic, syntactic, and pragmatic knowledge. There are three core tests for children who are 3 years of age: Basic Concepts (receptive language/semantic knowledge), Syntax Construction (expressive language/syntactic knowledge), and Pragmatics (expressive language/pragmatic knowledge). Age-normed standard scores were computed for each of the three core tests and were used to calculate a composite standard score with a normative mean of 100 and a standard deviation of 15.

The two language outcome measures were chosen because they assessed both children's receptive and expressive language abilities. See Table 1 for language outcome scores at both time points for the two groups (CNH and CHH). SAS version 9.4 was used for all analyses. The statistical techniques that were utilized to answer each question are noted in the relevant areas of the results section.

RESULTS

We were interested in how caregiver linguistic input to CNH and CHH differed, how caregiver talk to CHH changed over time, which child and family characteristics contributed to variance in caregiver talk to CHH, and the longitudinal relationship between caregiver talk and CHH's language outcomes. Six variables were selected to represent caregiver linguistic input: two to represent quantity and four to represent quality. Although the vast majority of caregiver-child interactions were between 4 ½ and 5 ½ minutes in length, 3% of the samples were shorter in length than 4 ½ minutes and 8% of the transcripts were greater than 5 ½ minutes in length (M = 5.12 minutes, SD = 0.40, Range: 3.52–8.25), thus the counts were divided by the number of minutes in the sample (rate per minute) and then multiplied by five to normalize all count variables to five minutes.

Before addressing the research questions, we sought to ensure that there was good internal consistency among the measures selected to represent each of the caregiver linguistic input constructs (quantity and quality). Quantity of caregiver talk was represented by number of total utterances (NTU) and number of total words (NTW). The Pearson correlation coefficient between these two variables was 0.90 for the combined groups of CNH and CHH at the 18-month visit and 0.71 for the combined groups of CNH and CHH at the 3-year visit. These strong correlations indicate that the variables measured a similar construct. Quality of caregiver talk was represented by number of different words (NDW), mean length of

utterance in morphemes (MLUm), proportion of utterances that were high-level (High-Level), and proportion of utterances that were directing (Directing). The Pearson correlation coefficients for the quality variables are presented in Table 3. A coefficient of alpha analysis provided an overall measurement of how correlated the group of quality variables were to one another. In order to perform the analysis, all pairwise correlations must be positive, thus Directing was multiplied by −1 to obtain a positive pairwise correlation with the other variables. The coefficient of alpha values were 0.73 and 0.74 at the 18-month visit and 3-year visit, respectively. A coefficient alpha above 0.70 indicates good internal consistency among the different variables. Thus, at both the 18-month and the 3-year visits, it can be concluded that the four variables are measuring a similar construct.

Differences in Caregiver Linguistic Input by Hearing Status

The first research question explored whether quantity or quality of caregiver talk differed based on child hearing status (CNH versus CHH). Two-sample *t* tests were performed for each of the quantity and quality variables at the 18-month and 3-year visits. When variances were unequal between groups, a Satterthwaite adjustment was implemented. In assessing normality, it was determined that one subject in the CNH was an outlier for Directing and consequently the CNH data for this variable were highly skewed (skew = 1.12). Given the relatively small sample size, a decision was made to remove the subject's data from analyses of the Directing variable. Summary statistics for the quality and quantity variables are included in Table 4. At the 18-month visit, neither of the quantity measurements differed significantly by group; the CNH and CHH were exposed to relatively similar numbers of total utterances and words by their caregivers. Of the quality measurements, only Directing differed significantly between the groups, with CHH being exposed to a greater proportion of directing utterances than were CNH. At the 3-year visit, the groups were exposed to relatively similar numbers of utterances. However, the groups differed significantly on NTW, with the CHH being exposed to significantly fewer total words than the CNH. All the quality variables differed significantly between groups, with the CHH being exposed to fewer different words, shorter utterances (lower MLUm), lower proportions of high-level utterances, and greater proportions of directing utterances.

Differences in Caregiver Linguistic Input to CHH at the 18-Month and 3-Year Visits

Our second research question explored whether quantity and quality of caregiver talk to CHH differed from the 18-month to the 3-year visit. We approached this question in two different ways, using both a cross-sectional analysis and a longitudinal analysis. In the cross-sectional analysis, only CHH observations were in the analysis and there were no repeated observations between the 18-month visits and 3-year visits (see Table 4). NTU did not differ between the 18-month and 3-year visits. However, NTW was significantly higher at the 3-year visit than the 18-month visit, indicating that caregivers directed more total words to the 3-year-old children. All the quality variables differed significantly between visits; at the 3-year visit, the CHH were exposed to significantly more different words, longer utterances, greater proportions of high-level utterances, and lower proportions of directing utterances than at the 18-month visit.

The longitudinal analysis was completed on data from CHH who participated in the Art Gallery task at both the 18-month and 3-year visits and who had the same caregiver(s) in both samples (n = 26). As noted in the methods section, these children were represented only in the 18-month visit data in the previous analyses. Table 5 contains the summary statistics for the paired t test analysis. Results generally matched those of the cross-sectional analysis. The only exception was that NTW did not reach significance in the longitudinal analysis, but did so in the cross-sectional analysis. Thus, children were exposed to similar numbers of total utterances and words at the 18-month and 3-year visits. However, at the 3-year visit, the CHH were exposed to significantly more different words, longer utterances, greater proportions of high-level utterances, and lower proportions of directing utterances than they were at the 18-month visit.

Factors Contributing to Variability in Quantity and Quality of Caregiver Linguistic Input

For the third question, we were interested in whether child and family factors influenced the quantity or quality of linguistic input caregivers offered to CHH. Child and family factors were child sex (male, female), BEPTA, age at HA fit (< 6 months, ≥ 6 months), child language abilities (represented by standard scores on the language outcome measures at each visit), and SES (represented by maternal education: high school education or less, some college, college graduate, graduate education). For each time point (18 months and 3 years), linear regression analyses were utilized to examine the contributions of the five child and family factors to variability in each of the caregiver input variables, thus there were six regressions (one for each of the caregiver input variables) completed at each age point. All five child and family factors served as the independent variables in each regression. As can be seen in Tables 1 and 2, a small number of CHH had missing data for maternal education, language abilities, or age at HA fit, thus resulting in seven CHH being excluded from the 18-month regression (n = 64) and ten CHH being excluded from the 3-year regression (n = 75). Zero-order correlations between the child and family variables are reported in Table 6 for children included in the regression.

At the 18-month visit, regression models were only significant for NTU and NTW (NDW R^2 = .14, p = 0.11; MLUm R^2 = .15, p = 0.09; High-Level R^2 = .05, p = 0.72; Directing R^2 = .15, p = 0.08). See Table 7 for results of the significant regression models. Overall, the child and family factors accounted for 18% of the variance in NTU and 19% of the variance in NTW. For NTU, only Sex and BEPTA accounted for significant, unique variance, with boys being exposed to fewer total utterances than girls and children with more HL being exposed to fewer total utterances than children with less HL. For NTW, only BEPTA and SES accounted for significant, unique variance, with children with more HL and children from lower SES homes being exposed to fewer total words.

At the 3-year visit, the model for NTW was not significant (R^2 = .08, p = 0.32), but models for the other five caregiver talk variables were significant. See Table 8 for results of the significant regression models. Neither Sex nor SES accounted for any significant, unique variance. BEPTA accounted for significant, unique variance only in NDW, with children with more HL being exposed to fewer different words. Age at HA fit accounted for significant variance only in MLUm, with children fit at or after 6 months being exposed to

slightly longer utterances than children fit before 6 months. Child language accounted for significant, unique variance in all five of the significant models, with stronger child language abilities being associated with fewer total utterances but higher quality input.

As a post-hoc analysis to explore why the direction of the relationship differed for child language with NTU as compared to child language with the quality variables, Pearson correlation coefficients were calculated for the relationship between NTU and the quality variables at the 3-year visit. NTU had a significant, positive relationship with NDW and Directing, but a significant negative relationship with MLUm and High-Level. Thus, caregivers who used more utterances were likely to also be using shorter utterances that were directing and not high-level. For comparison purposes, the same correlations were calculated for caregiver linguistic input at the 18-month visit. At the earlier time point, NTU had a significant positive relationship with NDW and MLUm, but a significant negative relationship with Directing. Note that the direction of the relationship for NTU with MLUm and Directing was reversed as compared to the 3-year visit. That is, at the 18-month visit, use of high numbers of utterances was associated with producing relatively long utterances and lower proportions of directing utterances, but at the 3-year visit, use of high numbers of utterances was associated with producing relatively short utterances and higher proportions of directing utterances.

Relationships Between Caregiver Linguistic Input at 18 Months and Language Outcomes at 3 Years

For the fourth research question, a longitudinal analysis of the relationships between caregiver linguistic input and CHH's later language abilities was completed with data from 35 CHH who completed the Art Gallery task at the 18-month visit and who also contributed CASL scores at the 3-year visit. Linear regression analyses were utilized to separately examine the contributions of quantity and quality of caregiver linguistic input at 18 months to children's language outcomes at 3 years. The Variance Inflation Factor was used to measure multicollinearity and since all values were less than 2, there was no cause for concern. The regression model for quantity of caregiver talk was not significant, $R^2 = .09$, $p = 0.24$. However, the regression model for quality of caregiver talk was significant, with the variables as a group accounting for 28.3% of variance in children's CASL scores at 3 years, $p = 0.04$. Of the four quality variables, Directing contributed significant, unique variance to CASL scores at 3 years ($\beta = -.51$, $p = 0.01$), while the other variables did not (NDW $\beta = -.20$, $p = 0.32$; MLUm $\beta = .39$, $p = 0.06$; High-Level $\beta = -.24$, $p = 0.18$). Figure 1 depicts the relationship between Directing at 18 months and CASL scores at 3 years ($r = -0.41$, $p = 0.03$). The direction of the relationship indicates that CHH who were exposed to greater proportions of directing utterances at the 18-month visit had weaker language skills at the 3-year visit than CHH who were exposed to lower proportions of directing utterances at the earlier time point (Fig. 1).

DISCUSSION

This study examined the quantity and quality of caregiver talk directed to CHH and CNH in an effort to determine ways in which such input contributes to variance in children's

outcomes. In general, the results suggest that quantity of caregiver talk was fairly comparable across the two groups at both 18 months and 3 years. However, quality measures were sensitive to differences, especially at 3 years. In particular, directiveness was a more common feature in dyads involving CHH than CNH. Longitudinal analysis involving only the CHH revealed that caregivers increased the complexity of their talk over time. However, analyses also suggested that directing utterances were negatively associated with child language outcomes, which is consistent with past findings on children who are typically developing (Akhtar et al. 1991; Rowe 2008) and those who are deaf (Vohr et al. 2010; DesJardin et al. 2014). Data from the 3-year visit revealed associations between child language and caregiver talk, which may be reflecting the inherent bidirectionality of these influences.

Between Group Differences

The first research question examined whether the quantity or quality of caregiver talk directed to CHH differed from that directed to CNH. For quantity of talk, no differences between groups were predicted. Although this prediction was upheld at the 18-month visit and for number of total utterances at the 3-year visit, caregivers did use significantly more total words with CNH than CHH at the 3-year visit. Given the similar number of utterances between groups and the differences observed in MLUm, this was indicative of the caregivers using longer utterances with the CNH. Differences in quality of talk to CNH versus CHH were predicted and subsequently indeed identified. At the 18-month visit, caregivers of CHH used a greater proportion of directing utterances than caregivers of CNH and at the 3-year visit the CHH were exposed to poorer quality input than the CNH. This fits with findings from previous work indicating that hearing parents use lower quality speech when communicating with their deaf children than do hearing parents of hearing children (Cross et al. 1980; Nienhuys et al. 1985).

The observed differences in this study may indicate that caregivers of the CHH were adapting their input to children's linguistic levels. That is, if parents were attuned to the fact that children had limited receptive or expressive language abilities, parents may have adapted their own language level by using a more limited range of vocabulary, producing less complex sentences, or asking fewer open-ended questions. Although this may have allowed children to be more successful in processing and responding to the language input, it is unclear whether, in the long-term, this serves to support or hinder children's language development. As Hoff-Ginsberg (1998) noted, while some simplification relative to adult-directed speech is needed in interactions with young children, the input to children must still be sufficiently complex to allow children to learn about the structure of the language. Over-simplified linguistic input, paired with frequent use of directing utterances and infrequent use of conversational eliciting strategies, is likely to provide the child with a less than optimal language learning environment, regardless of the child's stage of language development. Further research is needed to determine the levels or aspects of simplification that promote or hinder language development.

Longitudinal Changes in Caregiver Talk Directed to CHH

The second research question asked how caregiver talk to CHH changed over time. Data from both the cross-sectional and longitudinal analyses indicated that quantity is more stable over time than quality, which fits with the predictions outlined regarding this relationship and with findings of previous research (Cohen & Beckwith 1976; Olsen-Fulero 1982; Huttenlocher et al. 1991; D'Odorico et al. 1999). Changes in the quality variables from the 18-month visit to the 3-year visit indicated that caregivers provided the CHH with higher quality input at 3-years than 18-months. Although caregivers may alter their linguistic input simply in response to the child's age, it is also possible that these differences reflect caregivers' sensitivity to changes in their children's behavior and language abilities. As children expand their receptive lexicons and become more capable of processing complex sentences, caregivers may respond with increased use of quality features in their own talk. It is worth noting that although most caregivers increase their use of quality features of linguistic input over time, other research indicates that they also tend to maintain their positions relative to other parents in terms of the complexity of their speech (Huttenlocher et al. 2007). Thus, parents who provide their children with the least complex input relative to other parents at an early time point will continue to provide their children with the least complex input at later time points relative to other parents.

Influence of Child and Family Factors

The third research question explored the relationships of child and family factors with caregiver talk. Contrary to predictions and in contrast with findings of previous studies (e.g., Hoff-Ginsberg 1991 & 1995), SES contributed significant, unique variance to only one caregiver input variable at the 18-month visit and no variables at the 3-year visit. This may be a result of the group being relatively advantaged for SES, thus resulting in an underestimation of the impact of SES on caregivers' linguistic input. It is also possible that other measured and unmeasured factors were playing a more predominant role than SES. For example, all CHH were enrolled in early intervention services where their caregivers were likely coached regarding the types of linguistic input that would best support their child's language development. This intervention may have resulted in lower SES families providing their children with higher quantity and quality caregiver talk than they would have provided without intervention. Additionally, SES may have been related to child language abilities, which were controlled for in the analyses, potentially reducing the strength of the relationship between SES and the six caregiver linguistic input variables.

Findings were also mixed regarding the audiologic variables. BEPTA was found to contribute unique variance in both of the significant models at 18 months and one of the five significant models at 3 years. In each case, children with more HL were being exposed to poorer quantity or quality input. This is concerning given that these children are likely to have the most inconsistent access to linguistic input due to the severity of their HL. Inconsistent access, combined with exposure to fewer utterances, total words, or different words, will reduce these children's language learning opportunities. Age at HA fit, which served as the other audiologic variable, was only found to contribute unique variance in one of the significant models. Additionally, the finding was counter-intuitive, with the latter-fit

group of children being exposed to more complex utterances. This finding may have been spurious and thus limited conclusions can be drawn without further research.

The findings regarding the relationships between caregiver talk and child language abilities were mixed, with these relationships only emerging at the 3-year visit. It is possible that the younger children were not far enough along in language development to demonstrate the benefit from the quality features of caregiver talk. Yet, as their communication development progressed, they may have become more capable of taking advantage of the beneficial effects of high-quality linguistic input, thus leading to the observed relationships between caregiver talk and child language at the 3-year visit. Another possibility is that the additional 18 months of time between the two visits simply allowed for the cumulative effects of caregivers' linguistic input on children's language development to become apparent. The changing relationship may have also been driven by changes in the parent as opposed to the child. That is, parents may have become more sensitive to children's developing language abilities by the later time point, resulting in caregivers responding to children's advancing language abilities by providing them with higher quality linguistic input.

Contributions to Child Language Outcomes

The fourth research question explored the longitudinal contributions of quantity and quality of caregiver talk to child language outcomes. Contrary to predictions, quantity of caregiver talk was not positively associated with children's language outcomes at either time point. It is possible that this was related to the methodology used in this study, which included use of caregiver-child interactions that were restricted in length. It may be more valid to measure quantity of caregiver input in naturalistic settings, where variance in the amount of time that children and caregivers interact is allowed to vary freely over a longer period of time. In contrast with the findings related to quantity, quality of caregiver talk was related to child language outcomes, with directing utterances being the one quality variable that contributed significant unique variance to outcomes. This fits with previous findings indicating that parental interaction styles that are directive, as opposed to responsive, are associated with poorer child language outcomes (McDonald & Pien 1982; Akhtar et al. 1991; Kloth et al. 1998). However, several authors have hypothesized that not all directive utterances or directive styles have a negative effect on child language (Akhtar et al. 1991; Pine 1992; Taylor et al. 2009). For example, Akhtar and colleagues (1991) found that use of directive utterances that followed the child's focus of attention, such as directing the child to complete an action on a toy he or she is already playing with, was positively correlated with children's vocabulary development. On the other hand, use of directive utterances that changed the child's focus of attention was negatively related to outcomes. The coding for the current project did not differentiate between the two types of directing utterances.

Clinical Implications

In a recent international consensus statement on best practices for family-centered intervention for children who are deaf and hard of hearing, a panel of experts indicated that 1 of the 10 most important principles was "families and providers work together to create optimal environments for language learning" (Moeller et al. 2013, p. 436). This fits with recommendations from the Joint Committee on Infant Hearing that service providers have

the knowledge and skills to "coach families in the use of strategies that promote a language-rich environment to facilitate language, thought, and early literacy" (Joint Committee on Infant Hearing 2013, p. e1343). The results of the current study support these recommendations and, specifically, the early intervention practices of coaching families to be sensitive to their child's unique linguistic needs, while also providing their child with a language learning environment that is sufficiently complex to promote linguistic development. The standard practice of coaching parents to elicit conversations, as opposed to directing their child's attention or behaviors during interactions, is also supported. Based on the current findings and previous research, it may be especially important to carefully monitor and support caregiver-child interactions for families from lower SES backgrounds and for those who have children with moderate-to-severe HL.

Limitations and Future Research Directions

One potential limitation of this study is that caregiver talk was examined in relatively brief caregiver-child interactions, with an average length of just over five minutes. Longer samples may present a more stable picture of caregivers' linguistic input. However, it should be noted that, on average, the samples included around 100 caregiver utterances, which is generally deemed sufficient for language sample analysis (Leadholm & Miller 1992). Another potential limitation of the methodology is that the Art Gallery format may have encouraged a more adult-directed context than other formats, such as free play. However, despite the somewhat structured format, caregivers displayed substantial variance in their communicative styles. Future work should look at the stability of the features of caregiver talk in samples of varying length and samples collected with a variety of methodologies.

Another limitation of this study was that the coding system did not directly examine caregivers' responses to children's communication attempts, thus limiting the conclusions that could be drawn regarding caregivers' sensitivity and responsiveness to children's language abilities. Additional investigation in these areas may be warranted, including examination of caregiver use of linguistic features such as expansions and recasts, given the extensive literature documenting the importance of these caregiver behaviors. Models that more globally examine interactions for caregiver characteristics such as sensitivity, responsivity, and positivity could also be applied in future investigations of how caregivers interact with CHH, allowing for a more comprehensive picture of dynamics within these dyads. A further limitation of this study is that the design did not allow for specifying the directionality of the relationship between caregiver input and child language outcomes. Although it is suspected that this relationship is bidirectional, future investigations could shed further light on directionality by making comparisons between caregiver talk to CHH versus caregiver talk to other conversational partners with varying linguistic skill levels.

Future work may also benefit from better or differently matched groups. Specifically, the 18-month and 3-year CHH differed in age at HA fitting and should be better aligned on this variable in future studies. Additionally, matching groups based on the child's language age as opposed to chronological age may further our understanding of the relationship between caregiver input and child language. Future longitudinal work should also make use of the

same language measure at each time point and should compare longitudinal changes in talk to CHH to changes in talk to CNH.

Summary

In the introduction to this monograph, we hypothesized that HL interferes with the consistency and/or quality of children's access to linguistic input, which over time results in an overall reduction in cumulative auditory-linguistic experience. This process has the potential to impede language learning, although there are factors that can increase risk or protect against risk. The relationships that were identified between features of caregiver linguistic input and children's language abilities support inclusion of this variable in the model and the importance of providing CHH with optimal input as one means of protecting against risk. Currently, linguistic input may not be optimized for all CHH, as evidenced by the large variance in the caregiver linguistic input variables for the CHH and the CHH being exposed to linguistic input that was more directive at the 18-month visit and more limited in quantity and quality at the 3-year visit than the talk directed to the CNH. To ensure that all CHH are exposed to optimal input, it is important that we encourage early intervention practices of coaching caregivers to provide CHH with high amounts of quality linguistic input and to adopt an interaction style that is conversational-eliciting as opposed to directive.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Source of Funding:

This research was supported by the following grants from the NIH-NIDCD: R01DC009560, R01DC013591, and R03DC012647. The authors had full editorial control of this work and manuscript.

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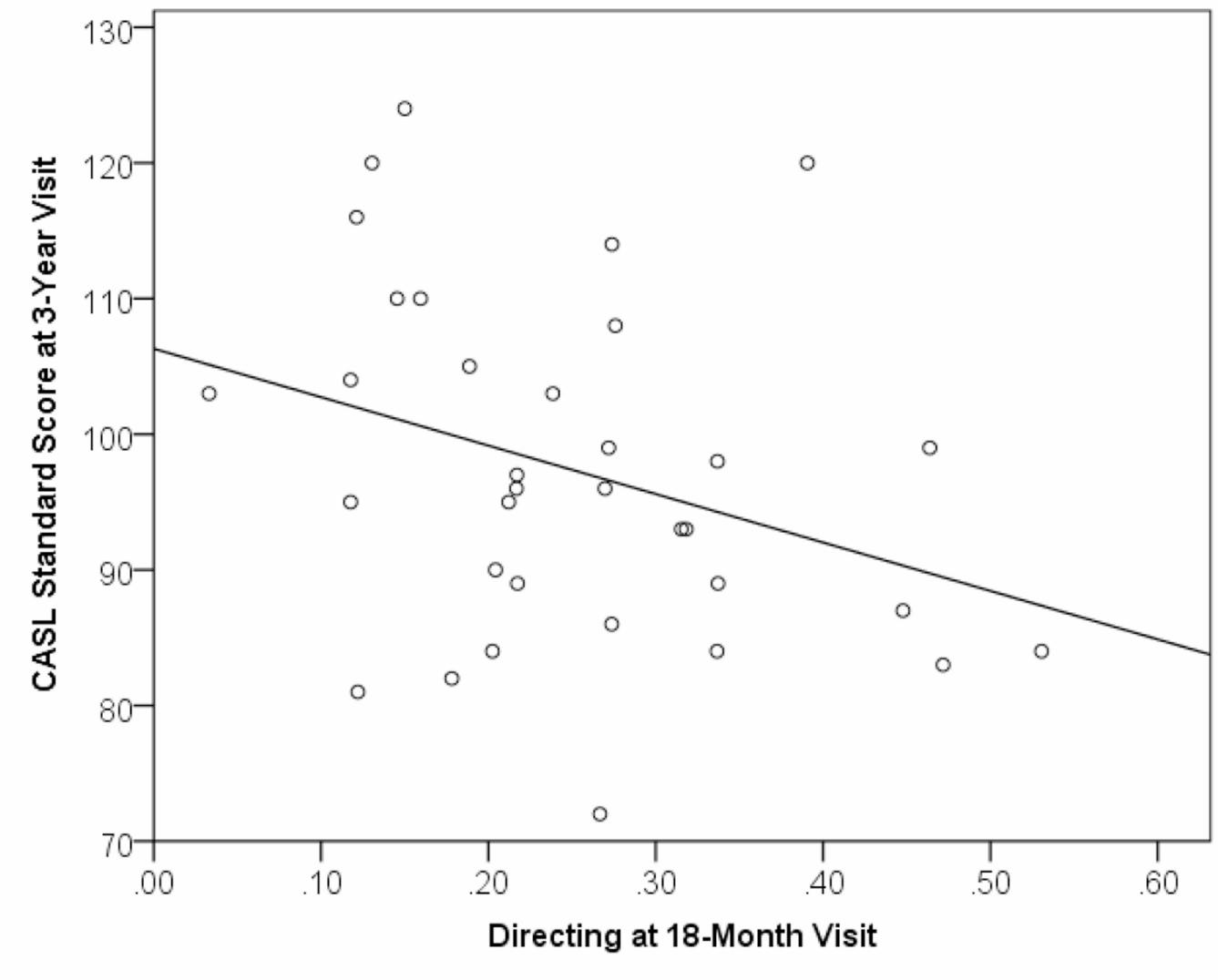

Figure 1.

Scatterplot displaying the relationship between the proportion of caregiver utterances that were Directing at the 18-month visit and standard scores on the Comprehensive Assessment of Spoken Language (CASL) at the 3-year visit.

Table 1

Demographic characteristics of the Normal Hearing (NH) and Hard of Hearing (HH) groups

	NH Group						HH Group					
	18-month visit			3-year visit			18-month visit			3-year visit		
Variable	***n***	***M* (*SD*)**	**Range**	***n***	***M* (*SD*)**	**Range**	***n***	***M* (*SD*)**	**Range**	***n***	***M* (*SD*)**	**Range**
Age (months)	18	19.1 (1.2)	17–21	41	37.5 (2.8)	33–44	71	18.6 (1.2)	16–21	85	37.7 (2.8)	34–44
Maternal education (years)	16	15.6 (2.3)	12–19	39	15.8 (2.9)	9–20	69	15.4 (2.5)	9–20	81	15.3 (2.2)	9–20
Language abilities* (standard score)	14	102.5 (13.2)	72–121	39	100.1 (16.80)	59–158	67	94.4 (13.0)	69–124	80	87.7 (17.9)	60–131

*Represented by children's scores on the Communication and Symbolic Behaviors Scales – Developmental Profile at the 18-month visit and the Comprehensive Assessment of Spoken Language at the 3-year visit.

Table 2

Audiologic characteristics for Children who are Hard of Hearing

	18-month visit			3-year visit		
Variable	***n***	***M* (*SD*)**	**Range**	***n***	***M* (*SD*)**	**Range**
BEPTA[1] (dB HL)	71	49.8 (12.2)	16.3–83.0	85	49.2 (13.9)	18.8–92.5
BESII	69	0.76 (0.14)	0.25–0.94	83	0.75 (0.17)	0.08–0.95
Age at HA fit (months)	71	5.2 (3.5)	1–17	83	12.9 (10.7)	1–41

Note. BEPTA = better-ear pure tone average; BESII = better-ear Speech Intelligibility Index; HA = hearing aid.

[1]Although eligibility criteria for the HH group included a better-ear three- or four-frequency pure-tone average no better than 25 dB HL and no poorer than 75 dB HL, exceptions to this criterion were made to allow for inclusion of children with bilateral, high-frequency HL (n = 3). In addition, children that initially fit this eligibility criterion but that later progressed beyond 75 dB HL were retained in the study (n = 4), unless they received a cochlear implant.

Table 3

Correlation matrix for the quality caregiver linguistic input variables for the combined groups, with 18 months (n = 89) above the diagonal and 3 years (n = 175) below the diagonal.

	NDW	MLUm	High-Level	Directing
NDW		0.72**	0.43**	−0.24*
MLUm	0.65**		0.43**	−0.26*
High-Level	0.44**	0.68**		−0.37**
Directing	−0.05	−0.26**	−0.42**	

Note. NDW = number of different words; MLUm = mean length of utterance in morphemes.

* $p < 0.01$

** $p < 0.001$

Table 4

Summary statistics and between-group comparisons of caregiver linguistic input

	18-Month Visit				3-Year Visit				18-Month vs. 3-Year	
	NH (*n*=18)	HH (*n*=71)	NH vs. HH		NH (*n*=41)	HH (*n*=85)	NH vs. HH		HH	
Input Variables	***M* (*SD*)**	***M* (*SD*)**	***p***	**Cohen's *d***	***M* (*SD*)**	***M* (*SD*)**	***p***	**Cohen's *d***	***p***	**Cohen's *d***
NTU	108.0 (26.9)	96.8 (28.8)	0.14	0.40	100.8 (20.5)	100.3 (21.4)	0.90	0.02	0.405†	−0.14
NTW	364.9 (115.2)	320.9 (125.4)	0.18	0.37	433.8 (109.5)	383.1 (91.3)	0.01	0.50	0.001†	−0.56
NDW	96.8 (25.8)	91.5 (29.5)	0.48	0.19	127.5 (27.0)	112.3 (24.6)	0.002	0.59	<0.001	−0.77
MLUm	3.8 (0.6)	3.7 (0.7)	0.50	0.15	4.9 (0.7)	4.4 (0.8)	<0.001	0.67	<0.001	−0.93
High-Level	0.12 (0.06)	0.1 (0.06)	0.15	0.34	0.22 (0.10)	0.18 (0.09)	0.05	0.37	<0.001	−1.10
Directing	0.19* (0.09)	0.26 (0.11)	0.02	−0.68	0.12 (0.06)	0.16 (0.10)	0.002†	−0.55	<0.001†	0.91

Note. NH = normal hearing; HH = hard of hearing; NTU = number of total utterances; NTW = number of total words; NDW = number of different words; MLUm = mean length of utterance in morphemes.

*Outlier removed.

†Indicates a Satterthwaite adjustment in the *t* test.

Table 5

Summary statistics and longitudinal analysis of caregivers' linguistic input to Children who are Hard of Hearing at the 18-month versus 3-year visit (n = 26).

	18 Month	3 Year	Between Group	
Linguistic Input Variables	***M* (*SD*)**	***M* (*SD*)**	***p***	**Cohen's *d***
NTU	107.2 (27.4)	102.7 (19.6)	0.38	0.19
NTW	364.7 (126.5)	401.7 (98.1)	0.10	−0.33
NDW	102.3 (31.8)	117.9 (22.7)	0.02	−0.56
MLUm	3.8 (0.6)	4.5 (0.8)	<0.001	−0.99
High-Level	0.10 (0.06)	0.16 (0.08)	0.004	−0.91
Directing	0.25 (0.12)	0.14 (0.60)	<0.001	1.20

Note. NTU = number of total utterances; NTW = number of total words; NDW = number of different words; MLUm = mean length of utterance in morphemes.

Table 6

Correlation matrix for the child and family factors entered in the 18-month regression above the diagonal and 3 year regression below the diagonal.

	Sex	BEPTA	Age at HA fit	Language abilities	Maternal education
Sex		−0.26[a]*	0.02[b]	−0.13[a]	−0.09[c]
BEPTA	0.06[a]		−0.05[a]	−0.07[a]	−0.07[c]
Age at HA fit	−0.04[b]	0.10[a]		−0.17[a]	−0.15[c]
Language abilities	−0.10[a]	−0.27[a]*	−0.18[a]		0.33[c]**
Maternal education	−0.20[c]	−0.09[c]	−0.03[c]	0.35[c]**	

Note. BEPTA = better-ear pure tone average; HA = hearing aid.

[a] Pearson correlation.

[b] Phi coefficient.

[c] Spearman's rho.

* $p < 0.01$.

** $p < 0.001$.

Table 7

Regression models for the relationship of child and family factors with caregiver linguistic input variables at the 18-month visit.

Child and Family Factors	NTU (R^2 = .18, p = 0.04)		NTW (R^2 = .19, p = 0.03)	
	β	*p*	β	*p*
Sex	−.30	0.02	−.18	0.15
BEPTA	−.27	0.03	−.29	0.02
Age at HA fit	−.09	0.44	−.14	0.25
Language abilities	−.12	0.34	−.12	0.35
Maternal education	.21	0.10	.28	0.03

Note. NTU = number of total utterances; NTW = number of total words; BEPTA = better-ear pure tone average; HA = hearing aid.

Table 8

Regression models for the relationship of child and family factors with caregiver linguistic input variables at the 3-year visit

Child and Family Factors	NTU (R^2 = .18, p = 0.02)		NDW (R^2 = .21, p = 0.01)		MLUm (R^2 = .52, p < 0.001)		High-Level (R^2 = .43, p = < 0.001)		Directing (R^2 = .27, p < 0.001)	
	β	*p*	β	*p*	β	*p*	β	*p*	β	*p*
Sex	.07	0.55	.01	0.93	.03	0.77	−.05	0.57	.10	0.35
BEPTA	−.06	0.59	−.24	0.04	−.13	0.15	−.12	0.21	−.15	0.17
Age at HA fit	−.12	0.33	−.00	0.98	.20	0.02	−.04	0.64	.14	0.19
Child language	−.39	0.002	.34	0.01	.67	< 0.001	.61	<0.001	−.42	0.001
Maternal education	−.08	0.50	−.05	0.69	.04	0.69	−.06	0.57	−.12	0.28

Note. NTU = number of total utterances; NDW = number of different words; MLUm = mean length of utterance in morphemes; BEPTA = better-ear pure tone average; HA = hearing aid.