Maternal Repetition and Expansion of Child Utterances at the Outset of Combinatorial Speech Promote Growth in MLU

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1. Introduction

Conversations with infants and young children are repetitive, with caregivers and children often using the same vocabulary words over successive utterances and conversational turns. As interlocutors tend to use the same lexical expressions to establish common ground (Garrod & Clark, 1993), it is not surprising that caregivers tend to repeat words that their child has just said and vice versa (Bloom et al., 1974; Bruner, 1983; Dale & Spivey, 2006). Caregivers' repetition of their child's words may serve as a critical form of feedback that recognizes and acknowledges the child's communicative efforts (Clark & Bernicot, 2008). Caregivers' overlapping utterances often contribute new information via expansions or recasts of the child's utterance—providing a form of indirect negative evidence that may help them learn the combinatorial properties of words and acquire more complex verbal constructions (Baker & Nelson, 1984; Nelson, 1973). The current study asks whether conversational overlap in the form of repeated lexical content might facilitate growth in utterance complexity specifically at the transition to combinatorial speech.

Even before children produce their first intelligible words, caregivers and infants use imitation and repetition to establish rapport (Bruner, 1983). The infant's propensity to imitate their caregivers' vocalizations is thought to be of importance for learning the speech sounds of the ambient language (Kuhl & Meltzoff, 1996). By the time they are toddlers, children readily engage in role-reversal imitation where they adopt the communicative devices (words and gestures) others have used for similar purposes (Tomasello, 1999). Hence, imitation appears to be an effective way for young children to expand their communicative repertoires.

Experimental research on the social shaping hypothesis (King et al., 2005) has shown that contingent social feedback increases the quality (Goldstein et al., 2003; Goldstein & Schwade, 2008) and quantity of infant vocalizations (Gros-Louis et al., 2014). That is, infants tend to produce increased numbers of communicative bids and vocalizations that are more speech-like (i.e., canonical

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babbling) when caregivers provide contingent verbal and non-verbal responses (e.g., touching, smiling, imitating vocalizations). Such findings mesh with longitudinal research on the benefits of maternal responsiveness in the form of prompt, contingent, and appropriate reactions to children's communicative bids (Bornstein et al., 2008). In one study (Tamis-LeMonda et al., 2001), maternal imitation of infant vocalizations at 13 months predicted the occurrence of the child's subsequent linguistic milestones (i.e., 50-word vocabulary, combinatorial speech, and past-event talk). In a review of 22 studies, caregivers' imitation of their infant's vocalizations had a larger effect on subsequent vocalizations than other forms of feedback including verbal comments and nonverbal sounds (Dunst et al., 2010). In a previous study using transcripts of mother-child interactions from the CHILDES database (New England Corpus; Ninio et al., 1994), maternal overlap predicted growth in children's language abilities from 14 to 32 months of age after controlling for the child's earlier language abilities and propensity to repeat their mother's words (Che et al., 2018). In this study, the benefits of mothers using words their child had just said in their responses were evident in analyses of mean length of utterance (MLU; Brown, 1973), developmental sentence structure (DSS; Lee & Canter, 1971), and vocabulary diversity (VOCD; McKee et al., 2000).

Other recent studies have generated mixed findings with regard to whether lexical overlap in child-directed speech promotes language development. Schwab et al. (2018) looked at word repetition in low-income fathers' speech in relation to the vocabulary development of their 2-year-old children. The researchers used the repetition index from the CHIP command (Sokolov & MacWhinney, 1990) and type-token ratio (TTR) as indices of word-level repetition and found a negative relation between fathers' use of repetition and their children's vocabulary knowledge at 24 months. Conica et al. (2020) similarly found that mothers and fathers engaged in more repetition with children who had less diverse vocabularies, suggesting that repetition may be used as a strategy to support communication. Although maternal repetition was unrelated to children's vocabulary growth, paternal repetition at 2 years showed a positive relation with child language at age 4 years after controlling for maternal repetition and child language at age 2 years (Conica et al., 2020).

The current study aimed to replicate previous findings on the benefits of maternal overlap (Che et al., 2018), i.e., mothers' repetition of words that their child had just said in their replies, using longitudinal data from CHILDES (MacWhinney, 2000). We used cross-lagged regression models to predict growth in utterance complexity (MLU, DSS) over time. We were specifically interested in whether benefits of maternal overlap were restricted to early language development—specifically the child's transition from single-word to multi-word speech. For each of four corpora, we looked at whether maternal overlap at 18 to 20 months of age predicted growth in MLU and DSS at an older age (ranging from 24 to 32 months), after controlling for complexity of child and maternal child-directed speech at the younger age. Based on previous findings indicating a lack of an effect of maternal overlap at age 2 years (Conica et al., 2020), we included two additional corpora to examine whether maternal overlap at 27 to 30 months predicted growth in child utterance complexity at ages 36 to 42 months.

2. Method

2.1. Corpora

We used longitudinal corpora of mother-child interactions from the CHILDES database (MacWhinney, 2000) to examine effects of overlap on language growth over time. Across corpora, we only included dyads with transcripts at both of the requisite ages to avoid problems associated with imputing missing data. We also excluded children who had no intelligible speech at time 1 as statistics could not be computed. All children were from English-speaking families.

2.1.1. Newman Ratner Corpus

The Newman Ratner corpus contains transcripts of interactions of mother-child dyads recorded at 7, 10, 11, 18, and 24 months of age. Dyads were instructed to play naturally with a standard set of toys (e.g., plush animals, baby doll with accessories, pretend eating/cooking related items, and board books). Each session lasted approximately 15 minutes (Newman et al., 2016). For the current study, we analyzed transcripts from 47 dyads who had data at 18 and 24 months of age.

2.1.2. Bates Corpus

The Bates corpus contains transcripts of interactions of mother-child dyads from middle-class families, with data collected between 1978 and 1980 in Boulder, Colorado (Bates et al., 1988). Dyads participated in a laboratory session at 20 (free-play) and 28 months of age (free-play, snack, and story). The free play activities at 20 and 28 months involved the same set of instructions and toys. For this study, we analyzed transcripts from 28 dyads who had data at both 20 and 28 months of age. We combined data across all three tasks at 28 months before calculating MLU and DSS scores.

2.1.3. New England Corpus

The New England corpus contains transcripts of interactions of mother-child dyads recorded at ages 14 and 20 months, with a third session recorded between 27 and 32 months of age (Ninio et al., 1994). Children were from families of lower-middle and upper-middle socioeconomic status. Sessions at 14 and 20 months of age included a warm-up, toy play, forbidden object activity, and four boxes containing a ball, cloth for peekaboo, paper and crayons, and a book. The session at age 27 to 32 months only involved the four boxes, with age-appropriate substitutions (hand puppets and Fisher-Price toy house replacing the ball and peekaboo cloth). Each session lasted approximately 20 to 25 minutes (Snow et al., 1996). For the current study, we used transcripts recorded at 20 months and at 27–32 months, with 35 dyads having data at both time points.

2.1.4. Ambrose Moeller Corpus

The Ambrose Moeller corpus contains transcripts of interactions of children with normal hearing and hearing loss at 13.5, 18, 22.5, 27, and 36 months of age. Dyads were instructed to play naturally using a standard set of toys in a laboratory playroom. Children with hearing loss were assumed to be wearing hearing aids until they received a cochlear implant. Each session lasted approximately 30 minutes (Ambrose, 2016). For the current study, we included data from 31 dyads who had data at 18 and 27 months (younger age) and from 36 dyads who had data at 27 and 36 months (older age).

2.1.5. Ellis Weismer Corpus

The Ellis Weismer corpus contains transcripts of interactions of mother-child dyads at 30 and 42 months of age. The sample included late talkers and children with normal language development matched by age, nonverbal cognition, and socioeconomic status. Dyads played with a standard set of toys (e.g., Fisher-Price farm and doll house sets; Ellis Weismer et al., 2013). For the current study, we included data from 74 dyads who had data at both 30 and 42 months.

2.2. Data Analysis

Transcripts were analyzed using the CLAN program (MacWhinney, 2000).

2.2.1. CHIP command

We used the CHIP command in CLAN to automatize coding of word-level repetition across conversational turns (Sokolov & MacWhinney, 1990). Utterances were tagged as instances of overlap if one or more words were shared across conversational turns. Content was compared across utterances line-by-line to identify the extent to which individual response utterances matched the preceding source utterance. Each response utterance is matched to the nearest utterance of their conversational partner within a window of six preceding utterances (Sokolov, 1993). Following methods used in Che et al. (2018), we used the percentage of overlapping responses out of the total number of utterances produced by the speaker (summarized in the CHIP output summary as '%_Overlap'). We used the '%_ADD_WORDS' line to determine the percentage of overlapping utterances that were expansions of what their conversational partner had just said, i.e., one or more words added in the response. We also used the '%_DEL_WORDS' line to determine the percentage of overlapping utterances that were deletions of what their conversational partner had just said, i.e., one or more words deleted in the response.

2.2.2. Mean Length of Utterance (MLU) command

The MLU command (Brown, 1973) generated the ratio of the number of morphemes divided by the number of utterances produced. MLUs for both mother and children were calculated at each age as an indicator of utterance complexity.

2.2.3. Developmental Sentence Score (DSS) command

The DSS command (Lee & Canter, 1973) provides a measure of the children's sentence complexity. It relies on the morphological (%mor) tier of the transcript and computes scores based on eight grammatical domains: indefinite pronouns, personal pronouns, main verbs, secondary verbs, negatives, conjunctions, interrogative reversal, and *wh*-questions. The DSS command extracts up to 50 unique consecutive sentences for analysis, while excluding incomplete sentences, unintelligible utterances, and sentence repetitions. Each extracted sentence is assigned points in accordance with the grammatical domains listed above. An average DSS score is computed by dividing the total points by the number of extracted sentences. Note that DSS scores could not be computed for all children at time 2 due to too few utterances. For this reason, we did not attempt to compute DSS scores at time 1.

3. Results

3.1. Percentages of Overlapping Utterances and Expansions

Table 1. Percentages of maternal and child utterances with overlapping content at time 1, with rates of expansions (mother) and reductions (child)

Corpus	Age at time 1 (months)	Maternal Overlap Overlap *M (SD)*	Maternal Overlap Expansion *M (SD)*	Child Overlap Overlap *M (SD)*	Child Overlap Reduction *M (SD)*
Younger age groups					
Newman Ratner	18	6.9% (6.9)	51.2% (24.9)	26.6% (16.7)	53.6% (25.7)
Bates	20	9.30% (7.2)	48.0% (23.7)	17.1% (13.3)	46.6% (28.5)
New England	20	10.9% (5.3)	57.1% (11.8)	14.5% (8.5)	56.1% (22.7)
Ambrose Moeller	18	5.0% (6.6)	48.1% (30.2)	32.1% (22.4)	52.9% (30.3)
Older age groups					
Ambrose Moeller	27	17.2% (10.7)	52.8% (12.3)	27.5% (19.2)	54.1% (16.1)
Ellis Weismer	30	25.0% (8.5)	51.6% (8.8)	20.3% (8.8)	55.9% (10.4)

Table 1 shows mean percentages of maternal and child overlap at time 1. In general, rates of child overlap were significantly higher than rates of maternal overlap: For the Newman Ratner corpus at 18 months, $t(46) = 8.33$, $p < .001$; for the Bates corpus at 20 months, $t(27) = 3.20$, $p = .003$; for the New England corpus at 20 months, $t(35) = 2.49$, $p = .018$; for the Ambrose Moeller corpus at 18 months, $t(30) = 6.66$, $p < .001$, and 27 months, $t(35) = 2.51$, $p = .017$. In contrast, for the Ellis Weismer corpus, the rate of maternal overlap was higher than the rate of child overlap at 30 months, $t(73) = -3.76$, $p < .001$.

Table 1 also shows the percentage of the overlapping utterances that were expansions (one or more words added) for the mothers and reductions (on or more words deleted) for the children. Replicating prior research (Sokolov, 1993), most instances of maternal overlap were expansions of what the child had said whereas most instances of child overlap were reductions of what the mother had said.

3.2. MLU

Table 2 presents descriptive statistics for maternal and child MLU at each age. At 18 to 20 months, child MLUs were close to 1, indicating that most utterances consisted of just one (intelligible) word. At the older ages, child MLUs were above 1.5, indicating increased numbers of multiword utterances. Maternal MLUs also increased with child age.

Table 2. Maternal and child MLU at time 1 (T1) and time 2 (T2)

Corpus	Age T1 → T2 (months)	Maternal MLU T1 *M* (*SD*)	Maternal MLU T2 *M* (*SD*)	Child MLU T1 *M* (*SD*)	Child MLU T2 *M* (*SD*)
Younger age groups					
Newman Ratner	18 → 24	4.14 (.68)	4.52 (.73)	1.32 (.41)	1.75 (.53)
Bates	20 → 28	3.80 (.69)	4.41 (.53)	1.26 (.31)	2.19 (.53)
New England	20 → 32	3.80 (.52)	4.43 (.70)	1.36 (.30)	2.60 (.73)
Ambrose Moeller	18 → 27	4.00 (.84)	4.24 (.73)	1.12 (.17)	2.00 (.94)
Older age groups					
Ambrose Moeller	27 → 36	4.21 (.72)	4.68 (.75)	1.92 (.91)	2.68 (1.15)
Ellis Weismer	30 → 42	4.69 (.61)	4.90 (.66)	2.08 (.68)	3.31 (.68)

Note. For the New England corpus, the 32-month-old group consisted of children ranging in age from 27–32 months.

3.2.1. MLU Regression Models

We ran cross-lagged linear regression models to determine whether maternal and child overlap at time 1 predicted growth in the child MLU growth at time 2, while controlling for utterance length (maternal and child MLU) at time 1. As shown in Table 3, maternal overlap at ages 18 or 20 months predicted growth in child MLU at time 2 in three of the four corpora. Maternal MLU at 18 to 20 months also tended to predict child MLU at time 2. Neither child MLU or child overlap at time 1 were associated with child MLU at time 2. Taken together, the results indicate that both complexity in maternal speech and mothers' repetition of their child's words contributed to growth in MLU at the transition to combinatorial speech.

In contrast, maternal overlap and maternal MLU at age 27 to 30 months were unrelated to child MLU at time 2. Rather, child MLU at 30 months (Ellis Weismer corpus) predicted growth in MLU at time 2. (For the Ambrose Moeller corpus at 27 months, the effect was in the predicted direction but failed to reach significance, $p = .065$). These results indicate stability in individual differences in MLU at the older ages.

Table 3. Standardized regression coefficients for cross-lagged regression models using child MLU, maternal MLU, child overlap, and maternal overlap at time 1 to predict child MLU at time 2

Variable	Newman Ratner 18 → 24 (*N* = 47)	Bates 20 → 28 (*N* = 28)	New England 20 → 32 (*N* = 35)	Ambrose Moeller 18 → 27 (*N* = 31)	Ambrose Moeller 27 → 36 (*N* = 36)	Ellis Weismer 30 → 42 (*N* = 74)
Child MLU	.08	.21	.14	–.13	.41†	.66***
Maternal MLU	.24†	.40*	.24†	.39**	.15	–.05
Child Overlap	.19	.03	–.03	–.02	–.20†	–.05
Maternal Overlap	.65***	.22	.65***	.66***	.23	.09
F	10.04***	2.39†	11.63***	10.38***	14.33***	16.03***
R^2	.49***	.29†	.61***	.62***	.65***	.48***

Note. For the New England corpus, the 32-month-old group consisted of children ranging in age from 27–32 months. ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$

3.3. DSS

Table 4 presents descriptive statistics for maternal and child DSS scores at time 2. DSS were not computed at time 1 due to children having insufficient data (i.e., lack of multiword utterances). DSS scores also could not be computed for some children at time 2, indicated by reduced *Ns* in regression models reported in Table 5.

Table 4. Maternal and Child DSS for each corpus at time 2

Corpus	Age at time 2 (months)	Maternal DSS *M* (*SD*)	Child DSS *M* (*SD*)
Newman Ratner	24	7.95 (1.35)	4.33 (1.91)
Bates	28	7.77 (1.26)	5.15 (1.24)
New England	32	8.28 (1.16)	5.86 (1.24)
Ambrose Moeller	27	7.44 (.99)	4.17 (1.22)
Ambrose Moeller	36	7.52 (1.64)	5.67 (1.81)
Ellis Weismer	42	7.59 (.98)	6.66 (1.33)

Note. For the New England corpus, the 32-month-old group consisted of children ranging in age from 27–32 months.

3.3.1. DSS Regression Models

We ran cross-lagged linear regression models to determine whether maternal and child overlap at time 1 predicted children's DSS scores at time 2, after controlling for utterance length (maternal and child MLU) at time 1. As shown in Table 5, maternal overlap at ages 18 or 20m predicted children's DSS scores at time 2 in three of the four corpora. Maternal MLU at time 1 also predicted gains in child MLU at time 2 in one corpus.

Again, in contrast to the effects observed at the younger ages, maternal overlap at ages 27 to 30 months was unrelated to children's DSS scores at ages 36 to 42 months. Instead, in the Ambrose Moeller model, there was a negative association between child overlap at 27 months and children's DSS scores at age 36 months. This suggests that children who produced more repetitive utterances at 27 months of age had less complex sentence structures at 36 months of age. Additionally, for both the Ambrose Moeller and Ellis Weismer corpora, we observed a significant effect of child MLU at 27 and 30 months in predicting DSS scores at 36 and 42 months, indicating stability in individual differences in language complexity in these samples.

These results largely replicate the patterns observed in the MLU analyses reported above albeit with somewhat smaller *Ns.* Notably, across all four corpora, we found evidence that maternal overlap at 18 to 20 months predicted growth in utterance length and/or complexity at time 2. In the two cases where the coefficients were not statistically significant (Bates corpus for MLU; Newman Ratner corpus for DSS), the effects were in the predicted direction.

Table 5. Standardized regression coefficients for cross-lagged regression models using child MLU, maternal MLU, child overlap, and maternal overlap at time 1 to predict child DSS at time 2

Variable	Newman Ratner 18 → 24 (*N* = 39)	Bates 20 → 28 (*N* = 28)	New England 20 → 32 (*N* = 35)	Ambrose Moeller 18 → 27 (*N* = 23)	Ambrose Moeller 27 → 36 (*N* = 35)	Ellis Weismer 30 → 42 (*N* = 74)
Child MLU	–.06	.01	.15	–.17	.46*	.41**
Maternal MLU	.14	.41*	.31†	.29	.26	–.18†
Child Overlap	–.08	.08	–.24	.08	–.34**	–.05
Maternal Overlap	.20	.48**	.37*	.66**	–.04	.15
F	.33	5.06**	3.98**	4.63**	12.29***	5.53***
R^2	.04	.47**	.35**	.51**	.65***	.24***

Note. For the New England corpus, the 32-month-old group consisted of children ranging in age from 27–32 months. ***p < .001; **p < .01; *p < .05; †p < .10

4. Discussion

The current study aimed to replicate and extend previous findings on lexical repetition in child-directed speech and how it might promote development at early stages of language acquisition (Che et al., 2018). We focused on maternal overlap in the form of repetition of the child's previous word(s) in the caregivers' successive utterance and its impact on growth in utterance complexity over time, as assessed using measures of MLU and DSS (Brown, 1973; Lee & Canter, 1971). We used cross-lagged statistical analyses to model the impact of maternal repetition at age 18 to 20 months when children were just beginning to produce word combinations (i.e., their MLUs were close to 1) and also at ages 27 and 30 months when the children were producing multiword utterances (i.e., their MLUs were close to 2) on child language at subsequent ages.

Across four longitudinal datasets in CHILDES (MacWhinney, 2000), we found higher rates of maternal overlap at 18 to 20 months predicted growth in children's utterance complexity, after controlling for child and maternal utterance complexity (MLU) and the child's propensity to repeat the mother (child overlap) at age 18 to 20 months. The main findings replicated across disparate samples and two measures of utterance complexity, underscoring the enormous value of CHILDES in promoting reproducibility as normative, scientific practice (Nosek et al., 2015). In addition to the effect of maternal overlap, we found some evidence that children benefitted from longer maternal MLU. This result aligns with a recent meta-analysis that found a positive association between parental MLU and language outcomes for children with disabilities (Sandbank & Yoder, 2016) and other findings suggesting that learners benefit from exposure to a wider range of grammatical constructions in the input (Brooks & Kempe, 2019).

In contrast to the positive effects of maternal overlap at the transition to combinatorial speech, we failed to find any effect of maternal overlap in child-directed at the older ages (27 and 30 months) when children were already producing multiword utterances. While our finding matched the results for maternal repetition reported by Conica et al. (2020), the authors notably found benefits of paternal repetition at age 2 years on language growth at age 4 years. Such discrepant findings indicate the need for additional longitudinal research on child-directed speech of fathers as well as mothers and its impact on language development outcomes.

Ninio (1992) found that 97% of the words children produced at the single-word stage were modeled by a parent expressing the same communicative intent. Across the four corpora, children at 18 to 20 months tended to repeat words used by their mothers at higher rates than mothers repeated their child's words (i.e., % overlap scores were higher for child utterances than maternal utterances). Such findings show the extent to which children engage in role-reversal imitation at the single-word stage (Tomasello, 1999). Paradoxically, child overlap did not predict growth in utterance complexity over time and, in the Ambrose Moeller corpus, *higher* child overlap scores at age 27 months predicted *lower* DSS scores at age 30 months. Notably, this longitudinal corpora included children with language delays that occurred as a consequence of congenital deafness. Consequently, the finding needs to be replicated in a longitudinal study of typical children (i.e., with a community sample) to determine whether high rates of overlap at age 2 are potential markers of language delay. We would predict that heightened rates of reductions and exact repetitions (as opposed to expansions) may be indicators of communicative difficulties.

To address the question of how maternal repetition might aid children at the transition to combinatorial speech, we need to take individual differences in communication styles into account (Nelson, 1973; Pine & Lieven, 1993). For "referential" children who start off with mostly single-word utterances, having a parent model through repetition and expansion how to link ideas should help them transition from the single-word stage to multi-word utterances. For "expressive" children who start out with many unanalyzed, frozen phrases (Lieven et al., 1992), having a parent re-work their utterances through repetition and expansion may help them to discover patterns and gain flexibility in word usage. In a large-scale analysis of CHILDES transcripts, Ninio (2014) found that child-directed speech contained many two-word examples of basic English grammatical relations (i.e., subject-verb, verb-object, verb-indirect objects). Moreover, the children's own two-word utterances tended to closely match the available input. Maternal two-word utterances that expand a child's preceding utterance would be ideally suited to facilitate learning of the basic grammatical relations by demonstrating the combinatorial properties of words the child already knows and can produce. Moreover, such just-in-time input would likely map onto concepts that the child already has in mind, which would facilitate comprehension of the more complex expression.

Given the diversity of languages represented in CHILDES, a logical next step would be to replicate our analyses using transcripts of children acquiring languages other than English. Here it is important to include non-WEIRD samples (Henrich et al. 2010) as many of the world's children are not exposed to copious amounts of child-directed speech characterized by maternal repetition of child vocalizations (e.g., Cristia et al., 2019; Schieffelin, 1990). Crosslinguistic studies will help elucidate how various features of child-directed speech including repetition and expansions of child utterances support learning at different stages of language development.

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