



Speech Science WiSe 2024/2025

Exercise 11: Q&A session Feb 3, 2025

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Your questions



- "Could you give us some exercises / examples on **narrow transcription** with solutions?"
- "What is the difference between the normal/fast Fourier transformation and the discrete Fourier transformation?"
- "What is the purpose of "Intonation Phonology with ToBI and Fujisaki's model"? Could you
 please explain it briefly?"
- "What is the differene between vowels and vocalic sounds?"
- "Do we have to use special symbols or doing a cardinal with diacritics is fine?"
- "Do we need to know formant frequencies of vowels for English?"
- "Should we be able to use AM/ToBI to transcribe sentences?"
- "Should we be able to classify **all sounds** from the **IPA**?"
- "Could you please explain the **source-filter-model** again?"

Your questions (2)



- "Could you please explain **pitch accent languages** and how to differentiate them from **tonal** languages?"
- "Could you clarify what specific aspects of **Praat** we need to know? Should we focus on the overall concept and functionality, or do we need to remember specific buttons on the taskbar to achieve certain results (if yes, what it could be)?"
- "Could we please discuss the difference between nasals and vowels in the **spectrogram**?"
- "Could you explain in which cases we get the sounds [a] and [b], as well as [e] and [ε] after transcription?"
- "Will we need to **write any definitions** during the exam?"
- "On slide 8/12 of Prof. Möbius's psychoacoustics slides he states that sound pressure (Pa) is an "objective measurement" while sound pressure level (dB) is a "subjective measurement", but on slide 22/32 from your session 9 slides you list both Pa/dB under "physical" measurements, so I was hoping we could briefly discuss what exactly differentiates these."
- "Could we briefly talk about the **tube model**?"

Narrow transcription

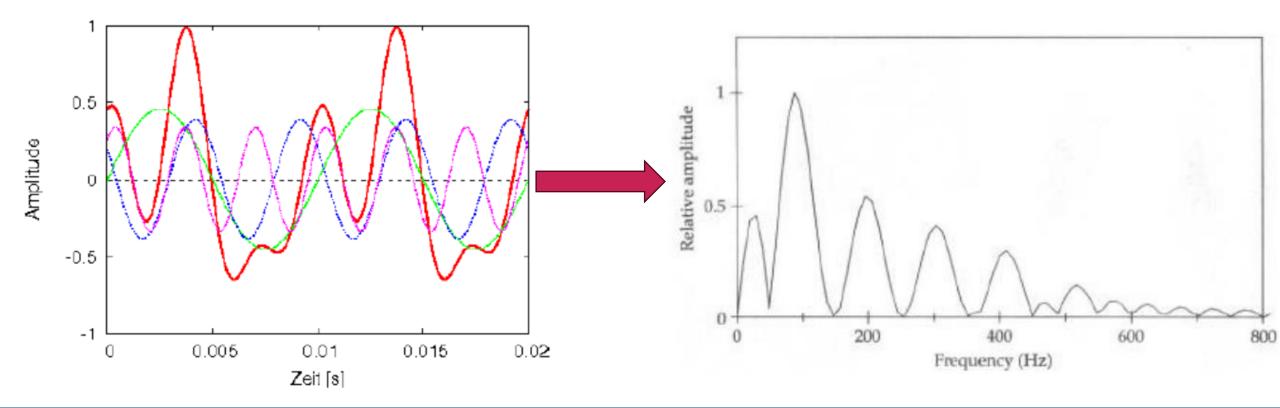


- Do we have to use special symbols or doing a cardinal with diacritics is fine?
 → Please use the specific IPA symbols, diacritics only to show a deviation from "the default"
- https://phonetics.ucla.edu/course/chapter2/exercises.htm
- <u>https://phonetics.ucla.edu/course/chapter2/exercises2/american.jpg</u>
- https://phonetics.ucla.edu/course/chapter2/exercises2/english.jpg
- <u>https://www.youtube.com/watch?v=cGpcwhx62sA</u>
- <u>https://sail.usc.edu/~lgoldste/General_Phonetics/Transcription/T3.html</u>
- <u>https://www.youtube.com/playlist?list=PL7pW8IXF6jZ_32ZHcFYWIPfJydI7EeAT</u>
 <u>p</u>

Fourier Transformation



Used to transform *samples* from **complex signals** from the **time** domain into a **set of sine waves** in the **frequency** domain



Fourier Transformation



"What is the difference between the normal/Fast Fourier Transformation and the Discrete Fourier Transformation? Is it just that we have to use the discrete version in reality because we do not have an infinite amount of values?"

Fourier Transformation



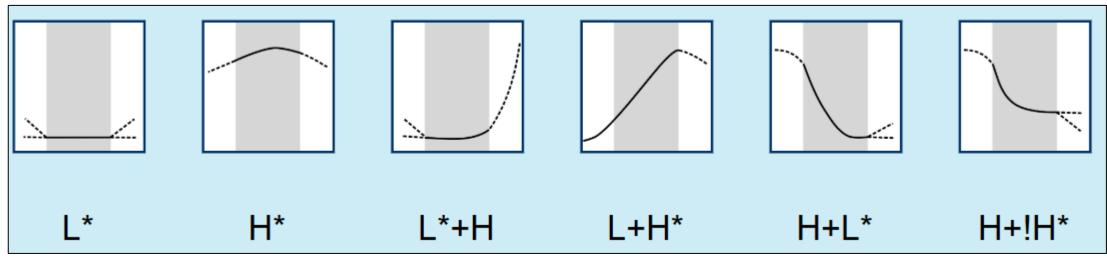


"What is the difference between the normal/Fast Fourier Transformation and the Discrete Fourier Transformation? Is it just that we have to use the discrete version in reality because we do not have an infinite amount of values?"

- FFT: Modified version of the DFT
- DFT: $\Theta(n^2)$, FFT: $\Theta(n \log n)$
- FFT: (any) algorithm performing the transformation faster

Intonation: ToBI, Fujisaki's Model





IP – Intonation Phrase; boundary tones: H%, L%

ip – intermediary phrase; phrase tones: H-, L-

• pw – prosodic word; pitch accents: H*, H*L, L*H, ...

Example [adapted from Pierrehumbert 1980, p. 276]

Η*

That's a remarkably clever suggestion.

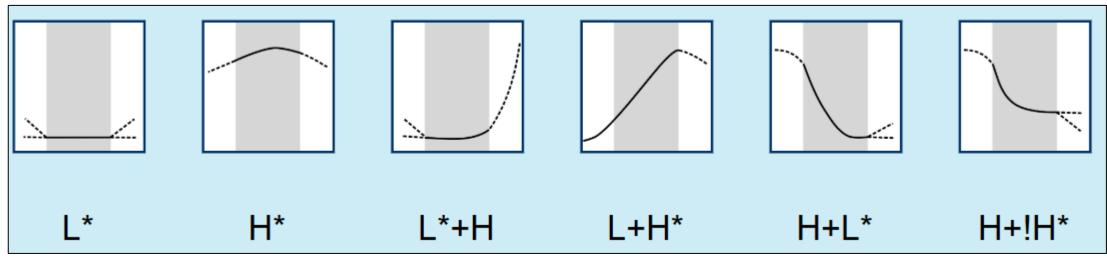
03.02.2025

ЯН

H*L L- L%

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Vowels and vocalic sounds



What is the difference between vowels and vocalic sounds?
 vocalic 1 of 2 adjective

vo·cal·ic (vō-ˈka-lik 🔊) və-

- 1 : marked by or consisting of vowels
- 2 a : being or functioning as a vowel

b : of, relating to, or associated with a vowel

vocalically (vō-ˈka-li-k(ə-)lē •)) və- adverb

vocalic 2 of 2 noun

: a vowel sound or sequence in its function as the most sonorous part of a syllable

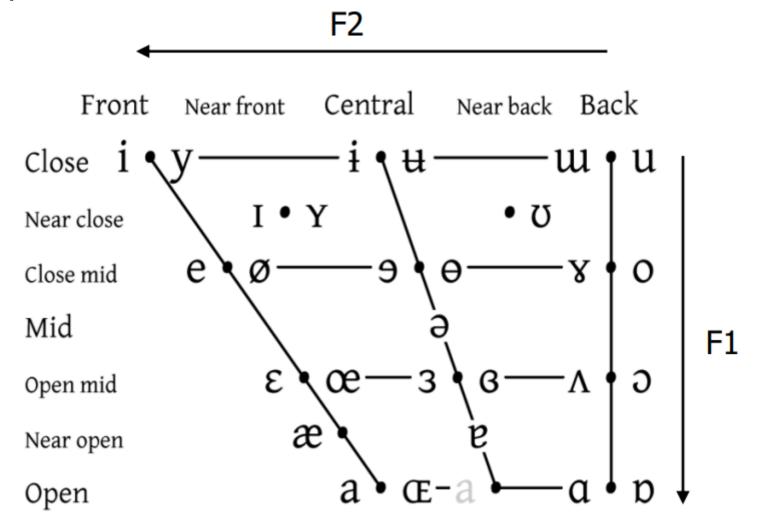
• "Vocalic R" \rightarrow /skwɛə/ (B.E.) vs. /skwɛɹ/ (A.E.)

Formant frequencies



- "Do we need to know formant frequencies of vowels for English?"
- \rightarrow Roughly.
- Formants can be used to differentiate vowels
- E.g. Large gap between 1st and 2nd formant for /i/ vs. small gap between 1st and 2nd formant for /u/





Vowels at right & left of bullets are rounded & unrounded.

IPA chart



	Bila	bial	Labioden	ital	Den	ntal	Alv	eolar	Postal	veolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p	b					t	d					k g			
Nasal		m						n					ŋ			
Trill								r								
Tap or Flap																
Fricative			f v	7	θ	ð	S	Z	ſ	3						h
Lateral fricative																
Approximant								ĩ				j	W			
Lateral approximant								1								

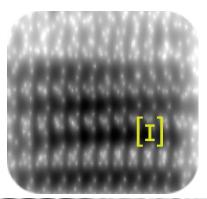
Reading spectrograms

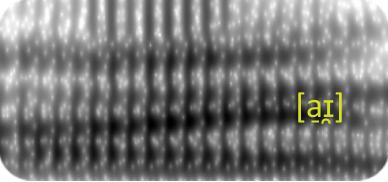


"Could we please discuss the difference between nasals and vowels in the **spectrogram**?"

Reading spectrograms: Vowels

- Voiced → quasi-periodic signal, voice bar in the lowest frequency area
- Concentrations of energy that can be found as horizontal frequency bands → Formants (F1, F2, F3, etc.)
- Discrimination from consonants:
 - Clearly visible formant structure
 - Can most likely be confused with laterals and nasals
- Diphtongs: clearly visible change of the vowel quality (formant structure) within the segment





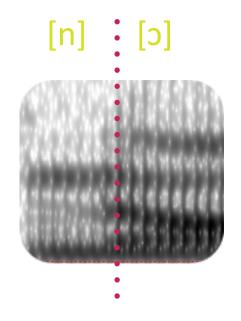
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Reading spectrograms: Nasals



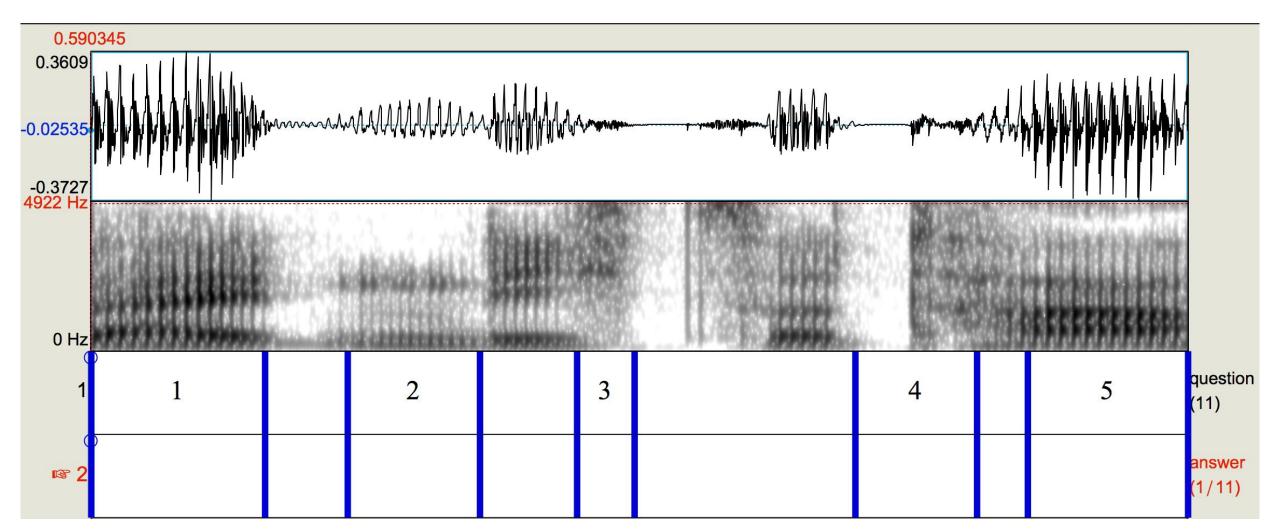
Discrimination from vowels:

- Opening nasal cavity → anti-formants emerge, muting parts of the spectrum → especially above 500 Hz
- Sudden change of formant structure



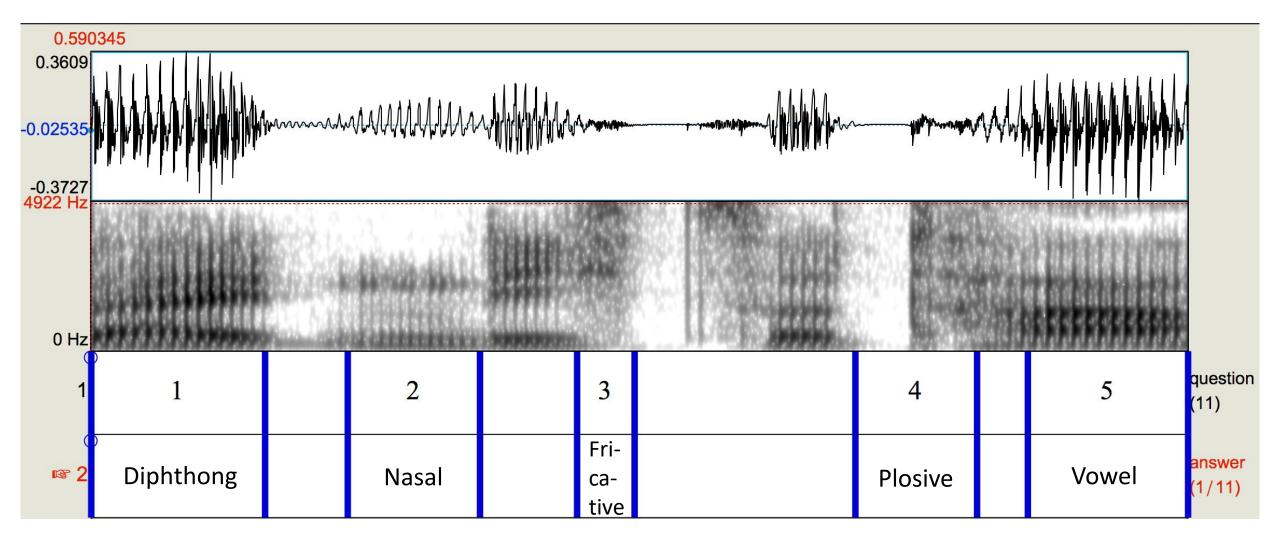
Reading spectrograms





Reading spectrograms





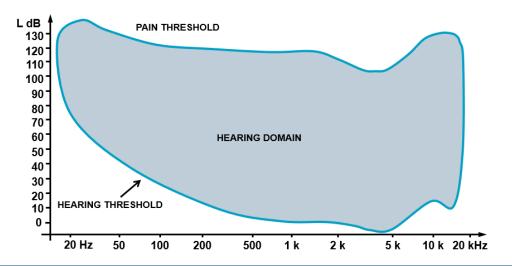


"Sound pressure (Pa) is an 'objective measurement' while sound pressure level (dB) is a 'subjective measurement', but on slide 22/32 from your session 9 slides you list both Pa/dB under 'physical' measurements?"



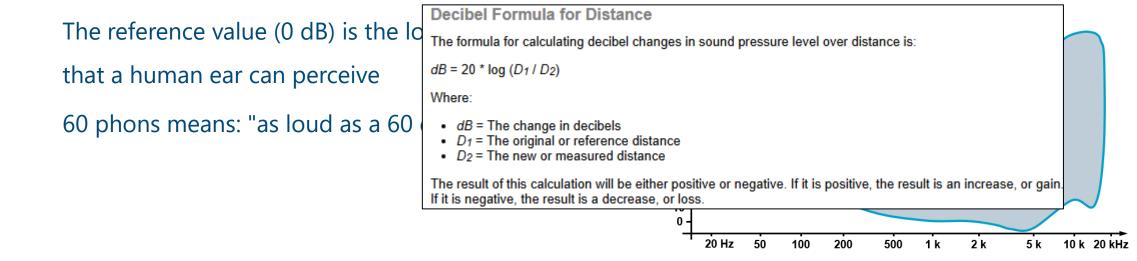
	Objective	Subjective			
Physical: Sound pressure	in Pa $1 \text{ Pa} = 1 \text{ N/m}^2$	in dB (sound pressure level)			
Perceptual: Loudness	in Phon				

- 60 dB means: needs a reference point
- "arbitrarily" set:
- The reference value (0 dB) is the lowest sound intensity
- that a human ear can perceive
- 60 phons means: "as loud as a 60 dB, 1000 Hz tone"





Decibel Formula for Power		Subjective
The formula for calculating a decibel change for power is:	/m²	in dB (sound pressure level)
$dB = 10 * \log (P_1 / P_r)$		
Where:		
 <i>dB</i> = The change in decibels <i>P</i>₁ = The new or measured power measurement <i>P</i>_r = The original or reference power measurement 		
The result of this formula will be either positive or negative. If it is positive, the result is an increase, or gain. If it is negative, the result is a decrease, or loss.		



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	Objective
Physical: wave length	Frequency in Hz
Perceptual: pitch	Pitch in mel, Bark

For physical measures: **Cannot** say: "X is twice as high / loud as Y"

Source-filter-model



- Two components involved in shaping sounds:
- 1. Source: Production
 - Vocal folds in larynx
 - Influence on: Pitch, Intensity
- 2. Filter: Modification
 - Vocal tract (different constellations)
 - Influence on: "Type of sound"

Pitch accent languages vs. tone languages



- Tonal language: **Each** syllable in a word has a pitch contour assigned to them: Used to differentiate meaning of a word
- Pitch accent language: One syllable in a word that contrasts in pitch, just one pitch change in a word;
 tone contour is part of the specification of syllables and words

only in parts of the lexicon

Tube model



<u>https://splab.net/apd/g300/</u>

Good luck for the exam!

