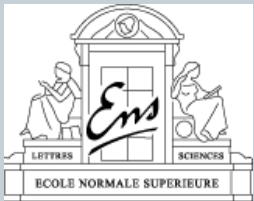


Acoustic Convergence and Initiator Effects in Mother-Infant Conversational Blocks



EON-SUK KO, MELISSA REIMCHEN,
ALEJANDRINA CRISTIA, AMANDA SEIDL &
MELANIE SODERSTROM



Social Sciences and Humanities
Research Council of Canada

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Why Study Convergence



- Amount is important, but feedback is key
- Adults converge conversational in many ways
 - E.g Giles, Coupland, & Coupland, 1991; Levitan & Hirshberg, 2011
- Mother-infants?
 - **Vowel Quality:** 3-6 month olds imitate (Kuhl & Meltzoff, 1996)
 - **Pause/utterance duration:** (E.g., Feldstein et al. 1993; Ko, 2013)
 - **Pitch patterns:** 6 month olds trained to imitate (Kessen et al., 1979)
 - **fo:** mixed (e.g. Masataka, 1992, but c.f. McRoberts & Best, 1997; Siegel et al. 1990)
 - *Almost exclusively < 12 months!!*

Our study



- Older infants/toddlers (13-30 months)
- Large naturalistic sample
 - N = 13, 2-5 days of recording per child [isn't it 3-5 days? – ES]
- Multiple Cues: Duration/pitch/speaking rate
- By conversational block (within pair analysis)

Data structure



- Block Type (fixed)
 - AICF CIC
- Age of infant (random)
- Gender of infant (random)
 - Male Female
- Speaker ID (fixed)
 - FAN CHN ~~MAN~~ — ~~OLN~~ — FUZ
- Mother-infant pair (random)
- Acoustic properties (variables of interest)
 - Segment duration, pitch (min, max, avg, range), speaking rates

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A1		Index																			
	C	D	E	F	G	H	I	J	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	Number	File_Hour	CHN	Child_Voc	Child_Nor	FAN	FAN_Non	M	Recording	Elapsed_T	Cl	Block_Dur	Block_Nur	Block_Type	Init_by	Segment	Speaker_I	Block_Info	Segment		
2	4	2.43	0	0	0	1.97	0		1	0	#	100.33	1	AICF	FA	1.97	FAN	BC			
3	4	2.43	0	0	0	0	0		1	1.97	#	100.33	1	AICF	FA	1.78	OLN				
4	4	2.43	0	0	0	0	0		1	3.75	#	100.33	1	AICF	FA	1.01	MAN	RC			
5	4	2.43	0	0	0	0	0		1	4.76	#	100.33	1	AICF	FA	1.14	FUZ				
6	4	2.43	0	0	0	0	0		1	5.9	#	100.33	1	AICF	FA	1.06	FUZ				
7	4	2.43	0	0	0	0	0		1	6.96	#	100.33	1	AICF	FA	1.46	FUZ				
8	4	2.43	0	0	0	1.27	0		1	8.42	#	100.33	1	AICF	FA	1.27	FAN	RC			
9	4	2.43	0	0	0	0	0		1	9.69	#	100.33	1	AICF	FA	0.8	SIL				
10	4	2.43	0	0	0	0	0		1	10.49	#	100.33	1	AICF	FA	0.91	FUZ				
11	4	2.43	1.15	1.15	0	0	0		1	11.4	#	100.33	1	AICF	FA	1.15	CHN	RC			
12	4	2.43	0	0	0	3.33	0		1	12.55	#	100.33	1	AICF	FA	3.33	FAN	RC			
13	4	2.43	0	0	0	0	0		1	15.88	#	100.33	1	AICF	FA	0.8	FUZ				
14	4	2.43	2.24	2.24	0	0	0		1	16.68	#	100.33	1	AICF	FA	2.24	CHN	RC			
15	4	2.43	0	0	0	1.25	0		1	18.92	#	100.33	1	AICF	FA	1.25	FAN	RC			
16	4	2.43	0	0	0	0	0		1	20.17	#	100.33	1	AICF	FA	1.28	OLN				
17	4	2.43	1.8	1.53	0	0	0		1	21.45	#	100.33	1	AICF	FA	1.8	CHN	RC			
18	4	2.43	0	0	0	1.95	0		1	23.25	#	100.33	1	AICF	FA	1.95	FAN	RC			
19	4	2.43	0	0	0	0	0		1	25.2	#	100.33	1	AICF	FA	1.87	MAN	RC			
20	4	2.43	0	0	0	0	0		1	27.07	#	100.33	1	AICF	FA	1.56	SIL				
21	4	2.43	0	0	0	0	0		1	28.63	#	100.33	1	AICF	FA	2.78	OLN				
22	4	2.43	0	0	0	0	0		1	31.41	#	100.33	1	AICF	FA	1.06	MAN	RC			
23	4	2.43	0	0	0	0	0		1	32.47	#	100.33	1	AICF	FA	1.97	OLN				
24	4	2.43	0	0	0	0	0		1	34.44	#	100.33	1	AICF	FA	1.57	MAN	RC			
25	4	2.43	0	0	0	0	0		1	36.01	#	100.33	1	AICF	FA	0.96	OLN				
26	4	2.43	0	0	0	0	0		1	36.97	#	100.33	1	AICF	FA	1	MAN	RC			

Ready

e20090519_113326_003109

100%

1:51 PM

Step 2: Clean up data table

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- Using R and Praat scripts:
 1. Calculate segment location/length
 - Calculated the beginning and end of each segment, i.e. each row, based on “elapsed time” and “segment duration”.
 2. Exclude segments
 - Other than CHN, FAN
 - where ChildVoc/Female speech < 50% of segment
 3. Calculate pitch values (max, min, mean)
 - using ERB scale
 4. Calculate speaking rates
 - Based on intensity/voicing to locate vowels

Step 3: Take mean across conversational block

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- CHN and FAN each has one entry value of acoustic properties for each block of conversation.

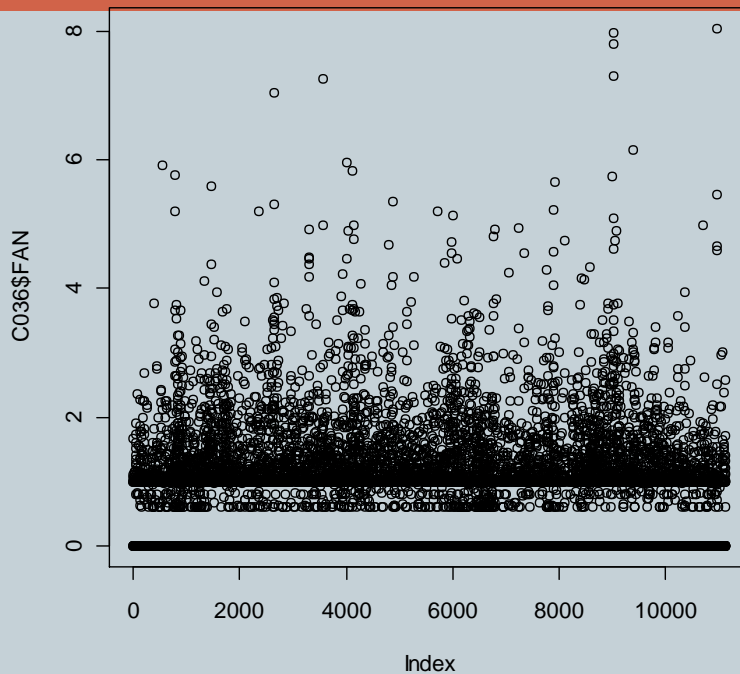
	Block.N	Block.T	CHI	Age	CHN.avg	FAN.avg	CHN.min	FAN.min
1	3	AICF	C003	765	8.676307	7.257332	7.619782	5.033533
2	25	AICF	C003	765	8.227647	6.475297	4.853860	4.452857
3	32	AICF	C003	765	8.381634	6.720497	6.700553	4.977628
4	50	AICF	C003	765	8.113471	6.037453	6.294747	4.958514
5	59	AICF	C003	765	8.301553	7.444806	7.587508	4.808462
6	61	AICF	C003	765	7.895683	6.319403	4.455857	4.198858

Columns and Rows clipped

Step 4: Exclude segments < 1 s

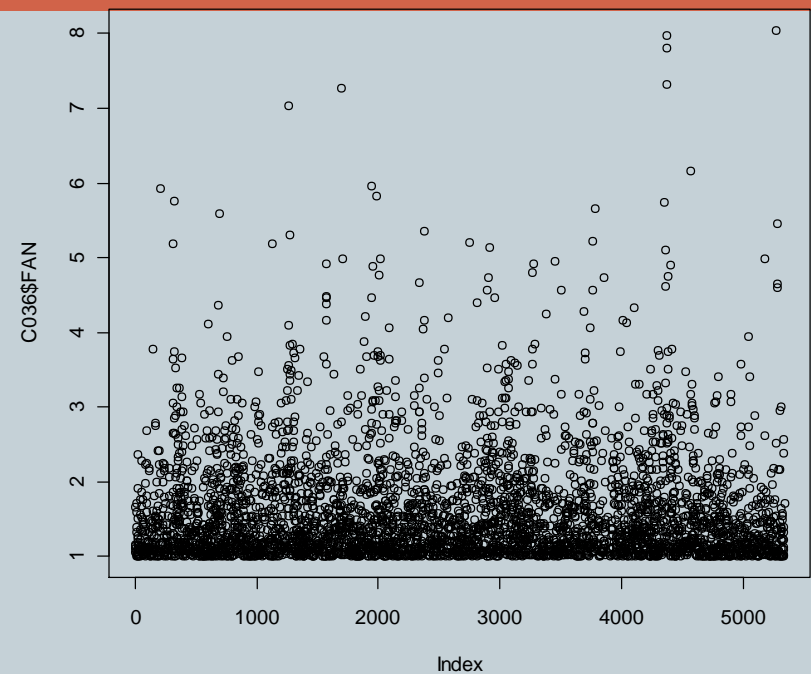
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Raw data N 81578 > 43112



Before

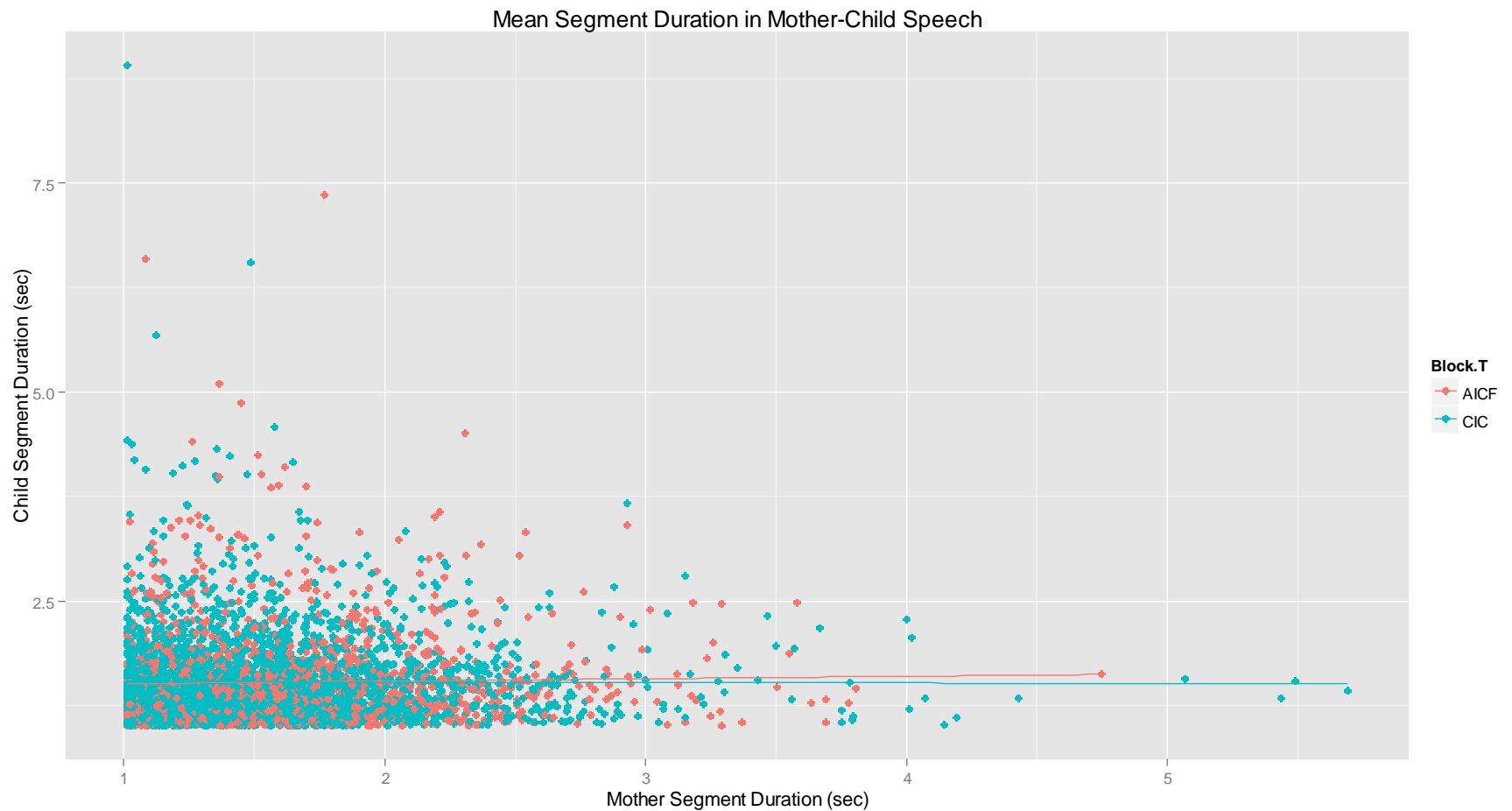
Blocks N 17586 > 8794



After

Segment duration not significantly correlated

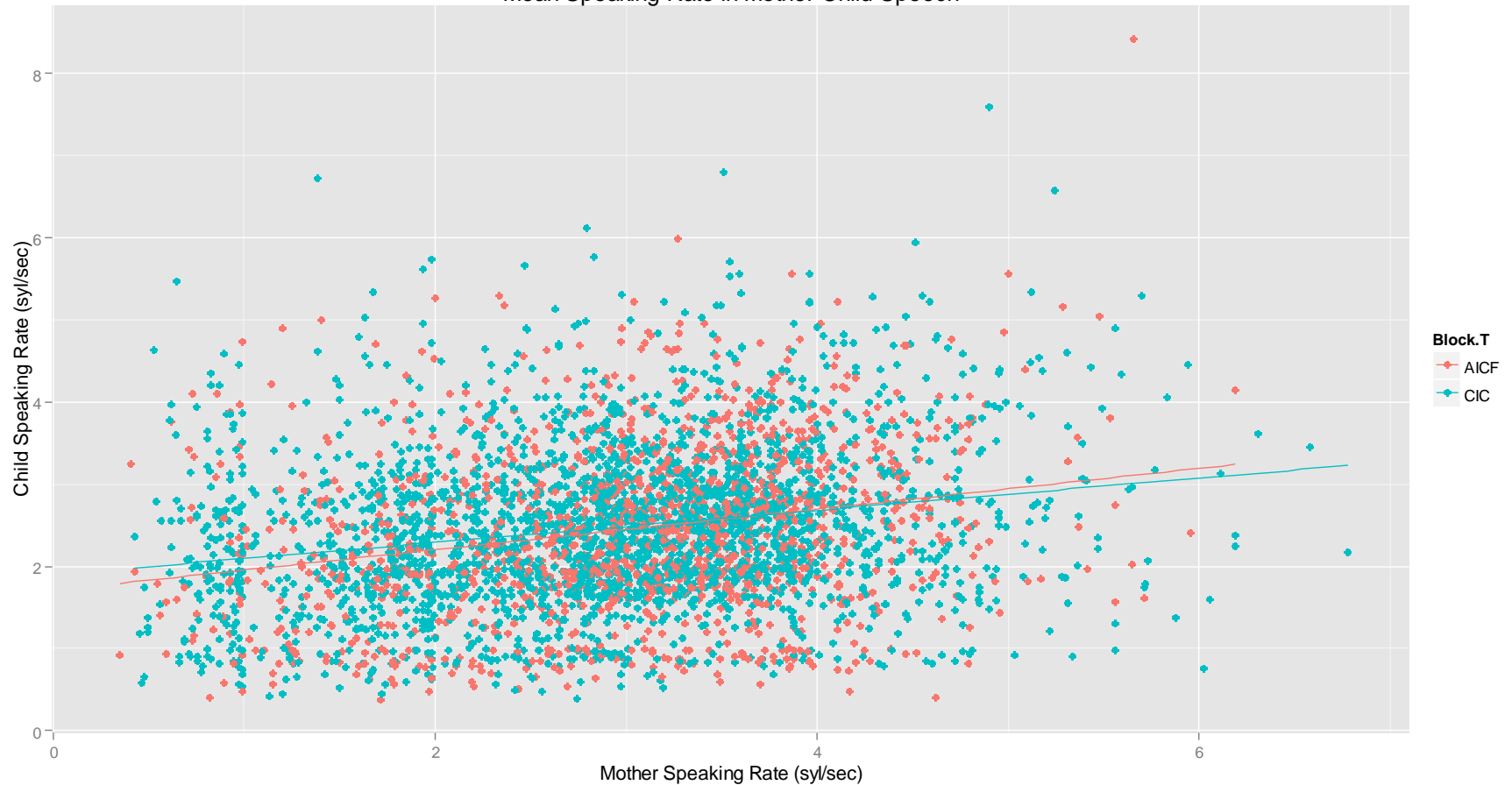
9



Correlated Mean Speaking Rate

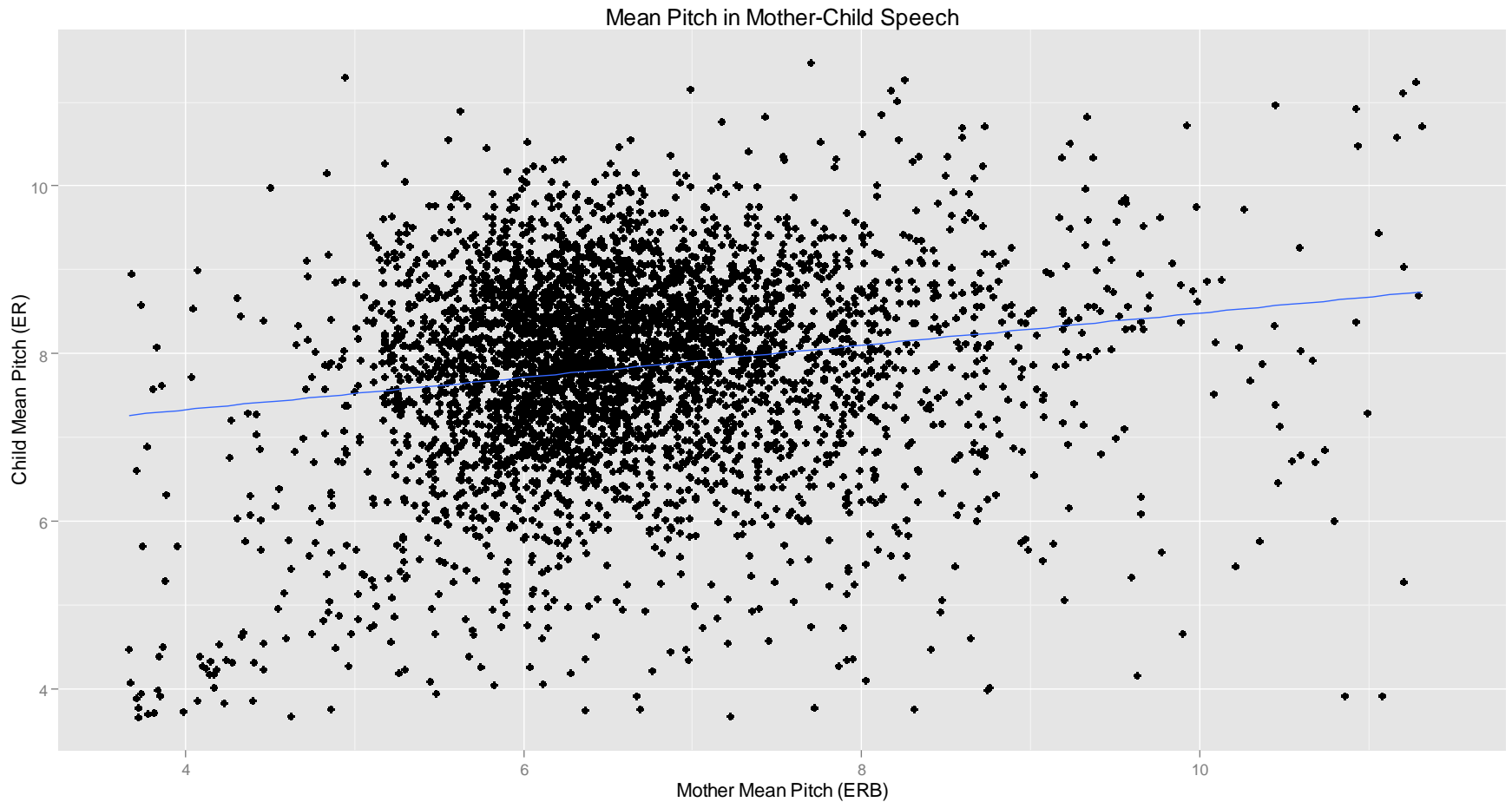
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Mean Speaking Rate in Mother-Child Speech



Correlated Mean Pitch

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Initiator effects in duration and rate

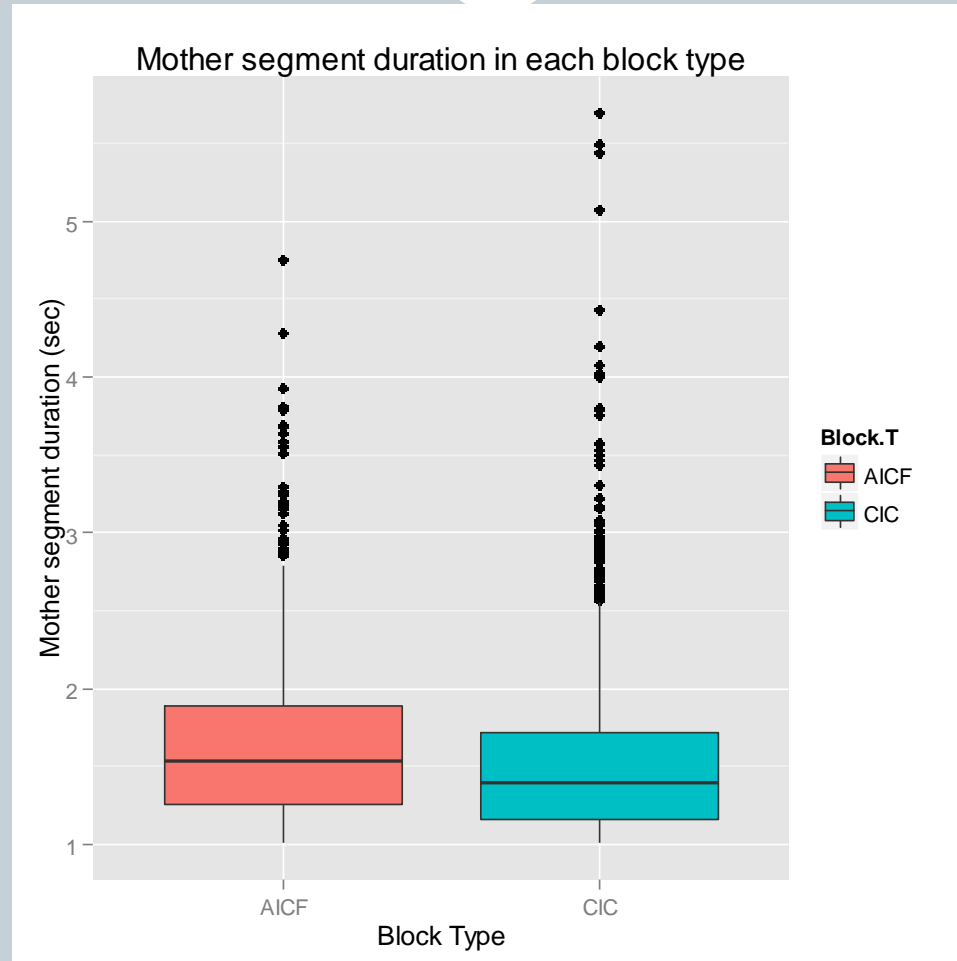
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- Logistic Regression
 - Can the Block Type (AICF, CIC) be predicted by any factors?
- Best model predicts Block Type by the following factors
 - FAN duration ($p < 0.001$)
 - FAN Speaking Rate ($p < 0.005$)
 - CHN Speaking Rate ($p = 0.06$)

*$lmer(Block.T \sim FAN.dur + rFAN.rate + CHN.rate$
 $(1|CHI) + (1|Age), data=data2.block,$
 $family=binomial)$*

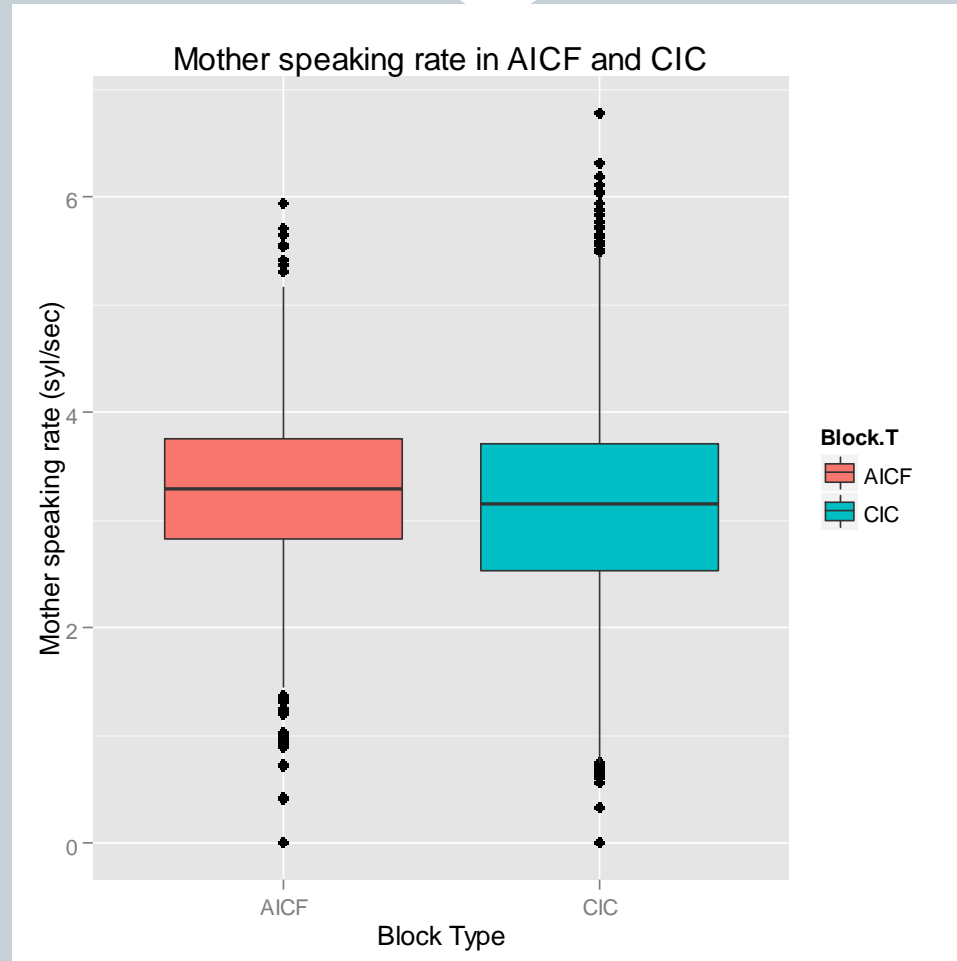
Longer FAN duration in AICF blocks

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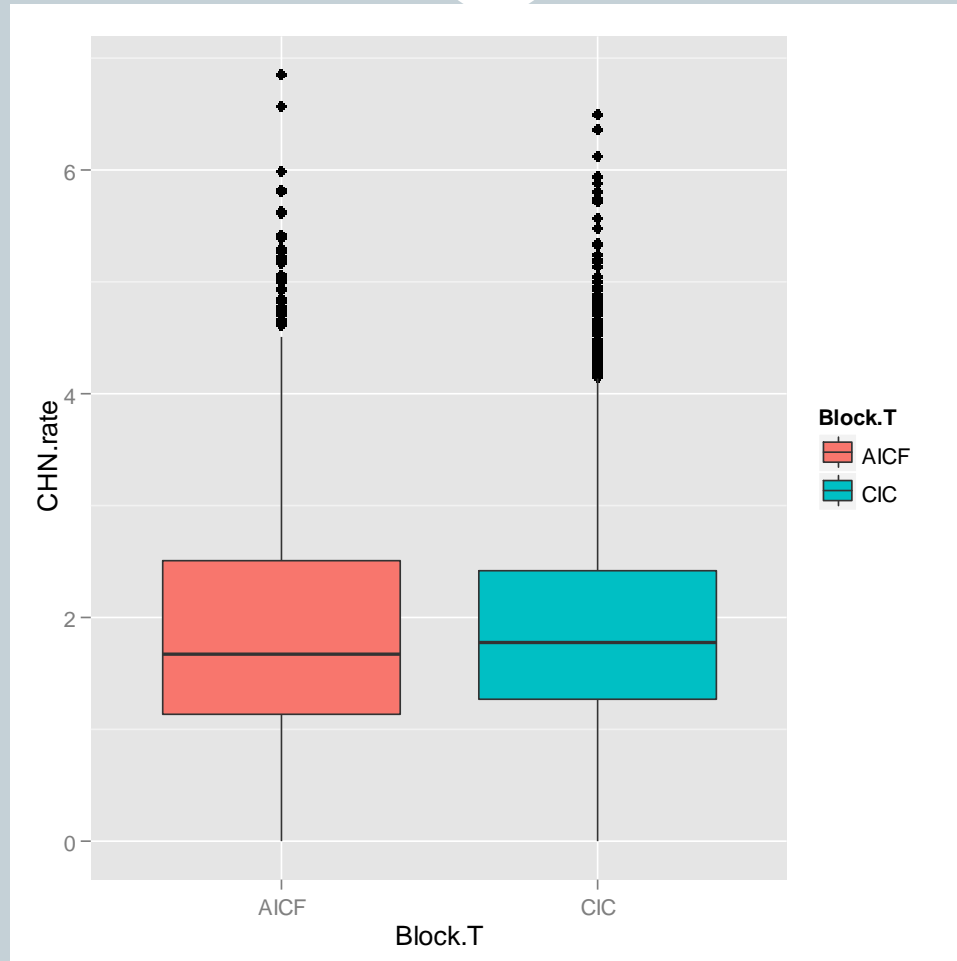
Faster FAN speaking rate in AICF blocks

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Faster CHN Speaking Rate in CIC blocks

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Summary

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- **Process**
 - Relatively smooth interface between ADEX, Praat and R
 - Min length constraints/segment assignment process creates anomalies in data – need a better solution
- **Findings**
 - Evidence for mother-infant acoustic convergence
 - Mother duration/speaking rate effects predict whether block is mother- or infant-initiated
 - Infants speak faster in infant-initiated blocks
- **Implications: Evidence of feedback effects, crucial for language learning**

Future Directions

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- Refine data set
 - Only one-on-one interactions
 - Exclude non-linguistic vocalization
 - Better solution for small durations
- Examine Father-infant convergence
- Within-block convergence
 - Contingent analysis
 - Who is leading whom?
- ASD: lack of convergence a predictor?

Acknowledgments

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