

Article

Are All Conversational Turns Equal? Parental Language Input and Child Language in Children with Hearing Loss during Daily Interactions

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Abstract: (1) Background: Conversational turns between parents and children contribute to the language development of children. This study aimed to examine parental language input during interactions with high numbers of conversational turns (focused interactions) and those with fewer turns (regular interactions) in children with hearing loss at home. (2) Methods: Twelve children (aged 18–47 months) with hearing loss and their parents participated. Each child wore a Language ENvironment Analysis system digital language processor for 2 days to record all conversations between the parent and child. Focused interactions were characterized by high conversational turns, while regular interactions were defined by median conversational turns. The quantity of language input was reflected by the number of words parents used during the interaction, and the quality was reflected by the mean length of parental utterances, the use of low- and high-level facilitative language techniques, lexical diversity, and the use of (de)contextualized talk. (3) Results: During focused interactions, parents exposed their children to more words than during regular interactions, while the opposite was found for lexical diversity. The quality of parental language input did not differ between the two types of interactions. Parental language input was associated with children's spontaneous language. (4) Conclusion: Not all conversational turns are equal but are nonetheless associated with children's language development.

Keywords: hearing loss (HL); parental language input; speech- and language development (SLD); children; LENA



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1. Introduction

Children with hearing loss (HL) often show less favorable language outcomes compared to children with normal hearing (NH) (Moeller 2000; Stika et al. 2015; Tomblin et al. 2015). Even with optimal auditory rehabilitation, children with HL have reduced or inconsistent access to auditory-linguistic information. This reduced access impacts their speech and language development (Borg et al. 2007; Cupples et al. 2018; Koehlinger et al. 2013). Early intervention, including hearing devices and Family-centered Early Intervention (FCEI), has been proven to mitigate this impact (Holzinger et al. 2020; Walker et al. 2022). Better outcomes are seen when started early, and when families are provided with guidance on fostering their child's development (Moeller et al. 2024). Parents play a crucial role in language development during infancy, toddlerhood, and preschool age in both NH children (Anderson et al. 2021; Golinkoff et al. 2018; Hart and Risley 1995) and children with HL (Ambrose et al. 2015; Arora et al. 2020). Recent studies have increasingly

focused on the importance of conversational turn-taking during parent–child interactions as a crucial predictor of language development (Donnelly and Kidd 2021; Gilkerson et al. 2017a; Romeo et al. 2018). Increased parental responsiveness, joint attention, and active participation in interactions lead to more conversational turns (Scofield and Behrend 2011; Weisleder and Fernald 2013; Zimmerman et al. 2009). Interactions with high numbers of conversational turns between parents and young children allow parents to align with their child’s developmental abilities and adjust the complexity of their language input, thereby maximizing learning potential (Vygotsky 1978). When children engage in longer episodes of conversational turns, they have more opportunities to expand their emerging language development and cognitive skills (Romeo et al. 2018). Most research on conversational turns in relation to children’s language development has been conducted among children with NH. The few studies that focused on children with HL indicate that there are no differences in the number of conversational turns throughout the day when comparing them to NH children (Kondaurova et al. 2022; Vandam et al. 2012). In addition, a positive association between conversational turns and young children’s language development is also reported in this group of children (Ambrose et al. 2014; Vandam et al. 2012).

As children’s language abilities progress, they become more adept at engaging in conversational turns. Simultaneously, during toddlerhood, the quantity and the quality of language input become increasingly crucial for fostering language development (Donnelly and Kidd 2021). It is well established that both quantity and quality are positively linked to children’s language development, with the quality of language input showing a stronger association, especially as children age (Anderson et al. 2021; Golinkoff et al. 2018; Jones and Rowland 2017; Rowe 2012; Rowe and Snow 2020). Quantity is often reflected by measures such as the number of total words (NTW) directed at the child, while the quality of input involves measures such as lexical diversity (type-token ratio; TTR), sentence complexity (mean length of utterance; MLU), use of contextualized and decontextualized language, and the use of Facilitating Language Techniques (FLT, such as open-ended questions) (Rowe and Snow 2020).

Several studies on young children with HL examined both the quantity and quality of parental language input (Ambrose et al. 2015; Dirks et al. 2020; Kondaurova et al. 2022; Nitttrouer 2010; Tomblin et al. 2015; Vandam et al. 2012). Results regarding the quantity show that children with mild-to-severe HL under the age of two are exposed to a similar amount of parental talk as their peers with NH (Tomblin et al. 2015; Vandam et al. 2012). However, by the age of three, children with HL are exposed to fewer words compared to children with NH (Ambrose et al. 2015). The quality of language input is also different for children with HL, with parents using fewer high-level FLT (e.g., open-ended questions, recasts, expansions) and less complex sentences (reflected by mean length of utterance; MLU) (Ambrose et al. 2015; Dirks et al. 2020; Nitttrouer 2010). This difference is unfavorable because children exposed to higher-level FLT and longer, syntactically more complex utterances demonstrate better language skills (Girolametto et al. 1999; Huttenlocher et al. 1991).

For children with NH, lexical diversity, such as the number of different words or the type–token ratio (TTR), is another quality aspect of language input that is related to language development (Hoff and Naigles 2002; Rowe 2012). However, for children with HL, Wang et al. (2020a) emphasize the importance of lexical repetition for language development; for example, to help identify and segment words. The use of (de)contextualized language is also a quality feature of language input. Contextualized language is grounded in the immediate spatial and temporal context. It refers to the present moment and what is occurring in the child’s environment (e.g., naming things, characteristics, and activities) (Grimminger et al. 2020). It is the most useful for language learning in infancy (Rowe and Snow 2020). In contrast, decontextualized language extends beyond the immediate context or current events. It considers the non-immediate spatial and temporal context (Grimminger et al. 2020). It is more abstract or refers to invisible entities (e.g., during pretend play), discussing past or future events (e.g., narratives), or providing causal explanations (Demir et al. 2015; Rowe 2013). As children age, the use of decontextualized language

becomes more important and is found to be predictive of a child's vocabulary skills (Rowe 2012). However, for children with HL, the use of decontextualized language has been less often the subject of research.

Studies on language input traditionally often use clinical or experimental settings in which parents and children engage in structured activities like reading or play (Ambrose et al. 2015; Sosa 2016; Tamis-LeMonda et al. 2017; Yont et al. 2003). These methods do not reflect the variability of interactions that often occur in the home environment during the day (Wang et al. 2020a). Soderstrom and Wittebolle (2013) suggest that studying parent–child interactions in natural settings, such as the home environment, reveals more comprehensive results. The LENA (Language ENvironment Analysis) system, for example, provides a powerful tool for exploring language input at home (Ford et al. 2009). LENA is a lightweight, wire-free recording device integrated into a customized t-shirt with a front pocket, worn by children throughout the day. It allows for automated analyses of all-day recordings of children's auditory environments, such as conversational turn counts and adult word counts (Gilkerson et al. 2017b). LENA gathers data that closely mirror a child's language experience throughout an entire day (Wang et al. 2020b; Xu et al. 2008). Few studies have examined language input among children with HL in naturalistic settings (Arora et al. 2020; Smolen et al. 2021). These studies usually involve data from a whole day and typically focus on only a few aspects of language input, such as quantity measures (Ambrose et al. 2014; Kondaurova et al. 2022; Vandam et al. 2012; Vohr et al. 2014).

Naturalistic interactions between young children and their parents during the day are brief, and whole-day data do not provide insights into the language input during specific interactions. Several past studies have shown that LENA recordings can be used for transcribing or hand-coding subsets of the daylong recordings with good results (Garcia-Sierra et al. 2016; Weisleder and Fernald 2013). The LENA system would allow for diving into specific interactions, and of interest are those with a high number of conversational turns. While it is known that conversational turns are an important predictor of children's language development, less is known about the nature of parental language input during interactions with a high number of turns. Investigating both the quantity and quality of language input—considering measures such as FLTs, MLU, TTR, and (de)contextualized language—within these interactions is of interest. The number of conversational turns and the language input during interactions likely varies throughout the day (Donnelly and Kidd 2021). Some interactions may be characterized by more conversational turns, while others have fewer. Building on prior research, the present study classifies interaction types into “focused” and “regular” types. Focused interactions are defined as those exhibiting a high number of conversational turns. More conversational turns reflect a greater level of engagement and responsiveness (Scofield and Behrend 2011; Sultana et al. 2020; Weisleder and Fernald 2013; Zimmerman et al. 2009). However, it is assumed that such focused interactions occur less often during the day (Donnelly and Kidd 2021; Soderstrom and Wittebolle 2013; Tamis-LeMonda et al. 2017). Therefore, it is also valuable to look into more common, regular interactions with fewer turn-taking to discern differences in language input between both types of interactions (Donnelly and Kidd 2021).

In the present study, the quantity and quality of parental language input during focused and regular interactions in young children with HL will be examined. Due to the challenges in language development for children with HL, it is important to characterize the naturalistic language environment. This understanding can help to optimize intervention and foster high-quality language input for children with HL. Our main aim is to examine differences in parental language input and child language during focused and regular interactions at home. Additionally, we aim to investigate how parental language input during both types of interactions is associated with children's language. Because it is argued that observational assessments of spontaneous language provide greater ecological validity than standardized language tests, particularly in relation to parental input (Bornstein and Haynes 1998), the current study examines children's spontaneous language. By using

real-time measures of both parental and child language during both types of interactions, insights into parent–child dynamics will be established.

The comparison of language input and its associations with the language skills of children with HL across different interaction types is a relatively new area of study. Consequently, the aims of the study are primarily exploratory, focusing on understanding patterns rather than testing specific hypotheses. Despite its exploratory nature, several expectations can be drawn from existing literature on parental language input and child language development in children with HL. First, it is anticipated that children with HL will be exposed to a lower quantity of language input during regular interactions compared to focused interactions, as regular interactions typically involve fewer conversational turns and potentially less talking overall. Second, a positive relationship is generally expected between the quality of parental language input and the child’s spontaneous language skills.

2. Materials and Method

2.1. Participants

The study included 12 Dutch children (eight girls, four boys) with permanent bilateral hearing loss who had no additional developmental difficulties. The age range of the participating children was 18 to 47 months (Table 1). All children had a congenital bilateral moderate-to-profound hearing loss and used hearing aids. All children and their families were enrolled in an FCEI program. These FCEI programs aim to support parents in promoting their children’s language and communicative development. During frequent home visits, parents receive information about HL, hearing technology, communication, and child development. Early interventionists guide parents in fostering their child’s development. In addition to the home visits, parents can participate in courses at the FCEI center, and children can attend an intervention group starting at 18 months of age (van der Zee and Dirks 2022). Seven mothers and five fathers were selected as key parents. The key parent, as defined in Section 2.2 (procedures), was the parent who most actively engaged in conversations with the child. Eight parents had high education levels, and four parents had medium educational levels (Centraal Bureau voor de Statistiek 2024). The current study is part of the AUDIOLISTIC study on the acoustic and linguistic environment of children with HL. The study was approved by the ethics committee (202100419) of the University Medical Center Groningen, and all parents provided informed consent for participation. Recruitment of the children and their families took place through various FCEI centers in the Netherlands. Demographic information on the children and their families was collected via a parent questionnaire, and information related to hearing loss was retrieved from Electronic Patient Files.

Table 1. Demographics of participating children.

	M	SD	Range
Age	34.17	9.54	18–47
Age diagnosis (months)	4.00	10.17	0–36
Age first HA fitting (months)	7.42	10.62	1–37
Pure Tone Average (PTA4)	50.33	9.06	40–69

Abbreviations: HA, hearing aids; PTA4, pure tone average of the octave bands 0.5–4 kHz.

2.2. Procedures

Each child wore a LENA digital language processor (DLP) for 2 days (1 weekday and 1 weekend day), recording home interactions for approximately 16 h per day. The LENA software divided recordings into 5-min conversational blocks, estimating adult word count, conversational turn count, and child vocalization count (Ford et al. 2009).

In this study, conversational turn count (CTC) was used to identify focused and regular interactions within daylong recordings. A conversational turn in LENA includes one key child segment with vocalization and one adult segment with a word, consisting of one

initiation and one response within 5 s (Gilkerson and Richards 2020). The accuracy of LENA's CTC metric varies across studies. Validation efforts have demonstrated varying degrees of correlation between LENA's CTCs and human counts across different languages. A LENA study performed with native Dutch children showed moderate ($r = 0.52$) reliability correlations between human and LENA CTCs for children aged 2 to 5. Discrepancies were due to LENA's limitations in detecting turns during overlapping speech or noisy segments (Busch et al. 2018).

Using LENA Advanced Data Extractor software (ADEX), 5-min fragments were selected. Following Sultana et al. (2020), a 5-min fragment with the highest CTCs was selected, indicating a focused interaction. The term "focused" refers to interactions characterized by a peak frequency of turn exchanges between the parent and the child. However, it does not specify an exact number of turns required to classify an interaction as such. The assumption is that the number of conversational turns that constitutes a focused interaction and what is considered "highest" will vary across participating families.

Consequently, a 5-min fragment matching median CTCs was selected, indicating a more regular interaction. This operationalization facilitated capturing and comparing different interaction types, acknowledging that the frequency of turn-taking and the quantity and quality of language input can vary throughout the day (Donnelly and Kidd 2021; Tamis-LeMonda et al. 2019).

Using the LENA ADEX categories, fragments with other children were excluded to prioritize the target child's speech. Fragments with zero CTCs were excluded. Using the LENA ADEX categories "male voice" and "female voice", fragments with the highest CTCs identified the key parent. If different parents were key parent on different days, the parent with more conversations overall was selected. Fragments matching median CTCs were randomly chosen considering the key parent. Selected fragments were verified using LENA Pro software to ensure criteria were met, excluding inaudible or unsuitable fragments. The chosen audio fragments were manually transcribed and coded for analysis. Ultimately, we extracted 20 minutes of recordings per child (two 5-min fragments per day for 2 days). Examining these 5-min interactions of 12 children across 2 days, each meeting the criteria (possessing one or more CTCs, without siblings present, and solely accompanied by the one key parent), yielded a total of 1475 5-min interactions. These 5-min conversation blocks showed a right-skewed distribution in CTCs. The median number of turns was 6.00, with an interquartile range (IQR) of 3.00 to 11.00. After selection, 24 5 min regular interactions of 12 children over 2 days were included, with a median of 4.5 CTCs (IQR: 3.00 to 6.50). Twenty-four 5 min focused interactions of the same children were also included, with a median of 20 CTCs (IQR: 14.5 to 24.5).

The first author selected all 5 min audio fragments and transcribed parent and child language using the Codes for the Human Analysis of Transcripts (CHAT) (Macwhinney 2023). Utterances were defined as conversational units, involving simple clauses, compound clauses consisting of coordinate clauses, and complex clauses consisting of a main clause and its subordinates (e.g., "If you are freezing, then you should wear a hat"). Clauses were divided if an interlocutor responded before completion, or if a pause or change in intonation indicated the end of an utterance.

During transcription, activities in which focused and regular interactions occurred were listed into nine categories: care (e.g., washing hands, putting on shoes, brushing teeth, and changing diapers); play (both structured games and spontaneous playtime); book reading; talking (conversations and verbal exchanges between the adult and child that are not tied to a specific activity); mealtime (e.g., activities related to eating and drinking, including both the actual mealtime and the preparation involved); comforting (interactions where the adult provides emotional support and reassurance to the child during distressing moments; for example, when a child is crying due to pain, sickness, or other causes); daily chores (e.g., tidying up and gardening), bedtime ritual (e.g., preparing for bed and any calming practices that help the child wind down and get ready for sleep); and watching TV (viewing television or other screen-based content).

Both quantity and quality of language input of the 5-min fragments representing focused and regular parent–child interaction were assessed. To assess the quantity of parental language input, we used NTW exposed by the parent within the selected fragments. This measure was extracted based on the transcripts using the Computerized Language Analysis (CLAN) software (Macwhinney 2023). For quality analysis, the use of FLTs, MLU, TTR, and (de)contextualized talk was examined (Rowe and Snow 2020).

We analyzed parent utterances, categorizing them into “high-level” and “low-level” FLTs based on Cruz et al. (2013). Each utterance was assigned one of 10 FLT categories, (e.g., imitation, linguistic mapping, and closed/open questions; see Appendix A, Table A1 for details). We excluded simple confirmations (e.g., “okay”), back-channeling cues (e.g., “uh huh”, “mhm”), clarification requests (e.g., “hm?”), and unintelligible speech. The first author (HM) coded all utterances, with a second, independent researcher who works as a clinical linguist, double-coding a random 20% sample, showing substantial agreement (Cohen’s Kappa coefficient = 0.78). To ensure fair analysis, we calculated proportional scores for both “high-level” and “low-level” FLTs by dividing the total instances of each FLT by the total parental utterances. We used CLAN to assess TTR and MLU of both parental and child utterances. Lastly, we analyzed the use of contextualized and decontextualized talk based on prior research (Grimminger et al. 2020; Røe-Indregård et al. 2022; Rowe 2012; Van Den Dungen 2007). Contextualized talk involved naming objects and describing activities, while decontextualized talk included explanations, pretend play, and storytelling (see Appendix B, Table A2 for details). We additionally excluded repetitive utterances and instances of placeholder language (e.g., “those over there”). The first author (HM) coded all fragments, with the second independent researcher double-coding a random 20% sample, showing substantial agreement (Cohen’s Kappa coefficient = 0.75). Proportional scores were computed for both contextualized and decontextualized talk.

2.3. Statistical Analysis

To prepare data for statistical analysis, we first examined the agreement of language-input measures across weekdays and weekends, including both focused and regular interactions. The objective was to determine whether these data could be pooled together. No meaningful differences were shown in outcome measures and data from weekdays and weekends. Therefore, they were averaged together.

We assessed assumptions for parametric testing and conducted non-parametric analyses when assumptions were violated. Non-normal distributions were found in parental NTW and contextualized language, and in children’s TTR and decontextualized language (Shapiro-Wilk, $p < 0.05$). Therefore, non-parametric tests were performed. Although multiple paired tests and correlations were conducted, corrections for multiple testing were not applied. This decision is grounded in the exploratory nature of the research, where the primary objective is to identify potential relationships. Implementing such adjustments could increase the risk of Type II errors (false negatives), potentially leading to the oversight of true effects. In exploratory studies, the identification of potential differences and associations is crucial, and the cost of missing a true effect may outweigh the risk of incurring a false positive. For our first research goal, Wilcoxon signed-rank test was used to compare parental language input variables on quantity and quality during focused and regular interactions. For our second research goal, which examines the relationship between parental language input and the child’s spontaneous language during both focused and regular interactions, Spearman’s correlation was used.

3. Results

Table 2 presents the parent–child language characteristics during focused and regular interactions.

Table 2. Parent (N = 12) and child (N = 12) language during focused and regular interactions.

	Focused Interactions			Regular Interactions			
	M	(SD)	Range	M	(SD)	Range	Z
Parent language							
NTW	213.63	88.55	61.50–404.50	106.25	92.87	24.50–269.00	−2.67 **
MLU	3.99	0.99	2.43–5.46	3.81	1.10	2.27–5.49	−1.02
TTR	0.49	0.07	0.40–0.61	0.66	0.17	0.40–0.80	−3.06 **
FLT							
Low-level FLT (%)	0.49	0.13	0.23–0.67	0.54	0.20	0.19–0.91	−1.10
High-level FLT (%)	0.30	0.13	0.14–0.57	0.36	0.20	0.11–0.79	−1.02
Rest (%)	0.21	0.09	0.10–0.37	0.10	0.10	0.00–0.35	−3.61 **
Abstract language							
Contextualized (%)	0.24	0.13	0.06–0.50	0.25	0.14	0.06–0.45	−0.16
Decontextualized (%)	0.15	0.09	0.02–0.37	0.16	0.12	0.00–0.51	−1.41
Child language							
NTW	83.42	63.10	11.50–193.00	48.21	44.00	11.50–114.00	−2.40 *
MLU	2.13	0.97	1.03–4.06	2.13	0.92	1.04–3.59	−0.39
TTR	0.50	0.05	0.38–0.55	0.59	0.15	0.29–0.82	−1.88
Abstract language							
Contextualized (%)	0.21	0.13	0.05–0.44	0.20	0.10	0.03–0.35	−0.71
Decontextualized (%)	0.08	0.12	0.00–0.39	0.03	0.07	0.00–0.24	−1.54

Abbreviations: NTW, number of total words; MLU, mean length of utterance; TTR, type–token ratio; FLT, facilitating language techniques. * $p < 0.05$, ** $p < 0.01$.

3.1. Differences in Parental Language Input

The results of the Wilcoxon signed-rank test (Table 2) revealed significant differences in the quantity of language input between focused and regular interactions. Parents' NTW was higher during focused interactions, meaning they exposed their children to more words. For the quality of parental language input, significant differences between interactions were found for word diversity, with TTR being higher during regular interactions. No statistically significant differences were found in NDW, MLU, and the proportions of low and high-level FLTs between focused and regular interactions. A significantly higher percentage of residual expressions (e.g., backchanneling) was found during focused interactions. Lastly, the proportions of contextualized and decontextualized language showed no significant differences.

3.2. Differences in Child Language

The results of the Wilcoxon signed-rank test (Table 2) revealed that children also show differences in their language use during focused and regular interactions. They used significantly more words during focused interactions (NTW). No statistically significant differences were found in the quality measures MLU, TTR, and the proportions of contextualized and decontextualized language.

3.3. Associations between Parental Language Input and Child Language

In focused interactions (Table 3), Spearman correlation analysis revealed that the parent's MLU had significant and strong positive correlations with the child's total word count and the child's MLU. The proportion of parental use of contextualized language showed a strong positive correlation with the child's use of contextualized language. Additionally, parental contextualized language use had a strong negative correlation with the child's use of decontextualized language. The parent's decontextualized language showed strong positive correlations with the child's decontextualized language use and a moderate negative correlation with contextualized language use.

Table 3. Spearman correlations between parental language input and child language during focused interactions (n = 12).

Parent \ Child	NTW	MLU	TTR	Contextualized	Decontextualized
NTW	0.29	0.26	−0.51	−0.13	0.20
MLU	0.67*	0.74 **	−0.34	0.02	0.4
TTR	−0.25	−0.19	0.36	0.50	−0.27
Contextualized	−0.57	−0.51	0.02	0.82 **	−0.80 **
Decontextualized	0.78 **	0.73 **	−0.38	−0.65 *	0.91 ***
Low-level FLT	−0.14	−0.17	0.27	−0.43	0.06
High-level FLT	0.47	0.52	−.38	0.53	0.02

Abbreviations: NTW, number of total words; MLU, mean length of utterance; TTR, type-token ratio; FLT, facilitating language techniques. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In regular interactions (Table 4), Spearman correlation analysis indicated that parental MLU had a significant and strong positive correlation with the child's MLU. Decontextualized language had strong positive correlations with the child's MLU. There was also a statistically significant strong negative association between low-level FLTs and the child's total word count, as well as between low-level FLTs and the child's MLU. For high-level FLTs, a moderate positive association was found with the child's MLU.

Table 4. Spearman correlations between parental language input and child language during regular interactions (n = 12).

Parent \ Child	NTW	MLU	TTR	Contextualized	Decontextualized
NTW	0.33	0.32	−0.40	−0.03	0.15
MLU	0.28	0.65 *	0.05	0.27	0.08
TTR	−0.08	−0.06	0.25	0.11	−0.12
Contextualized	−0.17	−0.14	−0.23	0.51	−0.21
Decontextualized	0.50	0.78 **	0.13	−0.10	0.56
Low-level FLT	−0.82 **	−0.77	0.41	−0.08	−0.57
High-level FLT	0.48	0.66 *	−0.25	0.28	0.36

Abbreviations: NTW, number of total words; MLU, mean length of utterance; TTR, type-token ratio; FLT, facilitating language techniques. * $p < 0.05$, ** $p < 0.01$.

3.4. Type of Activities

The top three activities during focused interactions were playing (25%), care (21%), and storybook reading (17%) (Figure 1). The top three activities during regular interactions were play (29%), mealtime (17%), and care (13%) (Figure 2). The only activity that led exclusively to regular interactions was television time.

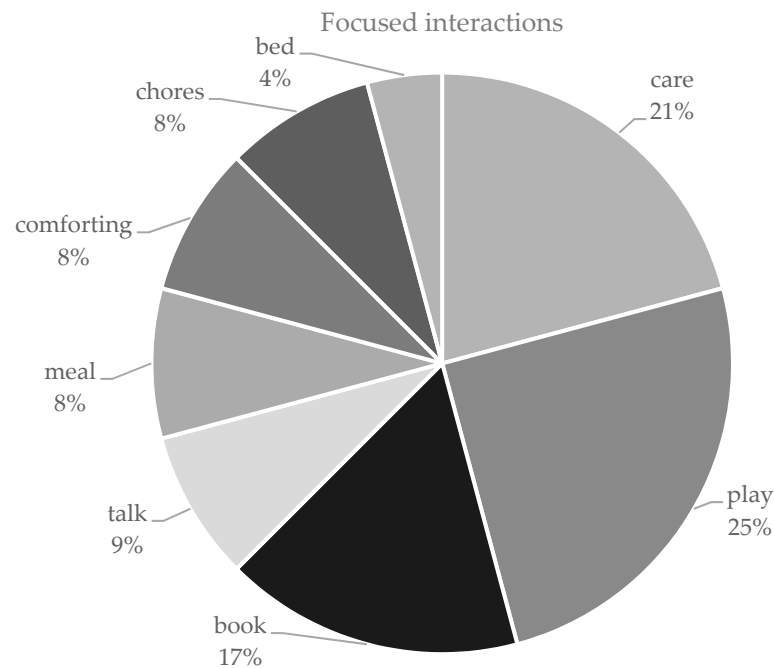


Figure 1. Different activities during focused interactions, shown in percentages.

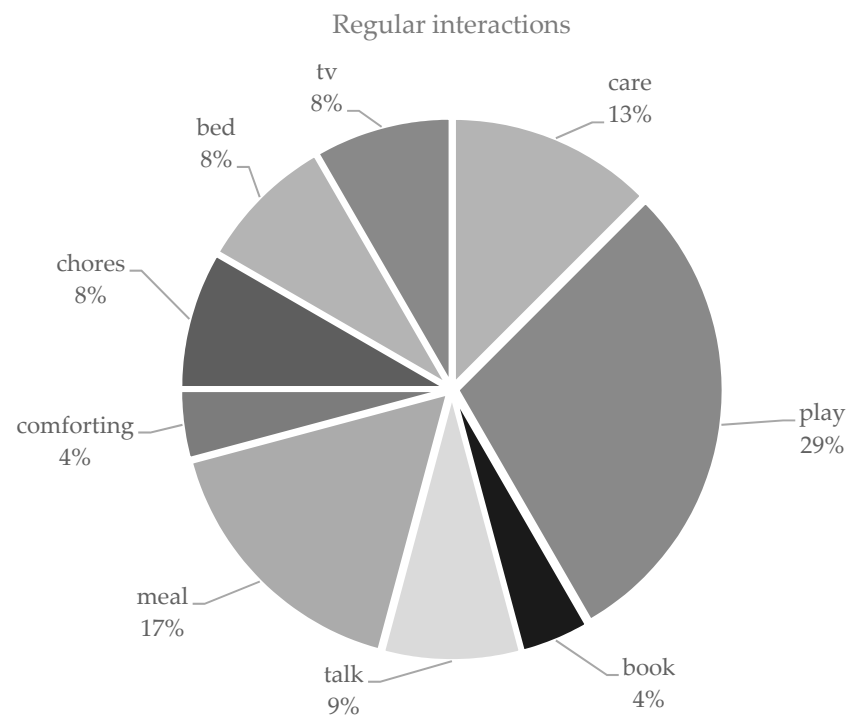


Figure 2. Different activities during regular interactions, shown in percentages.

4. Discussion

Children with HL are more at risk for difficulties in their language development (Moeller 2000; Stika et al. 2015; Tomblin et al. 2015). Therefore, it is important to obtain more insight into factors that are positively related to their development of language skills. One of the important predictors of language development is conversational turn-taking (Donnelly and Kidd 2021; Romeo et al. 2018). Conversational turn-taking is a vital part of early communication, but to date, it remains unclear whether the quantity and quality of language input differs between focused and regular interactions that vary in the number of turns. This study fills this gap by examining parental language input and child language

during focused and regular interactions in children with HL at home. In addition, it examines to what extent parental language input is related to children's spontaneous language use.

In line with our expectations, the results showed differences in the quantity of language input between focused and regular interactions. During focused interactions, parents and children used more words. In terms of the quality of language input, differences between these interaction types were found in lexical variability, with more variability during regular interactions. As anticipated, significant associations between the quality of parental language input and the child's spontaneous language were found in both interaction types.

4.1. Differences in Quantity and Quality of Parental Language Input

Previous studies using the LENA system to examine the amount of parental talk in children with HL often reported on the total number of words parents used during the entire day (Ambrose et al. 2015; Vandam et al. 2012; Vohr et al. 2014). In the current study, LENA was used to select interactions during the day that were characterized by a high number of conversational turns (focused interactions) and those with a median number of turns (regular interactions). During focused interactions, both parents and children used more words in comparison to regular interactions. This finding was expected since previous studies have shown a strong relationship between conversational turns and the number of words (Anderson et al. 2021; Romeo et al. 2018; Soderstrom and Wittebolle 2013). Regular interactions (those with fewer turns) possibly have more silent periods, with parents being less talkative. The number of words parents use during interactions thus varies per type of interaction and is probably related to the kind of activity the parent and child engage in. For example, in an activity such as storybook reading, children will be exposed to a high number of words spoken by the parent. It has been reported that infants are exposed to more words per minute during storybook reading and nursing than during feeding moments or playing with objects (Tamis-LeMonda et al. 2019). Soderstrom and Wittebolle (2013) found storybook reading to be the most productive activity according to the exposed number of adult words but one of the least-frequent activities during the day, taking only 1–2% of a child's daytime experience. In the current study, it was found that during focused interactions, 17% of the activities were storybook reading and 21% were related to care compared to, respectively, 4% and 13% during regular interactions. On the other hand, during regular interactions, 29% of the activities were play-related and 17% were mealtime-related, compared to 25% and 8% during focused interactions, respectively. A possible explanation for the increased number of words used by parents and children during focused interactions with a high number of conversational exchanges could be the proportion of storybook reading. Additionally, it is important to note that focused interactions with high turn counts are largely centered around care activities, which is a positive observation considering that care is a frequent and significant part of daily routines.

While we anticipated a difference in the quantity of language input between focused and regular interactions, no prior expectations were established regarding the quality of language input between the two types of interactions. The results showed that word diversity (TTR), a feature of quality, differed between focused and regular interactions. During focused interactions, there was less diversity in the words used by parents than in the regular interactions. There may be more lexical repetition during focused interactions. It is assumed that during interactions with less parental speaking, the chance of parents repeating words is smaller (Richards 1987). Lexical repetitions support children with HL in identifying and segmenting words, compensating for reduced auditory access and attention to speech (Wang et al. 2020a). However, in children with NH, it is emphasized that vocabulary diversity plays a crucial role in early language development, with diverse parental vocabulary predicting children's vocabulary better than word count (Rowe 2012). For children with HL, this may be different; developing a diversity of parental talk and the repetition of this talk may be equally important. In the present study, vocabulary was not examined, only the number of words a child used during the interaction and the

diversity of these words. These aspects of child language were not related to the diversity of parental language input. For future research, it would be of interest to include a measure of the vocabulary of children with HL to examine the unique contribution of diversity and repetition of language input on their language development. Other quality features of parental language input did not differ between the types of interactions. The use of Facilitating Language Techniques, both high-level and low-level, did not differ between focused and regular interactions. This is a positive finding because it may imply that different types of interactions during the day lend themselves to exposing children to high-level FLT. The use of high-level FLT promotes a child's participation in conversations because it elicits multi-word responses and consequently fosters language development (Ambrose et al. 2015; Cruz et al. 2013; DesJardin and Eisenberg 2007).

The results showed that both focused and regular interactions exhibited higher proportions of low-level FLT than high-level FLT. This finding is consistent with previous studies reporting that children with HL are exposed to more lower-level than higher-level FLT during parent-child interactions (Brock and Bass-Ringdahl 2021; DesJardin and Eisenberg 2007). Probably parents modify their language to align with their children's language proficiency. Nonetheless, for children with HL to achieve better language skills, parents also need to provide them with complex linguistic stimulation (Brock and Bass-Ringdahl 2021). Early interventionists could support parents in applying more complex FLT according to their child's zone of proximal development. Not all parental language input could be divided into low- or high-level FLT, resulting in a residual category. Focused interactions, in particular, showed a higher number of residual utterances (e.g., backchanneling), suggesting that during regular interactions, parents possibly put more effort into the use of FLT to engage children into the conversation.

Regular and focused interactions did not differ in the proportion of contextualized and decontextualized talk. Tamis-LeMonda and colleagues (Tamis-LeMonda et al. 2019) highlight the benefits of contextualized language learning. The use of contextualized language typically involves objects and events that are present in the immediate environment (Uccelli et al. 2019). The use of contextualized language seems particularly beneficial for word learning in children with HL because the use of different types of sensory input (visual, tactile, and taste) can compensate for the restricted access to auditory input. Infants' language experiences are structured and tied to daily activities, facilitating word associations with objects and actions, such as learning body parts during a bath or food names at mealtime. Diverse home activities are crucial for language acquisition, helping children to associate words with familiar objects (Tamis-LeMonda et al. 2019). Decontextualized talk, talk that goes beyond the here and now, is a more complex abstract language, benefiting language development in vocabulary, syntax, and narrative abilities (Uccelli et al. 2019). Parents' use of decontextualized talk increases as children age (Rowe 2012). In a study by Rowe (2013), it was found that at 42 months of age, about 10% of the parent utterances directed to their children were decontextualized. In the present study, it was found that in both types of interactions, around 15% of parental talk was decontextualized. The slightly higher proportion found in the current study might be the result of a different study design than the one by Rowe. Additionally, the children with HL were enrolled in FCEI, in which parents are supported to promote their child's language development. For example, within FCEI, parents can participate in a storybook reading program in which they also learn to use decontextualized language. The support parents received in FCEI may result in using more decontextualized talk in interactions with their child.

Finally, no differences in parental MLU were revealed between focused and regular interactions. This can be partially attributed to the overlap in activities in both types of interactions. Play activities, for example, occurred most often during both types of interactions. In some studies, with young NH children, it is found that parents use more didactic and responsive language toward their children during play than during feeding (Bornstein et al. 1999; Flynn and Masur 2007). This didactic and responsive language may result in using more complex language (longer MLUs). The high number of play activities

in both types of interactions may contribute to the consistent quality of language observed across both types of interactions. This phenomenon is notably beneficial since regular interactions occur more frequently throughout the day compared to focused interactions.

4.2. Associations between Parental Language Input and Child's Language

In both types of interactions, the quality of parental language input, but not the quantity, was significantly associated with the child's spontaneous language measures. This finding was expected and is consistent with previous studies that found an association between the measures of the quality of parental language input and child language development (Anderson et al. 2021; Rowe and Snow 2020; Tamis-LeMonda et al. 2012). The quality of language input in terms of the parental MLU and use of decontextualized language was associated with the child's MLU and the number of words the child used during focused interactions. During regular conversations, only parental MLU and their use of decontextualized language were related to the child's MLU. The use of high- and low-level FLTs was only related to the child's language during regular interactions.

During focused interactions, the use of parental decontextualized language was related to all aspects of a child's language, with the exception of the child's TTR. This finding adds to previous research suggesting a clear association between parents' use of decontextualized language and children's language outcomes (Anderson et al. 2021; Rowe 2013; Uccelli et al. 2019). High numbers of conversational turns during interactions may help parents to align their language input to the child's language level. When parents use semantically contingent responsive language, using utterances that follow the child's focus of attention, this may support the child's conversational engagement (Bornstein et al. 1999; Brassart and Schelstraete 2015; Hoff 2010). Parents who frequently use decontextualized language with their toddlers tend to have toddlers who also use more decontextualized language when interacting with their parents (Demir et al. 2015). If parents perceive that the child is ready for decontextualized language, they probably offer it more frequently, which in turn encourages the child to use it more, creating a reciprocal effect. The strong negative association between a parent's decontextualized language and the child's contextualized language use, as well as between the parent's contextualized language and the child's decontextualized language use, supports the assumption of more contingent responsiveness during focused parent–child interactions, as these associations were not observed during regular interactions.

The use of FLTs had been found to be associated with children's language performance. In the present study, it was found that during regular interactions, low-level FLTs were negatively and strongly associated with the child's word count and MLU. The more low-level FLTs the parent used, the fewer words a child speaks and the lower their MLU. This finding is in line with other studies reporting a negative association between the use of low-level FLTs (such as directive language) and the language outcomes of children with HL (Ambrose et al. 2015; DesJardin and Eisenberg 2007). The use of these low-level techniques may hinder the child's active participation. While low FLTs (e.g., linguistic mapping, imitation, labeling) support language learning in prelinguistic children with NH (Girolametto et al. 1999), their efficacy in older children with HL is debated (Cruz et al. 2013).

The current study shows some strengths and weaknesses. We have gained a broad and better understanding of the quantity and quality of language input of children with HL and its association with child language development during naturalistic interactions. We comprehensively investigated different aspects of the quality of language input during focused and regular interactions, with quality including variables on different domains. As Rowe and Snow stated: "The quality of caregiver input matters for child language development but cannot be analyzed on a single dimension" (Rowe and Snow 2020). To analyze naturalistic interactions, we used LENA software to select interactions based on conversational turn counts (CTC). The CTC measure from LENA has previously shown moderate reliability, attributed to factors such as background noise and overlap, potentially due to the presence of others like siblings. Therefore, in our study, we tried to consider

disruptive factors by selecting segments when no others (adults/siblings) were present (Busch et al. 2018). Subsequently, the coding of the quality of language input (FLTs and (de)contextualized language), was based on selected LENA audio clips. The absence of visual context made it challenging, in some cases, to determine whether an utterance aligned with the child's focus of attention, such as in the high-level FLT "parallel talk", or to assess if an utterance was contextually relevant to the immediate situation. In future research, the use of video recordings alongside LENA audio clips could provide significant added value. By using real-time visual information of the interaction, in addition to auditory information, a more comprehensive picture of the interaction will be established. Aspects such as joint attention and the use of gestures and signs that are associated with language development could help researchers to better interpret why certain variables correlate with the child's language during focused interactions but not during regular interactions. Video recordings would also allow for assessing reaction time or pausing between turns. A balanced distribution of turns occurs when participants contribute turns of comparable duration, preventing monopolization in the interaction (Kelly et al. 2022). A limitation of the current study is the comparison to an NH control group, limiting comparisons in the parental language input. Additionally, our cross-sectional design limits tracking language input over time; a longitudinal design would be ideal. Generalizability is limited to Western families, restricting cultural diversity.

5. Conclusions

This study provides new insights into the naturalistic language environment of young children with HL, focusing on the differences between parental language input during focused and regular interactions at home. The findings reveal that the quality of language input, reflected by the use of Facilitating Language Techniques, MLU, and contextualized and decontextualized talk, did not significantly differ between focused and regular interactions. The quality of language remains consistent despite the number of conversational turns within the interaction. A stable qualitative language input has a potentially important role in promoting language development in children with HL, particularly considering that interactions featuring a high number of conversational turns are exceedingly rare within a single day. The study underscores the importance of parental language quality, as it associates with the child's spontaneous utterances in both types of interactions. Additionally, it emphasizes the significance of frequent turn-taking, as the results reveal a strong positive association between the parental use of decontextualized language and the child's language during focused interactions. Although not all conversational turns are equal because they have different language contents, they are all likely to contribute to children's language development.

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Appendix A

Table A1. Lower and higher levels of Facilitating Language Techniques (Cruz et al. 2013).

Level	Technique	Description	Example
Lower-level	Linguistic mapping	Verbalizing or interpreting the child's utterances that are not recognizable as words.	The child vocalizes—the mother says, "Kitty".
	Comments	Utterance or phrase indicating that a message has been received or an expression to keep a conversation going.	The mother says, "Yes!" or "Thank you" or "Maybe so".
	Imitation	Literally repeating the child's prior vocalizations without adding new words	The child says, "Cup", and the mother says, "Yes, cup".
	Directive	Tells or commands the child to do something.	The parent says, "Look here!" or "You can play with this cup".
	Closed-ended question	Asking a question to which the child can only answer with one word.	The father asks the child, "Is that your favorite?" or "Do you like that picture?"
Higher-level	Parallel talk	Parent talks aloud about what the child is directly doing, looking at, or referring to.	The child looks at the picture of a bee, and the parent says, "The bumblebee is flying over the flowers". The child asks a question about what the parent is doing, and the parent says, "Mommy is cleaning the table".
	Open-ended question	The parent gives a sentence/question for the child to answer with more than one word.	As they look at a picture, the parent says, "What is happening in this picture?"
	Expansion	The parent repeats the child's verbalization by providing a more grammatical and complete language model without modifying the child's word order or intended meaning. With the addition of one or two words.	The child says, "Baby crying", and the caregiver says, "The baby is crying".
	Expatiation	Same as expansion, but the parent adds new information to the child's expression.	While looking at the picture, the child says "Swimming water", and the mother says, "Yes, we are going swimming at the beach. This summer, we are going to the beach".
	Recast	The parent repeats the child's vocalizations correctly.	The child says, "Anna gone outside", the parent says, "Oh, did Anna go outside?"

Appendix B

Table A2. Categories of contextualized talk and decontextualized talk (Røe-Indregård et al. 2022; Rowe 2013; Van Den Dungen 2007).

			Description		Example
Contextualized talk	cat 1	To name something	Naming and providing information. Nouns, places, opposites, numbers	Within the here and now and visible	"Wow, a truck" "Was it a car, hm?" "That's . . ." and "Look, that's a . . ." "That's not . . ."
	cat 2	Seeing and naming characteristics and activities	Properties, emotions, shapes, colors, possession relations, categories, quantities, verbs	Within the here and now and visible	"That one is big" "This one is red" "Those are two balls" "That one is angry" "Watch them go sailing"
	cat 3	Explanations	Object-purpose relationships, cause-effect relationships, motivating, inferring feelings	Within the here-and-now, but not fully visible	"Oh, we can't put them on the bus because the bus is full of blocks". "Because the lights have to be on for the remote to work". "I think the crocodile is hungry".
Decontextualized talk	cat 4	Pretend	Talking during pretend episodes of interaction, including having an object introduce another; attributing actions, thoughts or feelings to inanimate objects; assuming a role or character, performing scripts or routines	Beyond the here-and-now	"I will save you from the evil sister". "We should have the police come now to make a report".
	cat 5	Narrative	Predicting, recalling information, giving factual knowledge	Beyond the here-and-now	"At grandma's, I got tea, too". "He's going to look in your nose and your throat and your ears". "Oh, yes, we had popcorn in the cinema, remember?"

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