

# Prosody of children with mild to severe to hearing loss.

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Outcomes of Children with Hearing Loss  
a study of children ages birth to six



THE UNIVERSITY  
of NORTH CAROLINA  
at CHAPEL HILL



NIDCD

National Institute on Deafness and Other Communication Disorders



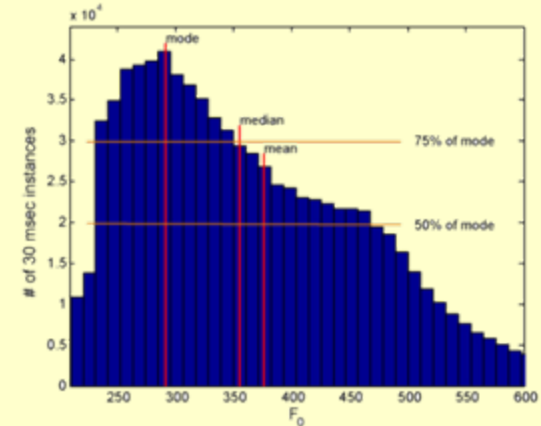
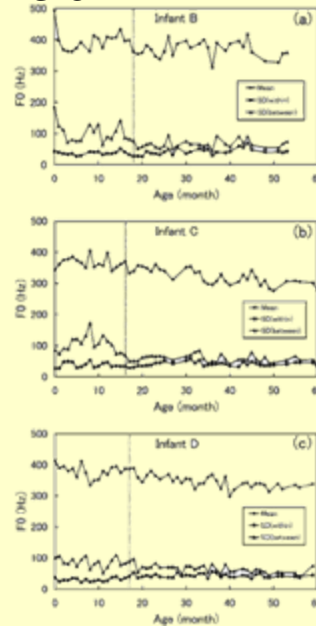
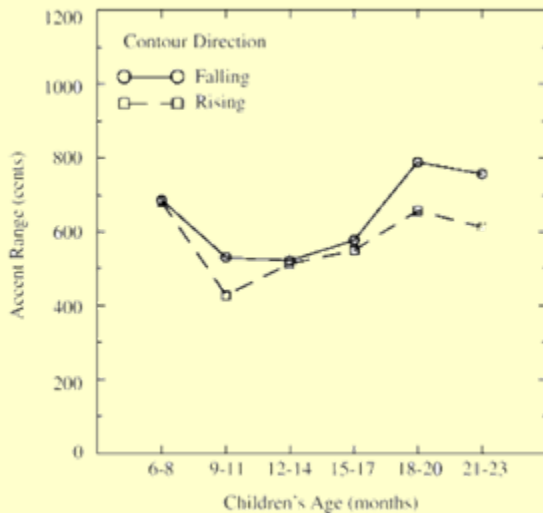
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# 0. Previous studies have found young children's $f_0$ :

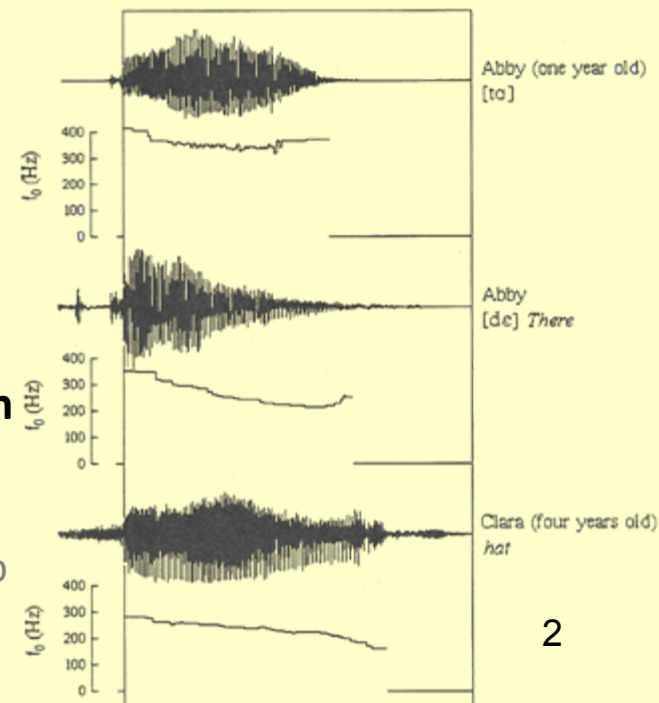
1. is higher in natural environments compared with elicited speech—maybe because kids are mimicking the lower pitch of examiners (Hunter 2008; Baker et al 2008)

2. may not be well-captured by the mean or average (Hunter 2008).

3. shows complex development during preschool years (Snow 2006, 2002; D'Odorico & Franco 1991; Loeb & Allen 1993; Amano et al 2006).



4. may be used more often for falling contours, compared with rising or level contours (Kent & Murray 1982; Robb, Saxman, & Grant 1989; Loeb & Allen 1993; Snow 1998, 2002, 2006).



# 0. Previous studies, $f_0$ in children with hearing loss: M. VanDam

1. Hearing loss may influence  $f_0$  in infants (Nathani-Iyer & Oller 2008) and older children (Ryalls & LaRouche 1992; McCleary, et al 2007), increasing overall  $f_0$  and variability.

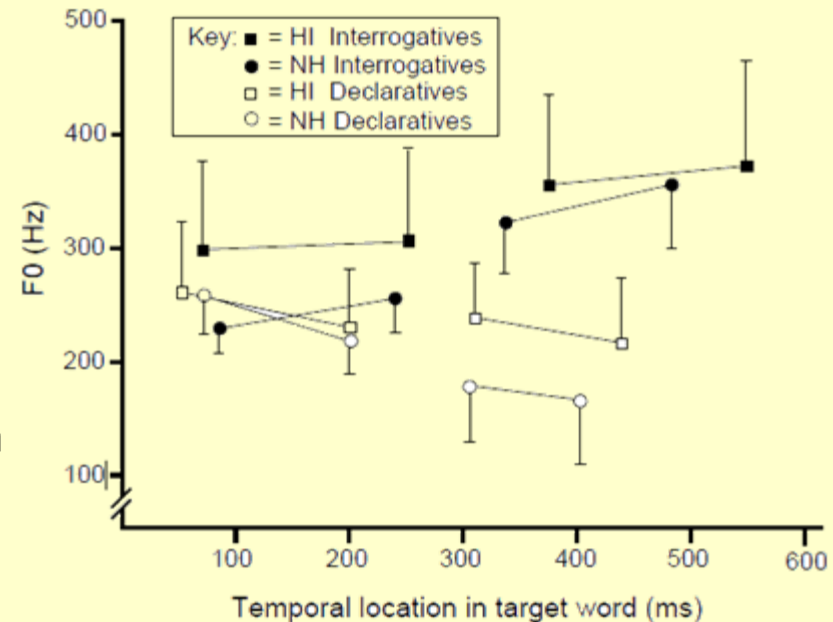
## 2. But there are issues:

A. Age-of-ID and intervention has been dramatically reduced in the last 30 yrs (Harrison, Roush, & Wallace 2003; Moeller, et al 2007).

Earlier work reflects a different population (eg, Hudgins & Numbers 1942; Angelocci 1962; Nickerson 1975; Monsen 1978; Kent et al 1987).

B. Studies use different methods.

C. Studies have contradictory results/implications.



3. What is the  $f_0$  distribution in young children with HL in natural environments?

# **1. Research questions:**

- 1. In natural speech, what is the distribution of  $f_0$  in children with HL?**
- 2. Do young children with HL use a variety of  $f_0$  contours? If so, which ones are used more often than others?**
- 3. Can new technology/methodology be used more widely (or cleverly) to ask new questions, or to give new answers to old questions?**

## 2. Method, data collection

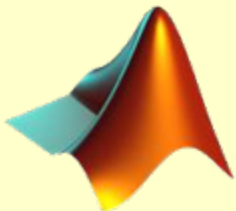
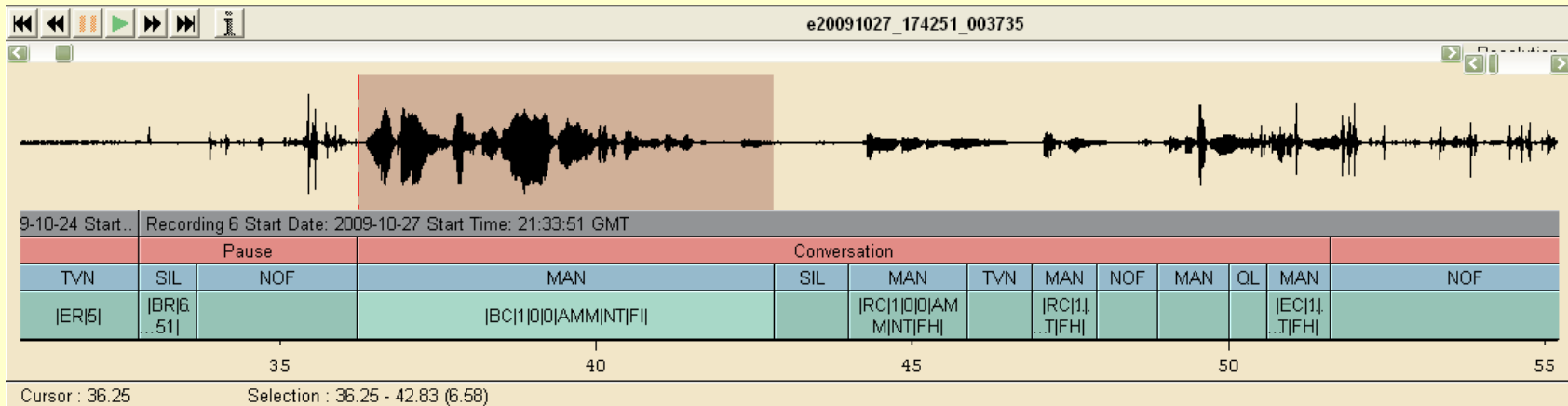
**LENA** (Language **EN**vironment **A**nalysis)

16 hr passive recording; wearable

Output: (1) wave file (16-bit, 16k, PCM)

(2) time-aligned talker-ID code

eg., *SILENCE, KEY-CHILD, ADULT-OTHER-CHILD, FEMALE-&-OTHER-CHILD, etc.*

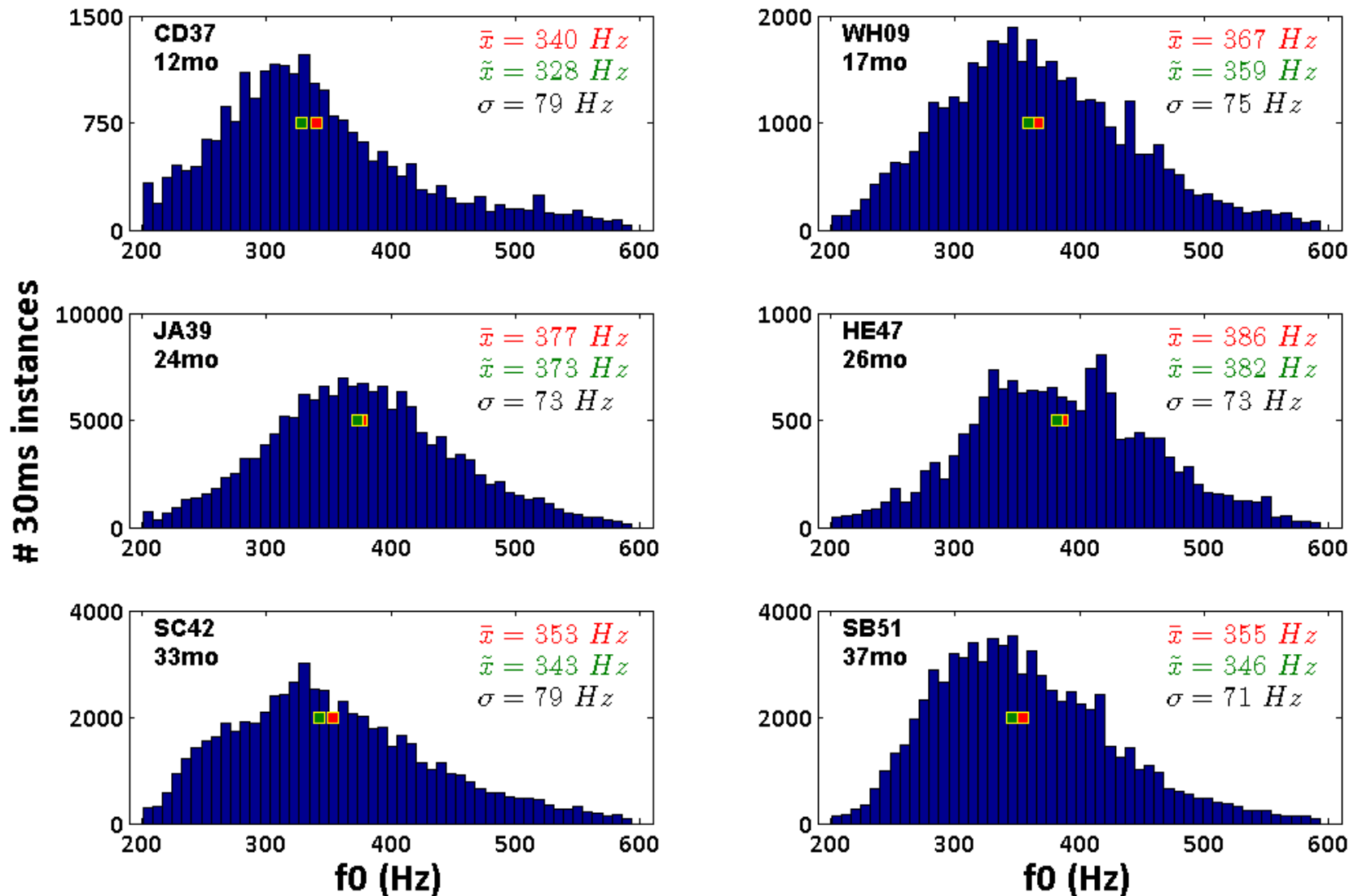


## 2. Method, participants

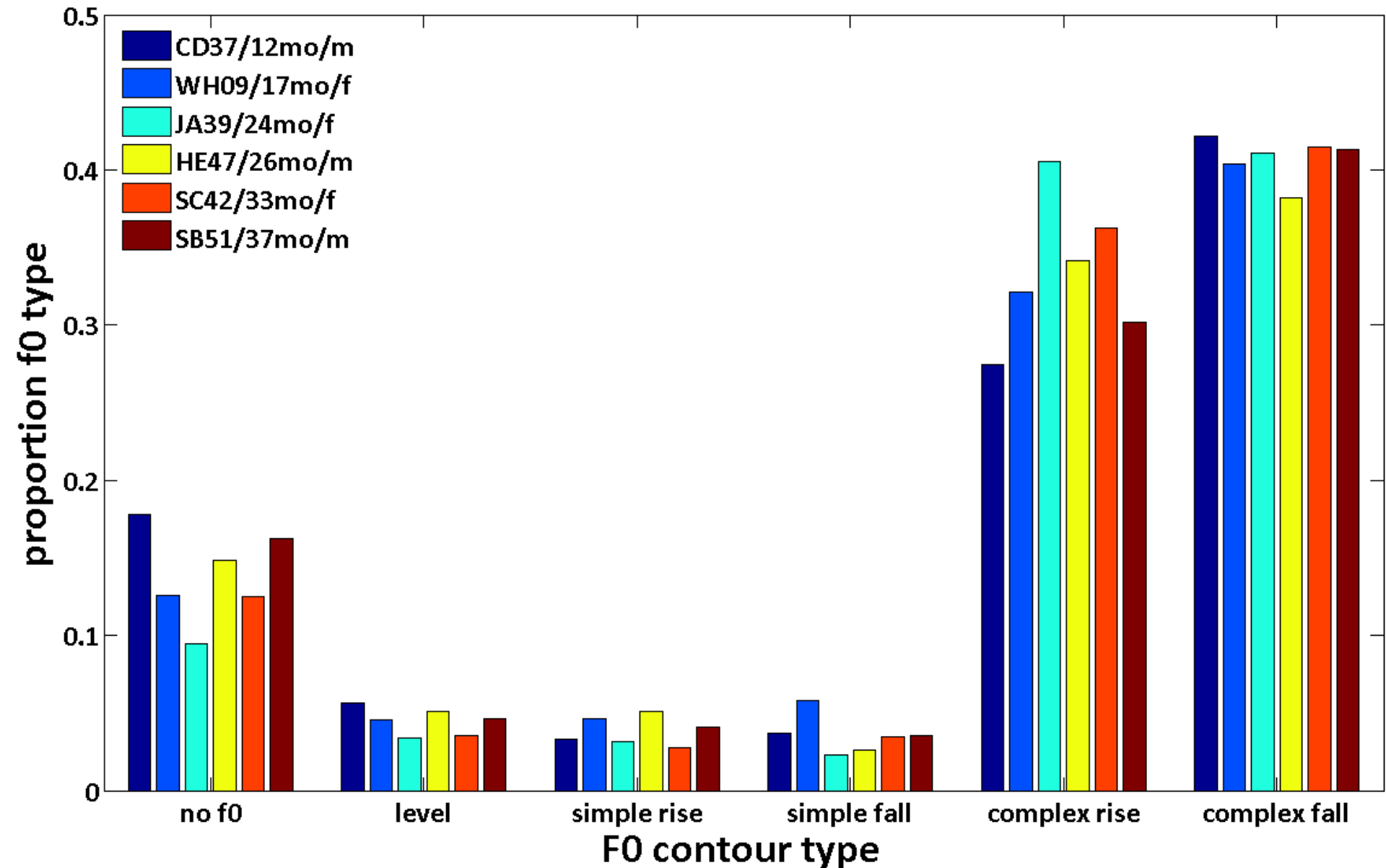
All children in this study have mild to severe hearing loss

child	age (mos)	sex	HL PTA (db)	age ID HL	record time
<b>CD37</b>	<b>12</b>	♂	<b>(cnt)</b>	<b>0</b>	<b>10h 46m</b>
<b>WH09</b>	<b>16</b>	♀	<b>68</b>	<b>0</b>	<b>11h 59m</b>
<b>JA39</b>	<b>24</b>	♀	<b>(abr)</b>	<b>&lt;20</b>	<b>13h 43m</b>
<b>HE47</b>	<b>26</b>	♂	<b>50</b>	<b>0</b>	<b>8h 58m</b>
<b>SC42</b>	<b>33</b>	♀	<b>35</b>	<b>18</b>	<b>12h 36m</b>
<b>SB51</b>	<b>37</b>	♂	<b>47</b>	<b>0</b>	<b>12h 07m</b>

### 3. Results: Distribution of $f_0$ in child utterances



### 3. Results: Distribution of $f_0$ contour types in child utterances





## 4. Conclusions

1. New methods of whole-day recording are possible and may reveal unexpected patterns in speech production of children.
2.  $F_0$  in children with HL is (a) highly variable and (b) not normally distributed, right skewed.
3. Children with HL make heavy use of complex  $f_0$  contours—possibly producing more complex-falling contours than other types.

### 4. Results for phonology:

- child directed speech
- prosodic identification
- lexical use & linguistic memory
- acquisition in special populations

### 5. Future work:

- duration of utterances
- range & variance of  $f_0$
- developmental changes
- longitudinal observations
- turn-taking
- environmental acoustic effects
- populations with HL
- methodological improvements