Lecture 1: The Semiotics of Prosody

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http://wwwhomes.uni-bielefeld.de/gibbon/Lectures/SummerSchool2021-Gibbon/

Online Summer School on Contemporary Phonetics and Phonology, July 2021

Overview of course
Recent Developments in the Phonetics of Prosody

The approach:

Domain:

Long-term Rhythmic and melodic modulations of speech

Method:

Acoustic analysis of the long-term speech spectrum

1.

Lecture 1:

The context: Semiotics of Prosody

Lecture 2:

The facts: Rhythm and the contribution of melody

Lecture 3:

The tools: Behind the scenes – how the software works

Overview, Lecture 1: Semiotics of Prosody

Prolog:

Phonetic domains – the speech cycle

The acoustic domain, a lookahead:

Example of the selected prosody domain and method,

an experimental phonetic classification of poetry recitations

Part 1: Rank Interpretation Theory of Semiotics

Part 2: Phonetic Interpretation of Prosody: AM and FM

Part 3: Functional Interpretation of Prosody

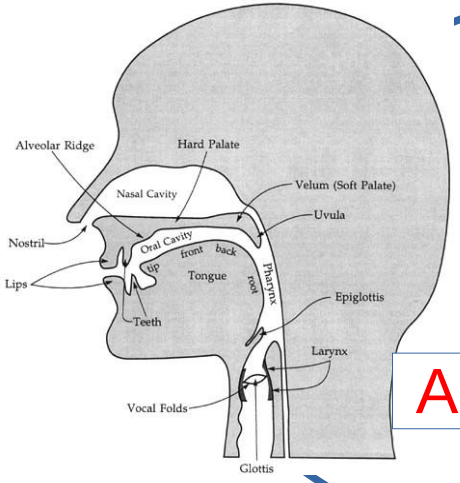
Prolog Part 1

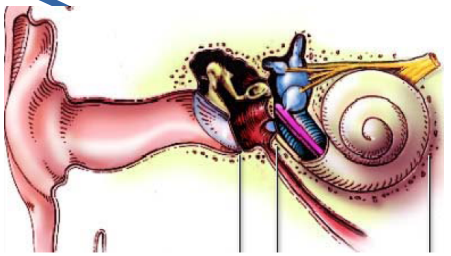
Phonetic domains: the speech cycle

Phonetic domains: the speech cycle

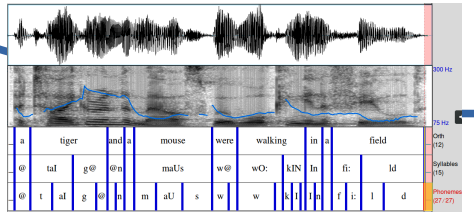
Articulatory Phonetics

Auditory Phonetics





A tiger and a mouse were walking in a field ...

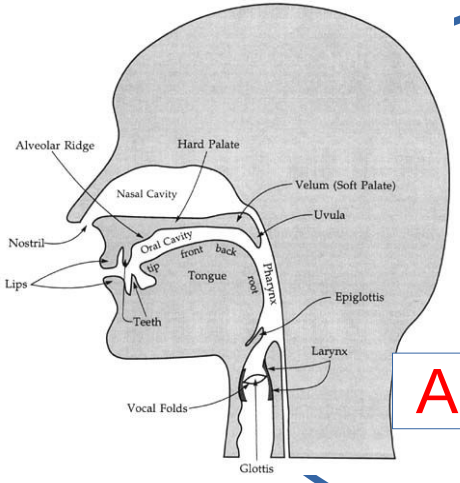


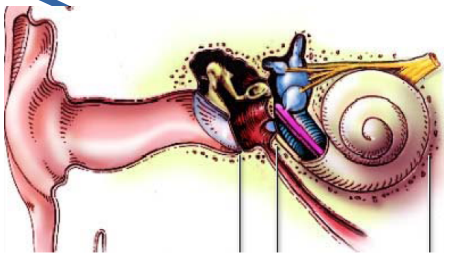
Acoustic Phonetics

Phonetic domains: the speech cycle

Articulatory Phonetics

Auditory Phonetics





outer ear middle ear inner ear

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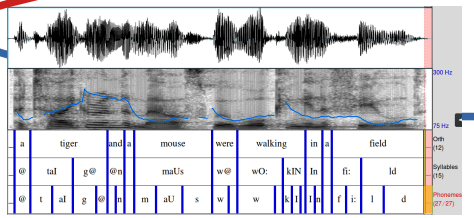


Acoustic Phonetics

The Modulation Code: two prosodic channels, AM and FM

AM envelope modulation signal:

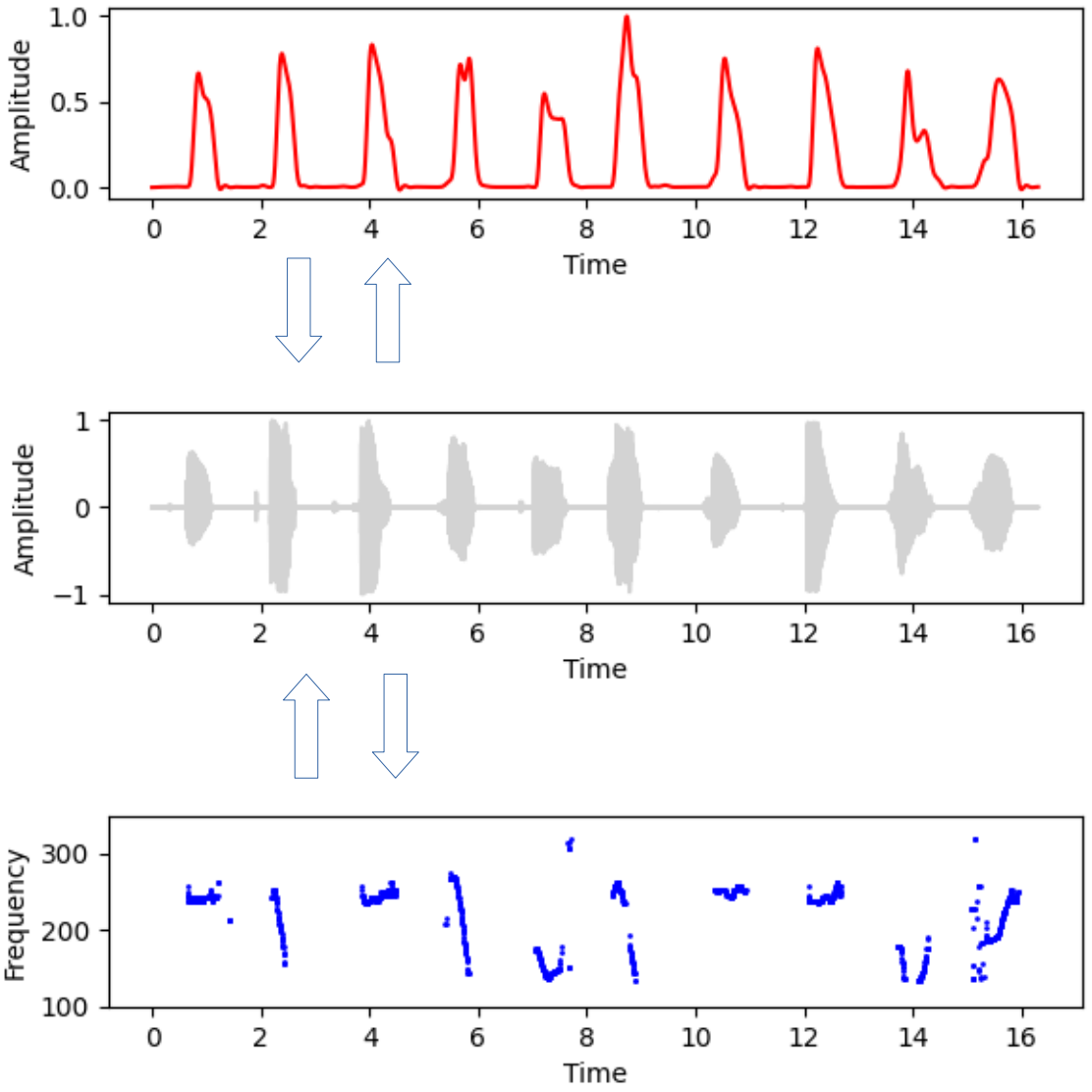
- phonetics:
  amplitude curve, syllable, stress-accent
- phonology:
  sonority curve, syllables, stress

Carrier signal:

- larynx:
  harmonic sounds
- constriction:
  noise sounds

FM envelope modulation signal:

- phonetics:
  F0, pitch track
- phonology:
  tones, pitch accents, intonation

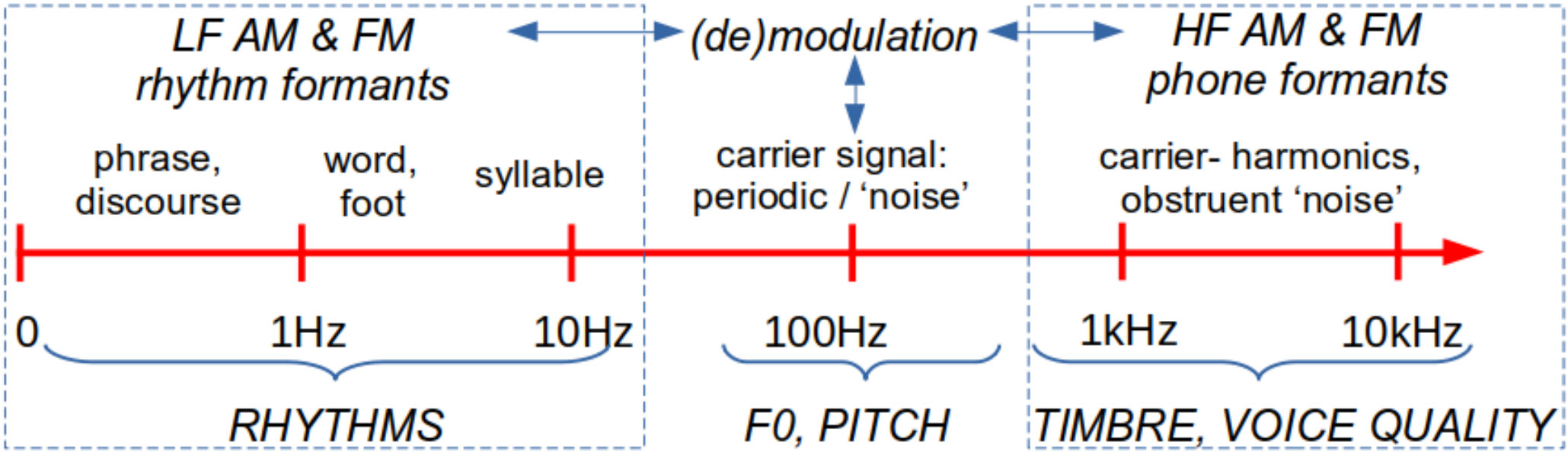


The Modulation Code: Frequency Scale

Low frequencies: rhythm

Mid frequencies: rhythm

High frequencies: consonants and vowels



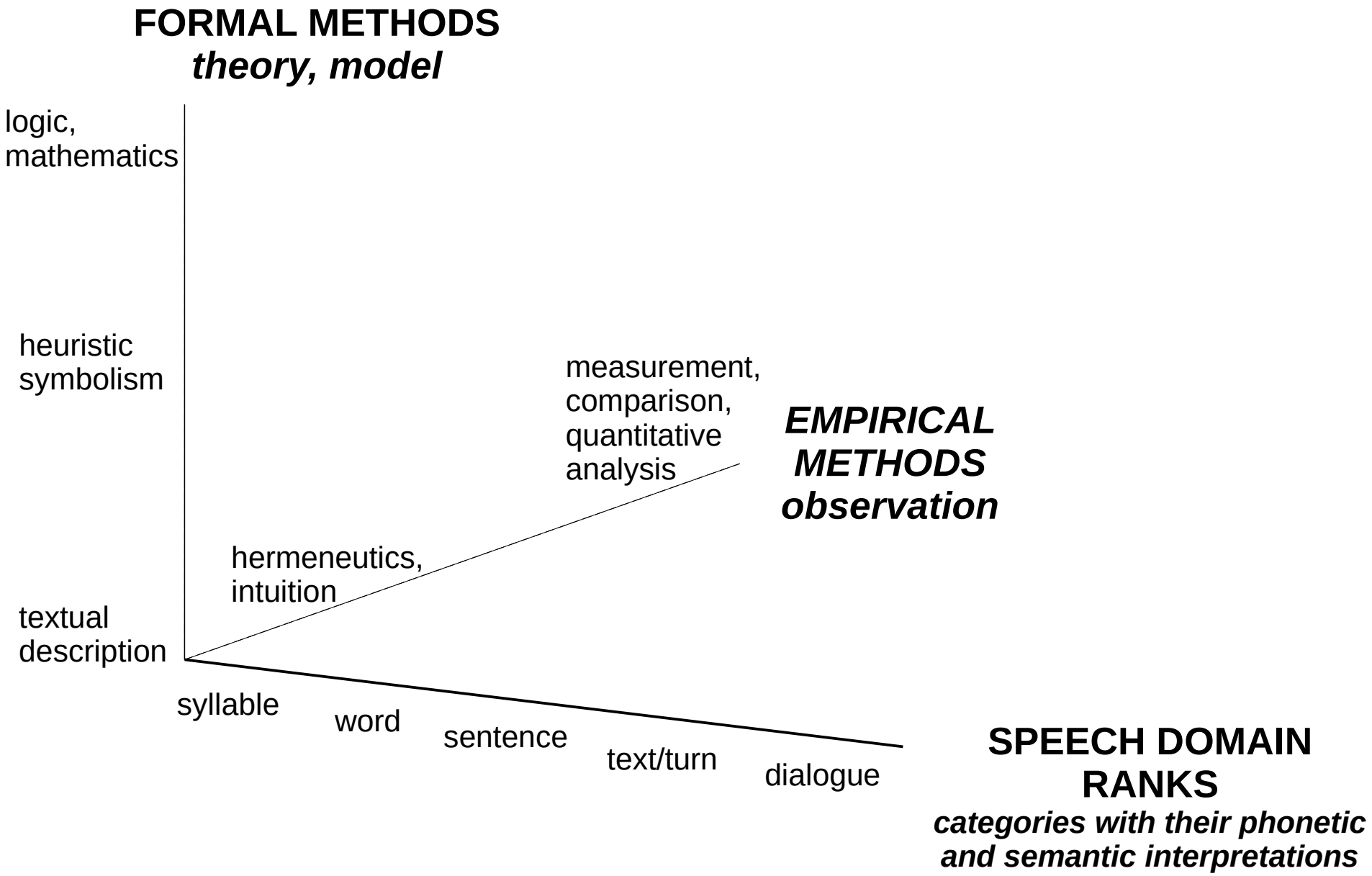
Low Frequency AM and FM modulations

High Frequency AM and FM modulations

Prolog Part 2

General remarks on methodology

Three-dimensional Model of Research Space

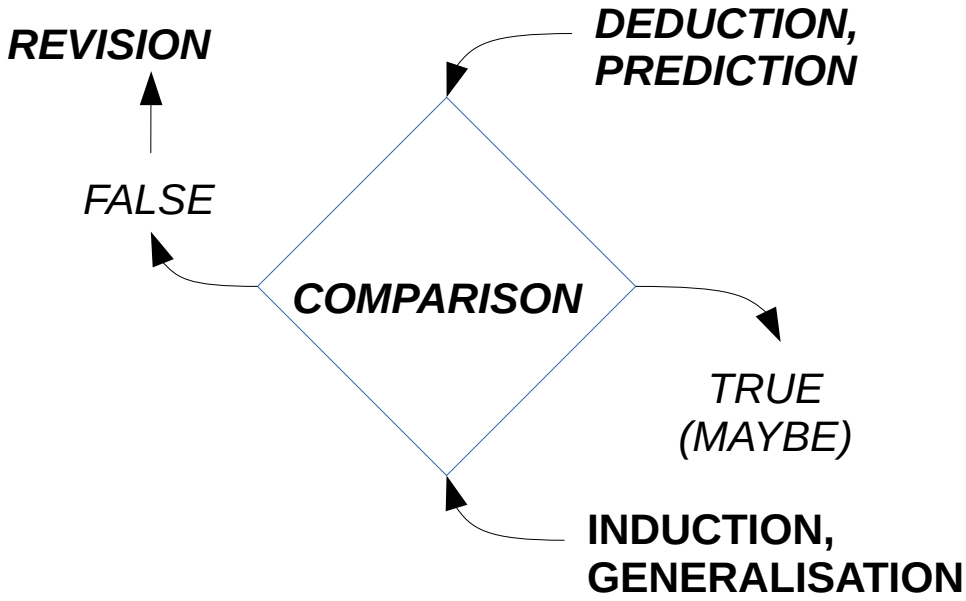


Critical Rationalist methods in linguistics and phonetics

The Logic

From a logical point of view, it is impossible to confirm a theory – you may find a counter-example any time!

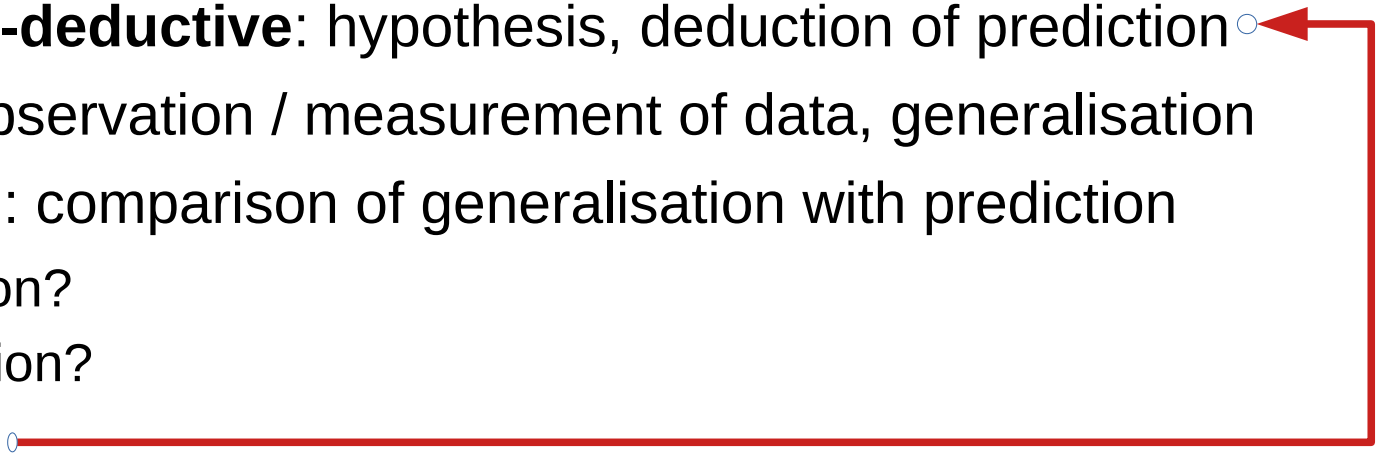
So we try hard to falsify the theory . If we succeed, we revise predictions in our research space. If we fail to falsify in many experiments, we call it confirmation.



Procedure

1. **Domain** (Carnap's "Logical Empiricism"):
    1. **Clarification**: phonetics, rhythms and melodies, rhythm formants
    2. **Delimitation**: not phonology, morphology, grammar
    3. **Explication**: descriptive → symbolic → formal/computational

2. **Method** (Popper's "Critical Rationalism"):
    1. **Hypothetico-deductive**: hypothesis, deduction of prediction
    2. **Inductive**: observation / measurement of data, generalisation
    3. **Comparison**: comparison of generalisation with prediction
        1. Falsification?
        2. Confirmation?
    4. **Revision**



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        1. Falsification?
        2. Confirmation?
    4. **Revision**

Logical Empiricism and Critical Rationalism

A more informal version of Logical Empiricism and Critical Rationalism has been revived recently in linguistics and related fields under a new name: *New Descriptivism*.

However, this approach was originally formulated by the Austrian philosopher Karl Popper in 1934, in *Logik der Forschung* (Logic of Research: *The Logic of Scientific Discovery*) and his colleagues such as Rudolf Carnap.

Varieties of this approach are the standard methods in experimental phonetics and other disciplines which use measurement and statistics.

An excellent example of the approach in linguistics is Noam Chomsky, 1957, *Syntactic Structures*. The Hague: Mouton.

Chomsky's first book: an application of Critical Rationalism

Chomsky, N. 1957. *Syntactic Structures*. The Hague: Mouton.

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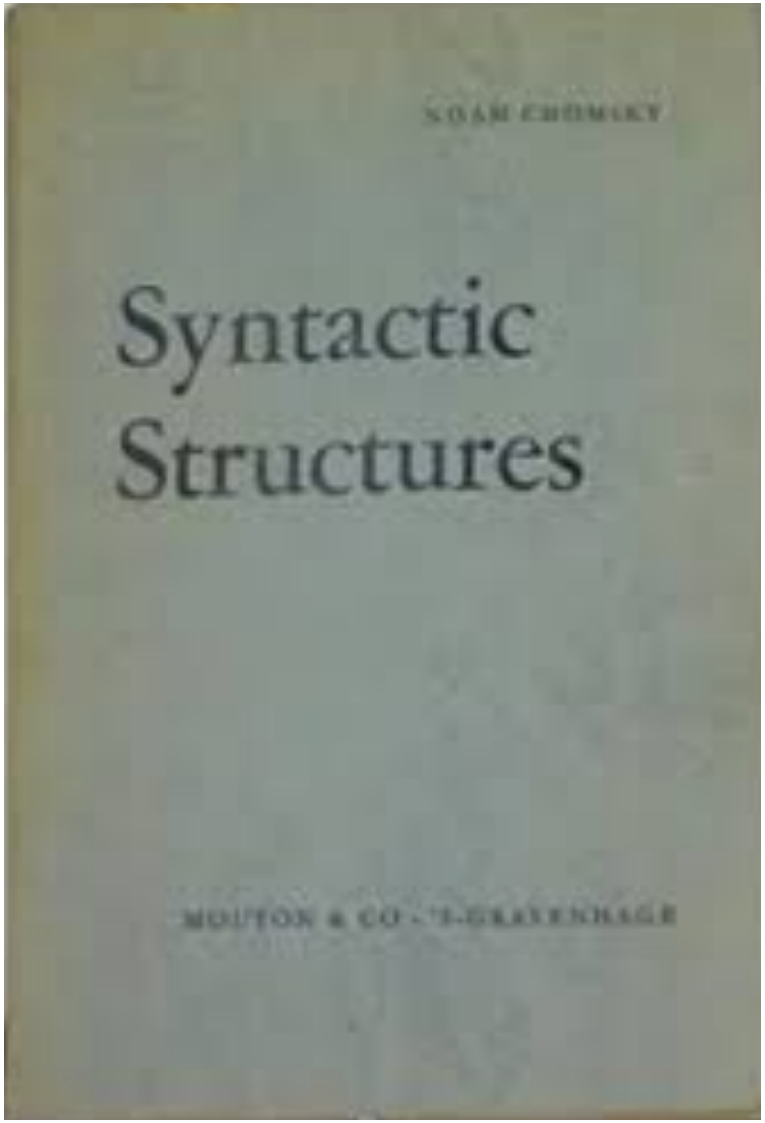

Scientific Discovery: a clear example of Critical Rationalism

Chomsky, N. 1957. *Syntactic Structures*. The Hague: Mouton.

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1. Domain characterisation and delimitation

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4. Transformational Grammars – not falsified!

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3. Phrase Structure Grammars – falsified!

4. Transformational Grammars – not falsified!

Later, Chomsky's models were shown to overgeneralise: complete but not sound, maybe unfalsifiable.

For example, phonology, prosody, morphology, as well as syntax in conversational speech (but not semantics), can be fully modelled with Finite State Grammars.

Semiotics Part 1

The Theory of Signs

Rank Interpretation Theory of Semiotics

Linguistic Units and Categories
Functional and Modality Interpretations
Rank Hierarchy

Semiotics and Prosody

Prosody is

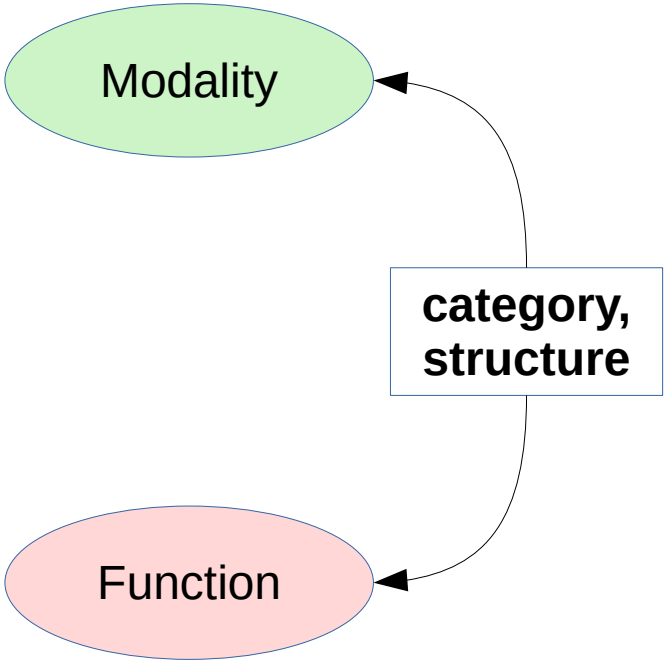
an independent sign system

with two main subsystems / channels:

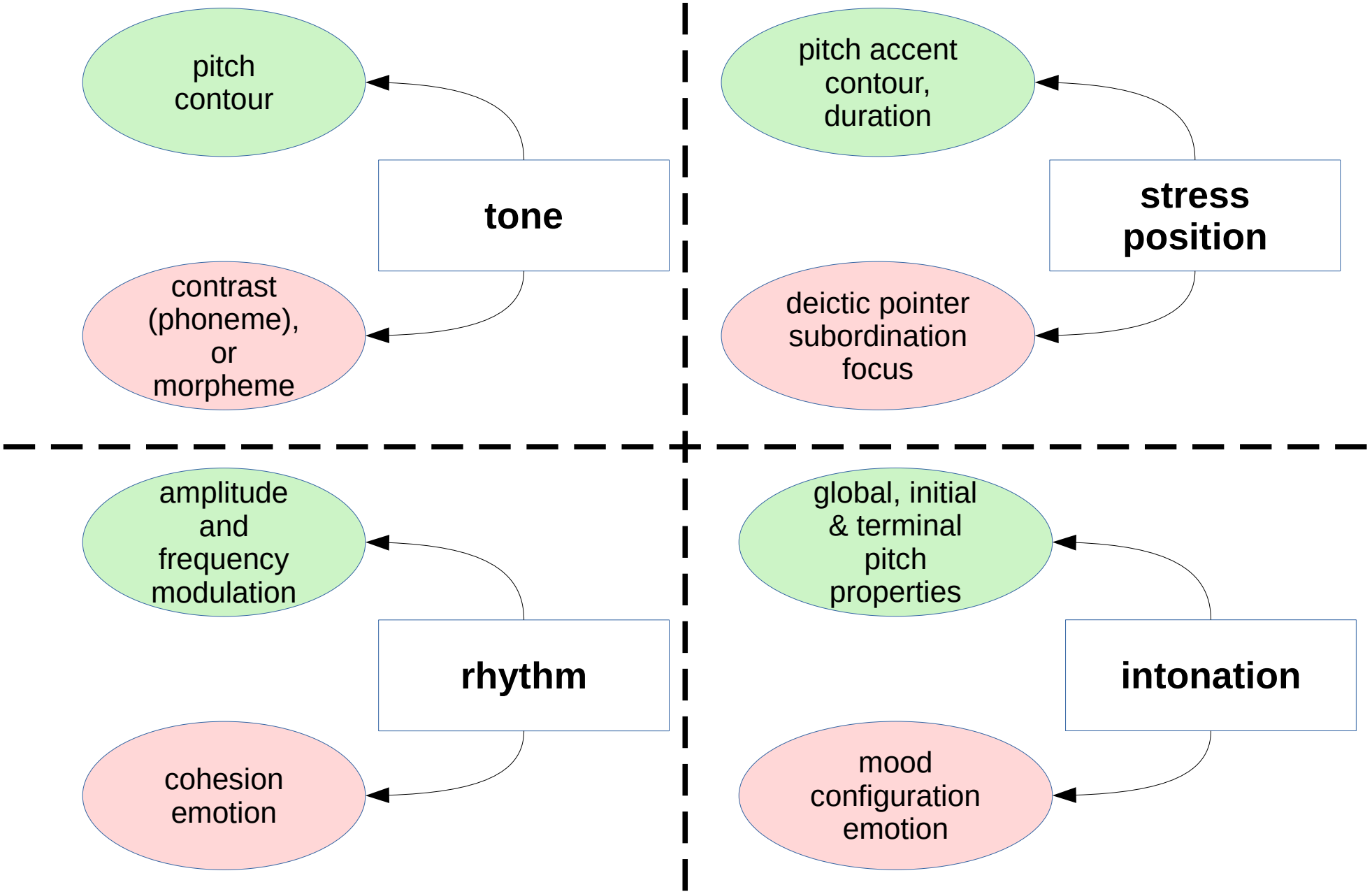
1. rhythms
2. melodies

with its own

1. syntax:
    1. linear and hierarchical patterns
2. modality:
    1. low frequency amplitude and frequency modulation of speech
    2. layout, punctuation and highlighting hierarchy in writing
3. functionality:
    1. semantics: deictic pointing to associated words, phrases
    2. pragmatics: attitudinal and emotional meanings

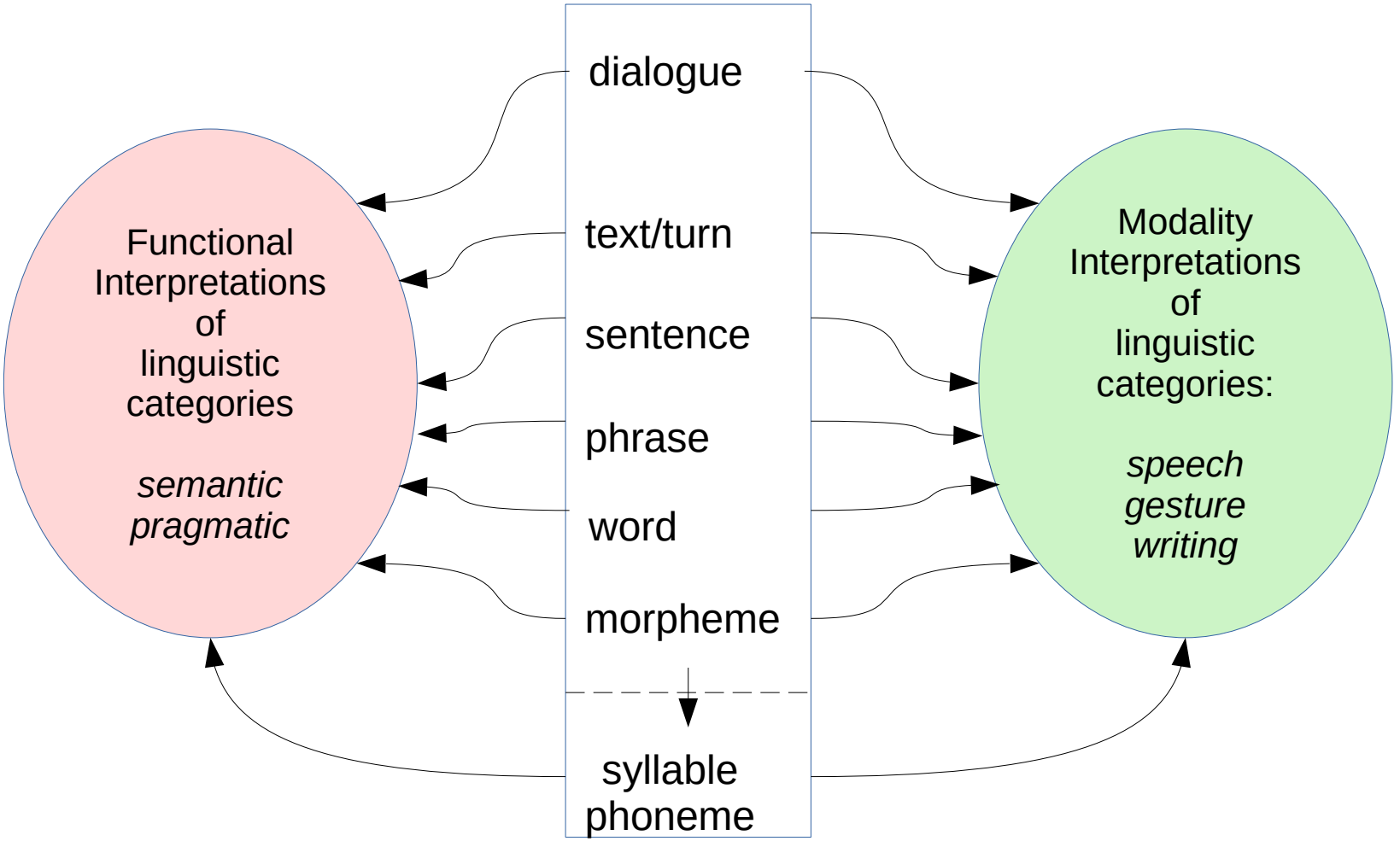


Semiotics of Prosody – four categories and their interpretations

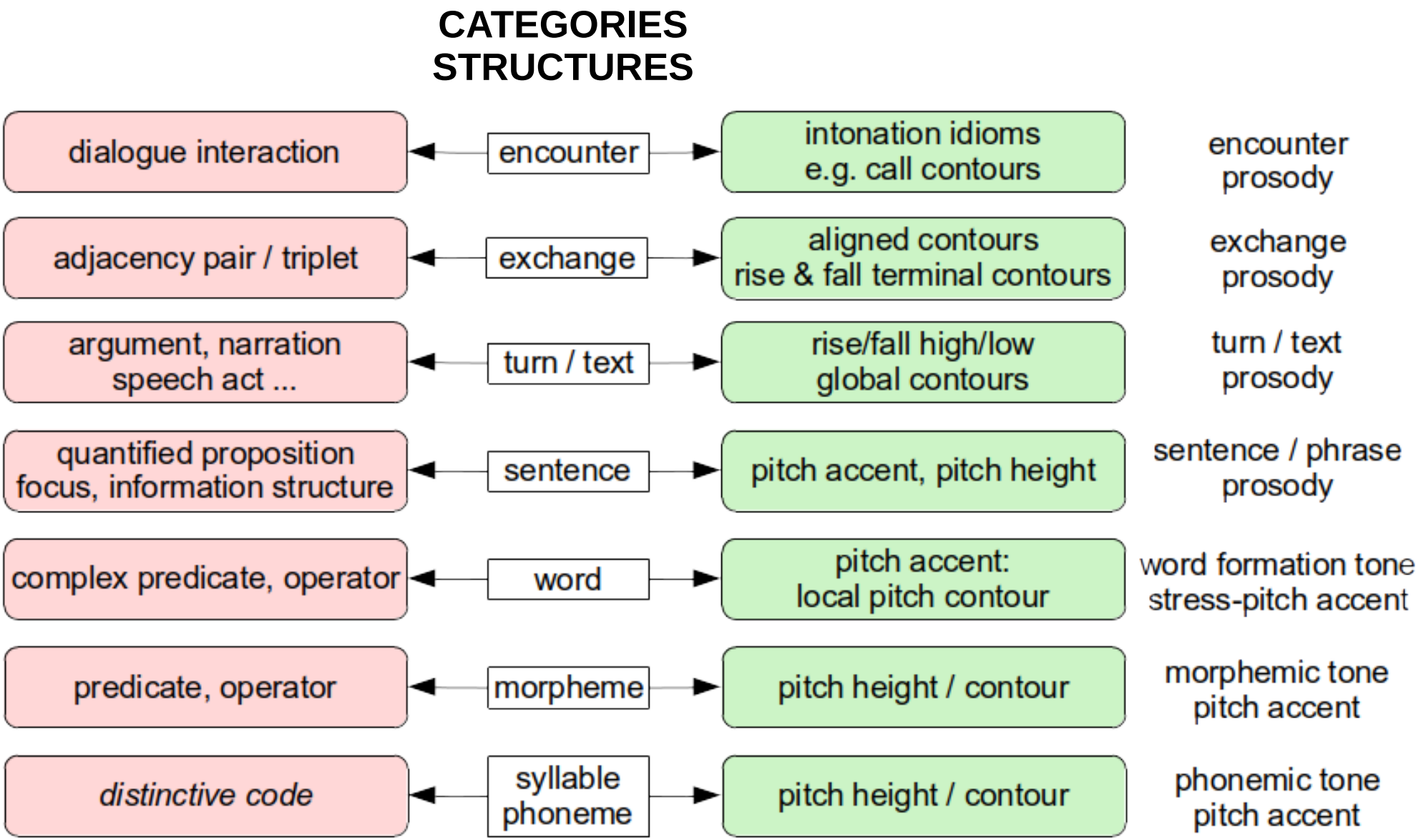


Rank Interpretation Architecture

1. Hierarchical ranks of signs
2. For each rank, its interpretations



Rank-Interpretation Architecture of Prosody



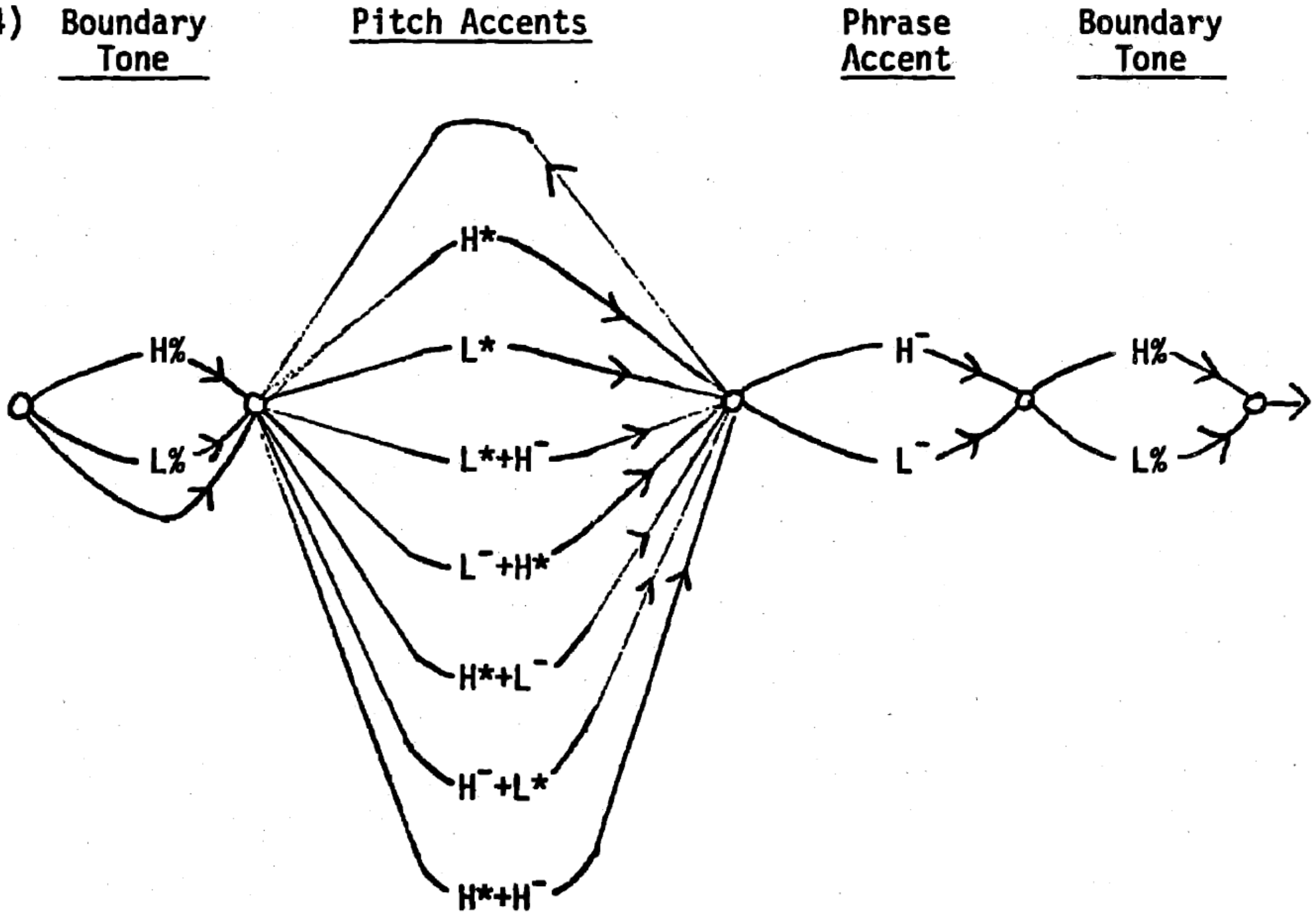
Prosodic categories in an autonomous grammar

in contrast to deriving prosody from locutionary grammar

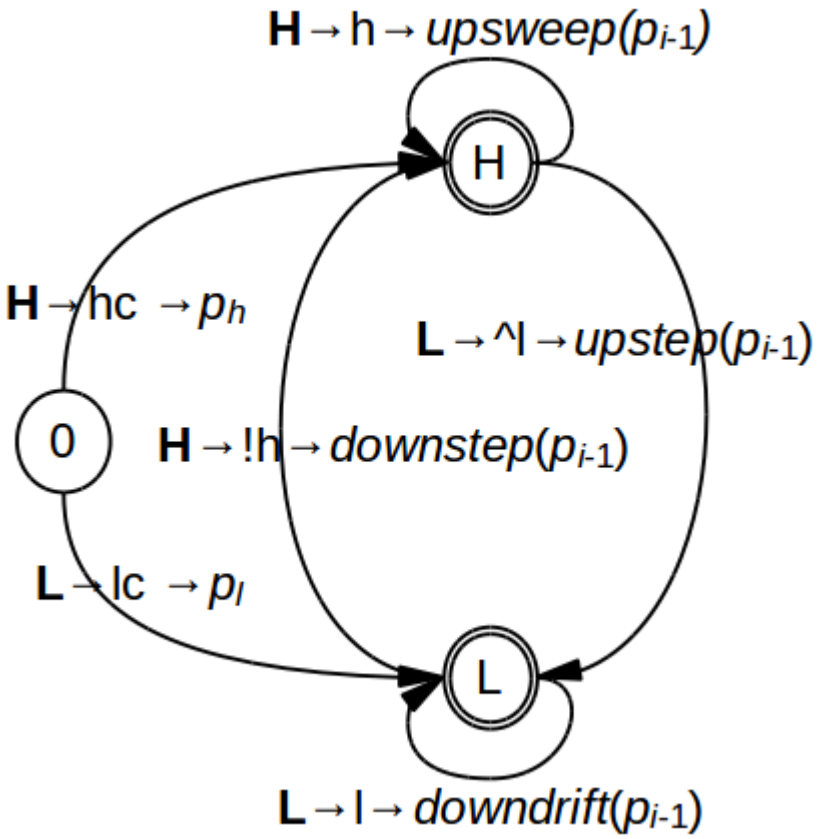
Gibbon & Griffiths 2017:

1. Language and speech are complex, but processes are essentially parallel and linear.
   Note that this contrasts with writing, where deeper structures are enabled by the additional memory of paper and screen, and slow multidirectional editing.
   If you don't believe me, just try spontaneously inventing sentences with a centre-embedding depth greater than 1 ☺
2. The modelling conventions require a finite depth rank hierarchy of units in specific categories, such as *dialogue*, *text*, *sentence*, *phrase*, *word*, cf. Selkirk (1984), the *Strict Layer Hypothesis*.
3. At each rank, structures are right-branching, left-branching or bounded in depth, not general centre-embedding recursive.
4. At each rank, the categories are interpreted in two domains:
   - the Modality Domain (speech, gesture, writing)
   - the Function Domain (semantics, pragmatics)

Autonomous grammar of intonation – Pierrehumbert (1980)



Autonomous grammar of Niger-Congo tone sandhi (Gibbon 1987 etc.)



For phonetic definitions of sandhi relations, cf. Pierrehumbert & Liberman (1984)

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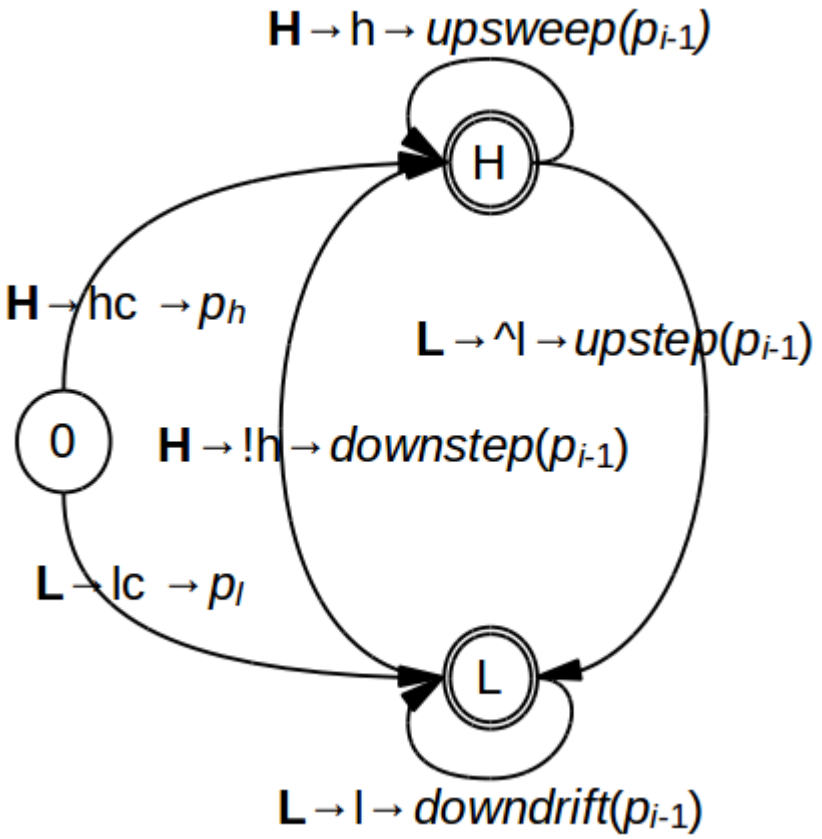
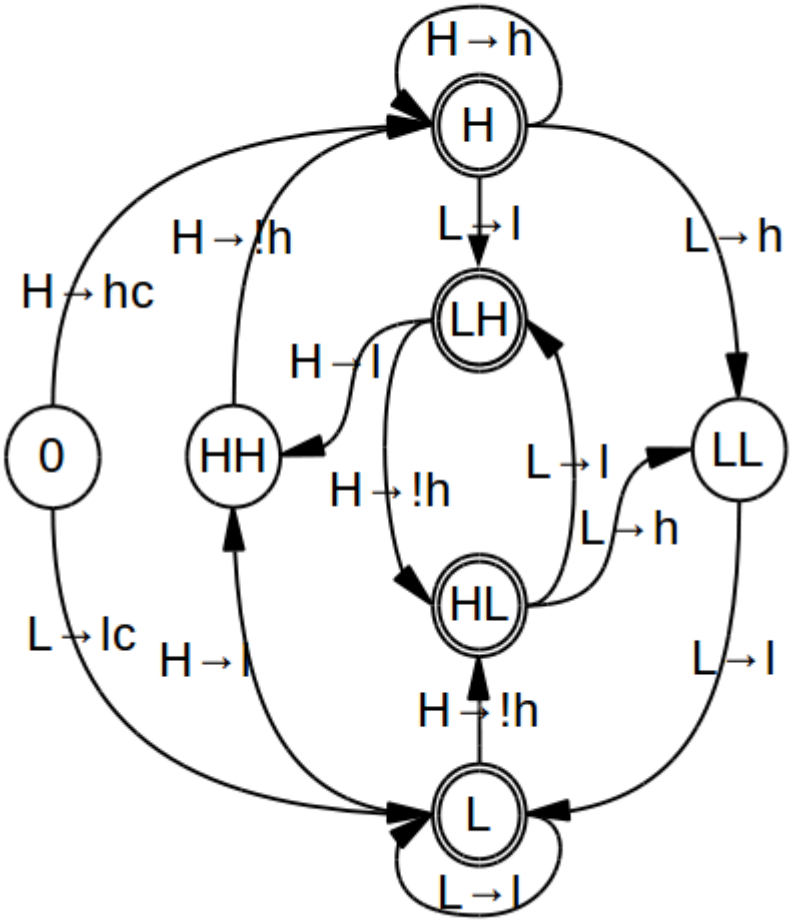
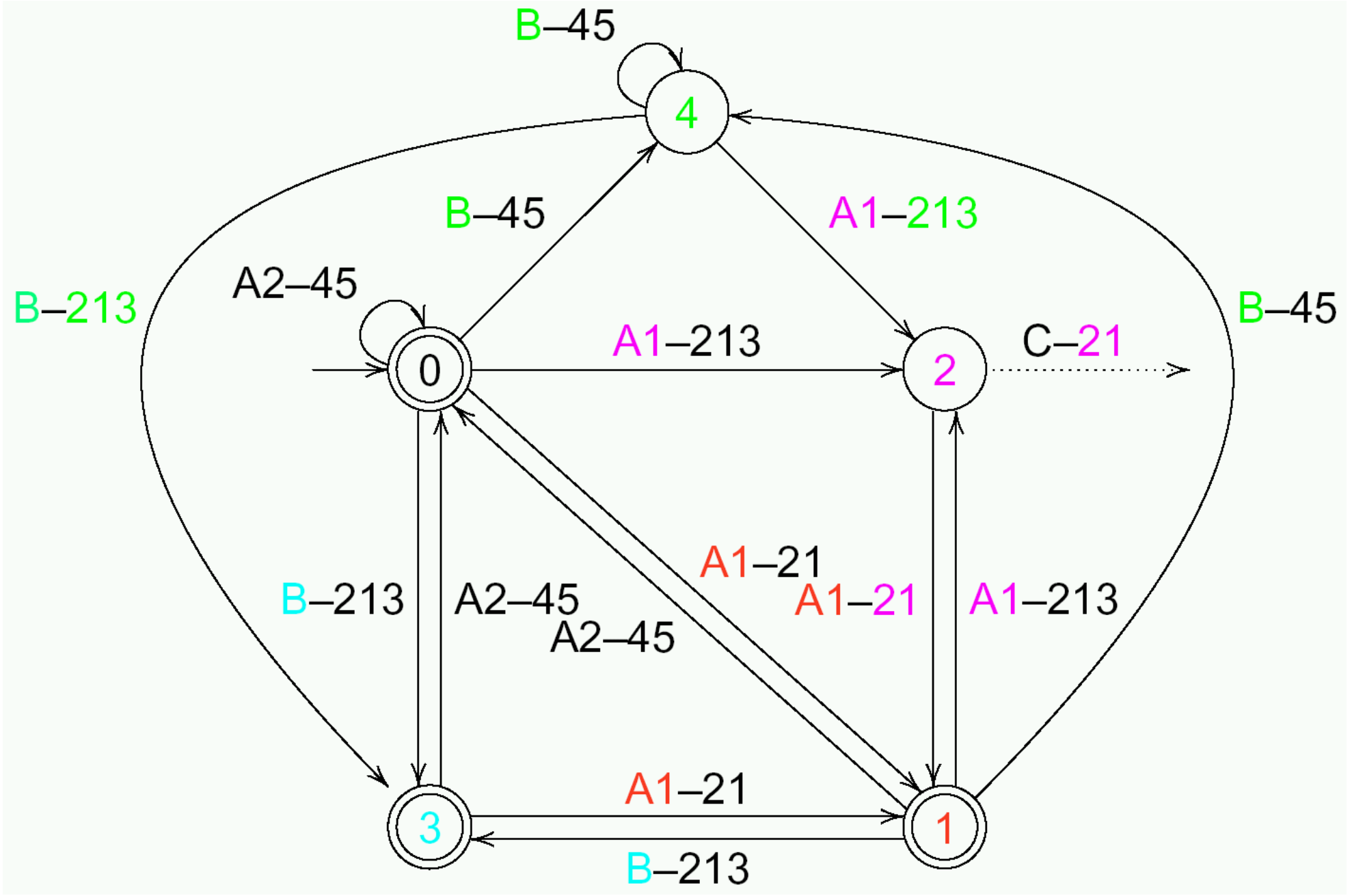




Autonomous grammar of Tianjin tone sandhi (Jansche 1998)



Semiotics Part 2

Case Studies In the Semiotics of Prosody

Semiotics of Prosody, Case Study 1:

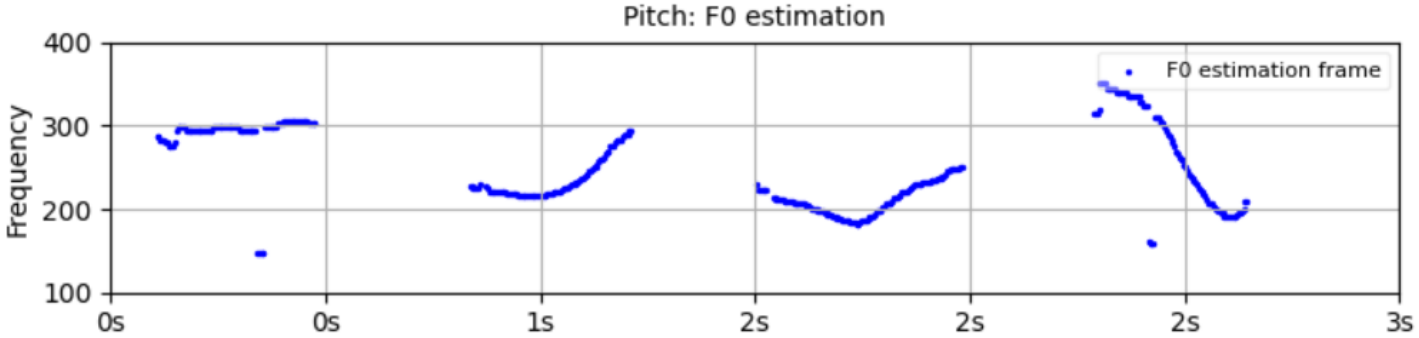
the Modulation Code and

Pǔtōnghuà Lexical and Morphological Tones

Pǔtōnghuà Lexical and Morphological Tones - Phonetics

Phonemic tones
Tones 1 … 4

high female voice



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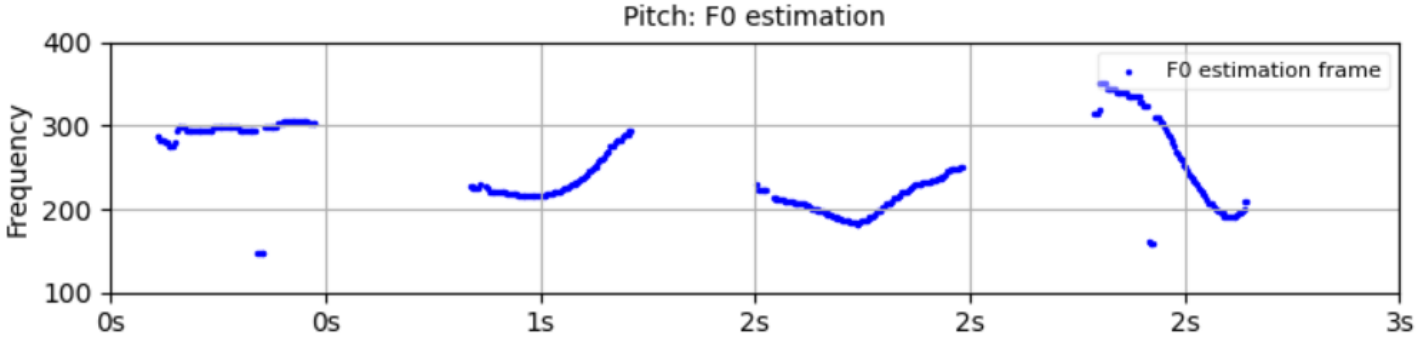
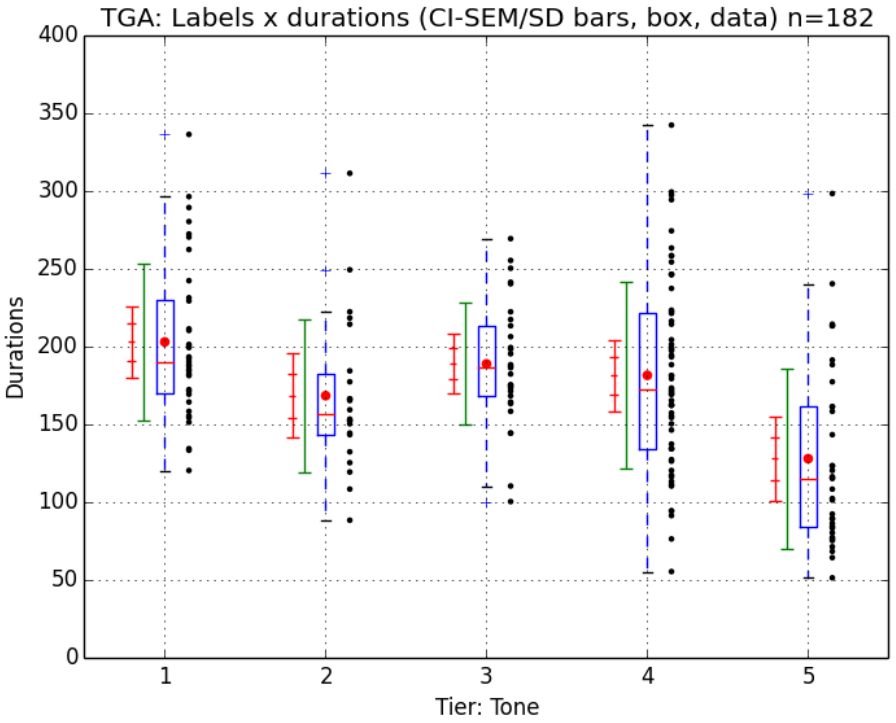




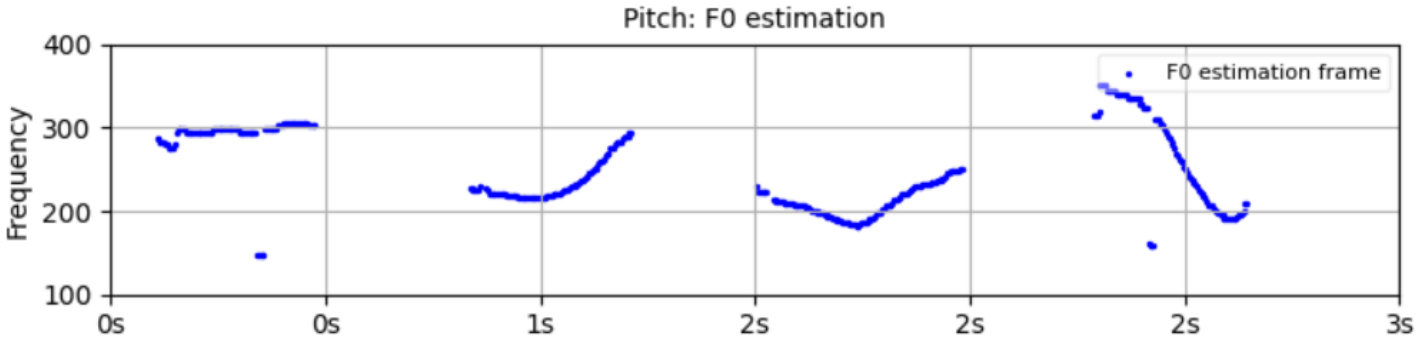
citation forms
vs.
forms in context
here: translation of
“The North Wind and the Sun”

Label	n	min	max	range	mean	median	SD	SEM	CI 95%	Coeff Var
1	35	120	336	216	203	190	50	12	23	25%
2	22	88	311	223	168	156	49	14	27	29%
3	29	100	269	169	189	186	39	10	19	21%
4	61	55	342	287	181	172	60	12	23	33%
5	35	51	298	247	128	115	58	14	27	45%

Pǔtōnghuà Lexical and Morphological Tones - Phonetics

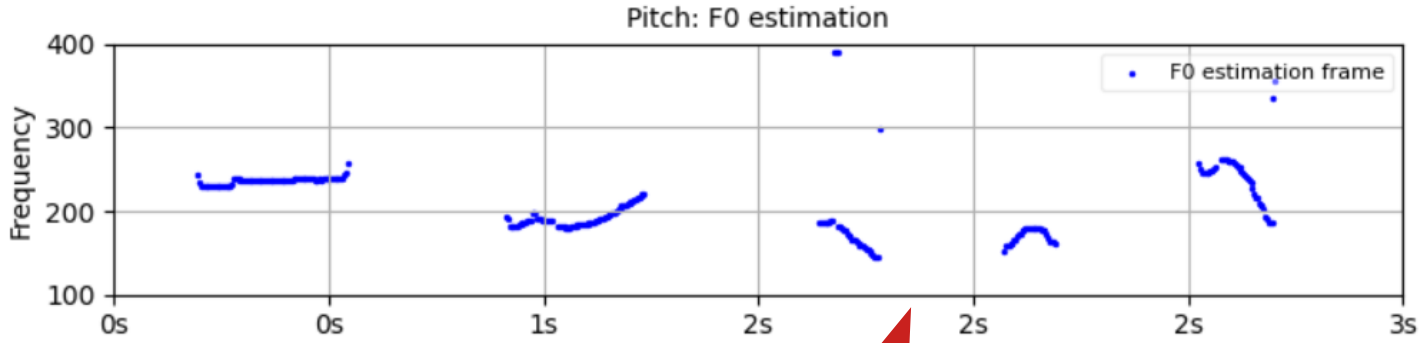
Phonemic tones
Tones 1 … 4

high female voice



Phonemic tones
Tones 1 … 4

low female voice: creaky Tone 3

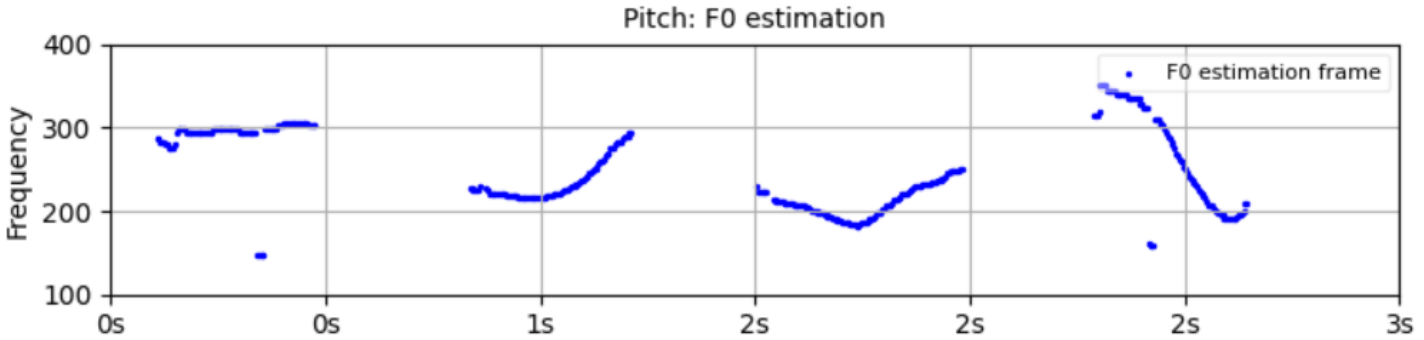


Allotones:
Why is there a gap?

Pǔtōnghuà Lexical and Morphological Tones - Phonetics

Phonemic tones
Tones 1 … 4

high female voice



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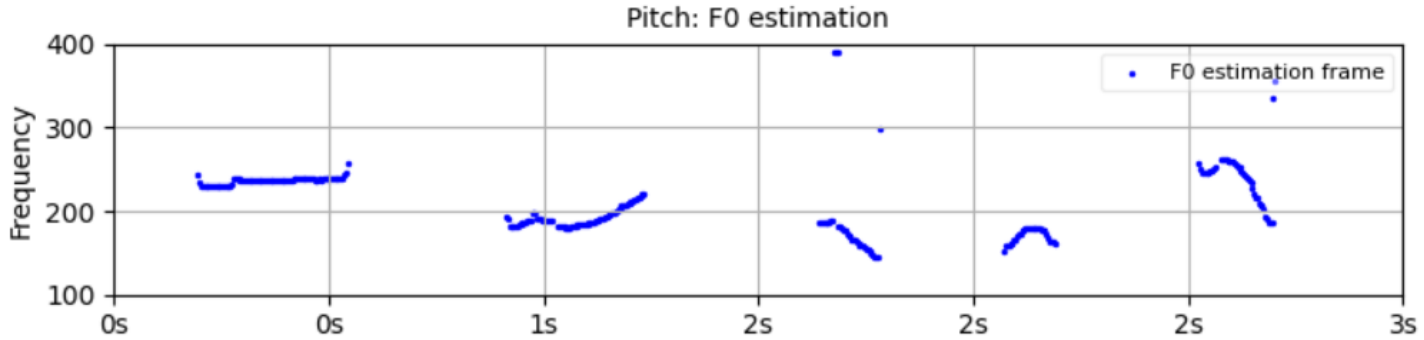
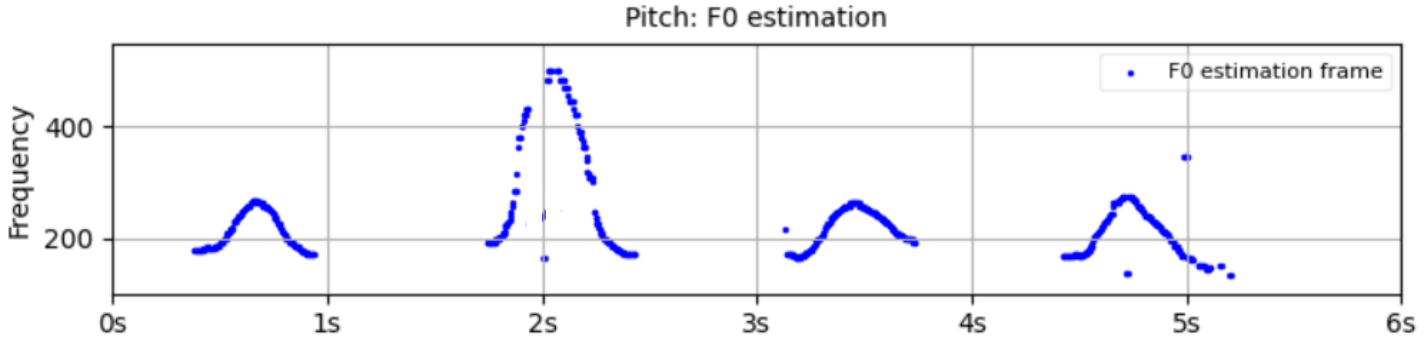
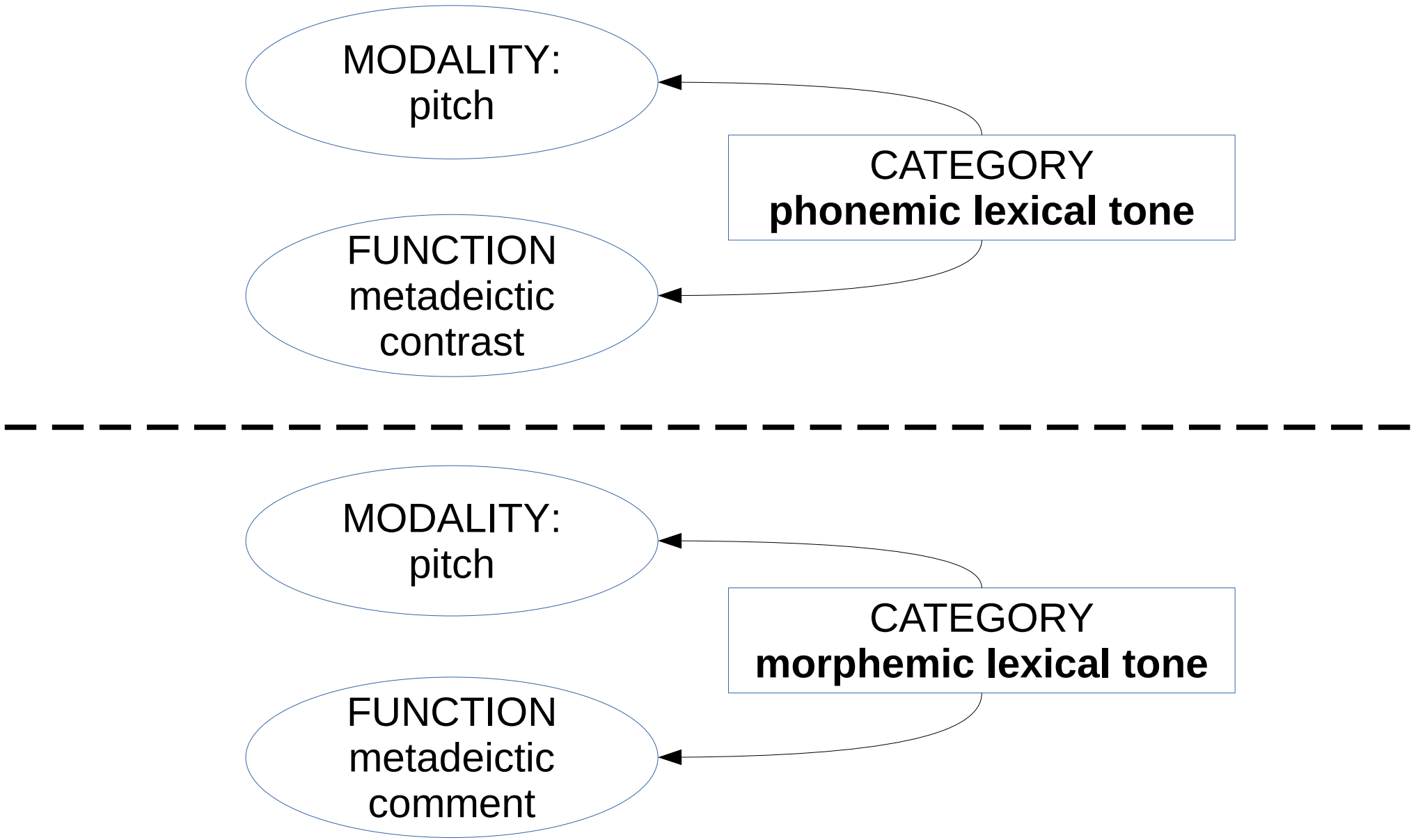


Morphemic tone
“Tone 6” ☺

low female voice:
4 allotones



Pǔtōnghuà Lexical and Morphological Tones: Summary



Semiotics of Prosody, Case Study 2:

the Modulation Code and

English stress-pitch accents

Case study 2: Prosodic typology: pitch accents

Tones, pitch accents and intonations are signs with grammar, modality and function:

autonomous grammar of pitch accents:
- linear concatenation
- cyclical finite state grammar
- phonetic interpretations of abstract stress positions

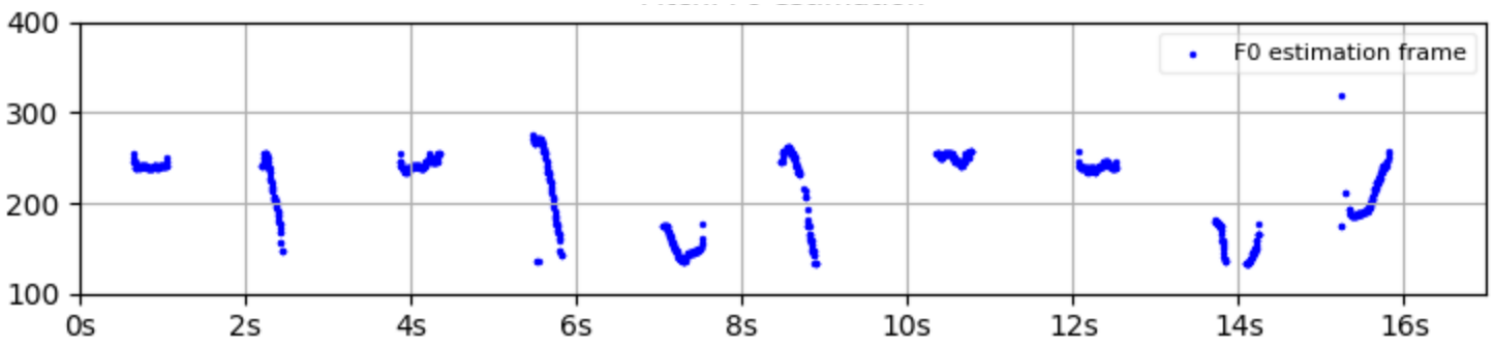
modality interpretation of stress-pitch accents:
- pitch accent contours:
  - high, low, high-low, low-high

functional interpretation of pitch accents:
- tones: contrastive coding
- stress-pitch accents:
  - metadeictic denotation of focal positions
  - indexical (attitudinal, emotional)

Tones, Pitch Accents and Intonation: the 'Modulation Code'

Sino-Tibetan
Pǔtōnghuà
ISO-693-3 *cmn*

lexical tone



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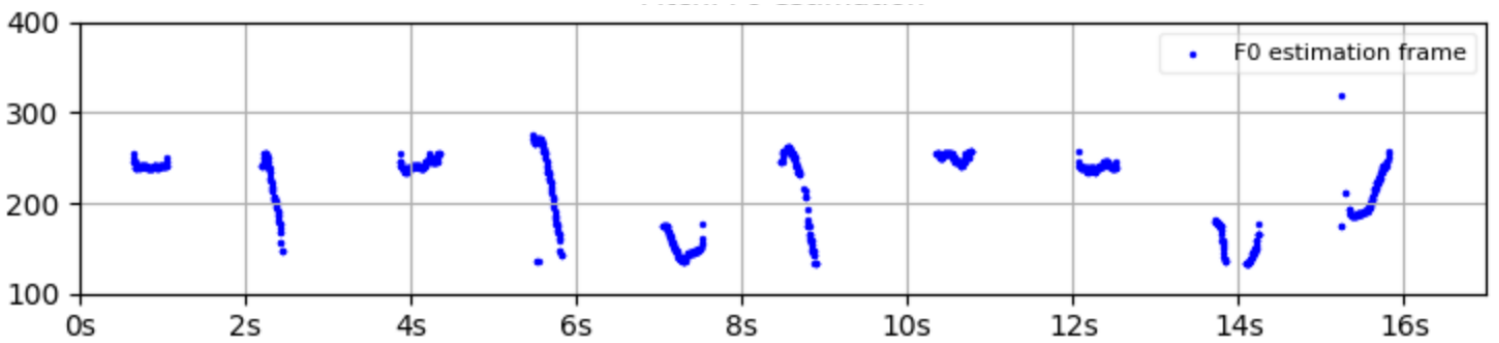
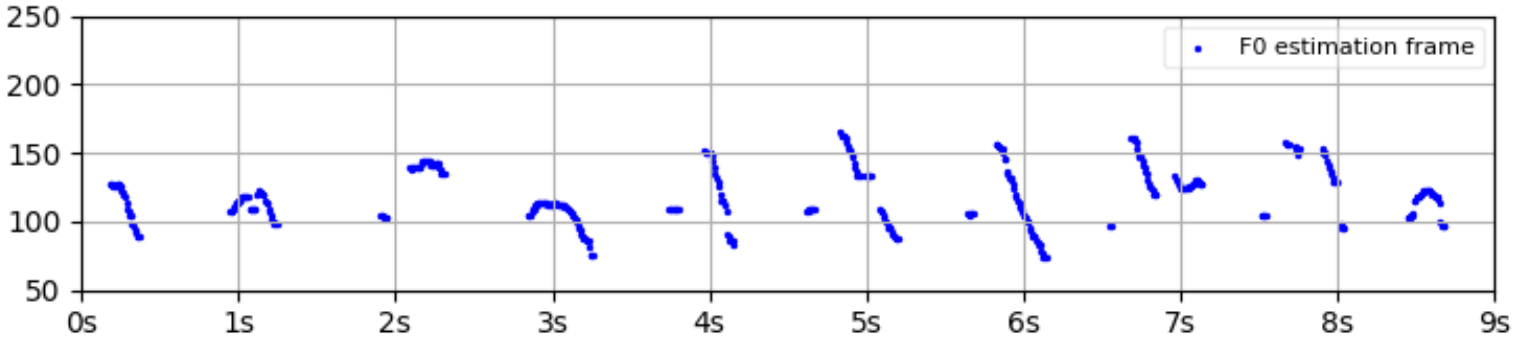


yī èr sān sì wǔ liù qī bā jiǔ shí

Niger-Congo
Ibibio
ISO-693-3 *ibb*

lexical and morphological tone



kèèd ìbà ìtá ìnàáñ ìtíòn ìtíòkèèd ìtíàbà ìtiáìtá ùsúkkéèd dùòp

Tones, Pitch Accents and Intonation: the 'Modulation Code'

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Pǔtōnghuà
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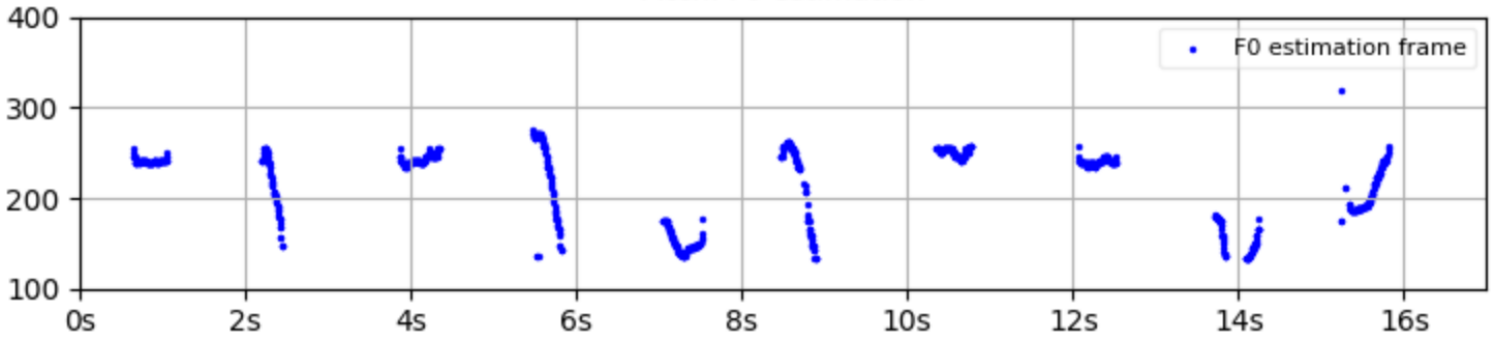
lexical tone



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Niger-Congo
Ibibio
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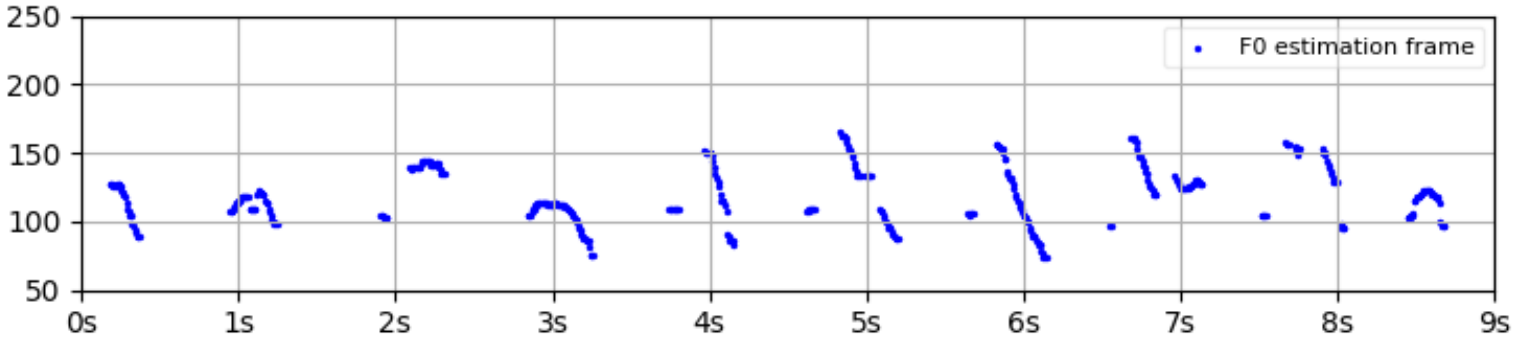
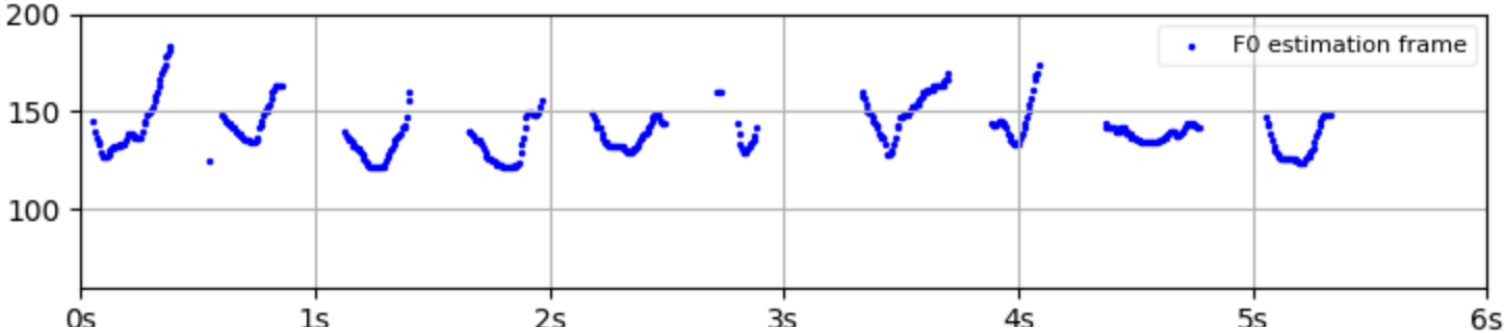
lexical and morphological tone



kèèd ìbà ìtá ìnàáñ ìtíòn ìtíòkèèd ìtíàbà ìtiáìtá ùsúkkéèd dùòp

Indo-Germanic
English
ISO 693-3 *eng*

stress-pitch accent & intonation

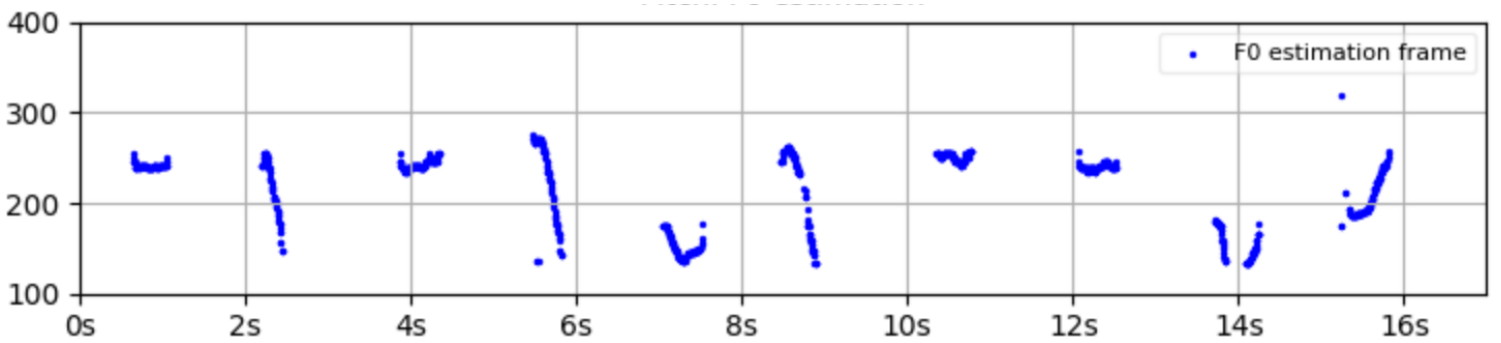


one two three four five six seven eight nine ten

Tones, Pitch Accents and Intonation: the 'Modulation Code'

Sino-Tibetan
Pǔtōnghuà
ISO-693-3 *cmn*

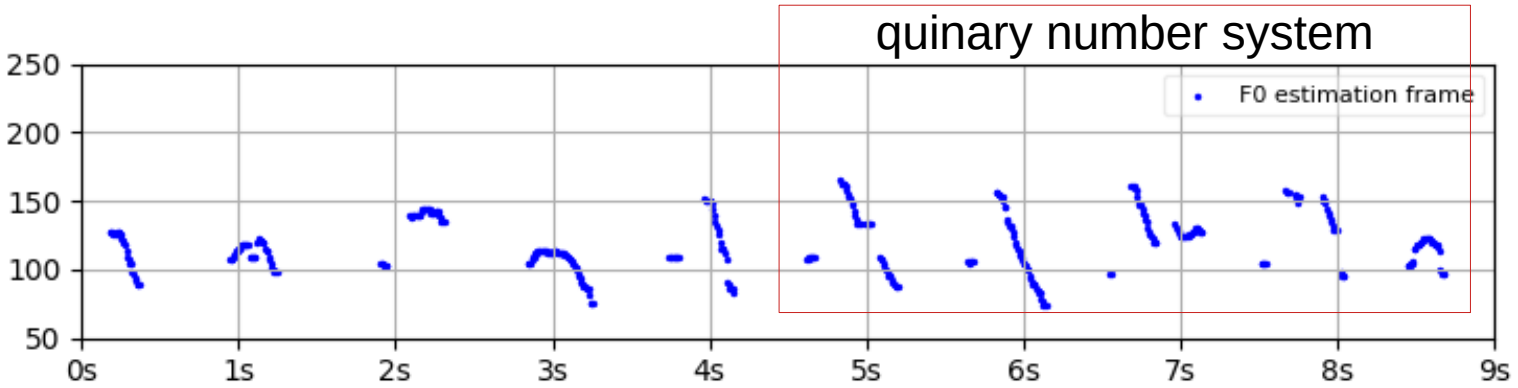
lexical tone



yī èr sān sì wǔ liù qī bā jiǔ shí

Niger-Congo
Ibibio
ISO-693-3 *ibb*

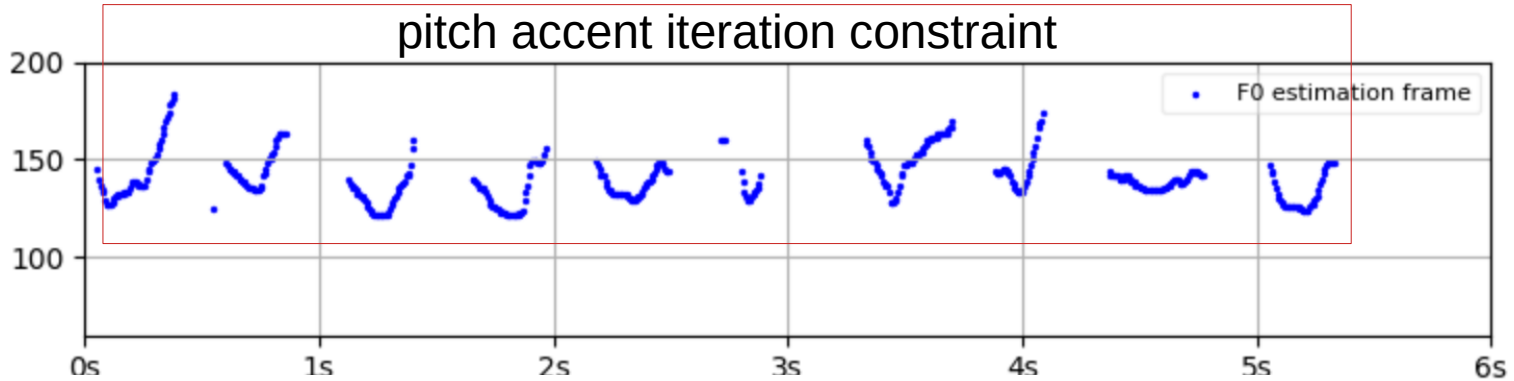
lexical and morphological tone



kèèd ìbà ìtá ìnàáñ ìtíòn ìtíòkèèd ìtíàbà ìtiáìtá ùsúkkéèd dùòp

Indo-Germanic
English
ISO 693-3 *eng*

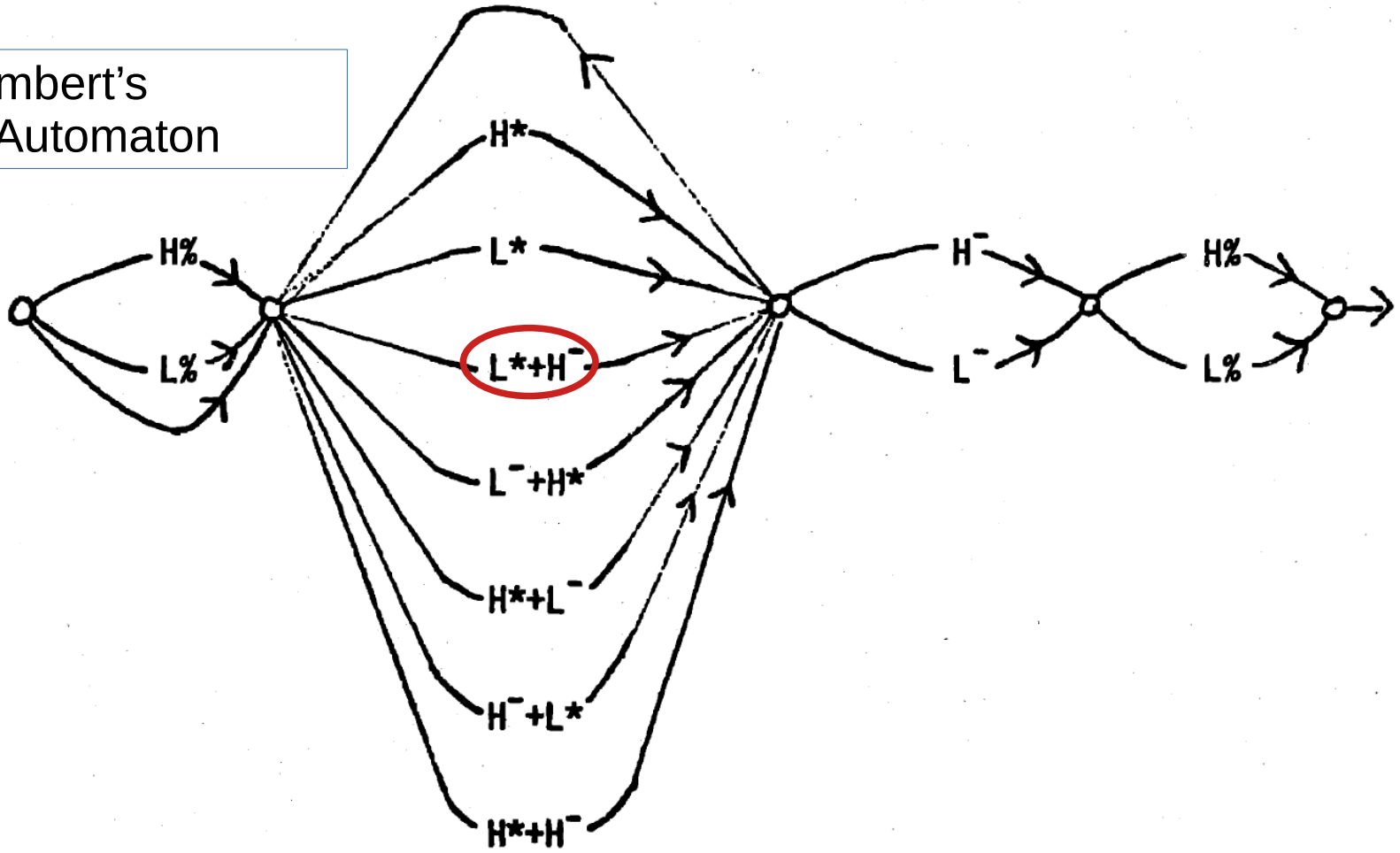
stress-pitch accent & intonation



one two three four five six seven eight nine ten

Tones, Pitch Accents and Intonation: the 'Modulation Code'

Pierrehumbert's
Finite State Automaton



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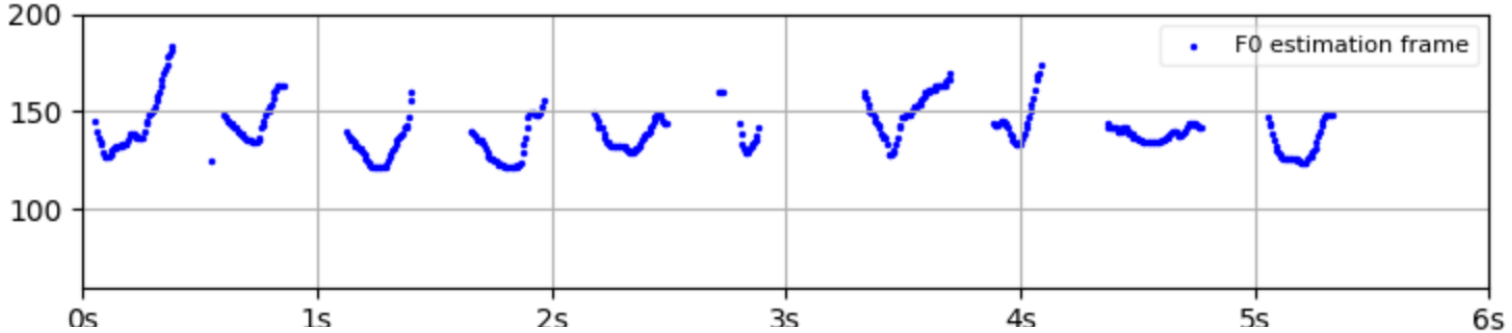

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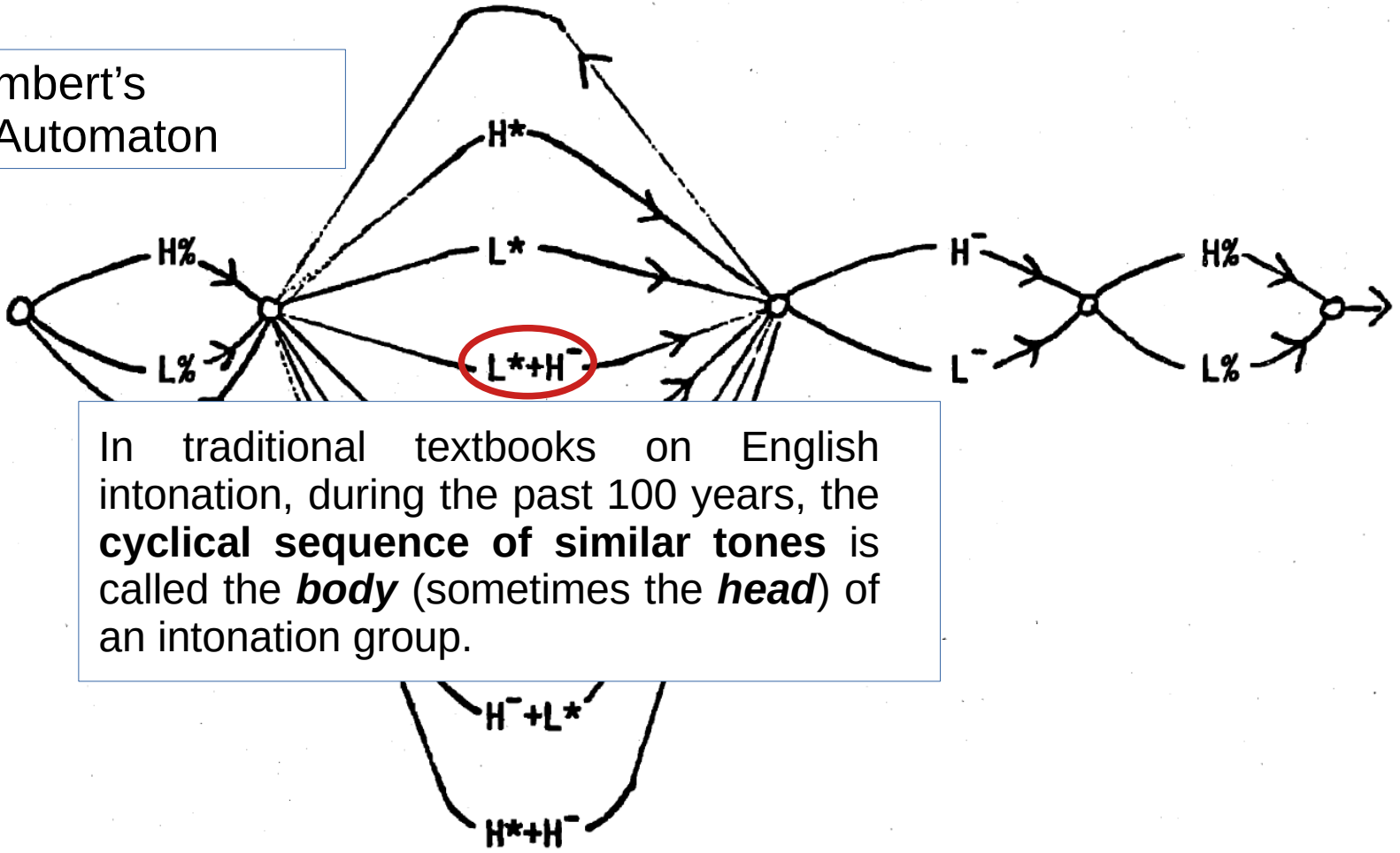
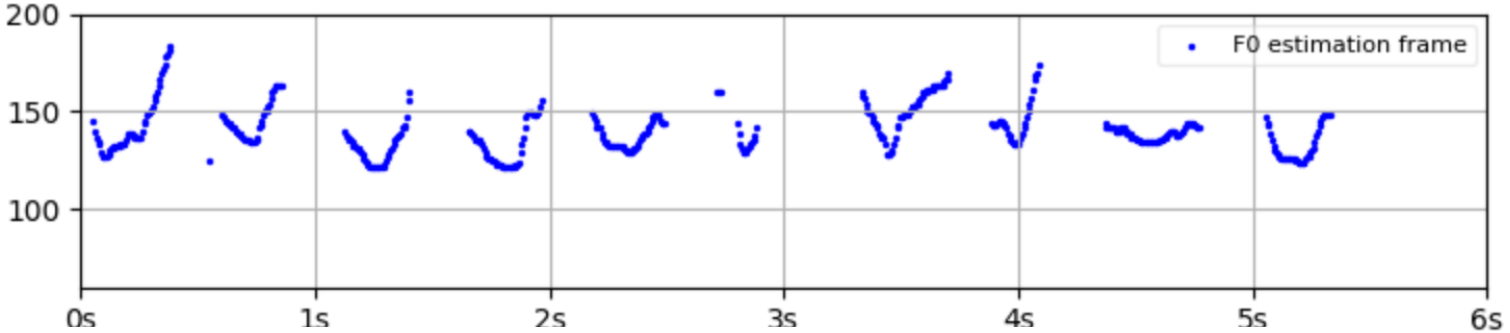


In traditional textbooks on English intonation, during the past 100 years, the **cyclical sequence of similar tones** is called the ***body*** (sometimes the ***head***) of an intonation group.

Indo-Germanic
English
ISO 693-3 *eng*

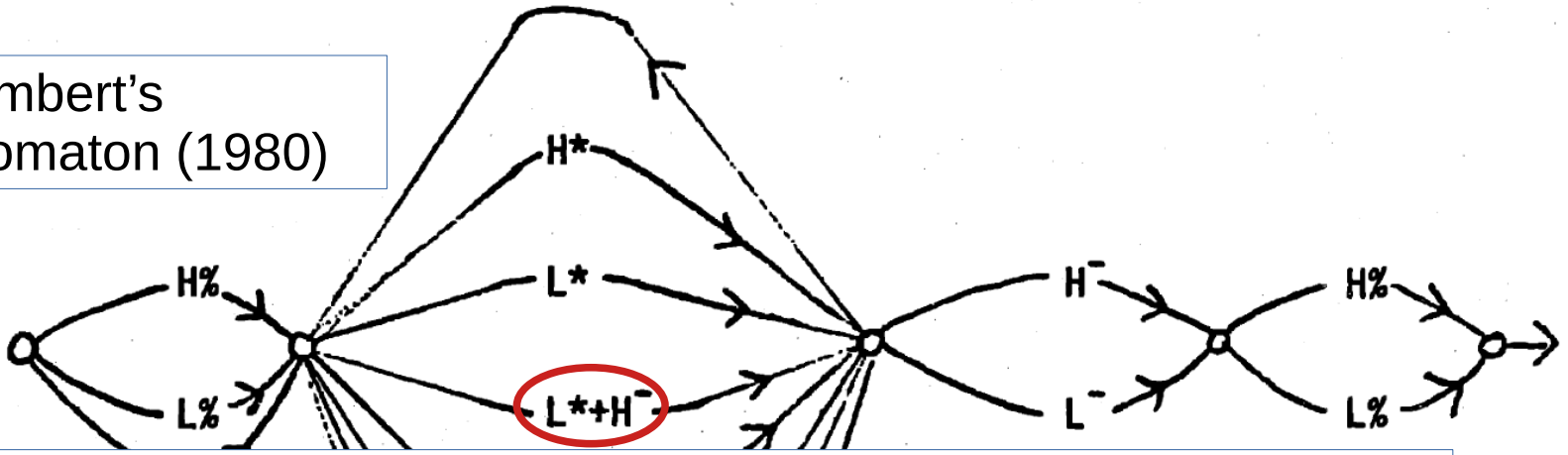
stress-pitch accent & intonation



one two three four five six seven eight nine ten

Tones, Pitch Accents and Intonation: the 'Modulation Code'

Pierrehumbert's
Finite State Automaton (1980)

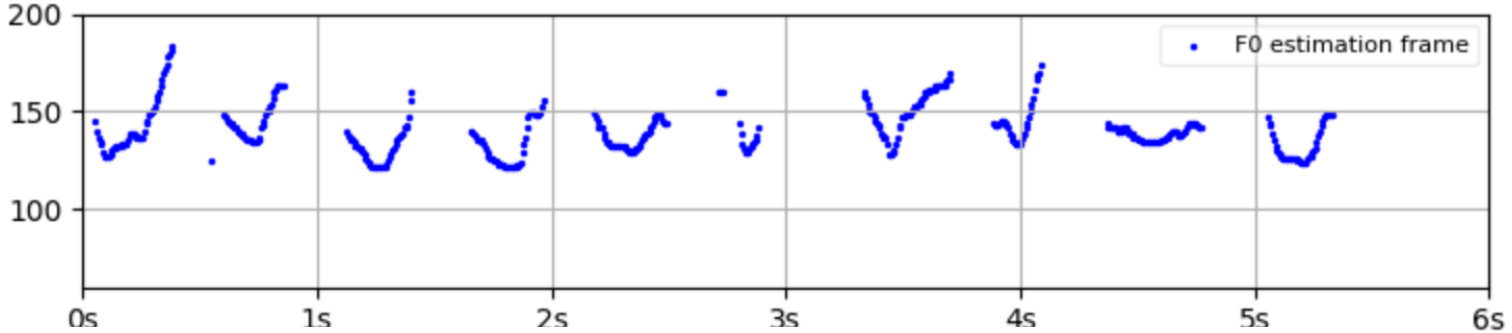


Dilley (1997: 87ff.)

- proposed an **accent sequence similarity constraint** for the head pattern,
- in order to explain such sequential pitch accent patterns as **correlate of coherent grammatical patterns** and
- as a means of **entraining the attention of listeners** to expect pattern changes such as nuclear tones.

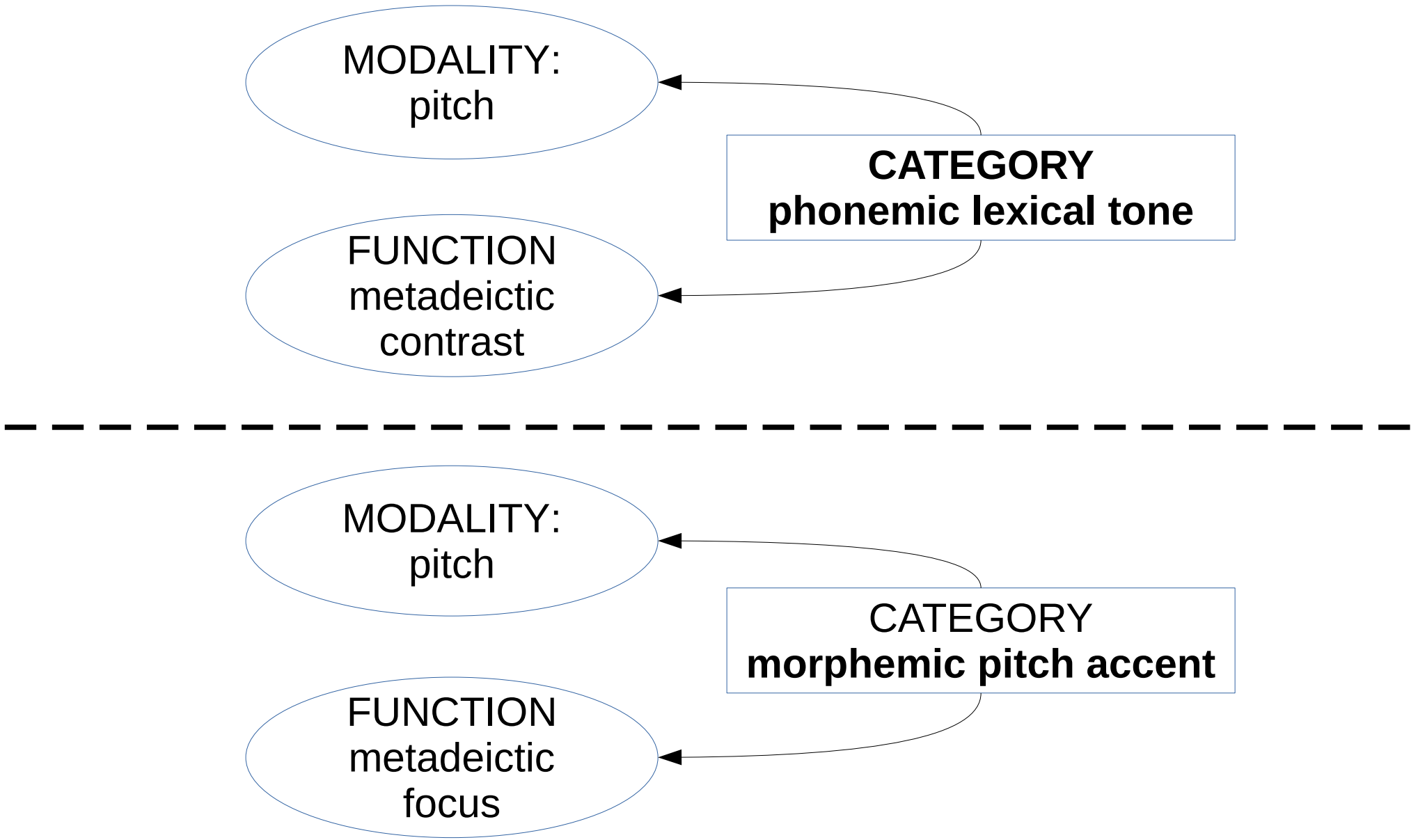
Indo-Germanic
English
ISO 693-3 *eng*

stress-pitch accent & intonation



one two three four five six seven eight nine ten

Tones, Pitch Accents and Intonation: semiotics



Semiotics of Prosody, Case Study 3

Intonation: Global Text and Dialogue Contours

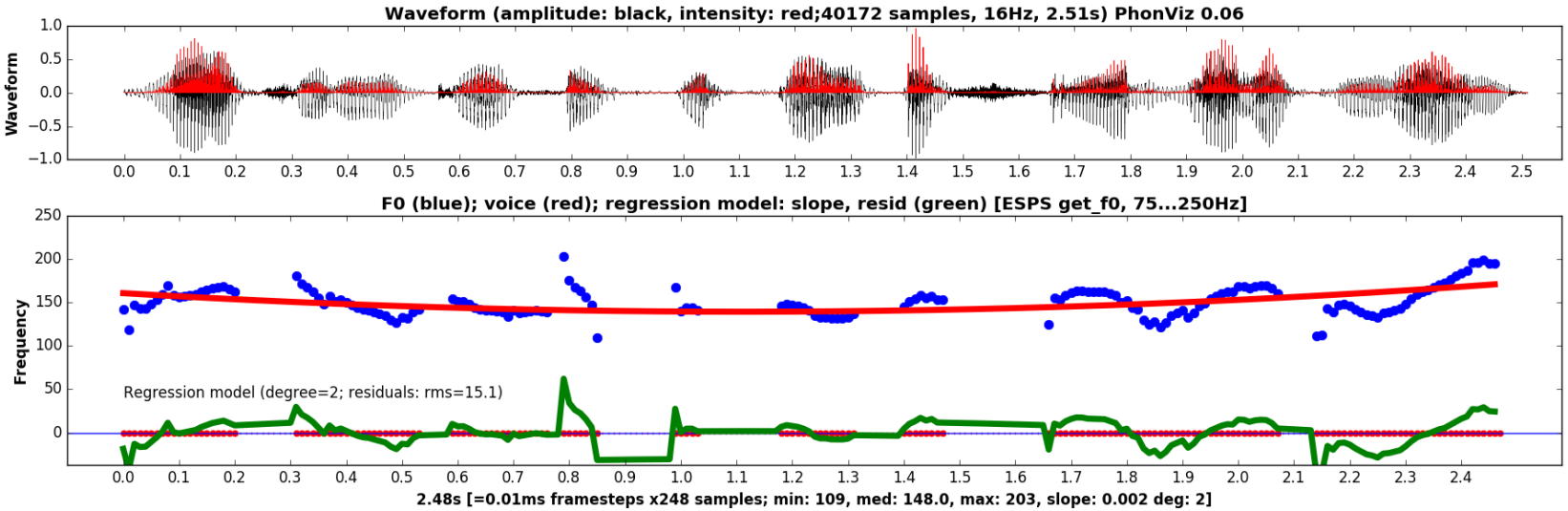
The argument:

Global intonation contours are signs with syntax, modality and function:

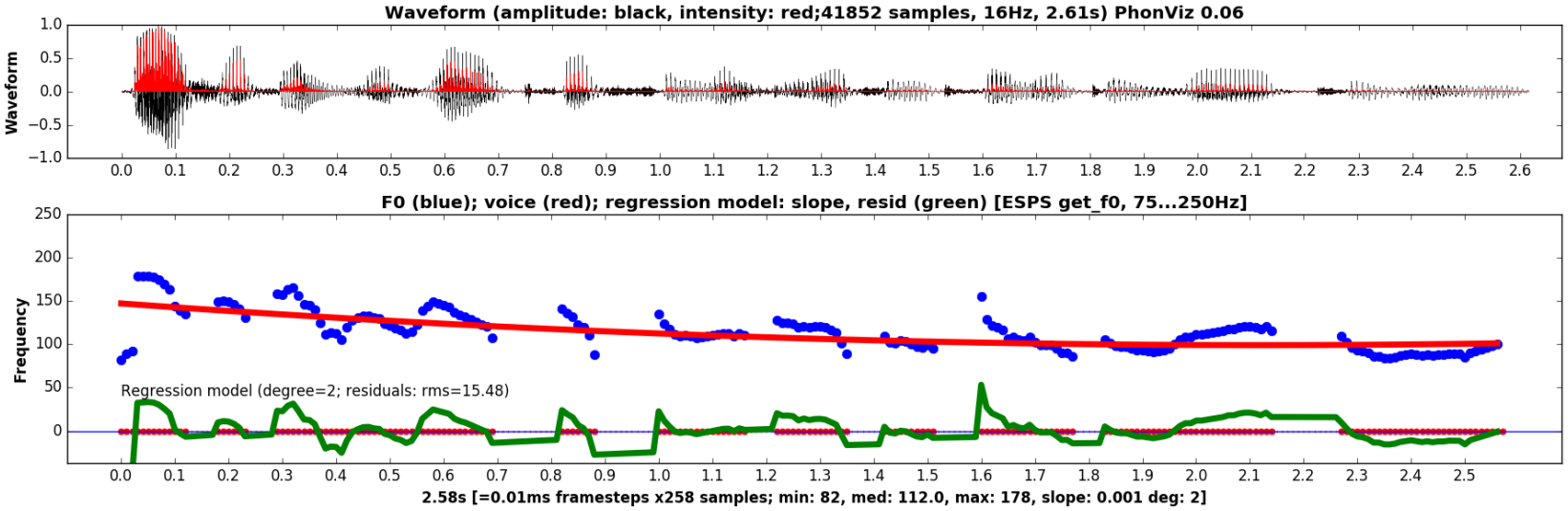
- global contours and syntax:
  - denotation of extent of locutionary units
  - linear concatenation
- modality interpretation of global contours:
  - pitch contours:
    - rise, level, fall, rise-fall, fall-rise
- functional interpretation of global contours:
  - metadeictic denotation of relational properties
    - incomplete (rise), complete (fall), closed gestalt (rise-fall)
  - indexical:
    - attitudinal, emotional

Case Study 3: Global Text and Dialogue Contours

falling-rising global question contour

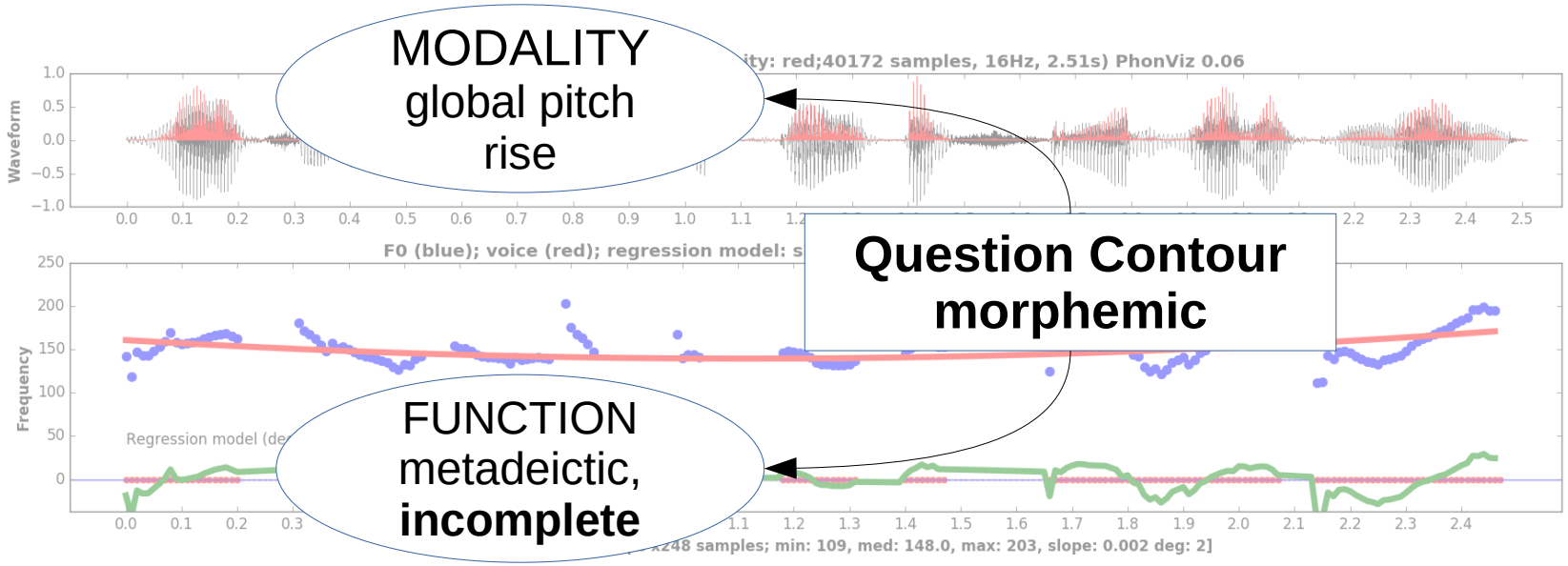


falling global answer contour

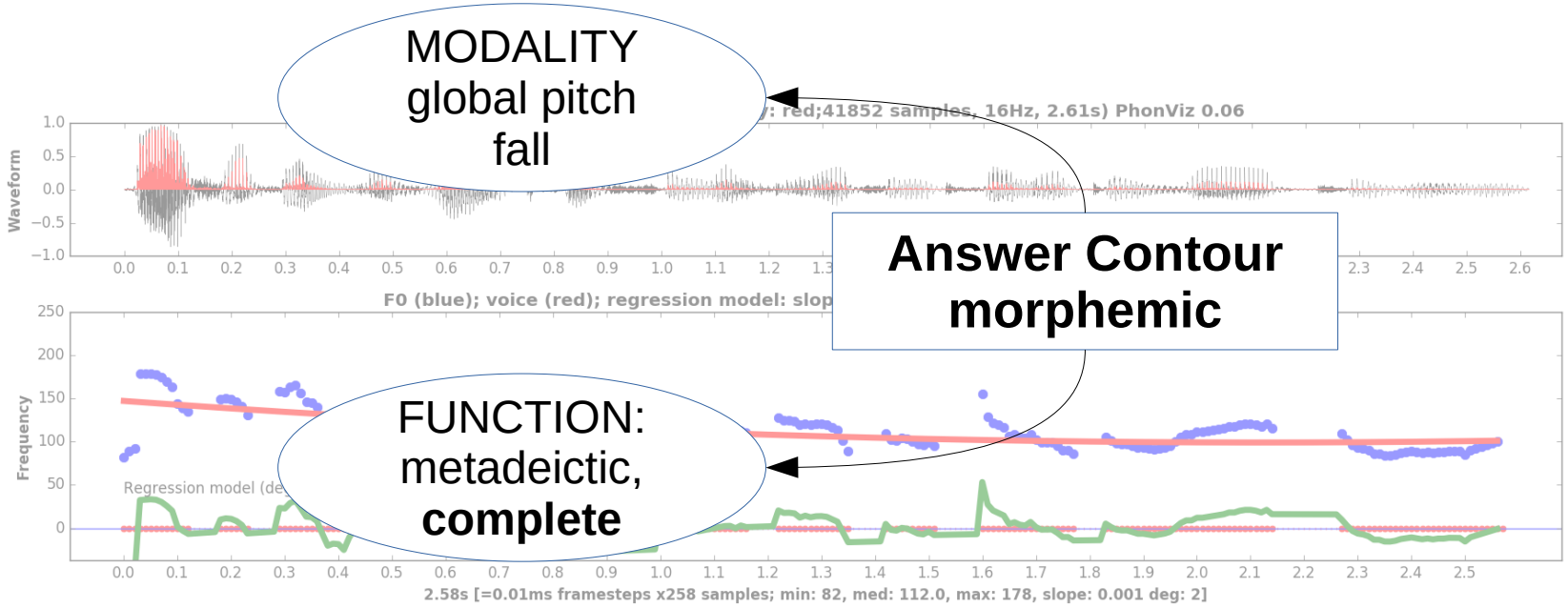


Case Study 3: Global Text and Dialogue Contours

falling-rising
global
question
contour

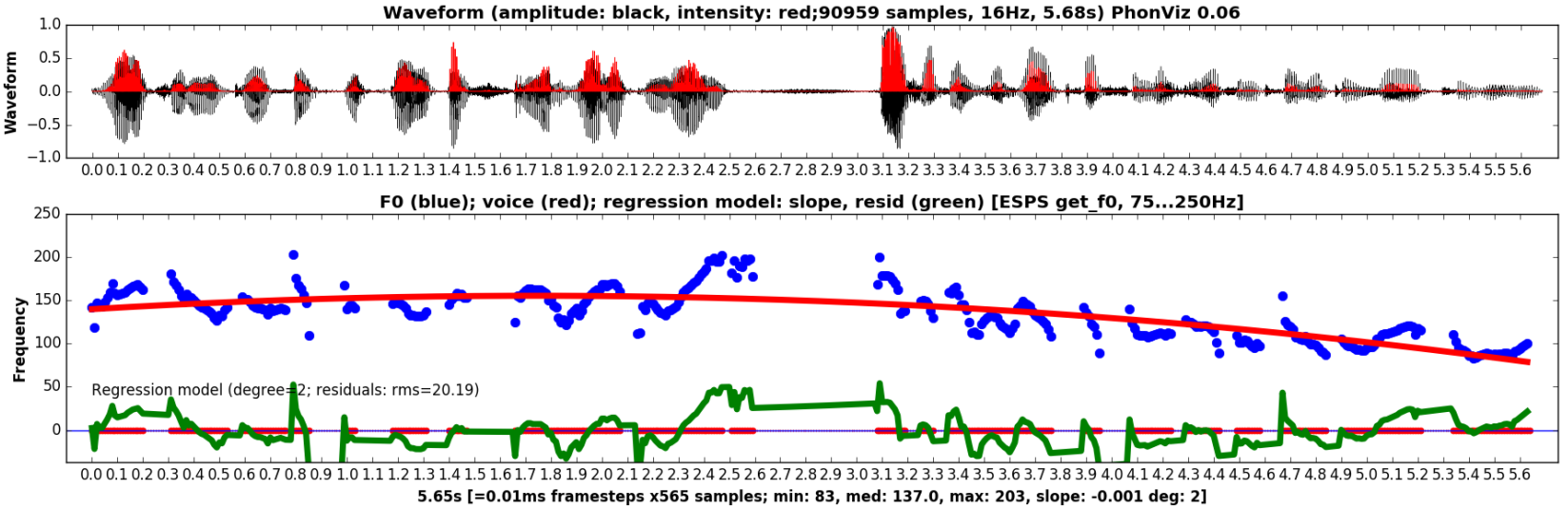


falling
global
answer
contour



Case Study 3: Global Text and Dialogue Contours

rising-falling global dialogue contour



MODALITY
pitch

Adjacency Pair Contour
morphemic

FUNCTION
metadeictic,
iconic gestalt alignment

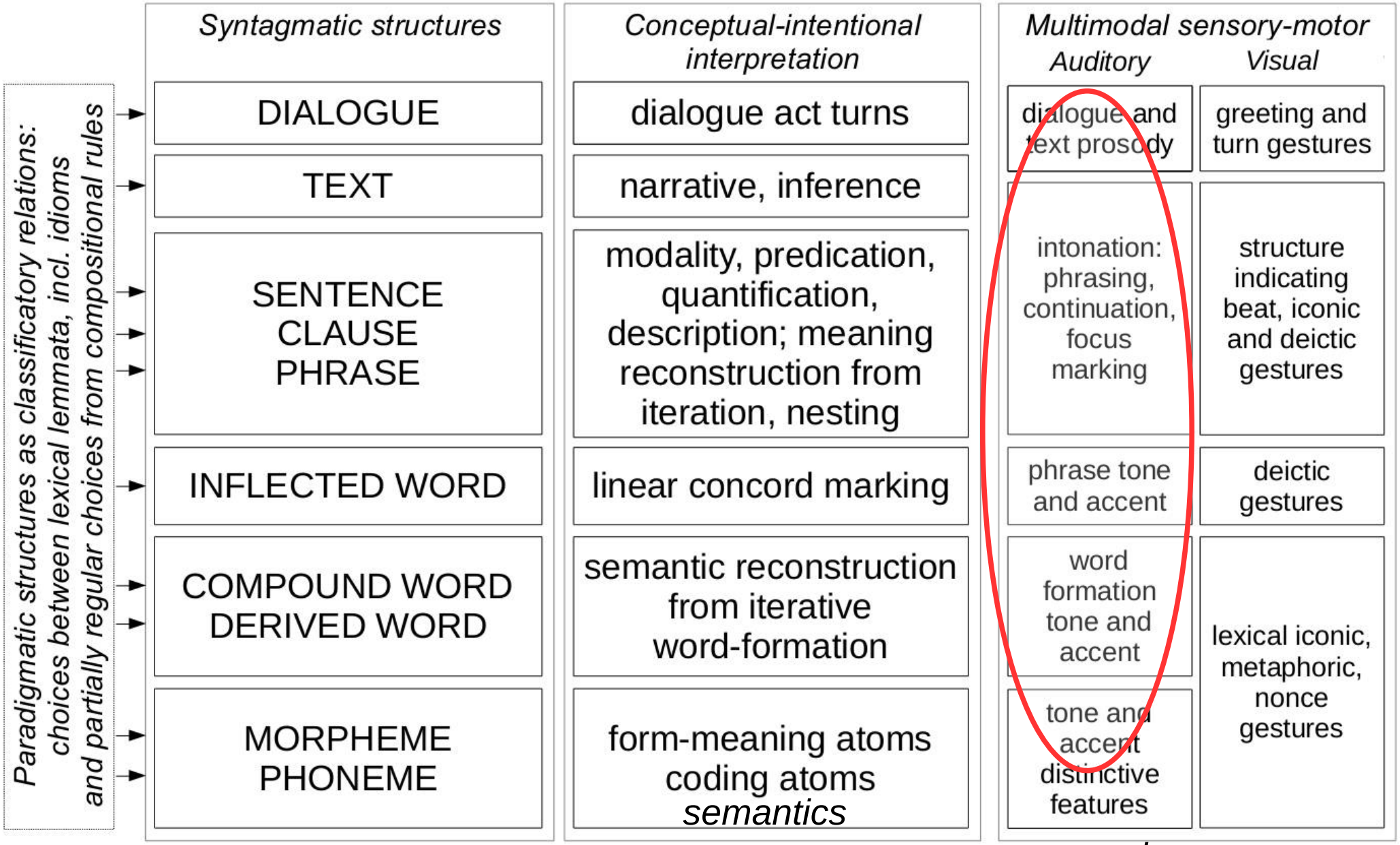
Now listen to these twins ...

Semiotics Part 3

Functions of prosody

in the Rank Interpretation Architecture

Prosody in the Rank Interpretation Architecture



Prosody in the Rank Interpretation Architecture

Discourse functions

- discourse framing
- turn-taking continuity
- speech act marking

Speaker characterisation

- identity, personality
- sentiment, excitement

Information structure

- given-new
- focus, contrast, emphasis

Grammatical cohesion

- phrasing
  - boundary marking
  - rhythm grouping
  - contour coherence
  - disambiguation
- morphosyntactic tone

Lexical functions

- phonemic & morphemic
  - stress
  - pitch accent
  - tone

How do prosodic markers and functions relate to category ranks?

- dialogue and text prosody
- intonation: phrasing, continuation, focus marking
- phrase tone and accent
- word formation tone and accent
- tone and accent distinctive features

?

MODALITY

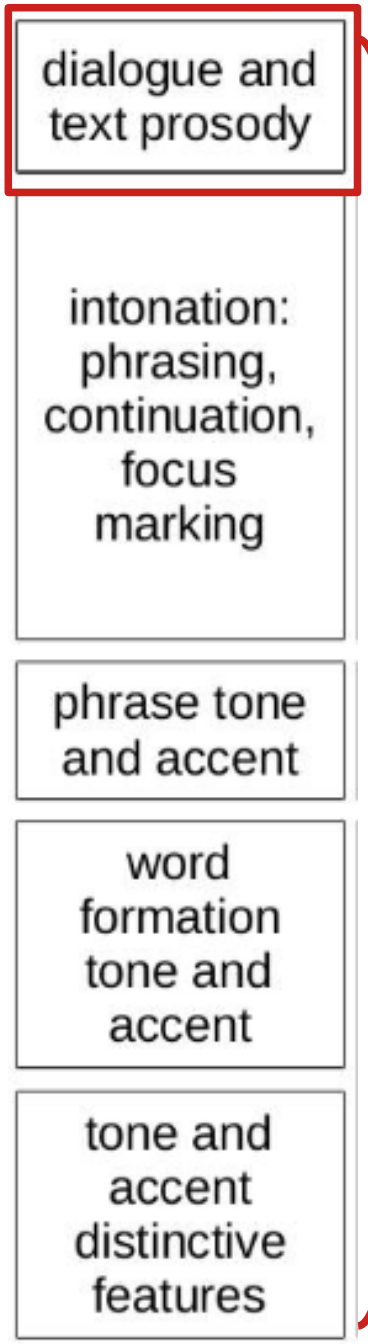
Prosodic markers
- call contours
- hesitation, vocalisations
- rise: continuity, uncertainty, subordination
- fall: termination, certainty, superordination
- rise-fall: topic-comment, question-answer, ...

FUNCTION

Discourse functions
- discourse framing
- continuity: topic-comment, turn-taking
- grammatical mood, speech act marking
- speaker characterisation

Lexico-grammatical semantic-pragmatic functions
- metalocutionary deixis (metadeixis)
- lexicon: distinctive/contrastive, phoneme/morpheme
- structure: cohesion, configuration: delimitation, culmination

Prosody-relevant complementary taxonomies of speech functions



Peirce: semantic-pragmatic functions
- symbol (morphemic)
- icon (teeny weeny mouse with low pitch)
- index (relation to time, place, person, cause)

Austin (1962), Searle (1969): speech act theory
- locution (syntax, semantics)
- illocution (pragmatics: interactive obligations)
- perlocution (effect: impression, insult, ...

Grice (1975): Cooperative Principle, Maxims of Conversation
- Maxim of quantity (long/short, deep/shallow in detail)
- Maxim of quality (truth/falsity, lying, ignorance, error)
- Maxim of relation (relevance/irrelevance)
- Maxim of manner (clarity/obscurity, direct/indirect)

Hirschberg & Pierrehumbert (1984)
- “semantico-pragmatic effects”
- discourse segmentation, topic/information structure
- parallelism, subordination, topic shift, interruption, turn-taking
- disambiguation, reference resolution, given/new, contrast
- (indirect) speech acts

Grosz & Sidner 1986
- linguistic structure, intentional structure, attitudinal state
- focus, contrast, emphasis, given/new, theme/rheme

A prosodic lexicon: idioms and prosodic morphemes

Greeting:

1. Good morning /
2. Good morning \

Ambiguity:

3. Excuse _me /
4. Excuse \ me /

Reproach:

5. And so ¯ you should \
6. And so / you should \

Appraisive exclamation:

7. Oh / wow /\ (cf. also the “wolf whistle” or “cat-call”)

And of course for the ‘call contour’ idioms

Universal paralinguistic indexical and iconic functions

Are pitch properties universal?

pitch height – biological size

intensity, range – energy and precision

boundary tones, declination – structure marking

Are pitch functions universal?

paralinguistic:

global: excitement (range)

local: insistence (prominence), e.g. No-wo-wo-wo-wo!

linguistic:

intonation hierarchy (paratone)

accent sequence constraints

Universal paralinguistic indexical and iconic functions

Note that some markers and paralinguistic functions are shared with animals.

Are pitch properties universal?

pitch height – biological size

intensity, range – energy and precision

boundary tones, declination – structure marking

Are pitch functions universal?

paralinguistic:

- global: excitement (range)
- local: insistence (prominence), e.g. No-wo-wo-wo-wo!

linguistic:

- intonation hierarchy (paratone)
- accent sequence constraints

Indexical functions of prosody

Speaker characterisation:

1. indexicality: identity, personality
2. emotionality: attitude, sentiment, excitement
3. size, gender, age

Direct iconic-indexical relation between modality and function leads to universal codes?

Acoustic:

Ohala: Frequency code: size, status, ...

Gibbon: Modulation Code: rhythms and melodies

Articulatory:

Gussenhoven: Size Code, Effort Code, Production Code

Modulation Code

Two low frequency time domain channels:

1. Amplitude Modulation

   phonological correlate: sonority curve

2. Frequency Modulation

   phonological correlates: tone, pitch accent, intonation

Two modulation scopes:

1. global

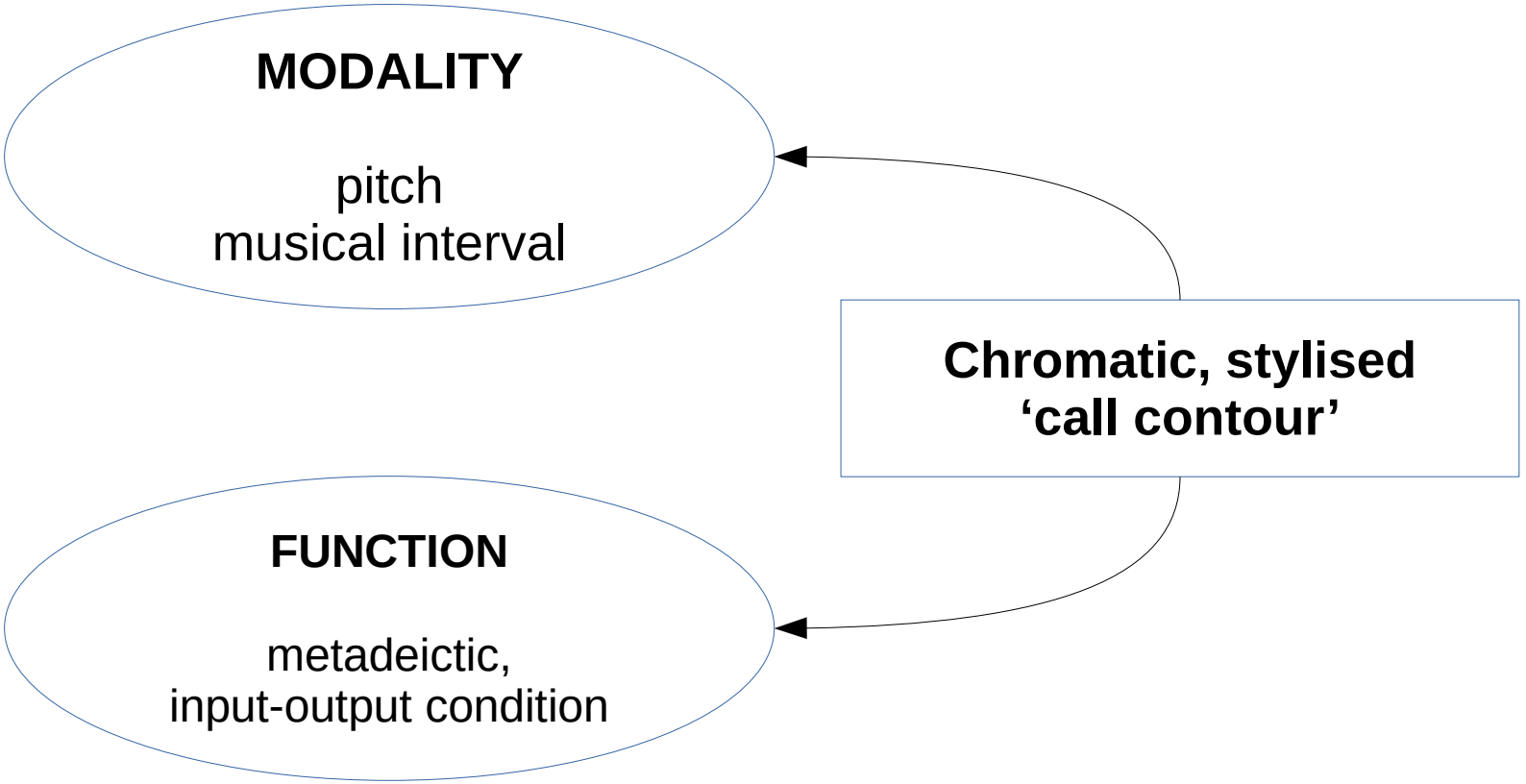
   range / intensity / tempo variation

2. local

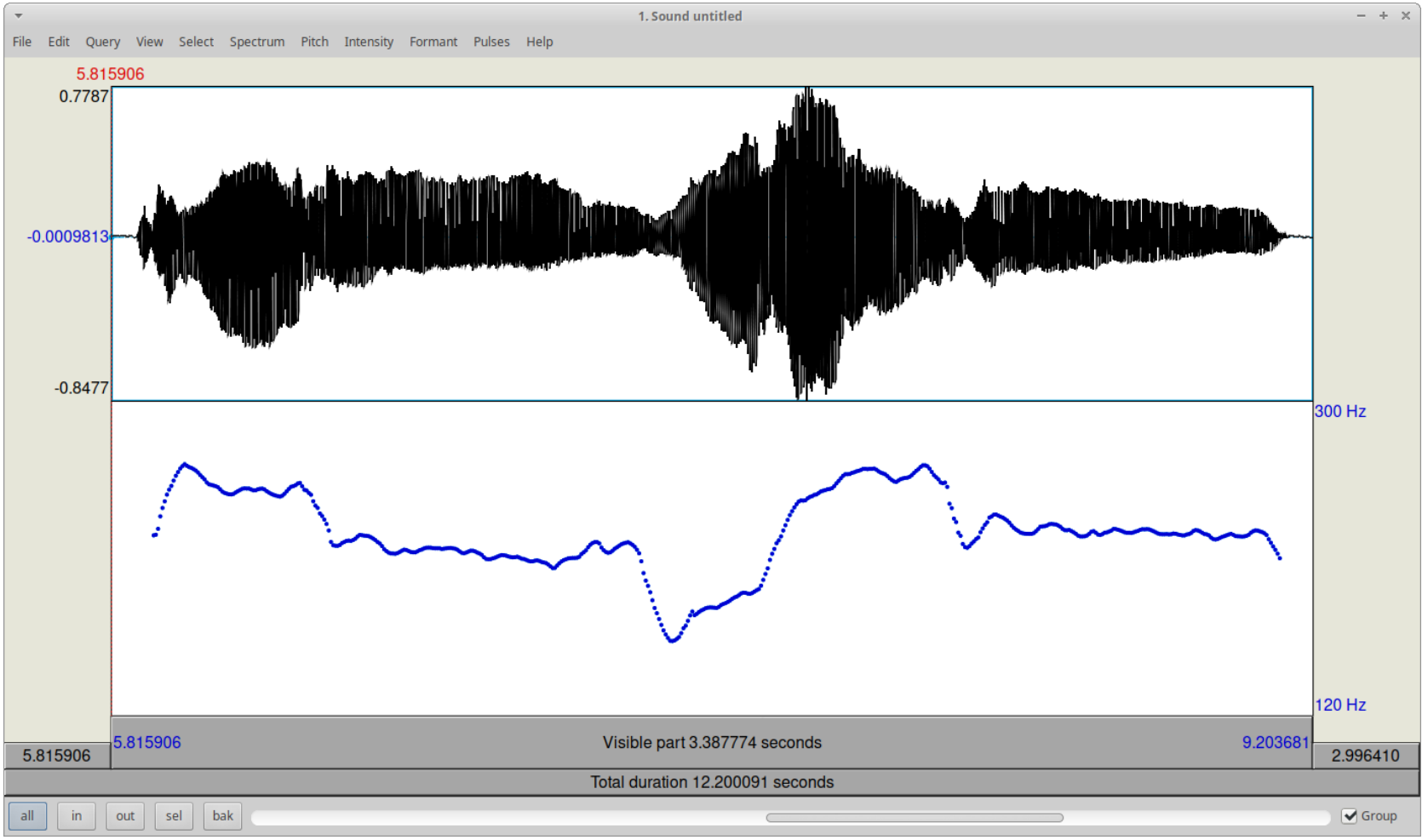
   prominence by pitch height and contour, intensity variation, tempo variation

Case study 4: ‘call contours’

Case study 4: 'call contours'

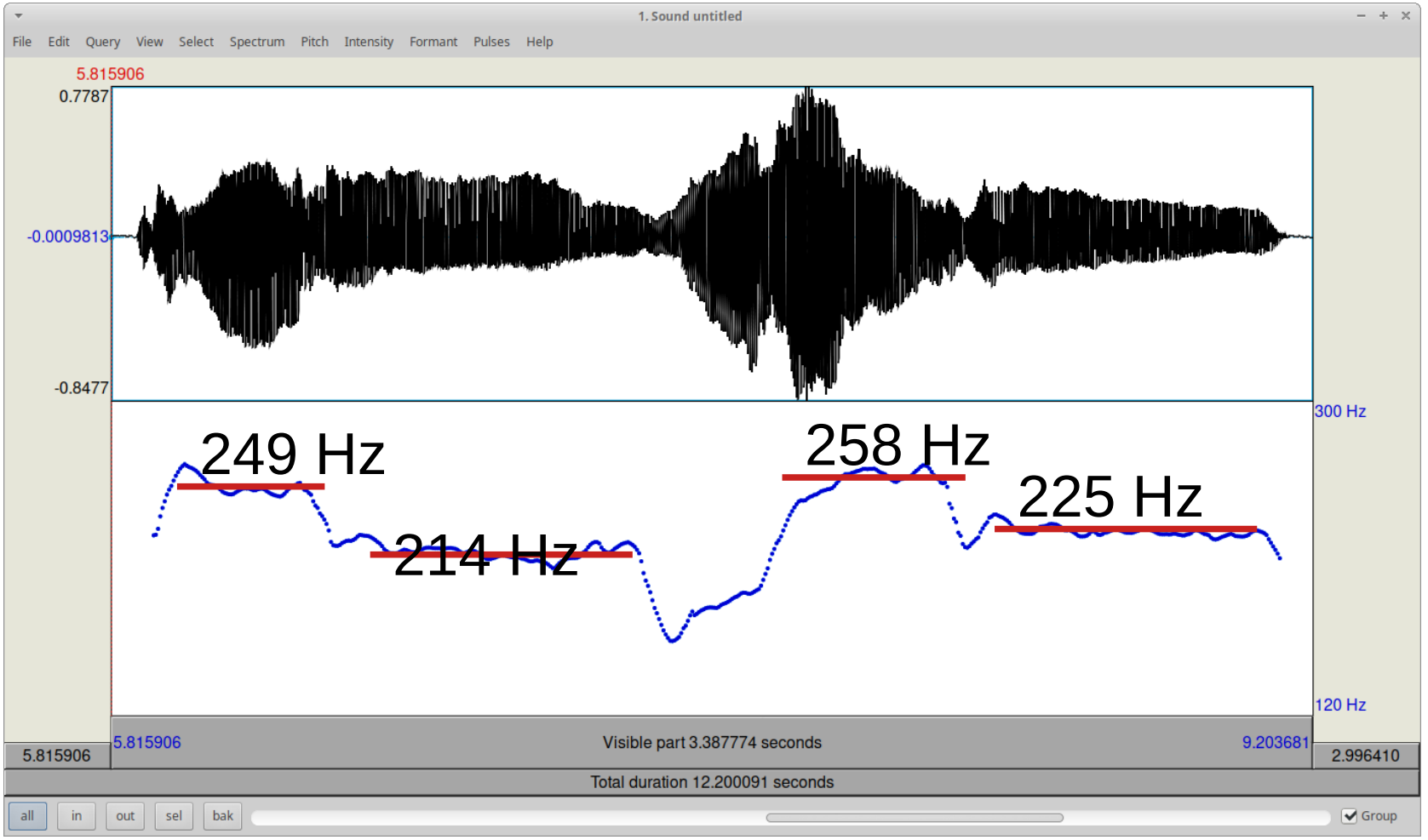


Case study 4: 'call contours' – MODALITY

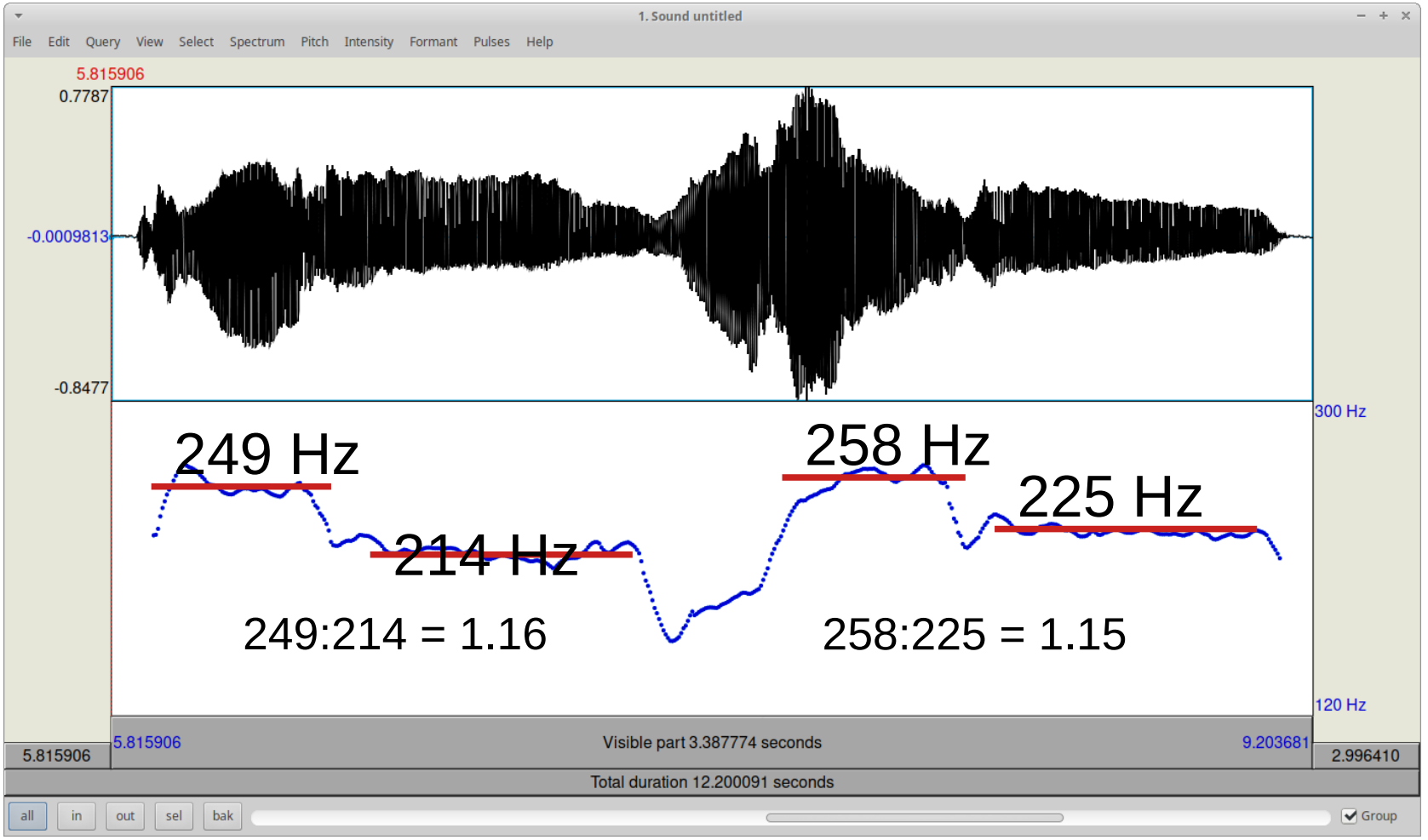


Johnny! *Where are you?*

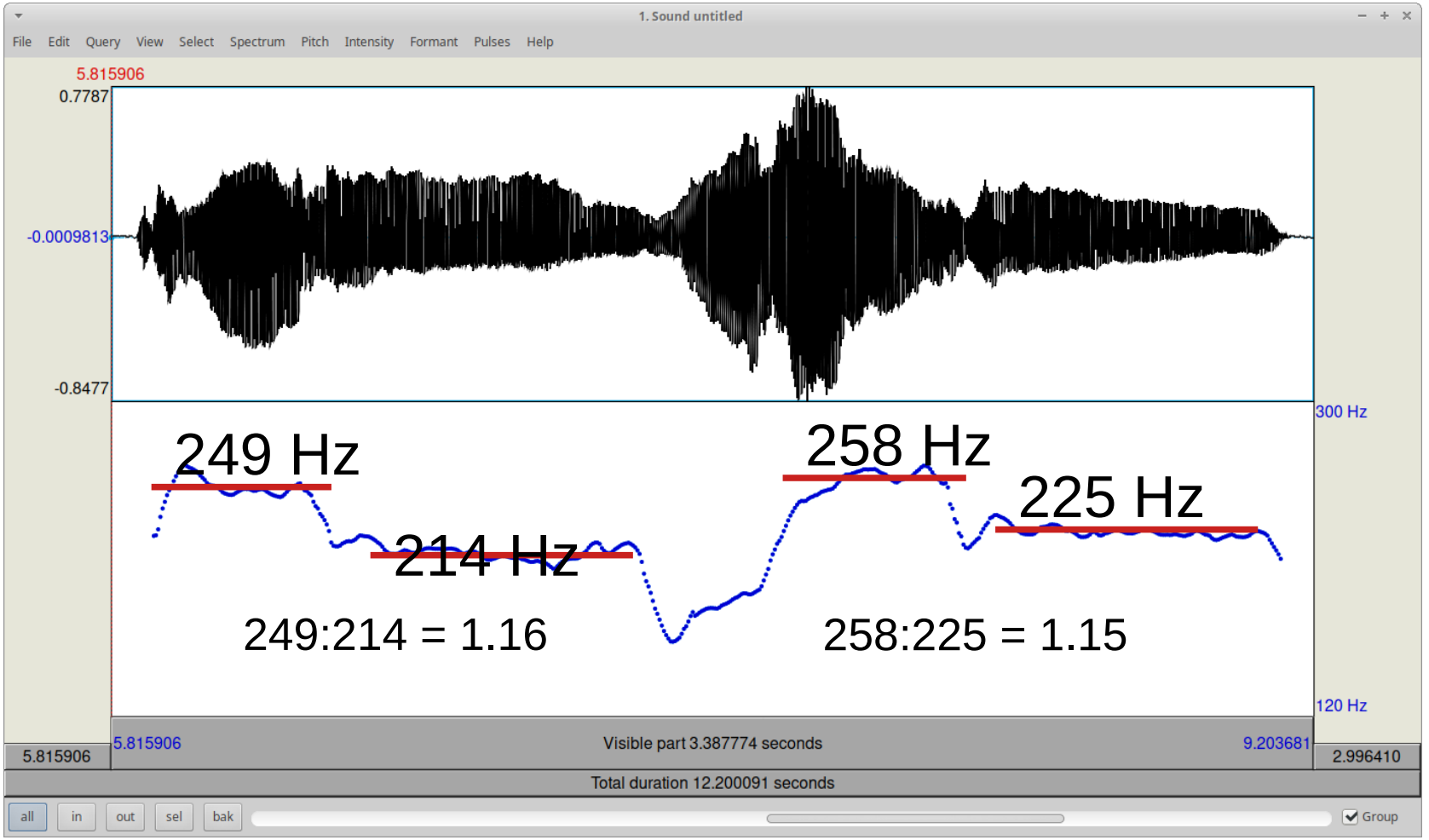
Case study 4: 'call contours' – MODALITY



Case study 4: 'call contours' – MODALITY



Case study 4: 'call contours' – MODALITY



Untypical pitch contour

- Acoustically a sequence of 2 level tones (with natural irregularities)
- Acoustically constant musical interval (with natural irregularities)
- In European music,
  - 3 semitones, ¼ octave
  - minor third (ratio between **1.12** and **1.19**, depending on context in scale

Case study 4: 'call contours' – FUNCTION

Discourse structure function in English:

Metalocutionary discourse framing:

Start: "Jooohn-neee!"

End: "Byyy-eee!"

But <u>not</u> at sentence or phrase rank:

* Yesterday I saw ˉJooohn-neee in town.

Also a metalocutionary discourse repair function in German:

ˉLau-ter ("Lauter!", louder)

Ich habe ˉJooohn-neee gesagt!

Case study 4: 'call contours' – FUNCTION

It has been claimed that the "call contour" is a speech act marker.

The question arises: What kind of speech act marker?

The question can be answered with reference to Searle's version of Speech Act Theory:

There are three basic conditions on speech acts:

1. Uptake condition (pragmatics)

   Normal input and output conditions obtain
2. Essential condition (pragmatics)

   Commitment to action
3. Sincerity condition (semantics)

   truth – probability – certainty

Case study 4: 'call contours' – FUNCTION

The function can be described in terms of Searle (1969) Uptake Condition for successful speech acts

> "1. Normal input and output conditions obtain."

In other words, in the discourse structural terms of Rank Interpretation Theory:

> a channel opening, repair or closing function**.**

Case study 4: 'call contours' – FUNCTION

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> a channel opening, repair or closing function**.**

ENGLISH: ¯JOHN-NY - ¯BY-E

GERMAN: Manu¯E-LA - - - - ¯LAU-TER - - - - - ¯WIEDER-SEHEN

Case study 4: 'call contours' – FUNCTION

The function can be described in terms of Searle (1969) Uptake Condition for successful speech acts

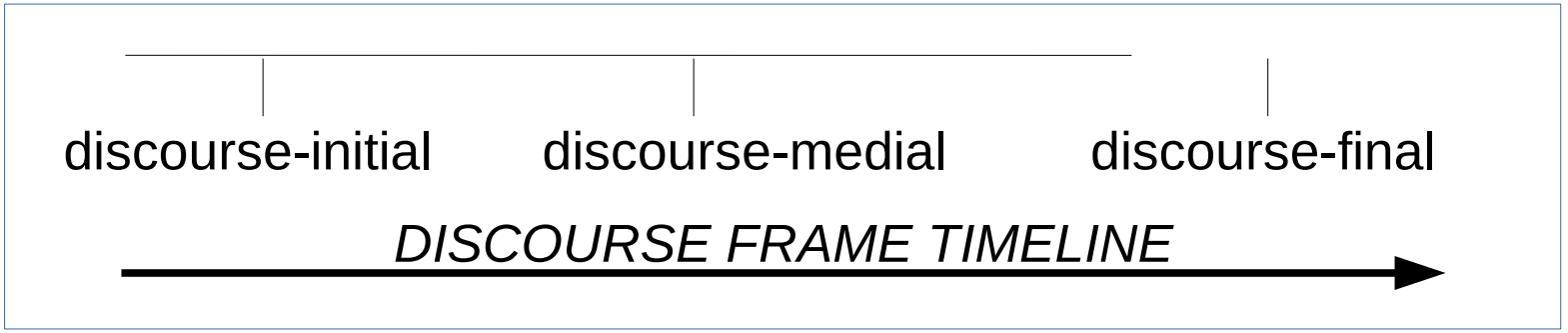
> "1. Normal input and output conditions obtain."

In other words, in the discourse structural terms of Rank Interpretation Theory:

> channel opening, repair or closing function in discourse grammar

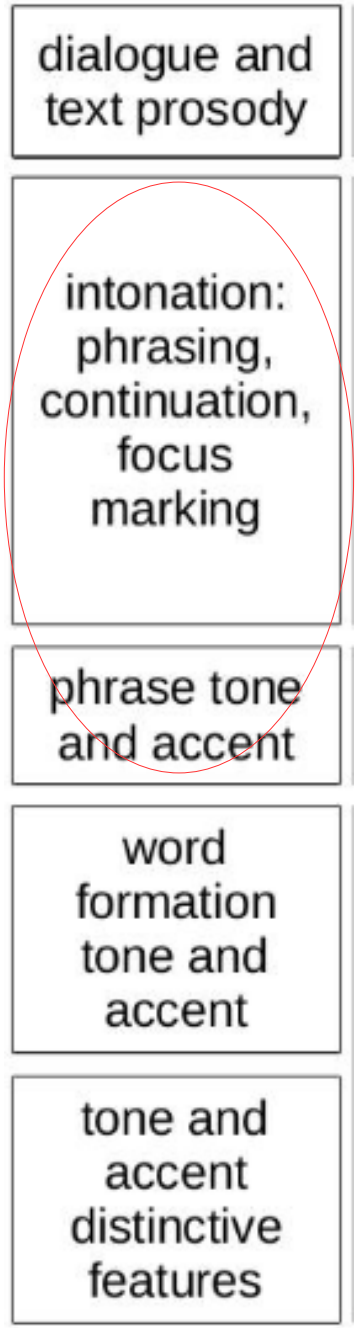
ENGLISH: ¯JOHN-NY - ¯BY-E

GERMAN: Manu¯E-LA - - - - ¯LAU-TER - - - - - ¯WIEDER-SEHEN



Iconic and indexical (metadeictic) grammatical functions of tone

Iconic and indexical (metadeictic) grammatical functions of tone



Grammatical function:

1. configuration relations (global pattern):
    1. boundary marking
        1. boundary tones: ‘startup tone’, ‘quitting tone’
        2. final lengthening
    2. rhythmic grouping, ‘flat hierarchies’
        1. quasi-isochrony of pitch accent / stress spacing
    3. contour coherence
        1. global fall (declination)
        2. global rise (inclination)d
2. culmination relations (local accents):
        - theme-rheme
        - given-new
        - contrast
        - focus, emphasis

Iconic and indexical (metadeictic) grammatical functions of tone

Single clause:

- predicate-argument patterns
  - ‘sentence stress’:
    - ‘neutral’
    - contrastive
    - focus
    - emphatic
- mood (grammatical and subjective):
  - e.g. final fall-rise – *the performance was ˋok/ay*
- (logical) scope
  - e.g. negation:
    - *I didn’t eat it, because I prefer vegetables.*
    - *I didn’t eat it because I prefer vegetables* *(but because I cooked it myself)*

Multiple clause:

- coordinating: *First John sang a song, then he played the violin.*
- subordinating: *John sang a song before he played the violin.*

Morphemic functions of prosody

Lexical function

compositional (structural):

1. linking tone
2. compound stress

morphemic (meaningful) function

- inflectional tone
- affective (“Wow!”)

phonemic (contrastive) function

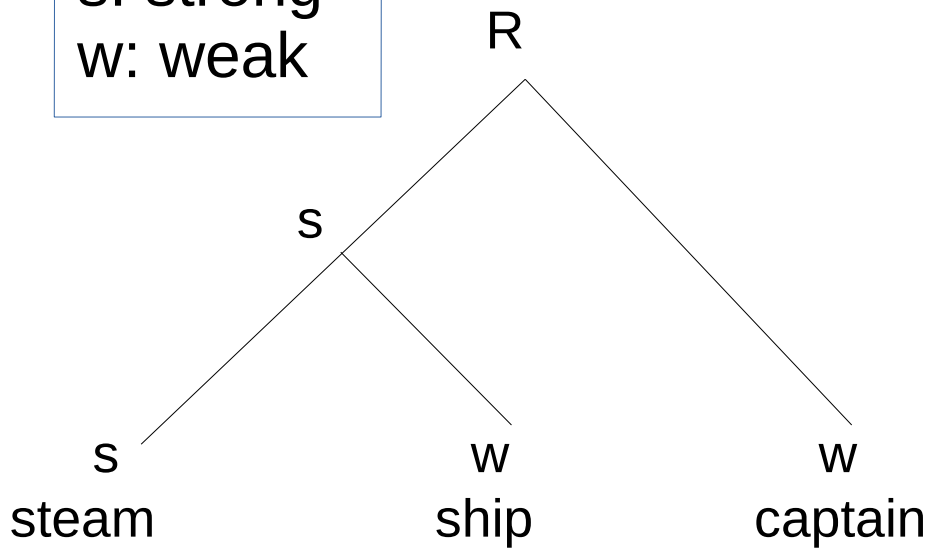
- stress position:
  1. duration
  2. intensity, amplitude
  3. pitch accent
  4. tone

1. English:

^{1}steam^{2}ship, ^{1}steam^{3}ship ^{2}captain

SPE Compound Stress Rule

R: root
s: strong
w: weak



Liberman's bottom-up algorithm for the Nuclear and Compound Stress Rules:

for each leaf in the tree:

stress level =

number of nodes in the path from the first non-strong node to the root (bottom-up)

number of nodes in the path from the last non-strong node to the root (top-down)

Morphemic functions of prosody: inflection

Inflection:

Ibibio

ISO 639-3 *ibb* Niger-Congo > Lower Cross, Nigeria):

j`a'a* (distal future) vs. *j'a`a (proximal future)

`mm`e	`afj'a	'edọn̄	'e+j^a+'e+b'ed	`Im'e
Plur	white	sheep	SubjAgr+Fut-Prox+SubjAgr+wait-for	Ime

The distal and proximal tones also apply to the past morpheme *maa*

Imagine ‘borrowing’ this function in English or in other languages!

Phonological functions of tone – phonemic functions

(done that)

Phonological functions of tone – morphophonemic functions

(done that)

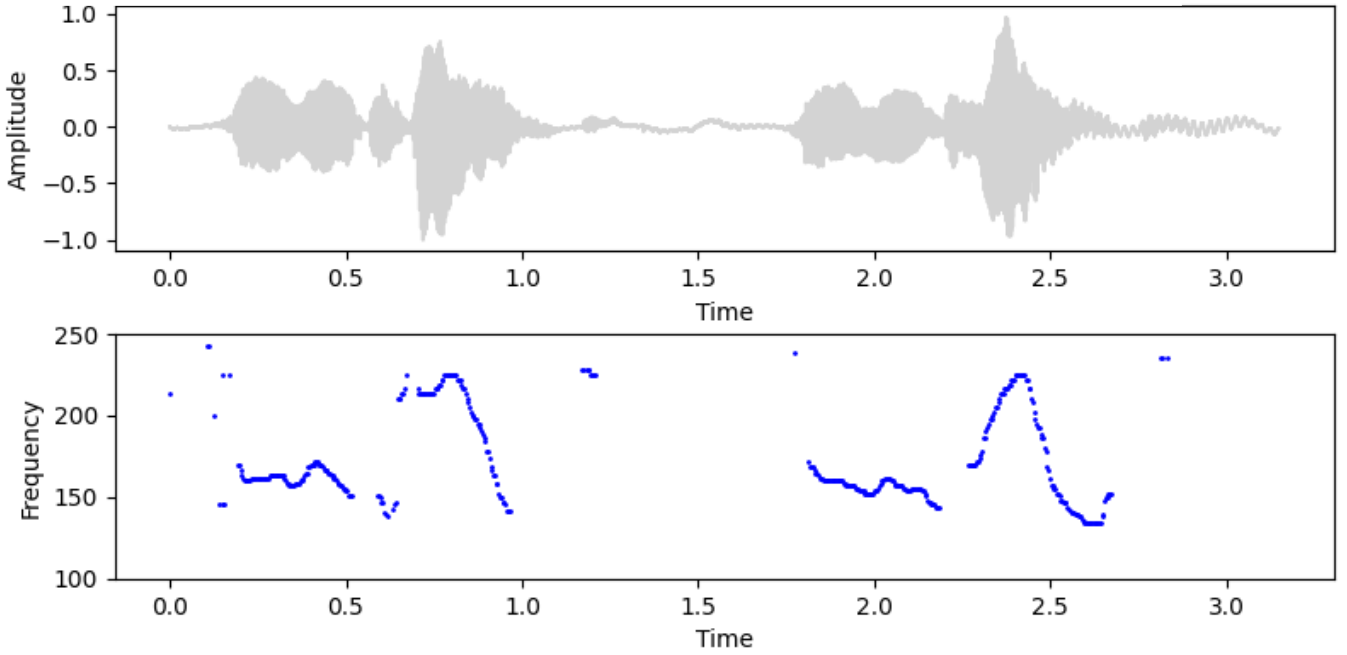
Phonological functions of tone: subphonemic microprosody

Pitch perturbation:

Consonant articulation affects air pressure

1. air pressure affects phonation rate
2. and thus also
    1. measurable fundamental frequency
    2. perceivable pitch

[t’] I will try it [d] I will dry it



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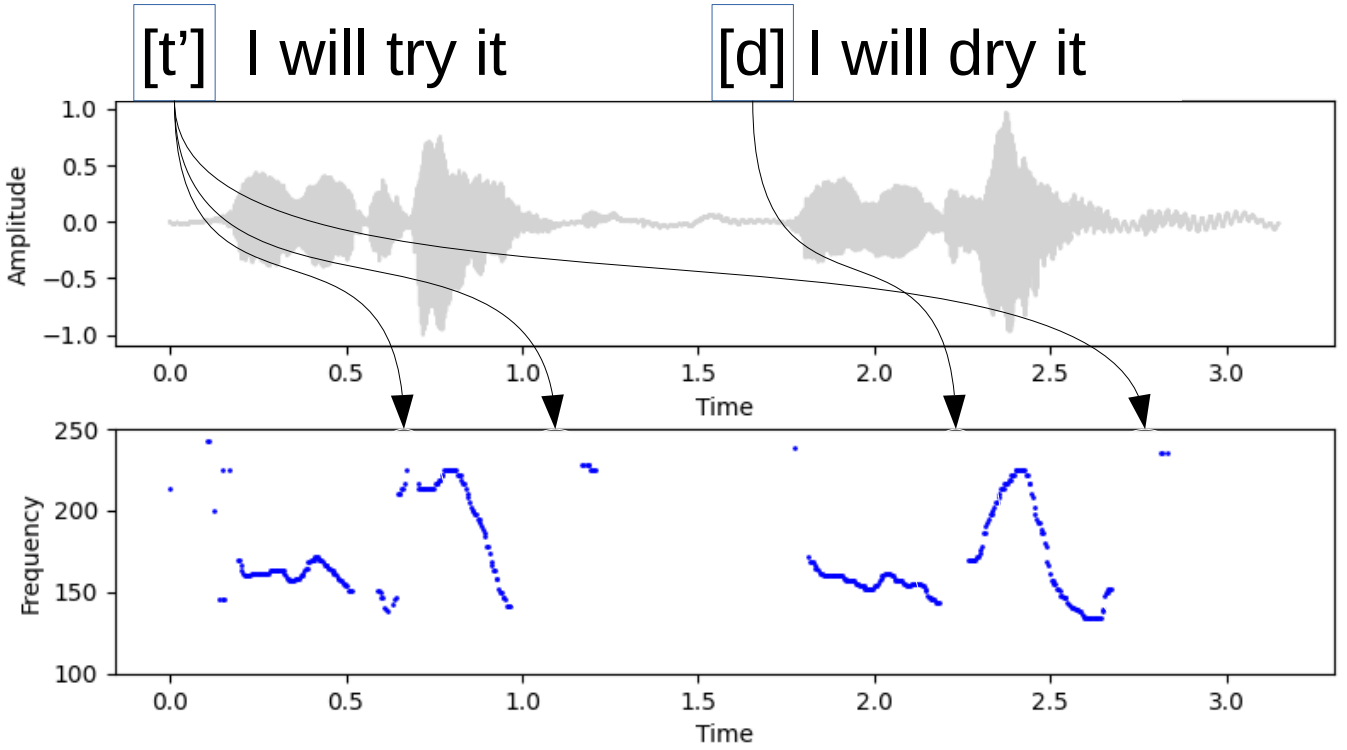


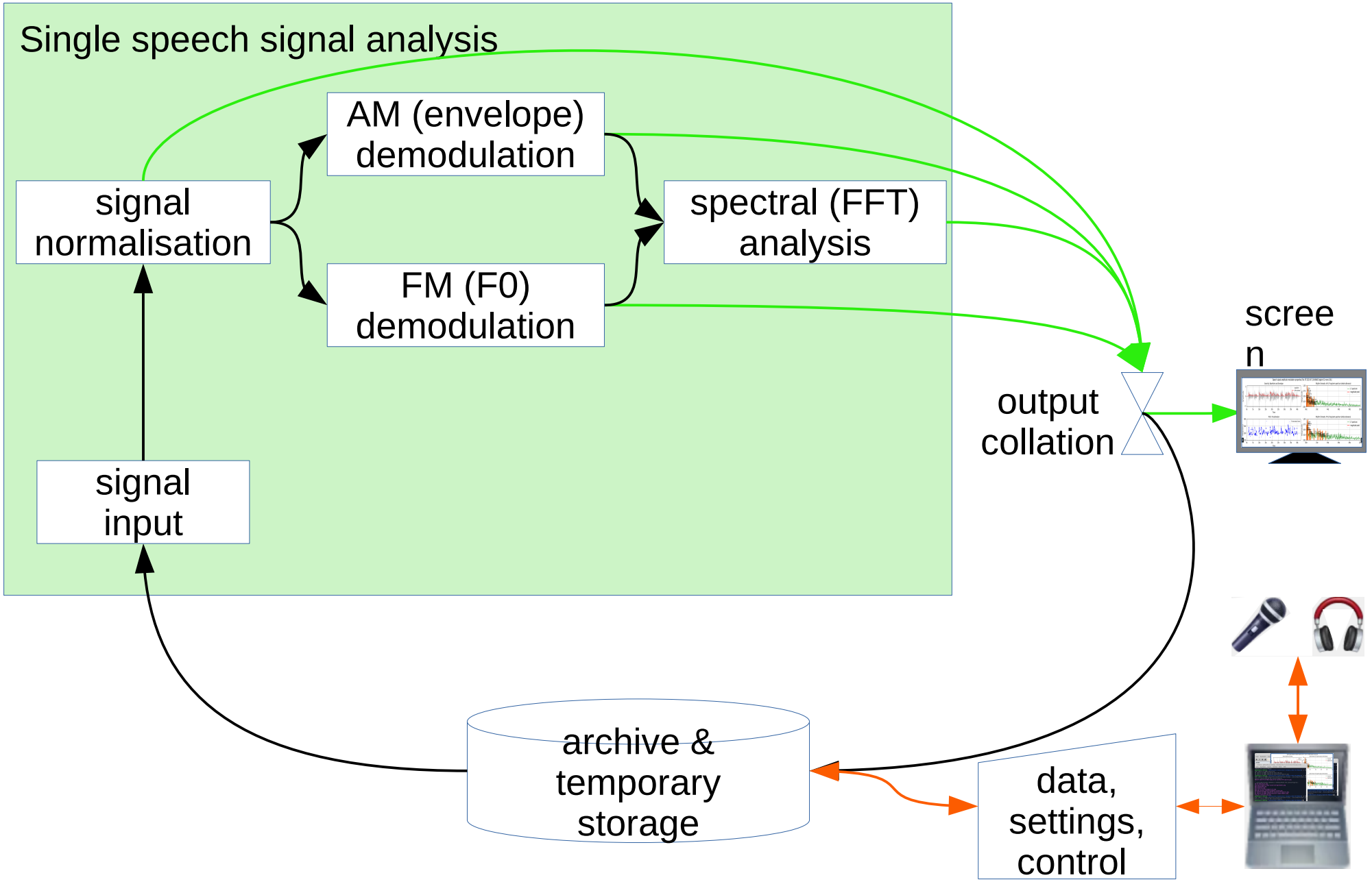
Function and Form: Rhythms in Tang dynasty poetry recitation

in cooperation with Dr. Lin Xuewei, JNU, Guangzhou

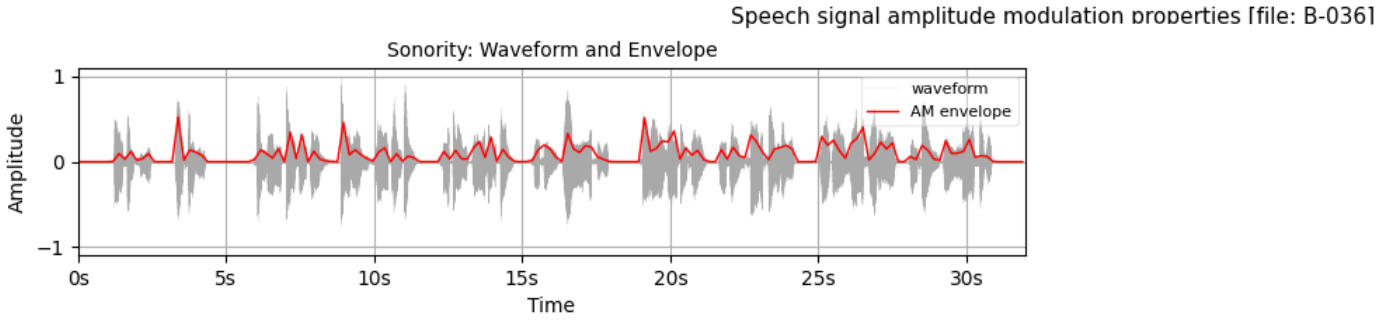
Function and Form: Rhythms in Tang dynasty poetry recitation

1. **Domains:**
    1. Functional classification of speech genres / subgenres
    2. Phonetic classification of speech genres / subgenres
2. **Method – comparison of domains:**
    1. **Data selection:**
        22 recitations, 11 each in two out of ten subgenres of poetry
    2. **Literary classification of the two subgenres:**
        1. **Subgenre B:** Five-character-folk-styled-verse **五言乐府**
        2. **Subgenre F:** Seven-character-regular-verse **七言律诗**
    3. **Experimental phonetic analysis of rhythms of the recitations:**
        Spectrum and Rhythm Formant Analysis
        Calculation of difference (‘distance’) between recitations
        Classification on the basis of distances
    4. **Comparison of literary and phonetic classifications**
    5. **Hypothesis:** The two groups are indistinguishable

Classification of Tang dynasty poetry recitation by rhythm

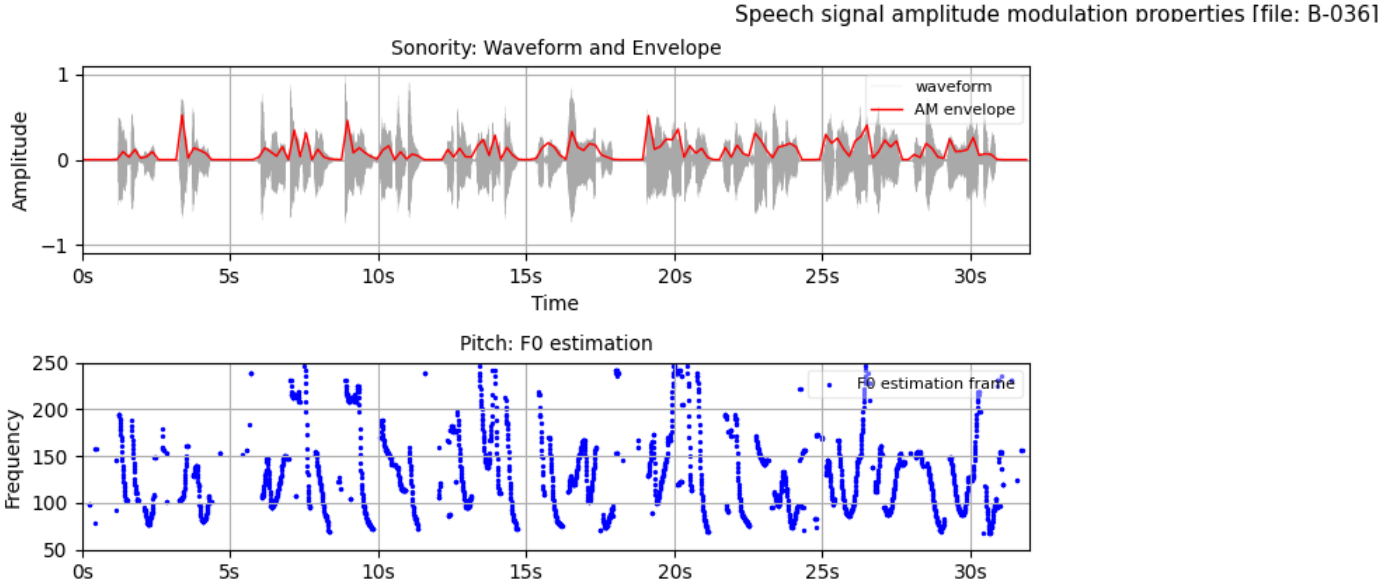


Function and Form: Rhythms in Tang dynasty poetry recitation



Time domain
- amplitude modulation (AM)
- frequency modulation (FM)

Function and Form: Rhythms in Tang dynasty poetry recitation



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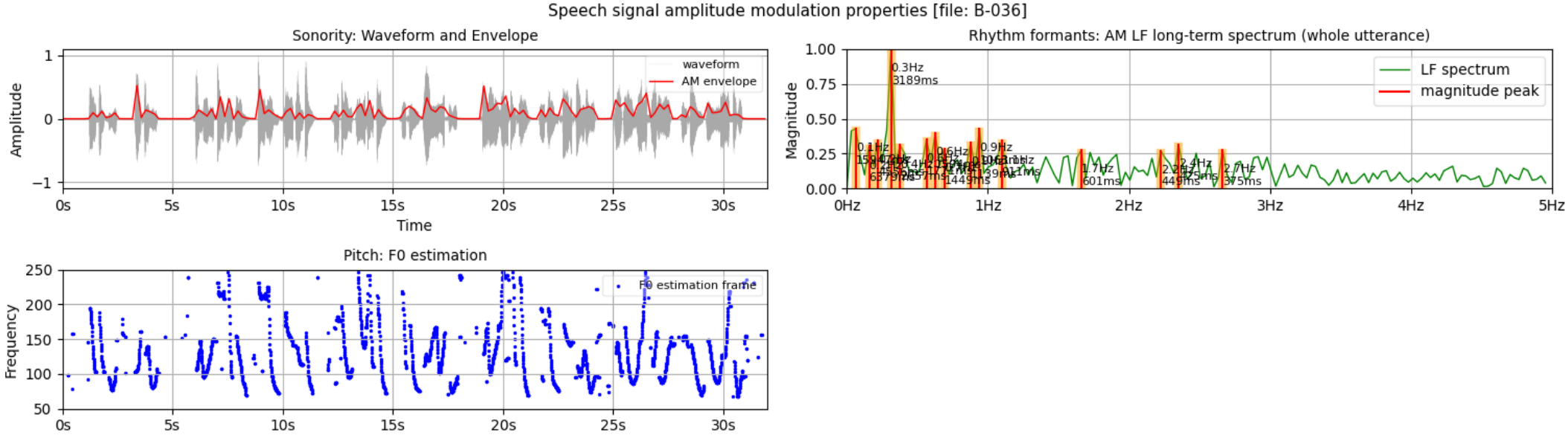
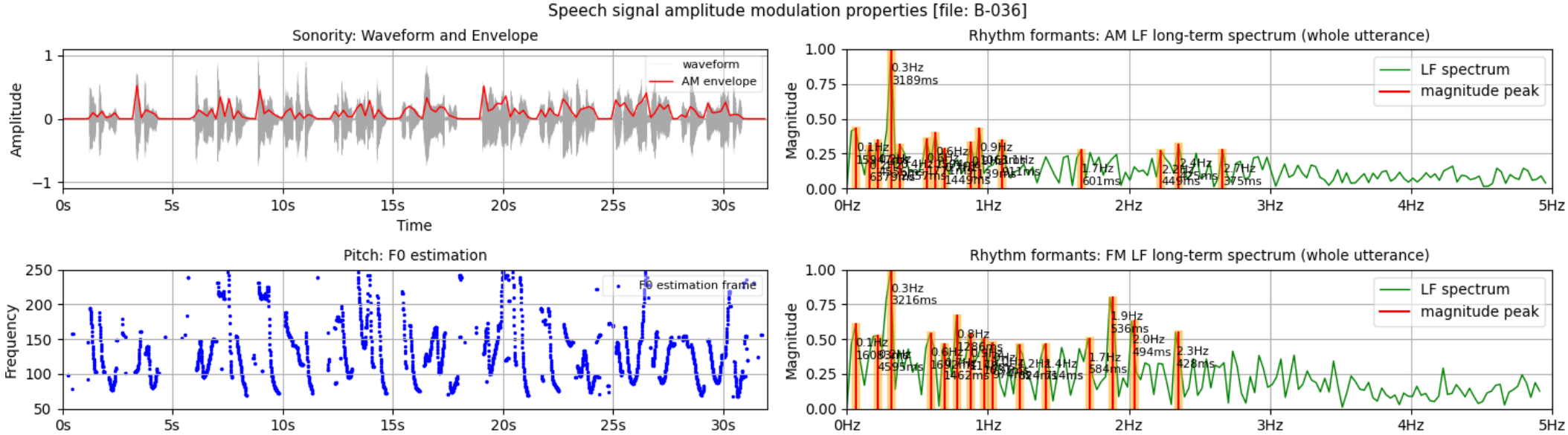


Time domain
- amplitude modulation (AM)
- frequency modulation (FM)

Spectral frequency domain
- AM

Function and Form: Rhythms in Tang dynasty poetry recitation



Time domain
- amplitude modulation (AM)
- frequency modulation (FM)

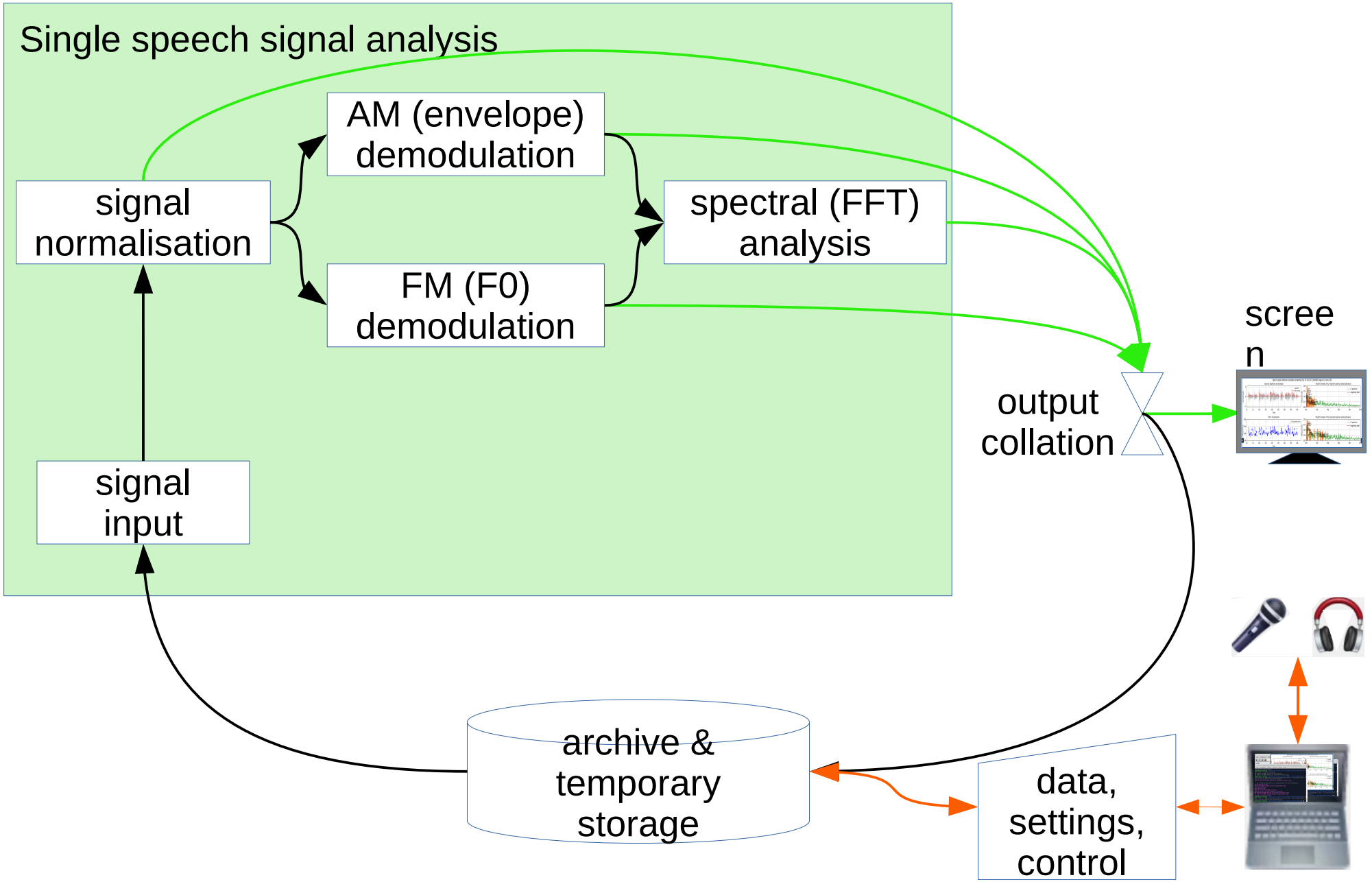
Spectral frequency domain
- AM
-FM

Current procedure:

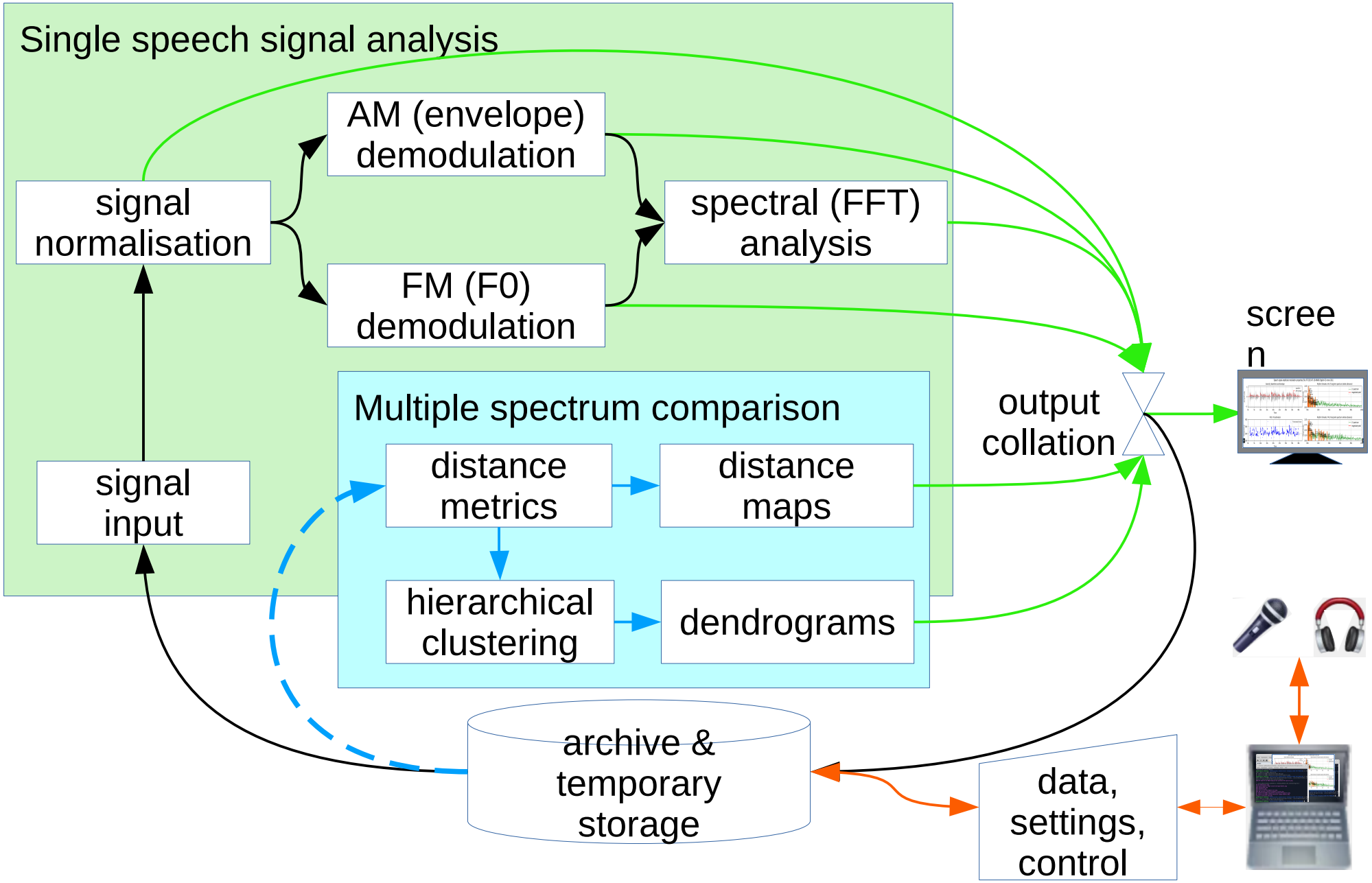
From the AM spectra of all 22 recordings,

- Collect the highest magnitude spectral values above a selected level
- Compare these values pairwise:
  - Select the relevant distance metrics
    - from, for example, Manhattan Distance, Normalised Manhattan Distance, Chebyshev Distance, Cosine Distance, Euclidean distance, ...
  - Create a ‘distance matrix’
    - Display the contents of the distance matrix as a ‘distance map’
  - Inductively create a hierarchy of pairs of recordings, and of pairs of pairs of recordings (hierarchical clustering)
    - Display the hierarchy as a dendrogram

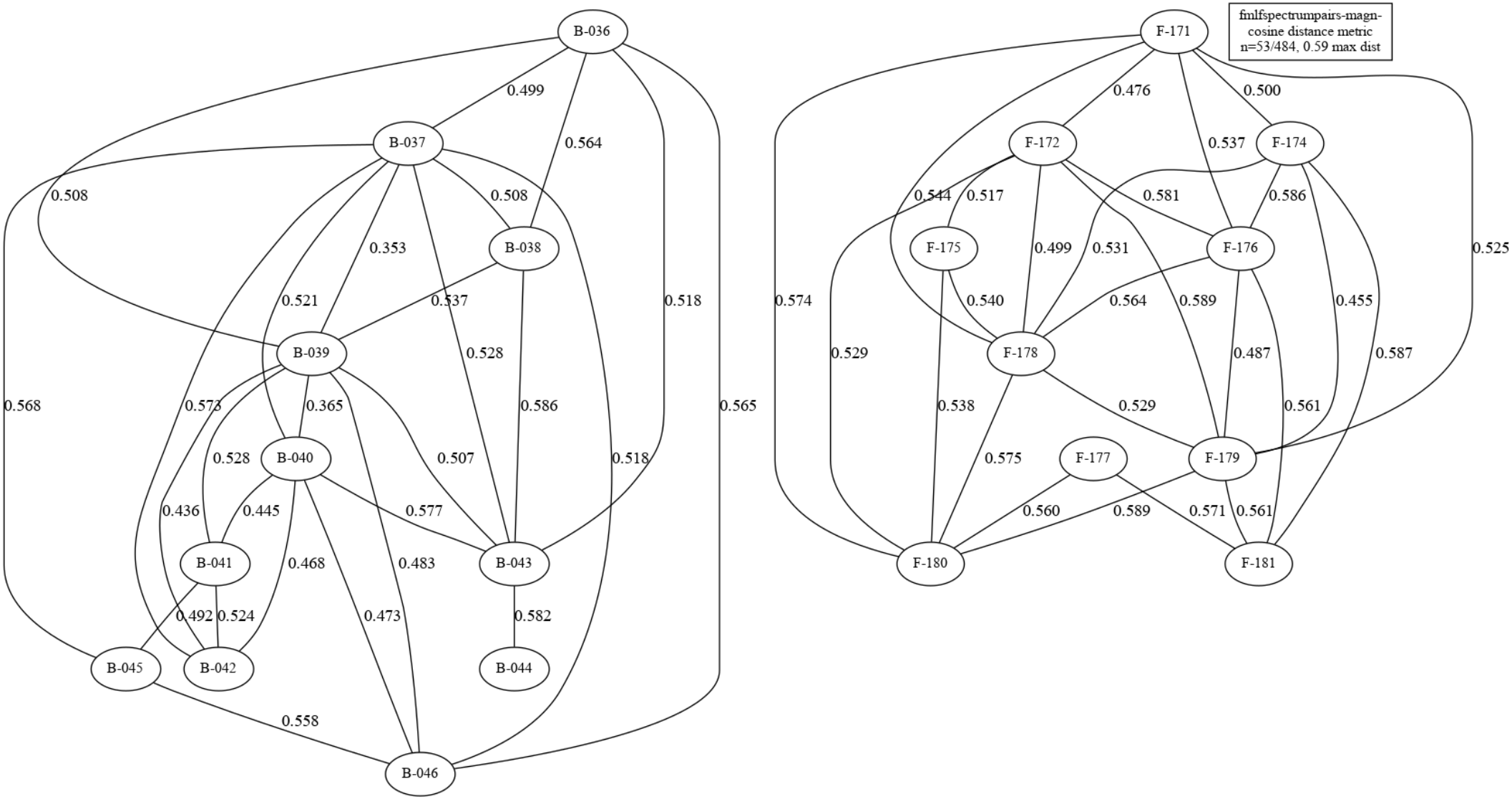
Classification of Tang dynasty poetry recitation by rhythm



Classification of Tang dynasty poetry recitation by rhythm

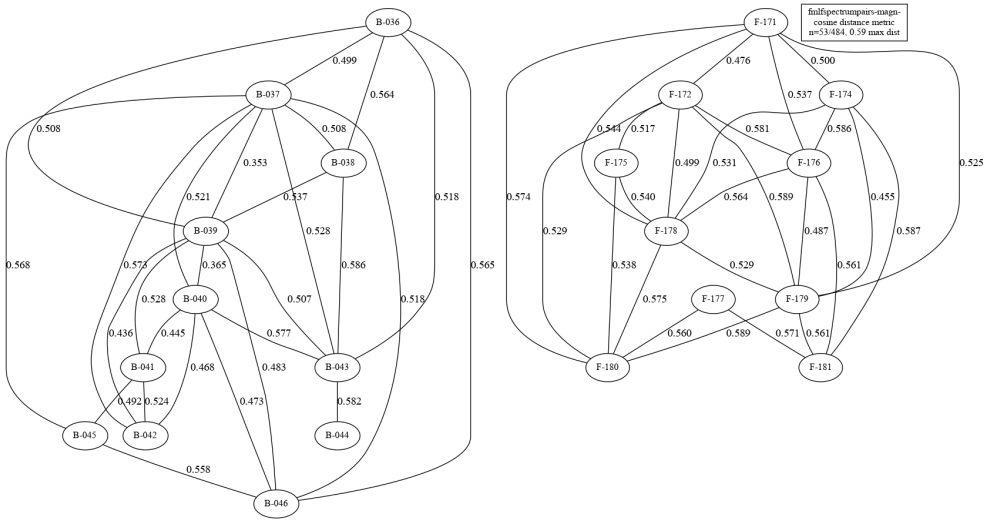


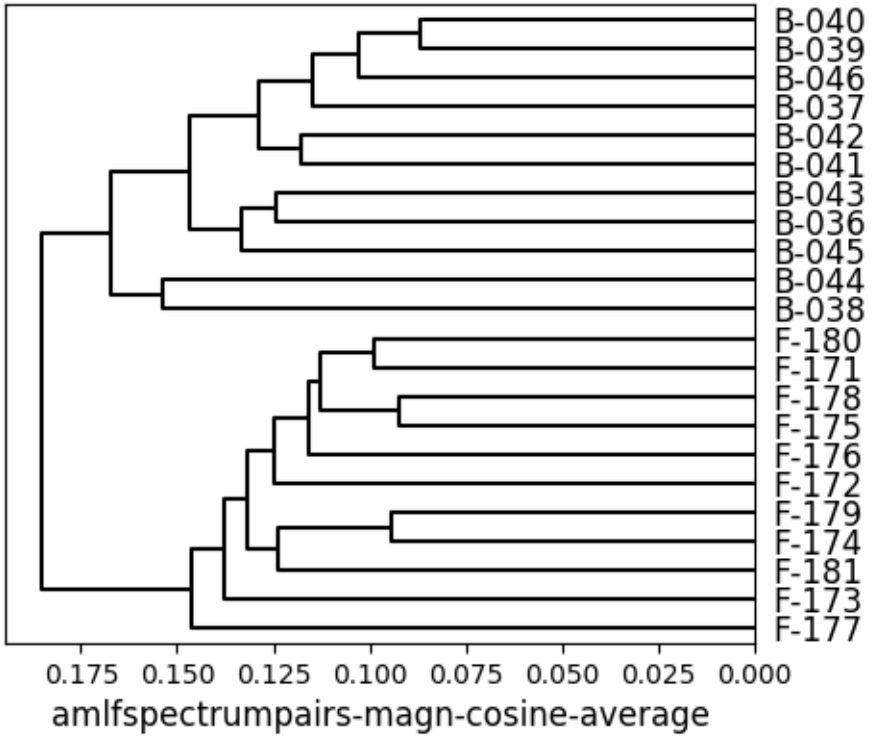
Rhythms in Tang dynasty poetry recitation



partitioned distance map

Rhythms in Tang dynasty poetry recitation



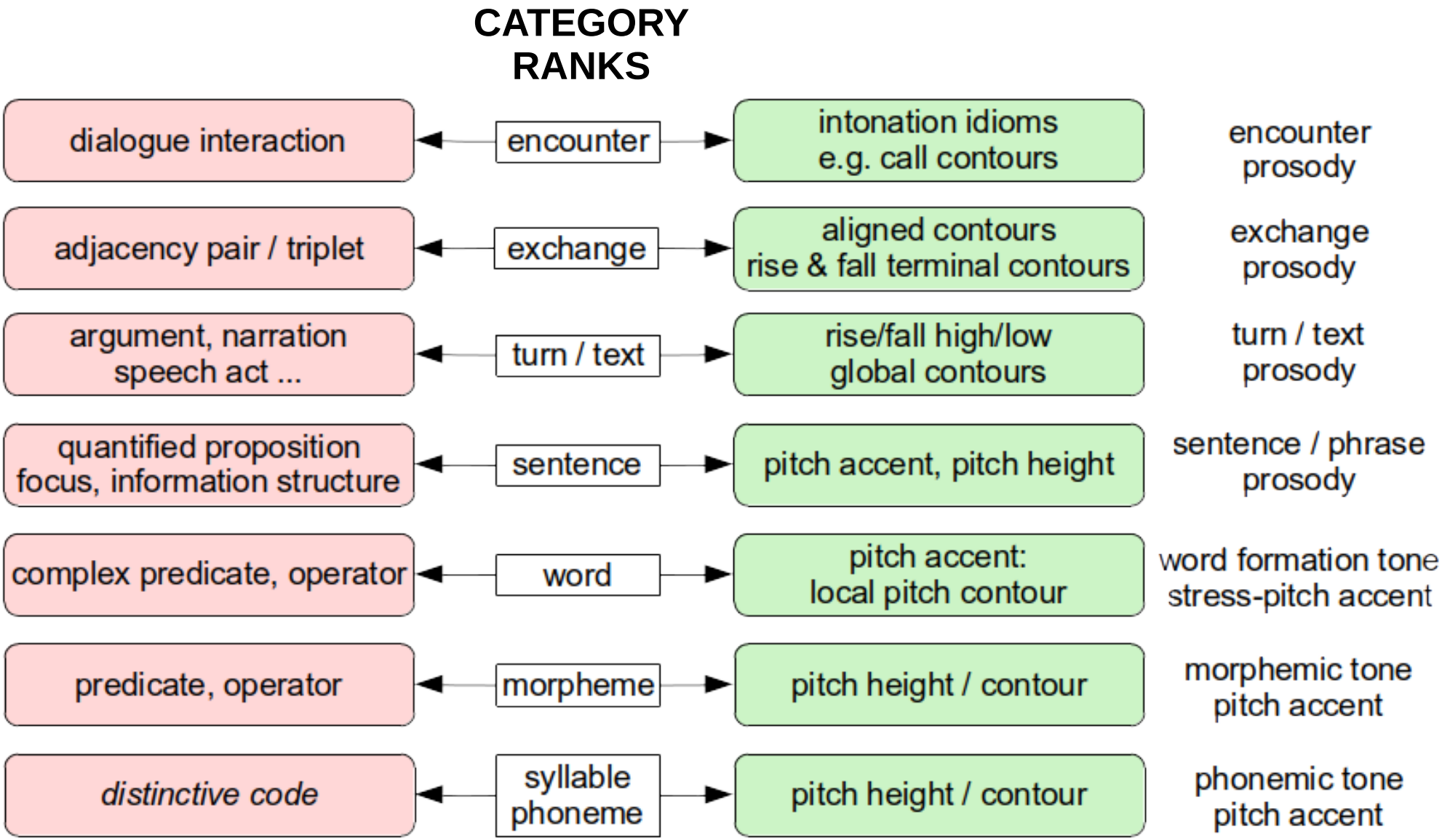


Success!
distance map with partition of regions
1. hierarchical dendrogram with partitioned clustering

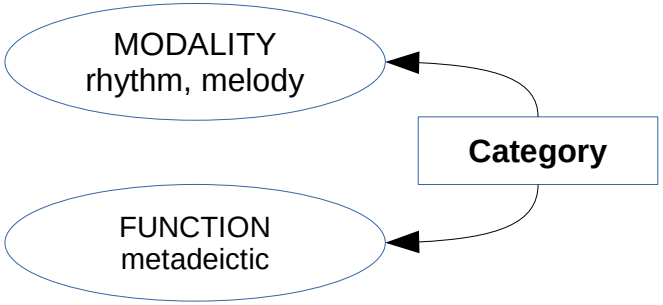
Next steps:
1. distance map with partition of regions
2. hierarchical dendrogram with partitioned clustering

Conclusion

Reminder: Rank-Interpretation Architecture of Prosody



Summary



1. What you should know:
    1. Semiotics: prosodic events are signs
    2. Rank Interpretation Architecture

Prosodic signs have many functions at different ranks

Discourse

there are many discourse functions, and many models of functions

Grammar

configuration

cohesion

boundaries

culmination

nuclear stress, focus, contrast, emphasis

Lexicon:

Morphemic

Phonemic

Sub-phonemic

谢谢

Many thanks for participating!

By the way, if you would like to discuss the application of any aspect of Rhythm Formant Analysis to your language, dialect or speech style, don't hesitate to contact me.

http://wwwhomes.uni-bielefeld.de/gibbon/Lectures/SummerSchool2021-Gibbon/