

Acquisition of intonation (Introduction)

CN MSc course 'Language Acquisition', 2011

Instructor: Aoju Chen

babbling **one-word stage** **two-word stage**



Intonation of (young) children

Lecture 1
(1 March)

Intonation and emotion & illocutionary force

Lecture 2
(3 March)

Annotate and interpret children's intonation

Practicum ≠ Praat
(17 March)

Intonation and information structure

Lectures 3 & 4
(15, 22 March)

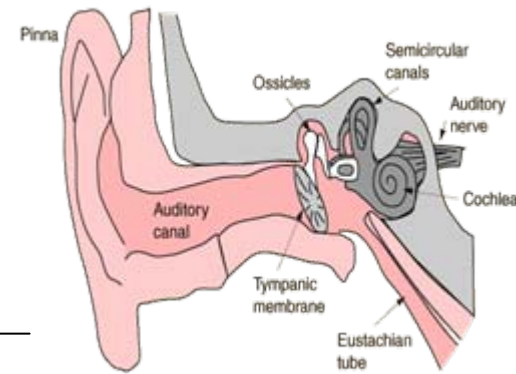
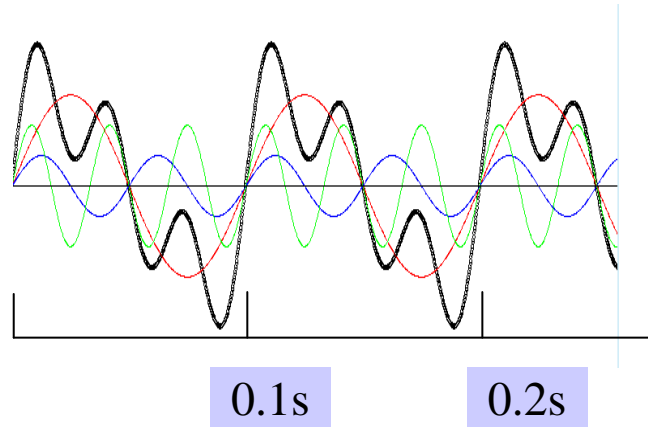
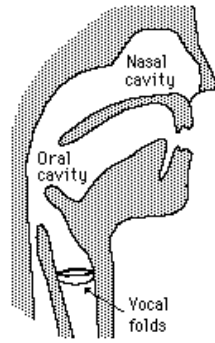
Course assignment

- A review article on a topic on acquisition of intonation that has not been discussed in the class
 - review at least 3 papers (more is welcome)
 - list relevant papers that cannot be included in the review in an appendix
 - Provide the state of art on the topic under review
 - Give your opinions on the drawbacks in the specific line of research
 - Speculate on research topics for further research
- Single-spaced, font 12, doc file
- Finishing date: 15 May 2011

pitch

fundamental frequency
(f_0)

Hertz (Hz)



■ Vocal sound production

- Vibratory activity in the vocal tract creates waves of variation in air pressure around us
- The air pressure variations are transmitted to the ear through the air

■ The pattern of air pressure variations is composed of sine waves with different frequencies

- Frequency (Hz) = $1/T$ (T is the time in seconds needed for a complete cycle/period)
- Fundamental frequency (f_0): the frequency of the repetition of the whole complex wave

pitch

fundamental frequency
(f_0)

Hertz (Hz)

- F0 is determined by how fast the vocal folds open and close (or vibrate).
- Sounds involving no vocal fold vibration in production do not have f_0 (e.g. voiceless consonants)
 - Discontinuity in f_0 track
 - The preference for words with only sonorants in production studies focusing on f_0

pitch

fundamental frequency

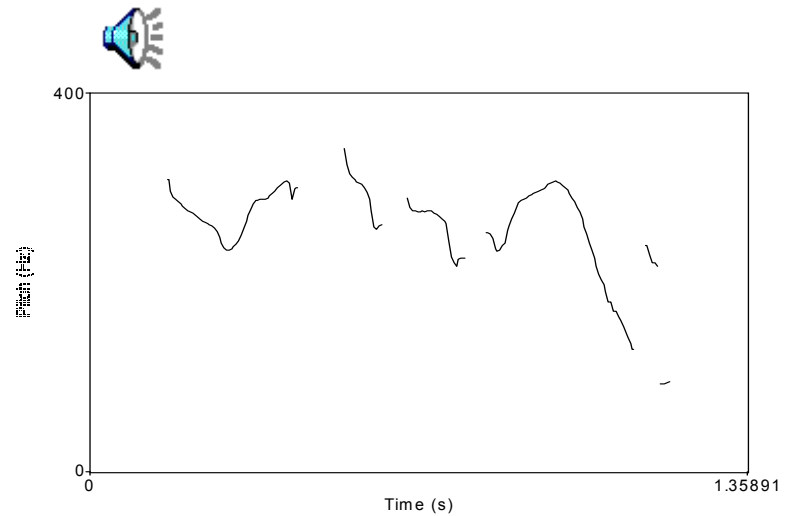
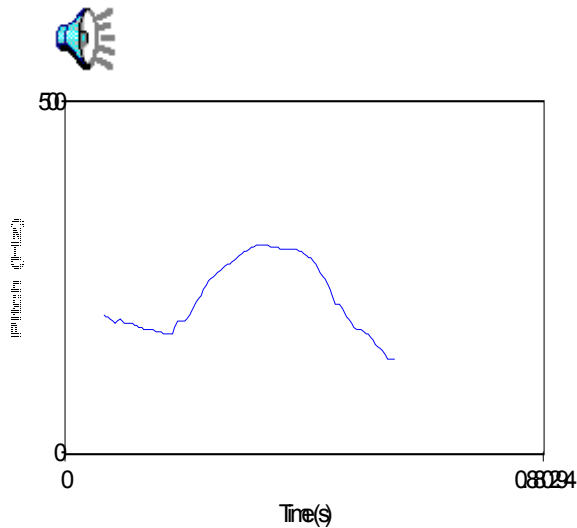
(f_0)

Hertz (Hz)

- The perceived pitch depends directly on the f_0
- Linearity of f_0 vs. non-linearity of pitch
- Accurately representing differences in pitch
 - Psychoacoustic scales: providing steps corresponding to equal perceptual intervals
 - The musical semitone scale: a logarithmic transformation of the Hz scale
 - The mel scale: linear below 500 Hz but logarithmic above
 - The ERB (equivalent rectangular bandwidth)-rate scale
 - <http://users.utu.fi/jyrtuoma/speech/>
 - Available in the pitch settings in Praat

Visual display of f0 Contours

- **Praat** (Boersma & Weenink 2010)
 - <http://www.fon.hum.uva.nl/praat/>



Lecture 1

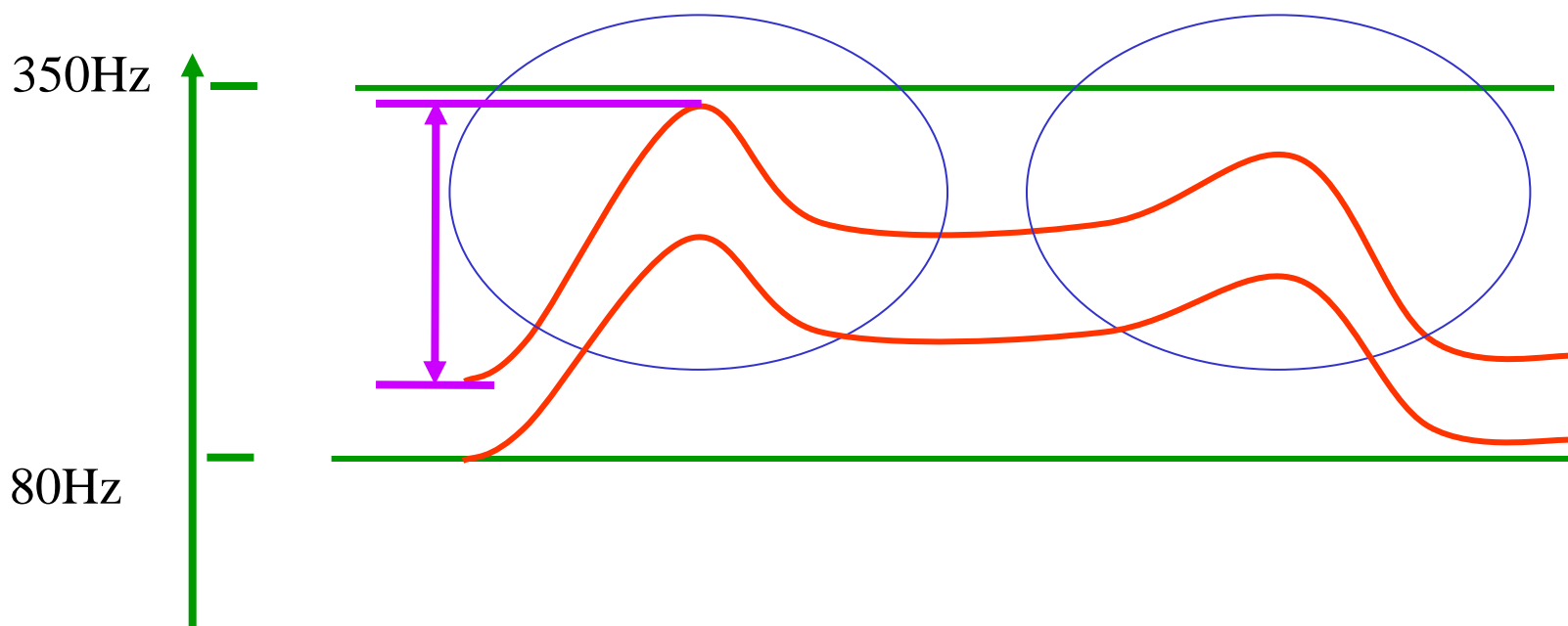
Acquisition of the formal properties of intonation



Language Acquisition, 1 March, 2011

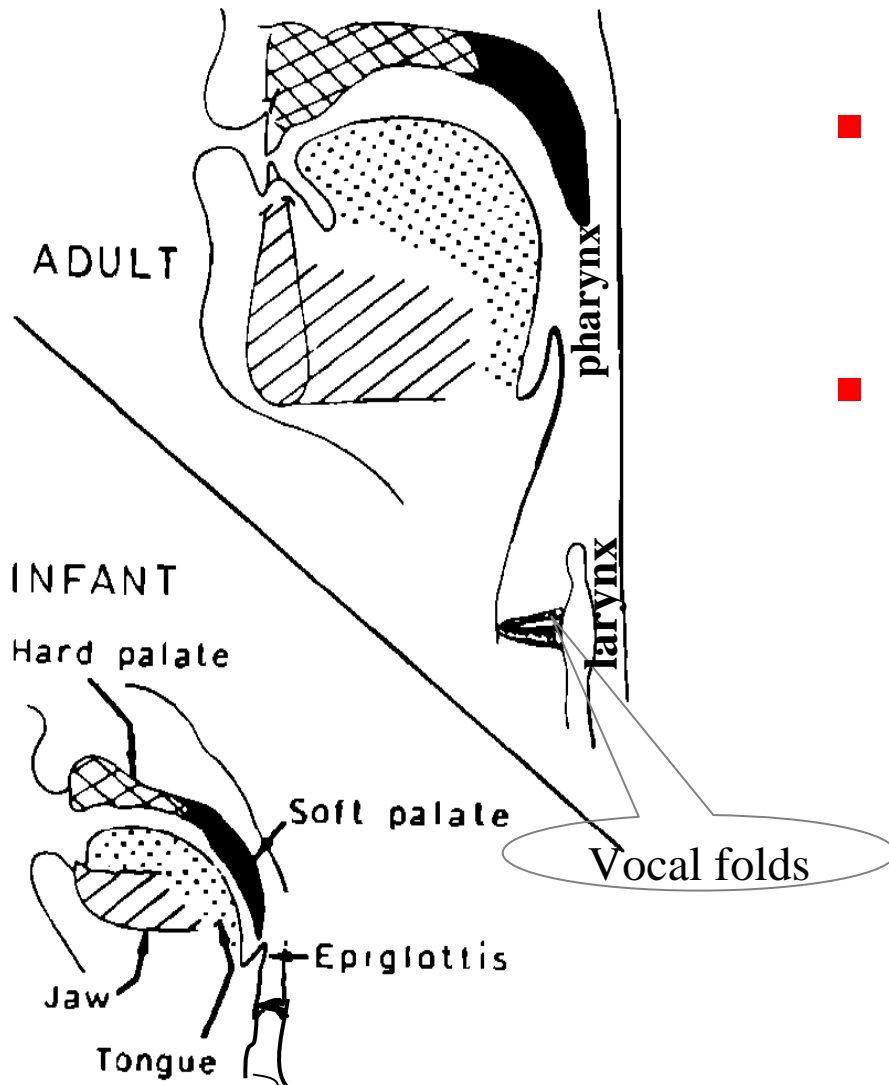
Instructor: Aoju Chen

Formal properties of intonation



- Overall shape
 - Pitch range
 - Span (or key)
 - Level (or register)
 - Structural components
- } a cross-linguistic perspective

Pitch range (1)



- Anatomical factors
 - a rather short vocal tract
 - thin vocal folds
- High pitch in infants
 - Pitch span: 350 Hz – 500 Hz
 - Pitch register
 - 3-month olds: 445 Hz
 - 6-month olds: 450 Hz
 - 9-month olds: 415 Hz

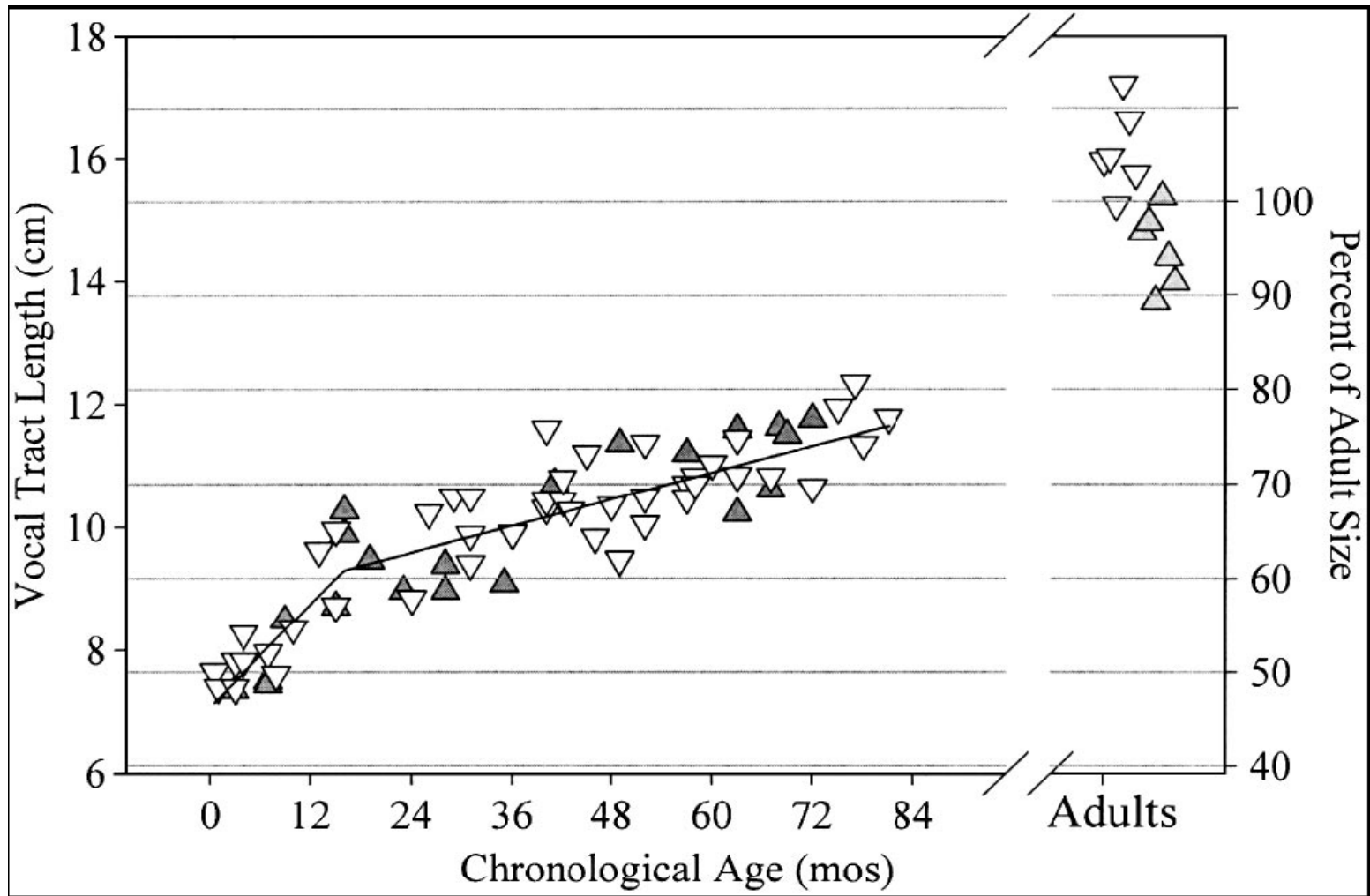


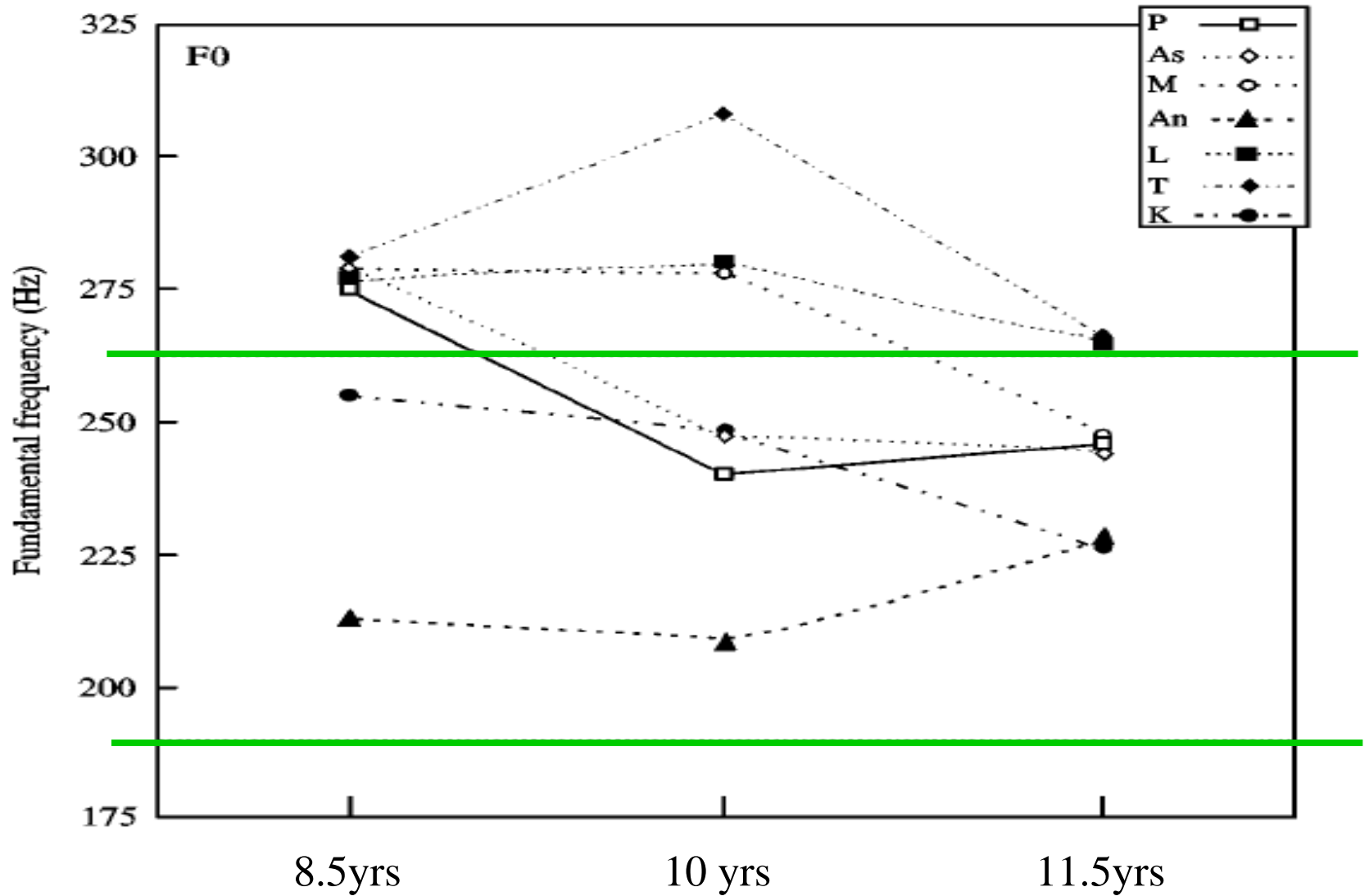
FIG. 4. Vocal tract length of the pediatric and the adult cases (open triangle down for males, and shaded triangle up for females). The second Y axis reflects the percent of adult size. Vocal tract length is defined as the curvilinear distance along the midline of the tract starting at the thyroid notch to the intersection with a line drawn tangentially to the lips.

Pitch range (2)

- Pitch register of English-speaking children
 - [Smith and Kenny \(1998\)](#)
 - 7 AmE-speaking girls
 - recorded at three different times at about 1.5 year intervals (8;5, 10, 11;5)
 - 20 successive repetitions of 'sissy' from each speaker
 - [Whiteside and Hodgson \(2000\)](#)
 - 3 boys and 3 girls in each age group (6 yrs, 8 yrs, 10yrs)
 - Picture naming in British English

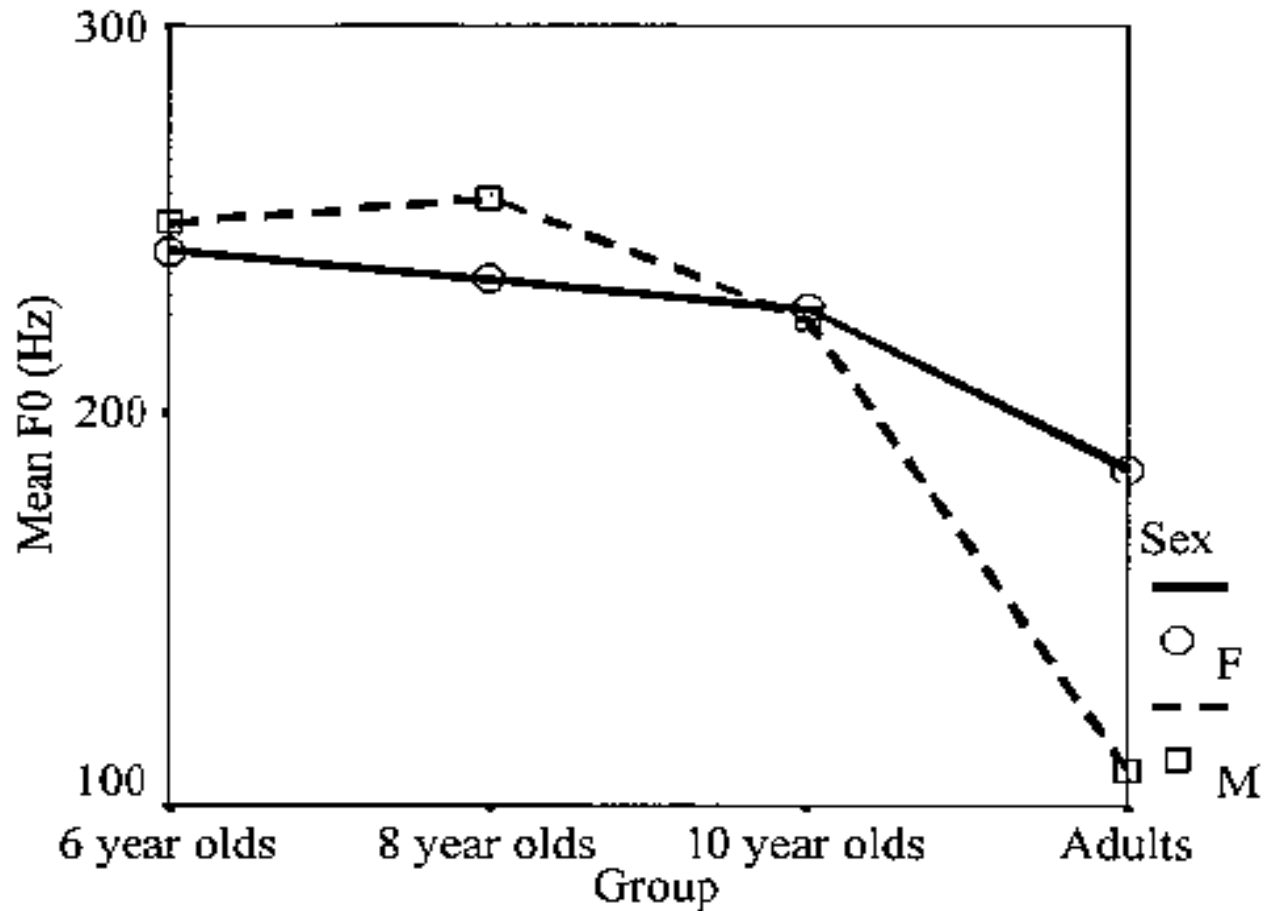


F0 at the midpoint of the stressed vowel /i/ in 'sissy'



(Smith and Kenny 1998)

Mean pitch of phrases (e.g. the green car) in English



[\(Whiteside and Hodgson 2000\)](#)

Pitch range (3)

- Properties to be acquired
 - Language-specific pitch range
 - e.g. wider standard pitch range in British English than in Dutch (de Pijper 1983, Willems 1982, de Bot 1982)
 - e.g. higher register and wider span in British female speakers than in German female speakers (Mennen et al. 2007)
 - Culturally appropriate pitch range
 - e.g. Female speakers in Japan, the US, the Netherlands (van Bezooijen 1988)
 - Gender-related uses of pitch range
 - e.g. Higher pitch register in male newsreaders but lower pitch register in female newsreaders to sound authoritative in British English (van Leeuwen 1999)

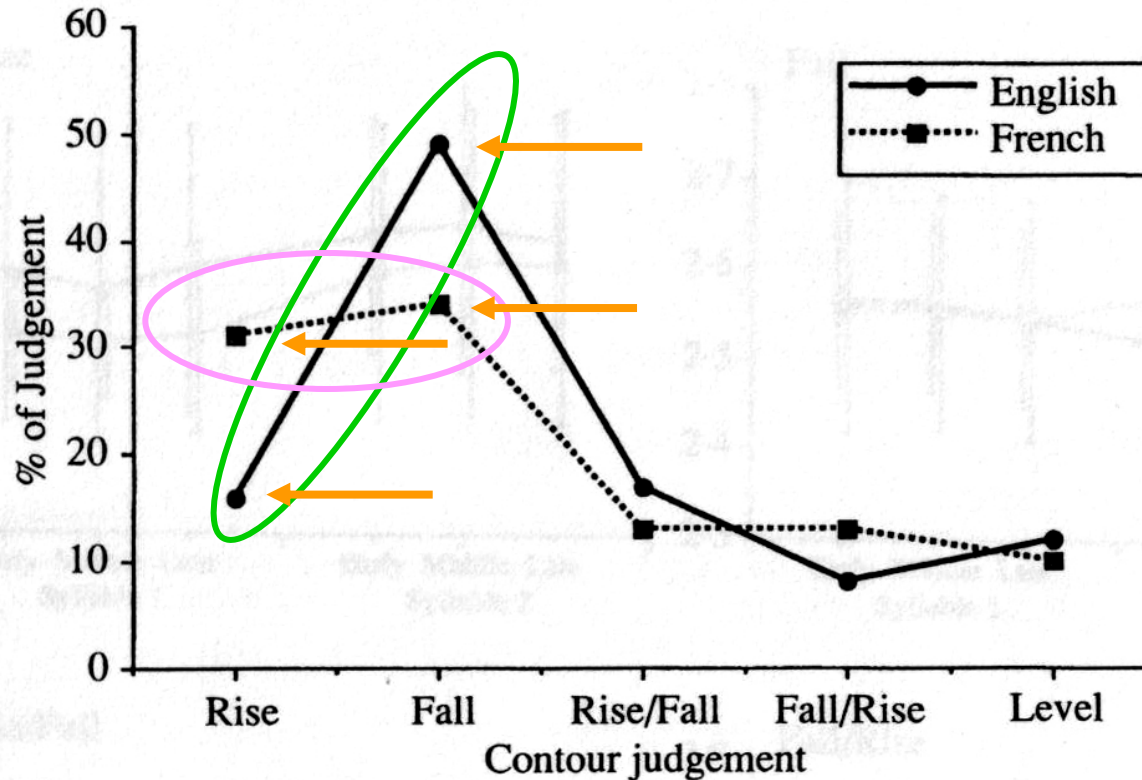
Intonation contours in early vocalisations

- In babbling (3~9 months) and one-word stage (10~15 months): fall-rise, flat, fall, rise-fall, rise etc.
- The myth of predominance of falling contours
 - Claim based on English-listening infants (Snow 2002)
 - Physiologically-motivated account: the breath-group theory (Lieberman 1967)
 - Unravel the myth
 - Task-induced effects
 - Effects of language-specific distribution of contour types

Intonation contours in early vocalisations -2

- Whalen, Levitt & Wang (1991)
 - 5 French-acquiring infants & 5 Am. English-acquiring infants (0;5-1;1)
 - Two- to three-syllable reduplicative babbles (e.g., 'baba') selected from recordings (10-20 minutes) made at weekly intervals at home
 - 80 babbles by French infants
 - 76 babbles by English infants
 - Categorization of infants' production by four adults, supported by measurements of f_0 in early, middle and late portion of each syllable

CHILD LANGUAGE

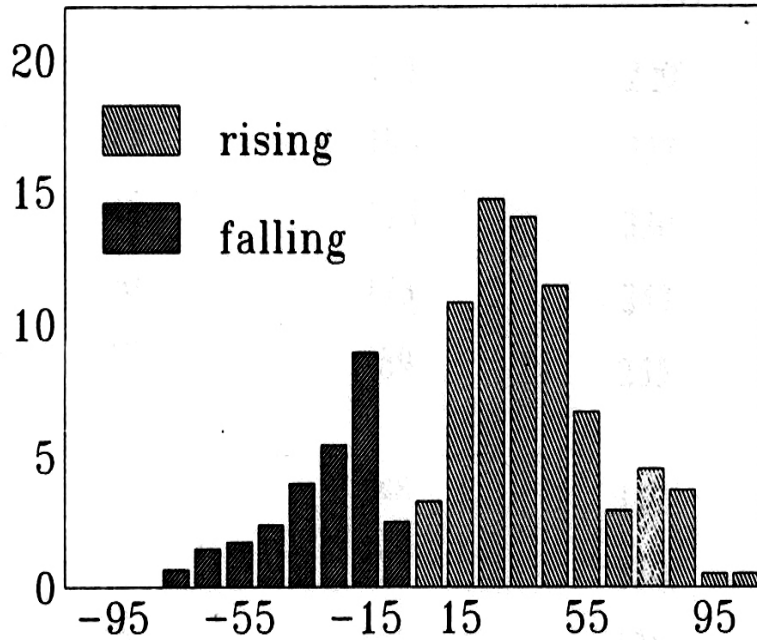


- Intonation of French and Am. English (Delattre 1961)
 - The American female speaker produced more falls (90%) but the French female speaker produced more rises (87%)

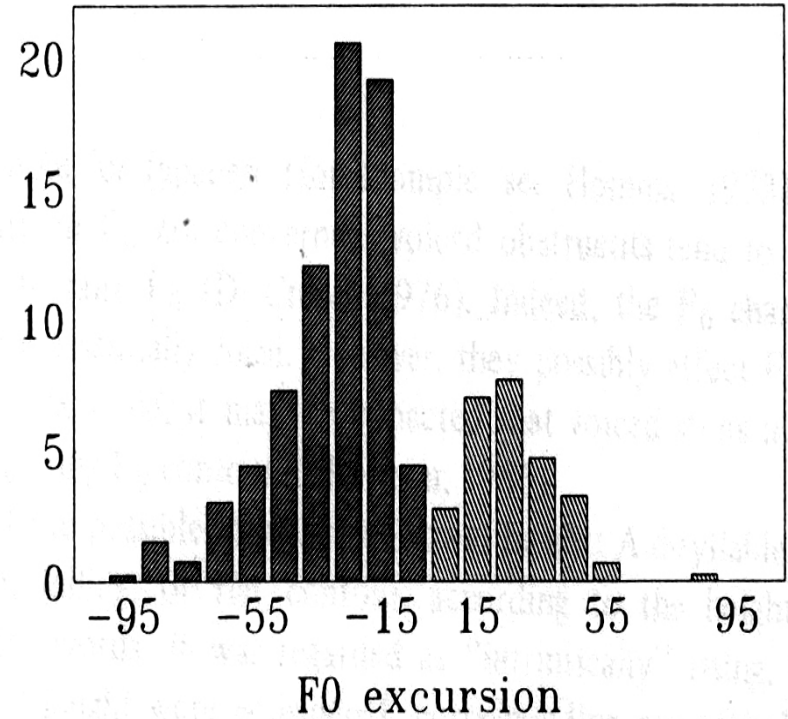
Intonation contours in early vocalisations -3

- Hallé, de Boysson-Bardies & Vihman (1991)
 - 4 French infants & 4 Japanese infants (1;6)
 - Disyllabic vocalisations (both babbling and words) in the bi-weekly 30-minute recording sessions
 - 497 by French infants (43%)
 - 458 by Japanese infants (45%)
 - Language-specificity in intonation of French vs. Japanese at utterance final position
 - The rising continuation contour in French
 - The flat or falling continuation contour in Japanese

(a) French



(b) Japanese



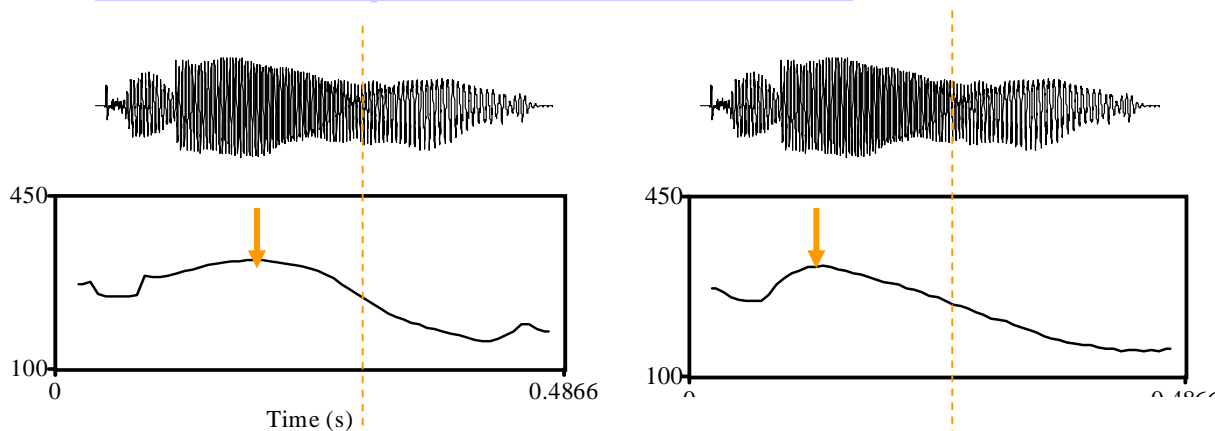
Hallé, de Boysson-Bardies and Vihman (1991)

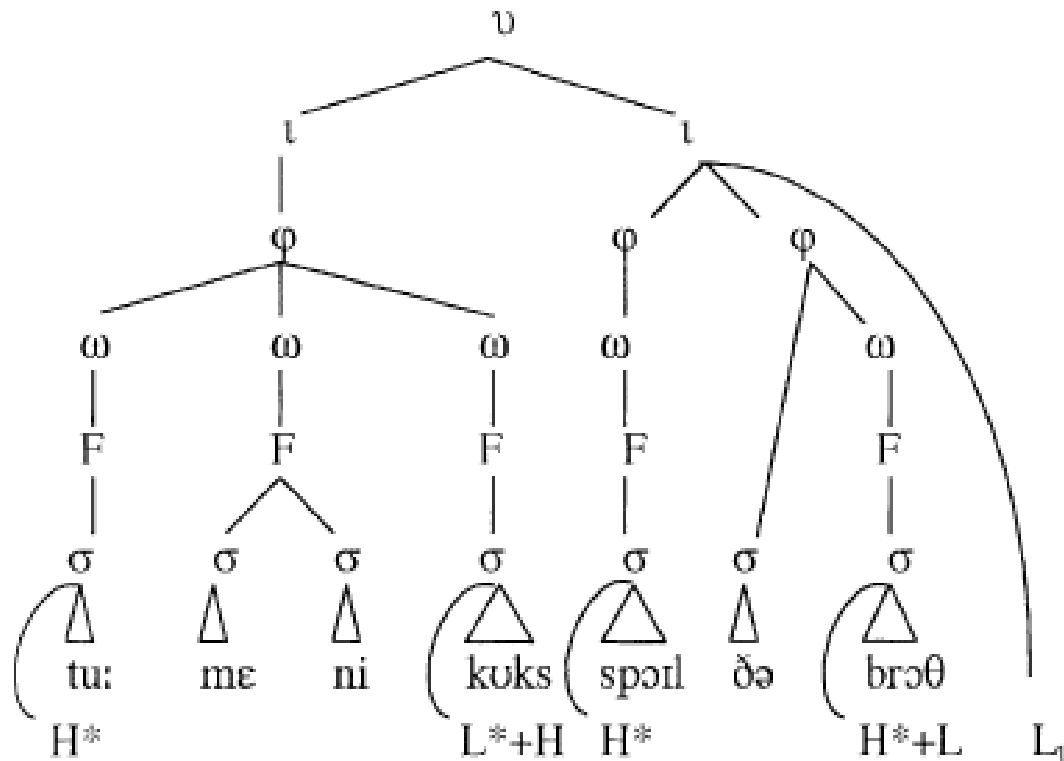
Intonation contours in early vocalisations - 3

- Distribution of contour types in different contexts in AD
- Adult-direct speech vs. infant-directed speech
 - Distributions of different contours in AD and ID
 - More attentive to ID than AD?
 - More exposed to AD than ID?

Structural properties of intonation in meaningful speech (1)

- The Autosegmental-metrical framework (Pierrehumbert 1980, Ladd 1996)
 - Pitch accents, boundaries tones (tonal events)
 - Pitch range of pitch accent (scaling)
 - Locus of highest and lowest pitch in the segments (alignment)
 - Intonational integration between words (phrasing)
- Transcription notations





Utterance

Intonational Phrase

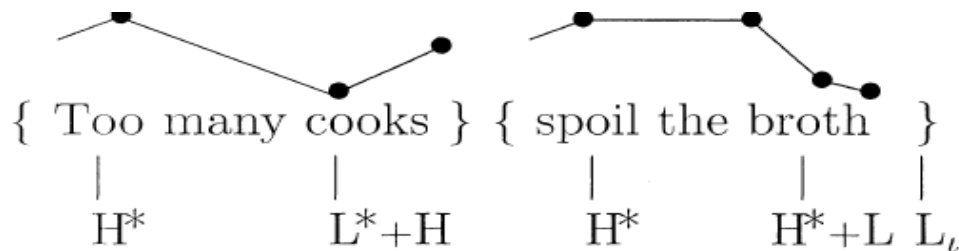
Phonological Phrase

Phonological Word

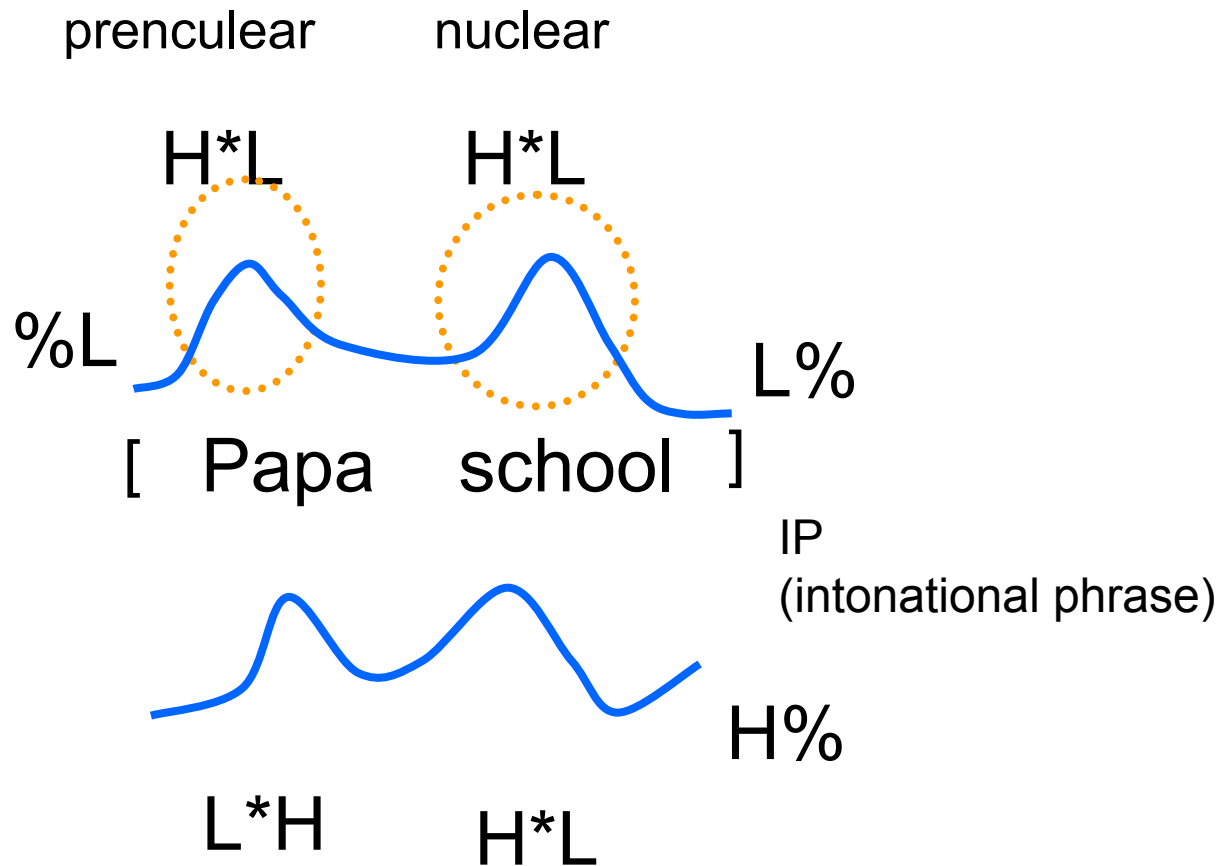
Foot

Syllable

segmental structure
tonal structure



Transcription of Dutch Intonation (ToDI)



Structural properties (2)

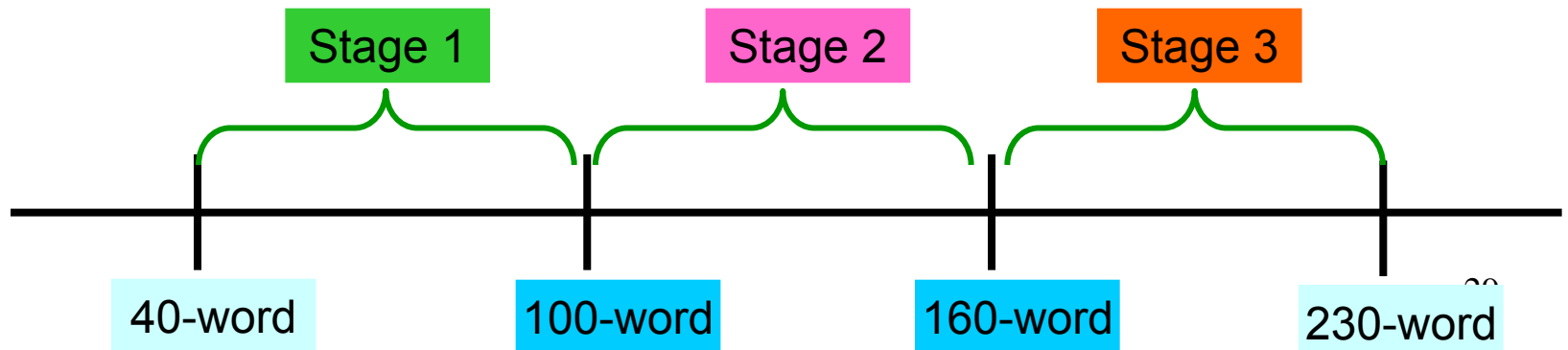
- In the one-word (10-15 mo) and two-word (16 ~ 25 mo) stage
 - Dutch (Chen & Fikkert 2007)
 - Catalan (Prieto & Vanrell 2007)
 - Portuguese (Frota & Virgrao 2008)

Structural properties (3)

- Longitudinal data from 3 monolingual Dutch children aged 1;4 ~ 2;1 (from the CLPF database)
 - Eva (1;4 – 1;7)
 - Jarmo (1;8 – 2;1)
 - Robin (1;7 – 1;10)
- Recorded during natural play sessions at home every other week for one year
 - Each session: 30 – 45 minutes
 - Interlocutors: one parent and/or one experimenter
 - Typical activities: reading picture books & playing with toys

Structural properties (4)

- Two-word utterances produced from the point of 40 unique recorded words to the point of 230 unique words (N=325)
- Developmental stages
 - Two-word utterances expressing a semantic relation frequent at the 100-word point in Italian (D' Odorico & Carubbi 2003)
 - A substantial increase of the production of two-word utterances at the 160-word point in our data



Structural properties (5)

- Classification of utterance types
 - Syntactic categories of the words (e.g. noun, verb)
 - word order (e.g. noun + verb vs. verb + noun)
 - 3 most frequent types of utterances
 - Noun + Verb (N=48): *banaan eten* 'banana eat'
 - Particle + Verb (N=32): *dicht doen* 'close do'
 - Noun + Noun (N=23): *eendje water* 'duck water'
- N = 103

Structural properties (6)

initial
boundary tone

%L

%H

pre-nuclear

H*

!H*

H*L

!H*L

L*!HL

L*H

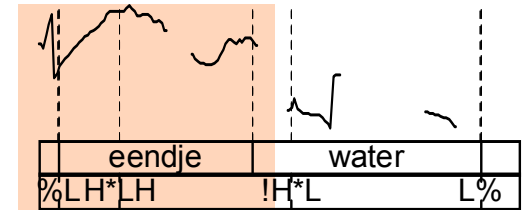
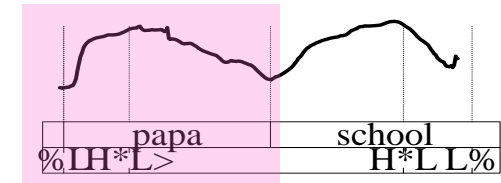
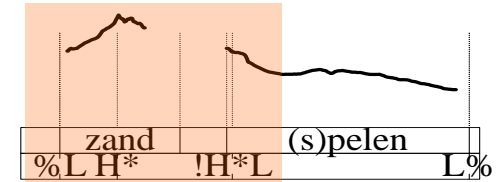
L*

H*LH

H*!H



H*L>



(Non-adultlike)

Structural properties (7)

nuclear

→ H*

!H*

(Non-adultlike)

→ H*L



H*L



→ !H*L



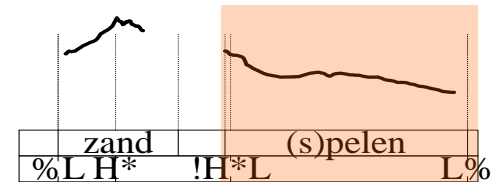
L*HL

L*!HL

L*

→ L*H

H*!H



Structural properties (8)

<u>initial</u> <u>boundary tone</u>	<u>pre-nuclear</u>	<u>nuclear</u>	<u>final</u> <u>boundary tone</u>
	H*	H*	
%L	H*L	<i>!H*</i>	L%
%H	H*LH	H*L	H%
	L*H	<i>!H*L</i>	(%)
	<i>H*!H</i>	L*	
		L*H	
		H*!H	

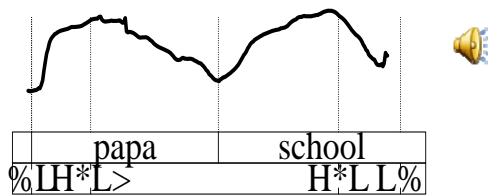
Figure 1. Overview of pitch accents and boundary tones in Dutch two-word utterances. Accents in bold appeared first in stage 3; accents in italics are not used in adult Dutch.

Structural properties (9)

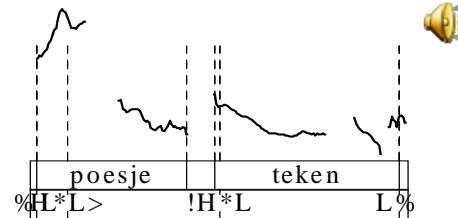
- Intonational integration
 - Increase in tunes with !H*L
 - Stronger dependence between accents
 - Increase in tunes starting with H*
 - Smoother transition to !H*L and H*L

Stage
2

H*L H*L (L%)

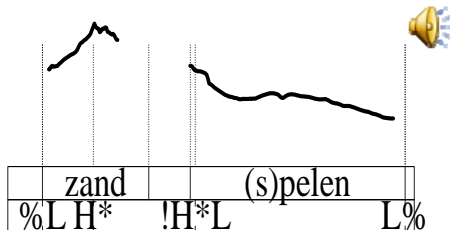


H*L !H*L (L%)

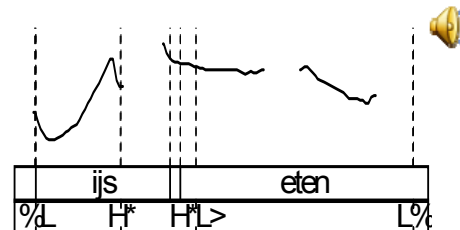


Stage
3

H* !H*L (L%)

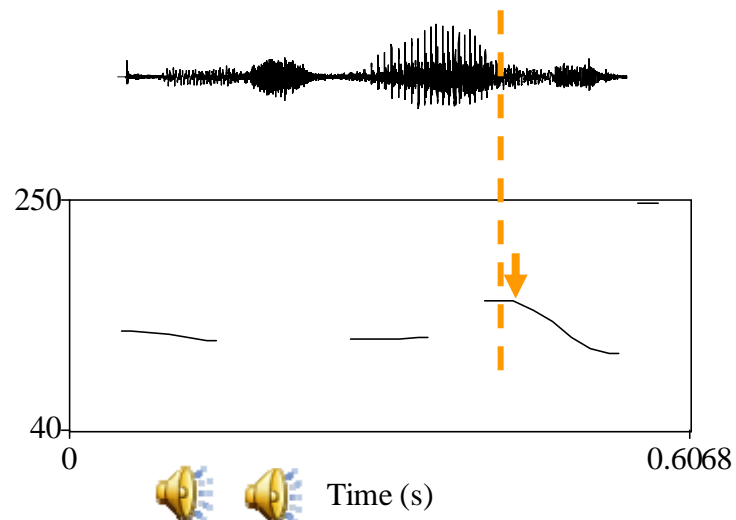
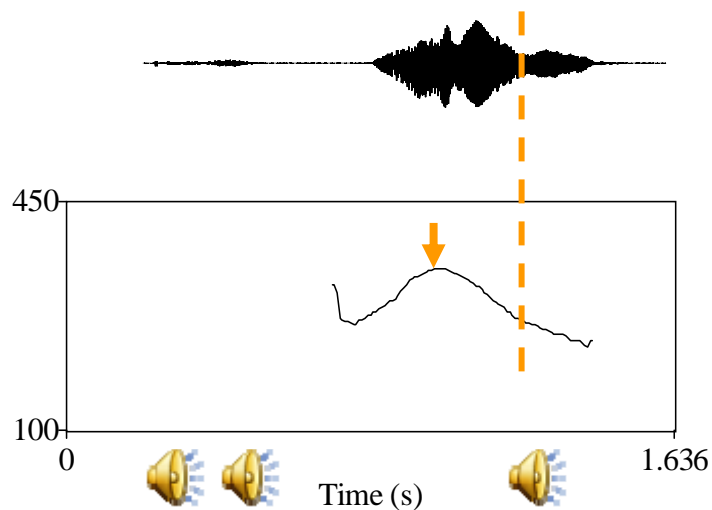


H* H*L (L%)



Structural properties (10)

- Alignment
 - Preclear H*L: the fall most frequently starts after the stressed syllable, as in adults, already at stage 2
 - Nuclear H*L: earlier fall in children than in adults even at stage 3
 - e.g. (poes) huilen
- Pitch range: roughly twice as wide as in adults at stage 3



Structural properties (11)

- **Portuguese** (Frota & Vigario 2008)
 - A case study of a girl
 - 443 one-word and two-word utterances (1;00-1;11, 2;02)
 - Main findings
 - At 1;09 (40 unique words): adult-like inventory of (nuclear) pitch accents and boundary tones
 - Alignment of H tone
 - In H*L: adult-like at 1;02
 - In HL*: adult-like at 1;09
 - Scaling: adult-like at around 1;06
 - Intonational integration: one accent per syllable until 1;04 when beginning to produce disyllabic words)

Structural properties (12)

- Catalan (Prieto et al. 2008)
 - Four children (1;1 ~ 2;2)
 - From the beginning of the 25-word stage to the onset of the two-word stage
 - Main findings
 - Adult-like inventory of pitch accents and boundary tones before onset of two-word stage
 - Alignment: adult-like already in one-word stage
 - Pitch scaling: not adult-like at onset of two-word stage

Structural properties (13)

- Dutch, Portuguese, Catalan
 - Adult-like inventory of pitch accents and boundary tones before the onset of the two-word stage in C and P but not in D
 - Alignment: adult-like in the one-word stage in C but not quite in P and certainly not in D
 - Pitch scaling: adult-like in the onset of the two-word stage in P but not in C and D
 - Intonational development (inventory) is independent of the onset of two-word stage in C and P, not in D
 - Intonational development (alignment & scaling) is related to increase in vocabulary size in D and P but not in C
- Why these cross-linguistic differences?
 - Simpler inventory of pitch accents and boundary tones in P and C than in D
 - Differences in rhythmic properties

