Paternal and Maternal Parentese: A Longitudinal Corpus Analysis

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1. Introduction

The quantity and the quality of parental language input have long been known to be important factors that aid in strong language outcomes (Hart & Risley, 1995). Quality can be measured in a variety of ways and can change depending on the child's age and linguistic level (Rowe, 2012). In infancy, one particularly important feature of quality is *parentese*: an acoustically exaggerated speech style of infant-directed speech that has been shown to enhance children's language outcomes during the first two years of life (Ferjan Ramírez et al., 2018, 2020, Ramírez-Esparza et al., 2014, 2017a, 2017b). While the associations between parental use of parentese and child language development are well documented, most of the extant research on parentese has been conducted with mothers (Ferjan Ramírez, 2022). The current exploratory study considers paternal parentese, and compares it to maternal parentese.

1.1. Parentese

Parentese, a style of infant-directed speech, differs from adult-directed speech (ADS) by a variety of segmental and prosodic features, such as simpler phonology, simpler grammar, fewer and simpler lexical items, higher pitch, a wider pitch range, slower speech rate, and exaggerated intonation (Cooper & Aslin, 1990; Fernald & Simon, 1984; Fernald, 1985; Fernald et al., 1989; Garnica, 1977; Grieser & Kuhl, 1988; Stern et al., 1983; Tang & Maidment, 1996). Several studies have shown that infants prefer parentese over ADS (Cooper & Aslin, 1990; Fernald, 1985; Hayashi et al., 2001; Newman & Hussain, 2006; Singh et al., 2002; The ManyBabies Consortium, 2020). A possible explanation for this

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preference is that parentese uses attentional-emotional, linguistic and social cues. Attentional-emotional cues, such as exaggerated facial expressions, convey positive emotions, drawing the infant in to engage in conversation with their caregivers. Parentese also uses unique linguistic structural properties, such as an expanded 'vowel triangle,' which results in clearer and more intelligible speech (Bradlow et al., 1996). Lastly, positive social interactions, such as parent-child turn-taking, joint attention, and gaze following, can enhance language development and have been shown to be related to children's vocabulary size (Brooks & Meltzoff, 2005; Hirsh-Pasek et al., 2015).

1.2. The Role of Parentese in Language Development

Parentese has been shown to enhance specific language learning mechanisms and is especially important in early infancy when infants are beginning to explore using language to communicate (Kuhl, 1997; Kuhl et al., 2003; Liu et al., 2003; Singh et al., 2009; Thiessen et al., 2005). A key aspect of parentese is that it is calibrated to the infant's level to provide the appropriate scaffolding. When engaging in parent-child turn-taking, parents provide feedback that is adjusted to their infants' linguistic abilities and, in turn, infants adjust their responses by increasing their complexity. This creates a system that promotes positive language growth (Warlaumont et al, 2004). The use of parentese in parental language input has been shown to improve the learnability of vowel categories (Kuhl et al., 1997), speech discrimination skills, and aiding in discovering word and grammatical boundaries (Thiessen et al., 2005).

1.3. Naturalistic Daylong Recordings

Utilizing Language Environment Analysis (LENA) technology, researchers are able to use pocket-sized recording devices to record daylong snapshots of an infant's natural environment. This allows research to be conducted on parentese as it occurs naturally, rather than in a lab setting. LENA recordings can be further processed with the Advanced Data Extractor Tool (ADEX), which is used to identify individual segments for further manual analyses (Bergelson et al., 2018; Ramírez-Esparza et al., 2014, 2016, 2017), such as the analyses of parentese, which cannot be automatically identified by LENA.

Several studies using naturalistic daylong recordings have investigated parentese and its associations with concurrent child language or child language outcomes. For example, the prevalence of parentese predicts concurrent babbling, and word production at 24 mo (Ramírez-Esparza et al., 2014, 2016, 2017). In a study where parents were coached to use parentese at 6, 10, and 14 mo, it was found that an increased use of parentese was correlated with children's language growth and language outcomes at 18 mo (Ferjan Ramírez et al., 2020).

Furthermore, studies have explored the associations between specific linguistic aspects of parental parentese, such as speech complexity, and child language outcomes. One common measure of syntactic complexity is mean length of utterance (MLU; Brown, 1973), typically calculated in words or morphemes,

on a sample of 100 consecutive utterances. MLU can be used to measure the complexity of child- (Valian, 1991; Klee et al., 1989) or caregiver-speech (McLaughlin et al, 1983; Rondal, 1980; Rowe et al., 2004). Of interest to the present study, studies that consider relations between parental MLU and child language outcomes have generally shown positive associations (Hoff & Naigles, 2002; Hoff-Ginsberg, 1986; Huttenlocher et al., 1991). Other common measures of syntactic complexity within parentese include diversity of sentence types and the number of yes/no questions and wh-questions (Rowe et al., 2004). Finally, type-to-token ratio (TTR) is a common measure that measures the diversity of vocabulary and lexical complexity. Several studies report that maternal word types in parentese predict child vocabulary growth more accurately than the amount of maternal talk (Huttenlocher et al., 2010; Pan et al., 2005, Rowe, 2012).

1.4. Paternal parentese

Currently, most of what we know about parentese and its role on infant language learning is based on maternal contributions. For example, studies on infant preference for parentese use almost exclusively female voices (Fernald & Kuhl, 1987; Liu et al., 2003; Saint-Georges et al., 2013; The ManyBabies Consortium, 2020). Furthermore, sessions in the lab are usually completed with the mother only (Cooper et al., 1997). Over the past few decades, fathers have had increased involvement in childrearing and more direct interaction with their children (Cabrera et al., 2000). Recently, with the COVID-19 pandemic, there has been an increase in the amount of time that fathers spend with their children (Craig & Churchill, 2021), suggesting that the mother-centered models of parentese may be outdated.

In modern society, there is a general consensus that fathers play an important role in children's cognitive development (Volling et al., 2019). Furthermore, researchers acknowledge that infant directed speech, and particularly parentese, plays an important role in language development, with potentially long-lasting consequences on cognitive development. Within this framework, the focus on maternal parentese alone is puzzling because all caregivers (Bruner, 1981; Kuhl, 2007; Tomasello, 1992; Vygotsky, 1962), including fathers, aid in a child's language acquisition.

Although frequently sidelined from research, fathers do, indeed, produce parentese (Fernald, 1989). Bergelson et al. (2018) conducted a study in North American households with infants between the ages of 3 and 20 months. Using the LENA technology to identify segments that contained at least 10 words from female adults and 10 words from male adults, Bergelson et al. (2018) then manually annotated the segments for speaker gender and presence of infant- and adult-directed speech. They found that women had produced 2-3x more infant-directed speech than men. However, in this study, it was unknown if both parents were home during the recordings. In a longitudinal study by Shapiro et al. (2021), which controlled for the presence of both parents in the home, the quantity of parentese from mothers and fathers was analyzed when the child was 6, 10, 14, 18, and 24 mo. The findings study demonstrate that fathers produced

quantitatively less speech and less parentese than mothers between 6 and 24 months of age, with the largest gaps between mothers and fathers occurring in early infancy (i.e. 6 and 10 months). While both mothers and fathers increased their parentese production between 6 and 24 mo, fathers' rate of increase was 2.8x that of mothers.

Aside from knowing that the quantity of paternal parentese is lower than maternal parentese, other information from the literature about paternal parentese is scarce and often conflicting. Specifically, there is conflicting evidence about the quality of parentese, how it may differ between mothers and fathers, and how characteristics of maternal and paternal parentese change as the infant develops and becomes a more competent communicative partner. Some studies suggest that there are not many qualitative differences between mothers and fathers (Ratner, 1988; Pancsofar & Vernon-Feagans, 2006). However, other studies provide evidence that fathers are more challenging linguistic partners and tend to ask for more clarifications or repetitions or use lower frequency words (Majorano et al., 2013; Rowe et al., 2004; Tamis-LeMonda et al., 2012).

1.5. Present study

The present study explores the qualitative aspects of maternal and paternal parentese, using a longitudinal corpus of naturalistic recordings collected at 6 and 24 mo. The dataset used in the present study was the control group from a study on parent-infant verbal interactions (Ferjan Ramírez et al., 2018; 2020). Shapiro et al., (2021) used this same dataset and showed that fathers use quantitatively less speech and parentese than mothers, and that they increase their rate of parentese production faster than mothers between 6 and 24 mo. Here, we conduct follow up qualitative analyses to explore the similarities, differences, and longitudinal changes in maternal and paternal parentese. We consider the following specific questions:

Question 1: Quantity of parentese

Shapiro et al. (2021) demonstrated that mothers produce a higher overall quantity of parentese compared to fathers. Using the same dataset, we asked whether this difference is due simply to mothers being overall chattier than fathers, or whether mothers use more parentese than fathers when controlling for their overall chattiness (i.e. volubility of speech). We hypothesized that compared to mothers, fathers would have fewer overall parentese utterances at 6 and 24 mo.

Question 2: Quality of parentese

Next, we asked how mothers and fathers change the quality of parentese between 6 and 24 months. Particularly, we investigated lexical semantics in the form of type-to-token ratio (TTR) and syntactic complexity in the form of mean length of utterance (MLU), in addition to words that denote complex speech. Although MLU is typically calculated on 100 consecutive utterances (Brown,

1973), we calculated it based on the total number of maternal and paternal parentese utterances present in our sample (19-529 utterances per participant). Since one of the key features of parentese is that it is adapted to the child's linguistic level, we expected to see an increase in complexity of maternal and paternal parentese over time, therefore hypothesizing that both mothers and fathers would increase their MLU and TTR between 6 and 24 months. Furthermore, based on previous findings that fathers are more challenging linguistic partners (Rowe et al., 2004; Majorano et al., 2013), we hypothesized that fathers would increase their use of words that denote complex speech to a greater degree than mothers between 6 and 24 months.

2. Methods
2.1. Participants and data collection

Using the same dataset as Shapiro et al. (2021), we analyzed the daylong recordings collected via LENA, from the same 23 infants at 6 and 24 months. These recordings were collected on two consecutive weekend days, where both mother and father were home and not working. According to demographic data collected prior to the audio recordings, 12 of the infants were girls. Participating mother-father families were English speaking, and ranged in SES from low-mid to high, as measured by the widely used Hollingshead Index (Hollingshead, 2011).

As seen in Figure 1, the audio recordings were segmented into 30-second segments. 50 segments from each recording day were chosen from the segments with the highest adult word count (AWC), a measure given by LENA. These segments were at least 3 minutes apart. This yielded 100 total segments per infant at each age point. Ferjan Ramírez et al., (2018, 2020) manually coded these 30-second segments for the presence or absence of parentese. A segment was coded as containing parentese if at least part of the 30-seconds was in parentese. Then, in the present study, we transcribed all utterances, regardless of whether they were in parentese or not, following previous established procedures (Ferjan Ramírez et al., 2018, 2020; Ramírez-Esparza et al., 2014, 2017a, 2017b). Each utterance was marked as being either parentese or standard speech. Unlike in Ferjan Ramírez et al., (2018, 2020), parentese was marked at the utterance level as opposed to the 30-second segment level, which allowed for a more qualitative analysis. Parentese was marked if the speech was directed towards an infant, categorized by higher pitch and exaggerated intonation. Singing and reading were also included as parentese if it was directed towards the infant. The present study contained analyses only on the utterances in parentese.
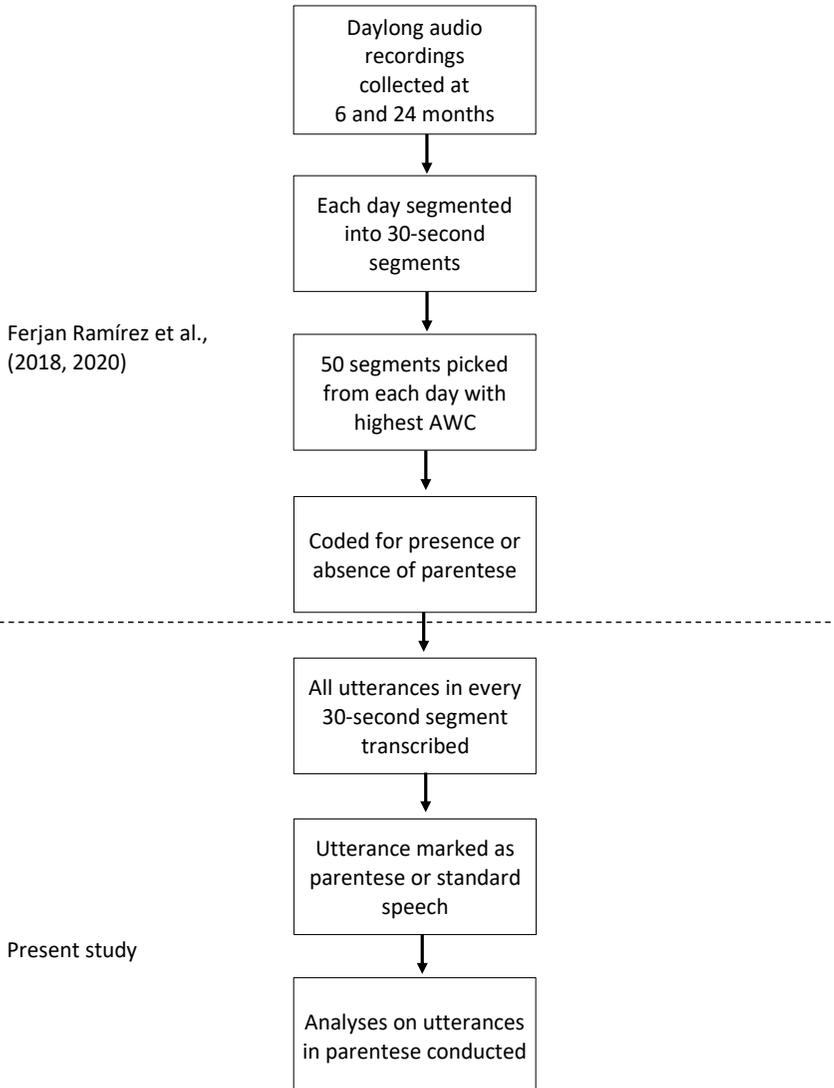
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(2018, 2020)                │ 50 segments picked  │
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Figure 1: Data collection and analysis steps.

2.2. Key variables

At each age, we considered for mothers and fathers, the MLU, TTR, question words, complexity words, mental state words, and parentese ratio. A description of each variable can be found in Table 1. The parentese ratio was used to control for parental *chattiness* (i.e. volubility of speech). For question, complexity, and

mental state words, the total number of instances of all words in each word group was counted within the transcribed utterances in parentese.

Table 1: Key variable names and definitions. All variables were manually annotated within all transcribed utterances that were spoken in parentese, within 100 30-second segments per participant per age.

Variable Name	Variable Definition
MLU	The mean length of all utterances in parentese
TTR	The number of unique words in parentese divided by the number of total words in parentese
Question Words	Words that denote complex speech: *who, what, where, why, when, how*
Complexity Words	Words that denote complex speech: *although, though, however, if, and, but, actually*
Mental State Words	Words that denote complex speech: *know, think, learn, understand, perceive, feel, guess, recognize, notice, want, wish, hope, decide, expect, prefer, remember, forget, imagine, believe*
Parentese ratio	The total number of utterances in parentese divided by the total number of all utterances in the sample.

2.3. Statistical analyses

Paired *t*-tests were conducted using SPSS (IBM Corp., 2020) to compare the means of the key variables between mothers and fathers at 6 and 24 mo. Paired *t*-tests were also used to compare the means of key variables in mothers at 6 and 24 mo, as well as in fathers at 6 and 24 mo, to see if they changed over time. Paired *t*-tests were used because mother's and father's data came from the same participant and are thus not independent of each other.

3. Results

Question 1: Quantity of parentese

Table 2 shows the descriptive statistics for all key variables.

Table 2: The means and standard deviations for all key variables for mothers and fathers at 6 and 24 mo.

	Mothers				Fathers			
	6 months		24 months		6 months		24 months	
	M	SD	M	SD	M	SD	M	SD
MLU	6.05	2.36	5.25	0.90	5.43	1.84	4.83	0.76
TTR	0.39	0.09	0.35	0.09	0.52	0.14	0.42	0.14
Question Words	15.65	12.18	23.61	15.93	8.26	8.76	15.30	12.68
Complexity Words	20.43	23.28	27.39	19.24	7.00	8.19	16.13	15.03
Mental State Words	11.61	9.61	17.65	13.05	4.52	5.69	9.26	9.25
Parentese Ratio	0.38	0.17	0.28	0.18	0.51	0.18	0.46	0.19

Mothers produced significantly more parentese utterances than fathers at 6 mo, $t(22)=3.14$, $p=.005$ and marginally significantly more at 24 mo, $t(22)=2.02$, $p=.056$. Additionally, both mothers, $t(22)=-3.22$, $p=.004$ and fathers, $t(22)=-4.14$, $p<.001$ increased their number of parentese utterances between 6 and 24 mo. Next, using the ratio to control for overall amount of speech, we found that mothers produce more parentese than fathers at 6 mo, $t(22)=2.63$, $p=.02$ but not at 24 mo, $t(22)=1.67$, $p=.11$. These results replicate the work of Shapiro et al. (2021), but at an utterance level rather than a 30-second segment level, indicating that the gap between maternal and paternal parentese is wider at younger ages.

Question 2: Quality of parentese

Our second question sought to understand how maternal and paternal parentese quality changes over time. Mothers had a higher MLU than fathers at both 6 mo, $t(22)=2.24$, $p=.04$ and 24 mo, $t(22)=2.97$, $p=.007$. However, neither mothers, $t(22)=1.62$, $p=.12$ nor fathers, $t(22)=1.49$, $p=.15$ increased their MLU during this time period. Mothers had a higher TTR than fathers at 6 mo, $t(22) = -3.91$, $p=.001$, but not at 24 mo, $t(22)=-1.96$, $p=.06$. Mothers, $t(22)=2.19$, $p=.04$ and fathers, $t(22)=3.98$, $p=.001$ increased their TTR between 6 and 24 mo, indicating that they were increasing their lexical complexity during this time period.

Lastly, we looked at the three word groups that denote complex speech. Mothers had a higher number of question words than fathers at 6 mo, $t(22)=2.38$, $p=.03$, but not at 24 mo, $t(22)=2.01$, $p=.06$. Mothers also had a higher number of complexity and mental state words than fathers at 6 mo (complexity: $t(22)=3.06$, $p=.006$; mental state: $t(22)=3.94$, $p=.001$) and 24 mo (complexity: $t(22)=2.38$, $p=.03$; mental state: $t(22)=2.57$, $p=.02$. We found that mothers increased their

number of question, $t(22)=-2.17$, $p=.04$ and mental state words, $t(22)=-2.33$, $p=.03$, but not complexity words, $t(22)= -1.41$, $p=.17$ between 6 and 24 mo. By contrast, fathers increased the number of complexity words in all three complexity groups: question, $t(22)=-3.33$, $p=.003$, mental state, $t(22)=-2.12$, $p=.04$, and complexity, $t(22)=-2.92$, $p=.008$.

4. Discussion

The present exploratory study compared the quantity and quality of maternal and paternal parentese in a sample of 23 English-speaking mother-father families. We quantified parental speech *quantity* by the total number of utterances in parentese. We quantified *quality* using the mean length of utterance (MLU), type-token-ratio (TTR), and words that denote complex speech, such as question, complexity, and mental state words. Daylong LENA recordings were used at 6 and 24 months in order to investigate the similarities and differences in quantity and quality of maternal and paternal parentese and how they changed over time.

First, we observed that all fathers in the sample produced parentese at both 6 and 24 mo, suggesting that fathers, like mothers, regularly engage their infants in language that is adapted to their level. We then asked whether mothers were simply overall "chattier" than fathers, or whether they also used more parentese than fathers when controlling for their overall chattiness. Partly confirming our hypotheses, we found that mothers were overall chattier than fathers, and produced more parentese than fathers at 6 mo, but not at 24 mo. When controlling for chattiness, we see that the gap between mothers and fathers is more prominent in early infancy (6 mo) and diminishes as the child becomes a more competent language user.

Next, we asked how mothers and fathers change their quality of parentese between 6 and 24 mo. We hypothesized that both, mothers and fathers would show an increase in complexity as measured by the MLU and TTR between 6 and 24 mo. Contrary to our hypothesis, we found that neither mothers nor fathers were increasing their MLU during this time period. One potential reason for a lack of increase in sentence length in mothers and fathers may be that, at age 2, children may not yet be linguistically ready for longer and complex sentences. It could be that children still need the scaffolding that is provided through shorter, simpler sentences. However, as hypothesized, both mothers and fathers demonstrated a significant increase in their TTR, suggesting that they are increasing their lexical complexity over time.

Lastly, we hypothesized that fathers would increase the use of words that denote complex speech to a greater degree than mothers between 6 and 24 mo. We found that fathers increased all three types of word groups, question, complexity, and mental state, while mothers' increase was limited to two word groups, question and mental state words, between 6 and 24 mo. This offers further support that perhaps fathers are more challenging linguistic partners.

Taken together, the present study suggests that maternal and paternal parentese have similarities and differences. For instance, we see that both follow the same trends of increasing the TTR, but not MLU over time. We also found

evidence suggesting that both mothers and fathers increase the syntactic complexity of their parentese between 6 and 24 mo; however, father did so to a greater degree than mothers. This, in conjunction with other research findings, such as fathers producing more wh-questions and explicit clarification requests (Rowe et al., 2004) and using lower frequency words (Majorano et al., 2013), offers support that fathers are more challenging linguistic partners. Although fathers speak quantitatively less to their children compared to mothers, when they do engage, they seem to present more conversational challenges. This may provide further benefits for their child's language development. These conversational challenges require a response from the child, placing a higher linguistic and cognitive demand on the child (Rowe et al., 2004), possibly encouraging the child to talk more.

Furthermore, the present study replicates the previous finding that there is a gap between mothers and fathers in the amount of parentese they produce that is more prominent in early infancy and diminishes over time (Shapiro et al., 2021; Majorano et al., 2013). For example, Majorano et al., (2013) showed that fathers talk more when the child becomes older, as the child is better able to engage in more conversational turns. One potential reason for this is that fathers may be more likely to engage in physical play, which very young infants may not yet be physically ready for. Further studies will be needed to investigate this through detailed qualitative investigation of father-child dyads in environments where fathers they can engage in behaviors of their choice.

4.1. Limitations and Future Directions

While this study offers further information about both maternal and paternal parentese, there are limitations. First, the data was collected from a small sample, consisting of only 23 families. Second, each family varied in how many parentese utterances they produced in the sample. Thus, measures such as MLU could be calculated from a varying number of parentese utterances, depending on the family, limiting statistical power. Future studies should continue to compare maternal and paternal parentese using measures that take into consideration behaviors that might be preferred by fathers, such as physical play. Future research should also include more timepoints, which is currently underway in our lab. Lastly, future studies should explore parentese in more diverse populations, including a broader range of SES groups, non-English speaking and multilingual households, single-parent families and same sex couples.

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