Supplementary File II for Bursty, irregular speech input to children predicts vocabulary size

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1 Conversational turns and vocabulary scores

Here we define speech input (and interaction) using conversational turns taken between the key child and an adult. We examine whether burstiness in *turns* also relates to children's receptive vocabulary sizes.

1.1 Data pre-processing

We wrote an ad-hoc script to mine the .its file associated with each LENA recording and provide us with the number of conversational turns within each 5-minute epoch of the recording. We applied the same sleep classifier as in the manuscript to identify sleep portions of the recording and remove them. The turn count was estimated from LENA's linguistic unit algorithm, which has been reported on widely elsewhere in the literature, though we emphasize that this measure shows widely variable specificity and sensitivity (Cristia et al., 2020; Ferjan Ramirez, Hippe, Braverman, Weiss, & Kuhl, 2023; Ferjan Ramírez, Hippe, & Kuhl, 2021) so we encourage readers to interpret these data carefully and bear in mind that the LENA's conversational turn estimator is not completely reliable. We imputed "empty" epochs (epochs without any conversational turns) for each recording, to reflect the times when the child was not exposed to any turns. In this supplementary analysis, we limited the computation to burst amplitude, since we didn't see large differences between burst amplitude and duration in the child-directed speech analysis in the full manuscript and also we didn't have strong apriori reasons to presume that conversational turn burst amplitude and duration would differ that much from one another. The average amplitude of bursty conversational epochs within the recordings was 13.2 turns (SD=8.74, range=1.54-78.33).

1.2 Model fitting

We fit a linear mixed effects model to predict receptive vocabulary scores (Peabody Picture Vocabulary Test-5 growth scale values) and included random intercepts of Child. We additionally included fixed effects of Child Age (in months, centered and scaled), Maternal Education (binned,

as described in the manuscript, and centered and scaled), and Child Gender (contrast coded). The variable of interest was the average amplitude (number of turns) within bursty conversational epochs, which was a significant predictor of vocabulary scores (β=0.14, p=0.01; model summary in Table 1). This analysis supports the idea that bursty interaction, in this case conversational turns between the key child and an adult, is likewise positively related to concurrent receptive vocabulary scores.

Table 1

The relationship between bursty converstational turns and concurrent receptive vocabulary size

Intercept	126.78***
	(124.06, 129.49)
	t = 91.62
	p < .001
Convo. Turn Amplitude	0.14**
	(0.04, 0.24)
	t = 2.78
	p = 0.01
Age (mos)	1.47***
	(1.38, 1.55)
	t = 33.76
	p < .001
Gender:Female	2.26
	(−1.23, 5.74)
	t = 1.27
	p = 0.21
Mat. Ed.	5.59***
	(4.53, 6.66)
	t = 10.28
	p < .001
Observations	544
Log Likelihood	−2,089.68
Akaike Inf. Crit.	4,193.36
Bayesian Inf. Crit.	4,223.45
Note:	*p<0.05; **p<0.01; ***p<0.001

2 References

Cristia, A., Lavechin, M., Scaff, C., Soderstrom, M., Rowland, C., Räsänen, O., ... Bergelson, E. (2020). A thorough evaluation of the Language Environment Analysis (LENA) system. *Behavior Research Methods*.

Ferjan Ramirez, N., Hippe, D. S., Braverman, A., Weiss, Y., & Kuhl, P. K. (2023). A comparison of automatic and manual measures of turn-taking in monolingual and bilingual contexts. *Behavior Research Methods*. doi: 10.3758/s13428-023-02127-z

Ferjan Ramírez, N., Hippe, D. S., & Kuhl, P. K. (2021). Comparing automatic and manual measures of parent–infant conversational turns: A word of caution. *Child Development*, *92*(2), 672–681. doi: 10.1111/cdev.13495