technische universität dortmund

Institut für Sprache, Literatur und Kultur

PS Sociolinguistics

Summer semester 2022 – Guest lecture

Introduction to Sociophonetics





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Slides

01 INTRO

Dialect survey

→ Get out your smartphones

→ Go to www.menti.com and type in the code 2906 3834

Language attitudes - Sociophonetics

Speaker 1	Supporter of Liverpool FC #**Scouse**
Speaker 2	RP speaker for the Accent Bias Britain Project #**RP**
Speaker 3	Interview with Stormzy #**MLE**
Speaker 4	Broadcast interview with Australian person #**AusE**
Speaker 5	CS50 Lecture by David Malan #**GA**
Speaker 6	MLE speaker for the Accent Bias Britain Project #**MLE**

”The results suggest persistent patterns of bias against certain accents in England, particularly Southern working-class varieties (…)” (Levon et al. 2021: 355)

Language attitudes - Sociophonetics

Speaker 7 Spud in the film *Trainspotting* #**Scottish**

Speaker 8 Interview with Florence Pannell (born 1868) #**VictorianRP**

Speaker 9 Irish farmer who had his sheep stolen #**IrishE**

Possibly at night‘ there‘d be a full moon there all night and should it‘d be bright out and could anyone walk up in the mountains in the night sure. Well, there was 35 sheep missing like […] sheeps are gone, just count just count a nice bit of money, like. Can be done about it? nothing..

Phonetic variables and variants

Example of the < **t** > in English:

< got a bottle of water >

phoneme / t /

This sound is realized differently in different English varieties…

Usual pronunciation alveolar plosive:	Other realizations: glottal plosive / stop (often BrE):	Other realizations: flapped/tapped alveolar stop (often AmE):	Other realizations: Retroflex plosive (often IndE):
[t]	[ʔ]	[ɾ]	[t]

Phonetic variables and variants

variable

variant	variant	variant	variant
[t]	[ʔ]	[ɾ]	[t]

Constrained/regular phonetic variation

„If the distribution of variants is neither random nor free, and instead shows systematic correlations with independent factors, those factors can be said to constrain the variation, or to be the constraints on the variable.“ (Meyerhoff 2019 : 12)

→ **Linguistic factors / internal factors can influence variation**

<part-time> → [pɑː.taɪm]

Sociolinguistic / Sociophonetic variation

variant

[ʔ]

Multicultural London English (MLE) speaker

< noticed >

variant

[t]

Received Pronunciation (RP) speaker

→ Speaker variability can be constrained by non-linguistic / external factors #**sociophonetic variation**

02 SOCIOPHONETIC RESEARCH

Sociophonetic research

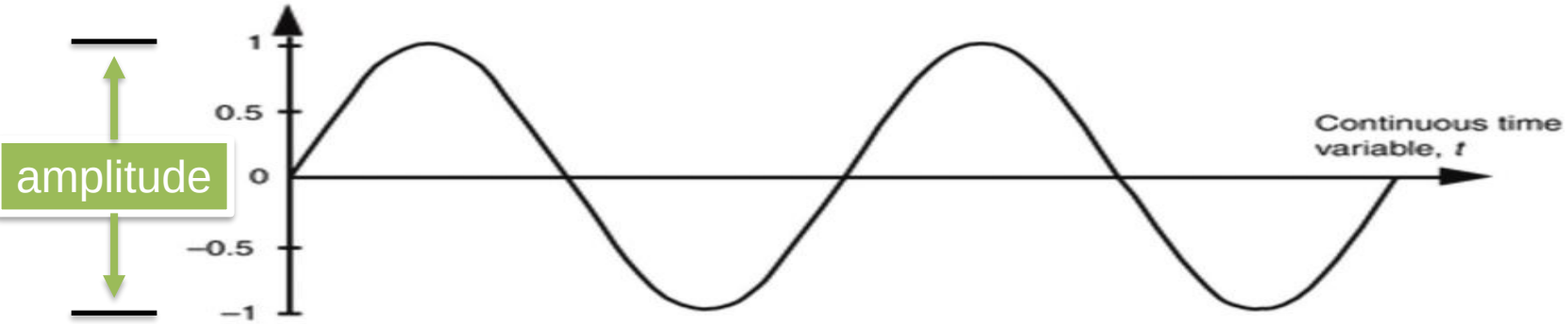
Articulatory Phonetics	Acoustic Phonetics	Auditory Phonetics
Articulation	What is sound?	**Perception**
quasi-periodic vibration of vocal folds	measured in **Hz**	pitch: low-high
articulatory effort, subglottal air pressure	intensity measured in **dB**	loudness: soft-loud
duration of speech gestures	duration measured in **ms**	length: short-long
vocal tract configuration	formant values measured in **Hz**	vowel quality: reduced-full

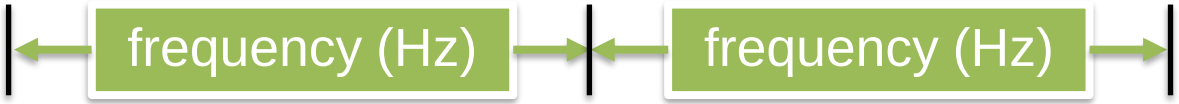
Acoustic phonetics

"The sensation of sound is caused by movement." (Gut 2009: 138)

→ small variations in air pressure that occur very rapidly (soundwaves)

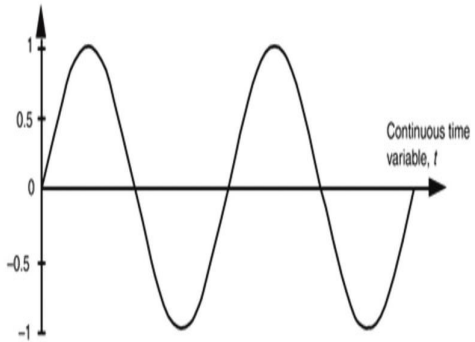
Introduction to Acoustic Phonetics

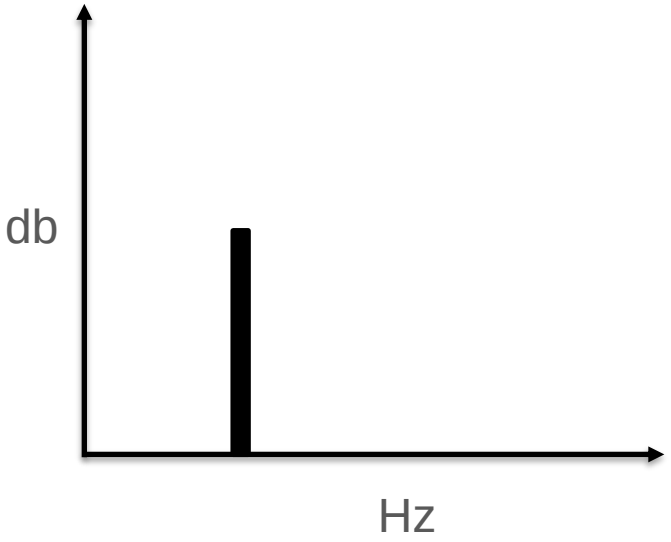




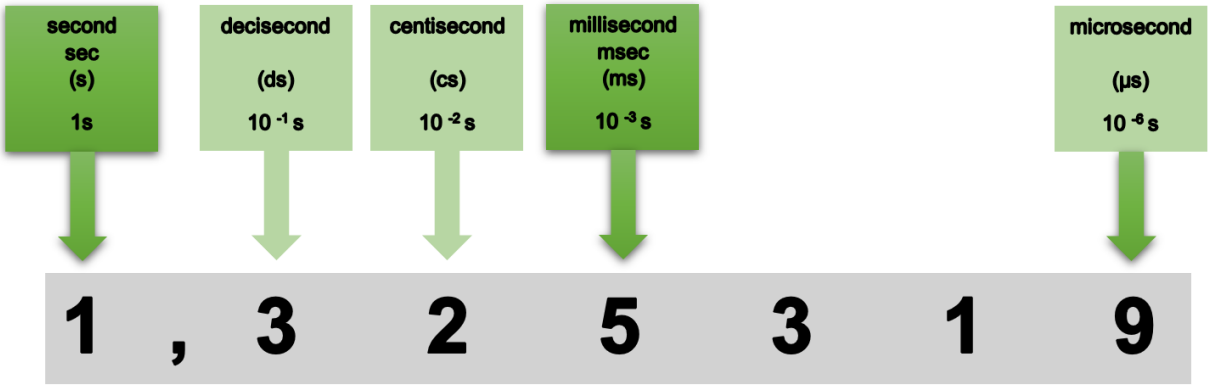
Introduction to Acoustic Phonetics

pure tone





Time

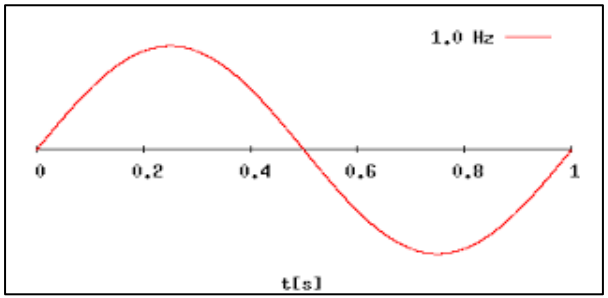


1s = ~ 1 heartbeat

duration

length

Frequency



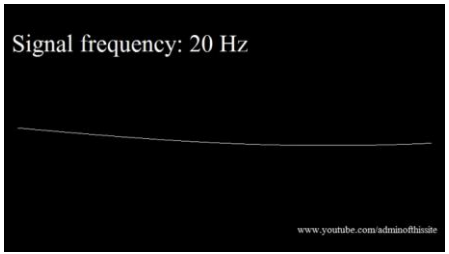
f = 0.5 Hz
T = 2.0 s

f = 1.0 Hz
T = 1.0 s

f = 2.0 Hz
T = 0.5 s

Hertz: Unit of frequency defined as cycles per second (→ wavelength)

Average human adult hearing capacity **~ 20 Hz – 16,000 Hz**
Babies: ~ 20 Hz – 20,000 Hz



fundamental frequency

pitch

Intensity

Intensity = proportional to square the amplitude

Deci**bel:** measurement of **intensity** on a **logarithmic scale**

→ Small increase in dB leads to a larger difference in intensity and perceived loudness

normal human conversation **~60 dB**

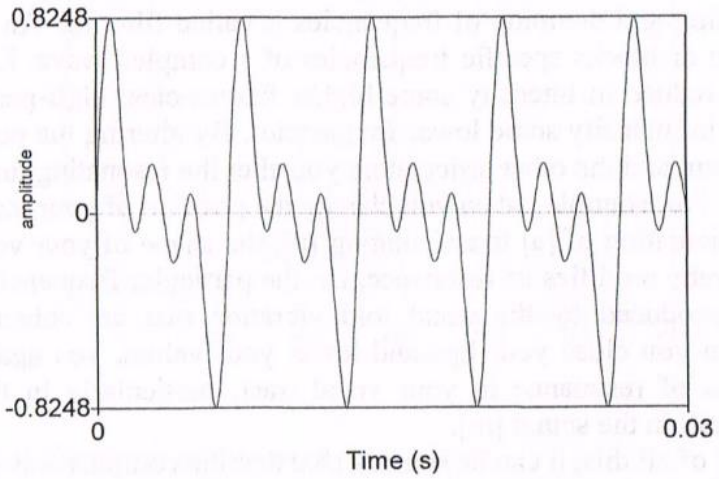
- **194 dB** Loudest possible tone
- **180 dB** Rocket launch
- **165 dB** 12-gauge shotgun
- **140 dB** Jet engine at takeoff
- **120 dB** Ambulance siren
- **119 dB** Pneumatic percussion drill
- **114 dB** Hammer drill
- **108 dB** Chain saw
- **108 dB** Continuous miner
- **105 dB** Bulldozer, spray painter
- **103 dB** Impact wrench
- **98 dB** Hand drill
- **96 dB** Tractor
- **93 dB** Belt sander
- **90 dB** Hair dryer/power lawn mower
- **80 dB** Ringing telephone
- **60 dB** Normal conversation

intensity

loudness

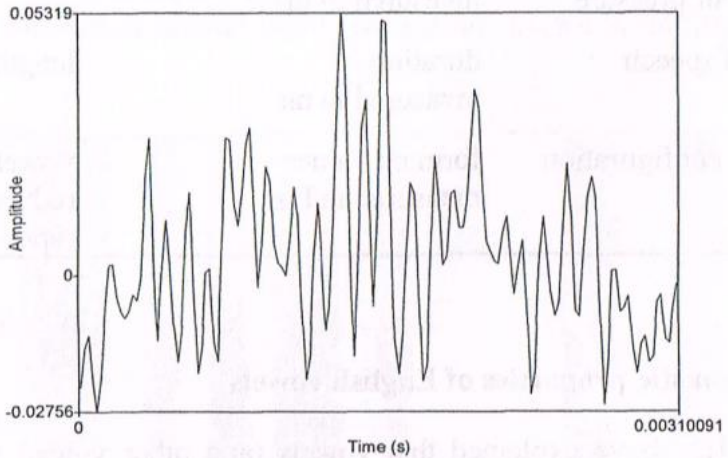
Complex soundwaves

complex periodic waves



voiced sounds

complex aperiodic waves



voiceless sounds

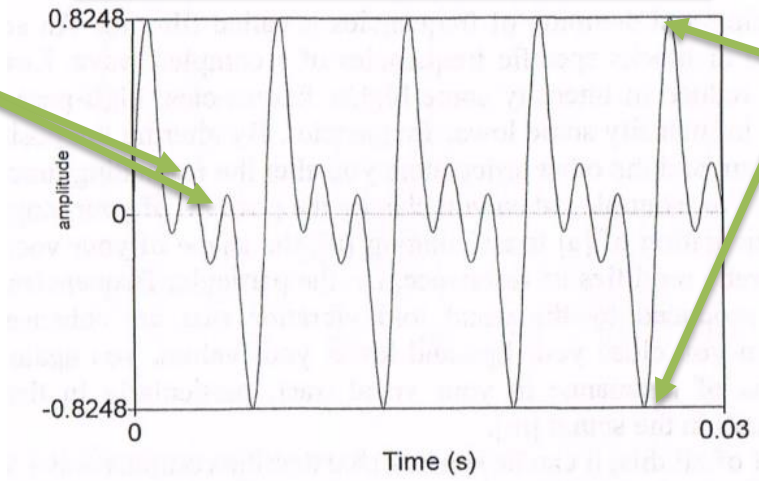
Complex soundwaves

complex periodic waves

harmonics

→ Sine waves with frequencies above the fundamental frequency

(integer multiples of F0)



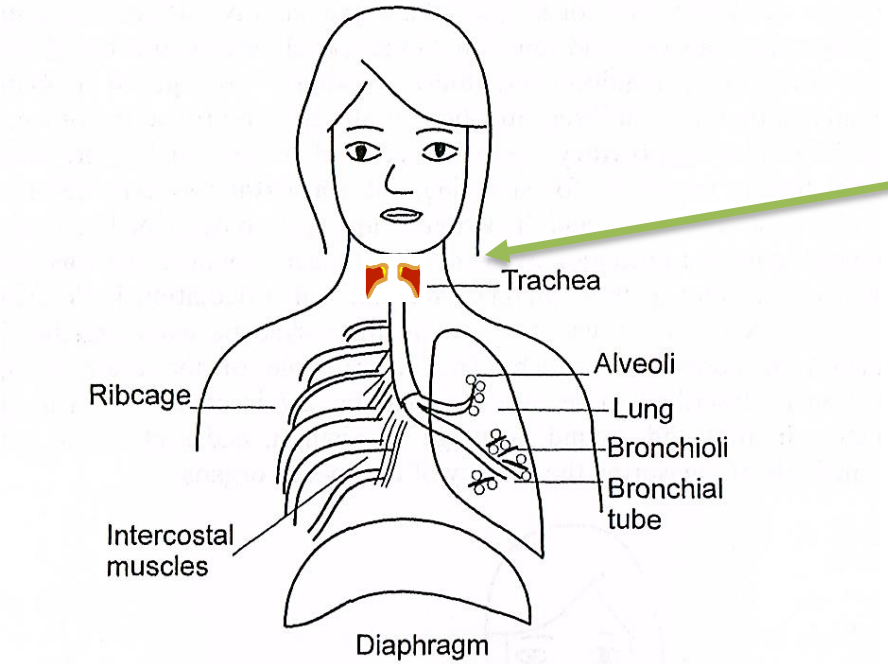
fundamental frequency

→ frequency of lowest sine wave in a complex periodic wave (F0)

→ perceived as pitch (height of voice)

Complex soundwaves

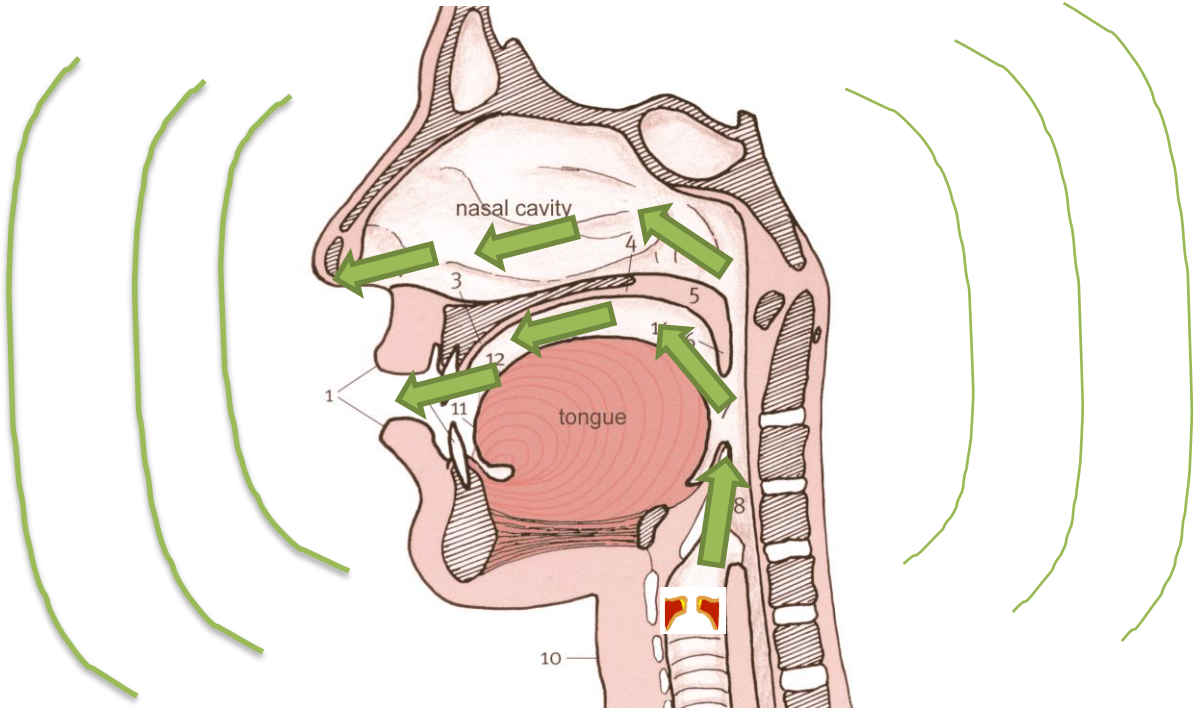
Complex periodic sound waves produced by vocal folds in the larynx



Complex soundwaves

Modification of sound wave in articulatory system

acoustic filter

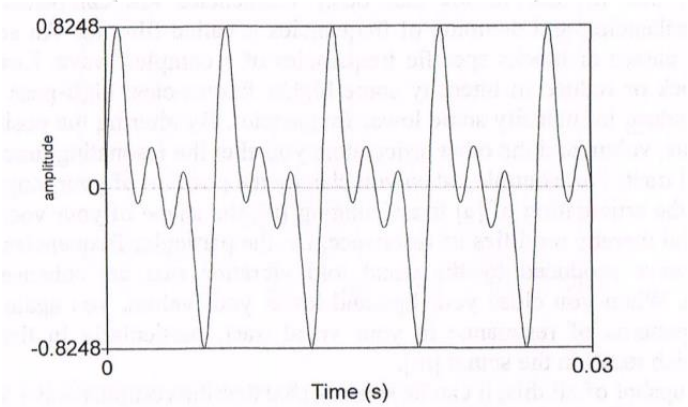


Complex soundwaves

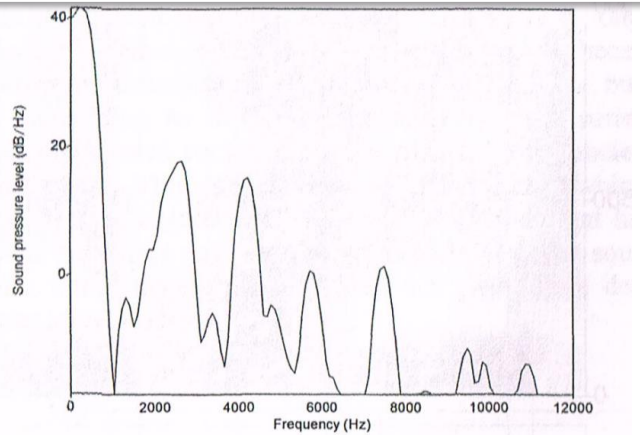
Modification of sound wave in articulartory system

Complex soundwaves

complex wave

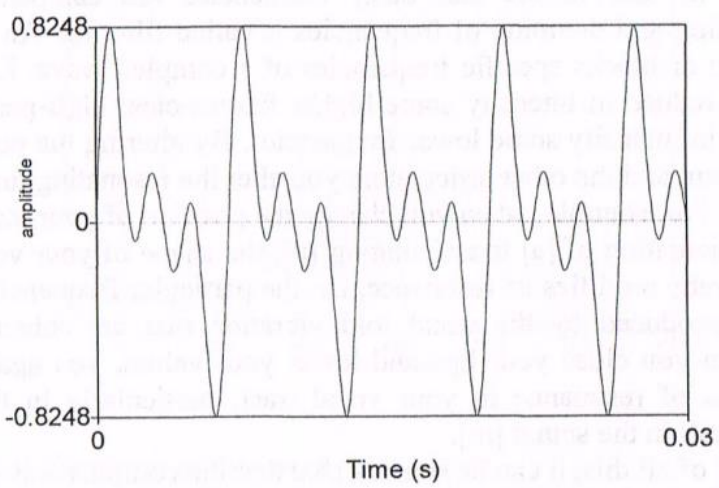


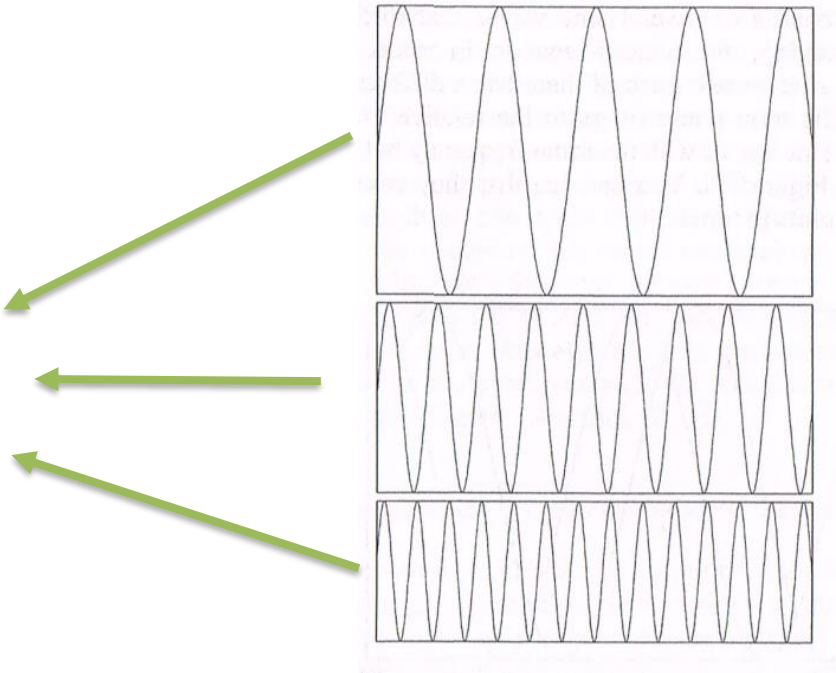
power spectrum of a complex wave



Complex soundwaves

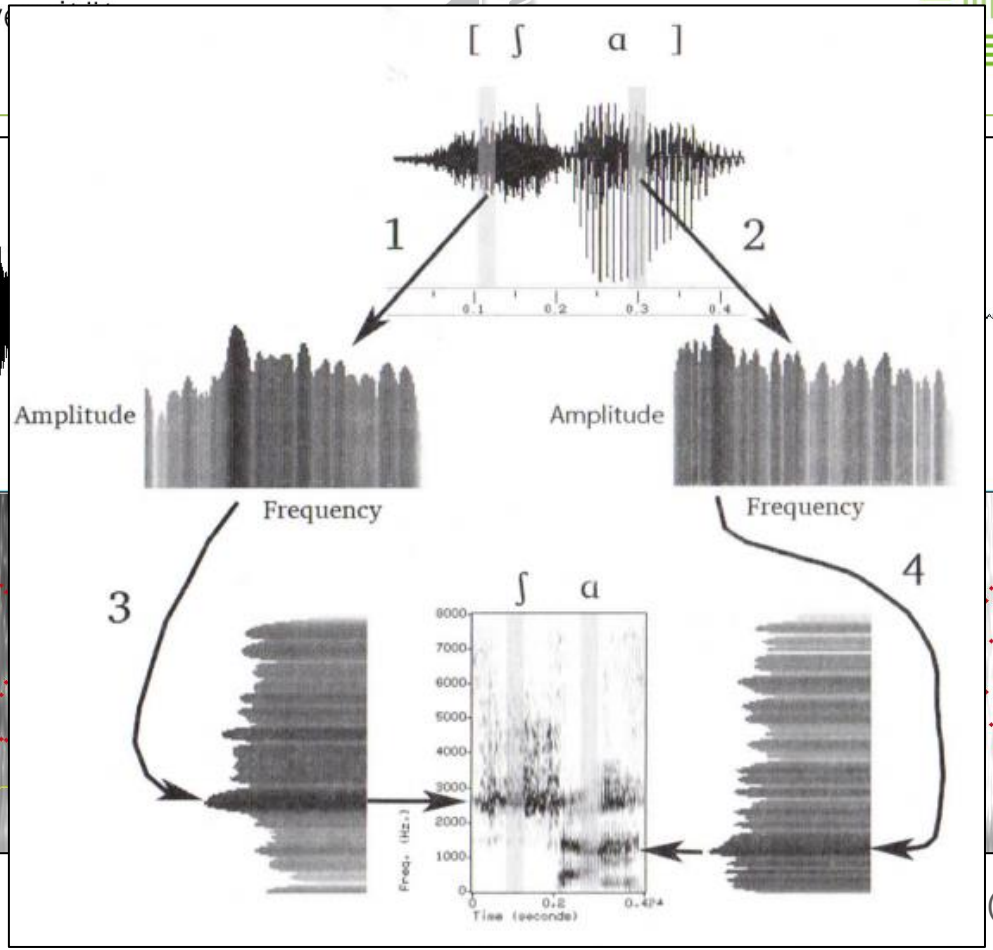
complex periodic waves





signal input (waveform)

broadband spectogram



Fourier transformation

(Ladefoged and Johnson 2015: 9)

Overview

Articulation	Acoustic features	Perception
	fundamental frequency (F0) measured in **Hz**	
articulatory effort, subglottal air pressure		loudness: soft-loud
duration of speech gestures		
vocal tract configuration		vowel quality: reduced-full

Overview

Articulation	Acoustic features	Perception
quasi-periodic vibration of vocal folds	fundamental frequency (F0) measured in **Hz**	pitch: low-high
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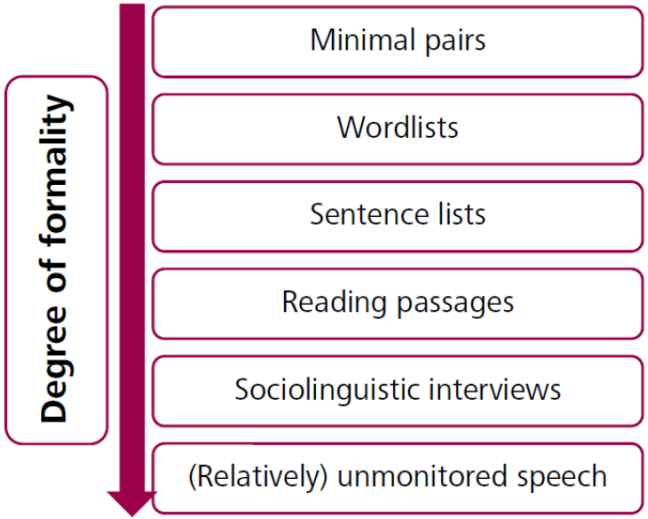
Speech production research: data collection



Paper	Soon	Underneath	Cart
Baker	Music	Roof	Alone
Silly	Lost	Huge	Coal
You	Year	Off	Queue
Avoid	Pepper	Pear	Bared
Girl	Buckle	See	Pip
Undone	Better	Time	Back
Soup	Like	Tell	Me
Hoof	Bottom	Dreadful	Days
First	Late	Shore	Daze
Bear	Know	Threshold	Loud
Doing	Head	More	Hate
Bit	Stone	Jealous	Fool
Very	Spoon	Poor	Few
Please	View	Matter	Curse
Made	Near	Face	Beer
Own	Walking	There	Tomorrow
Hill	Water	Under	Joint
Old	Manner	Whole	Law
Boot	Cat	Broom	Thread
Due	Coat	Dog	Paw
Turkey	Now	Yellow	Sawing

Word list by Trudgill (1974)

Speech production research: data collection

Regional background

Sex

Class

Gender

Occupation

Age

Languages

Speech production research : auditory analysis

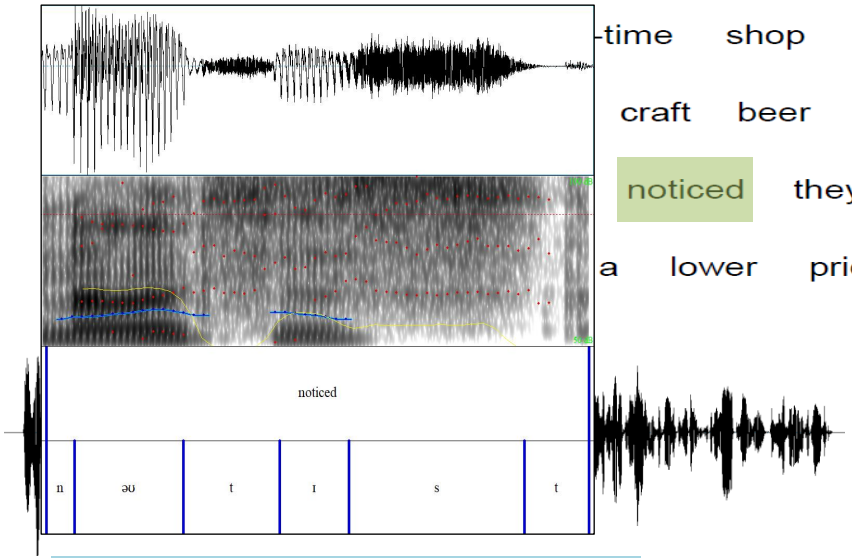
What differences in pronunciation can you identify?

I worked as a part-time shop manager. One of the things that I did was submit orders of craft beer to our suppliers. One night while shopping in the supermarket, I noticed they had started to sell some of the beer that we stocked at a lower price than we had been able to order.

Received Pronunciation (RP) speaker

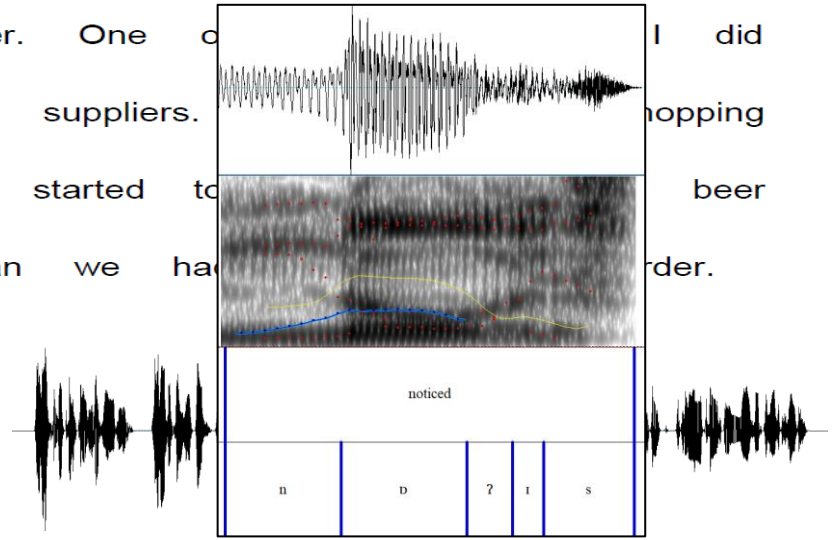
Multicultural London English (MLE) speaker

Speech production research : acoustic analysis



-time shop manager. One c craft beer to our suppliers. noticed they had started tc a lower price than we ha

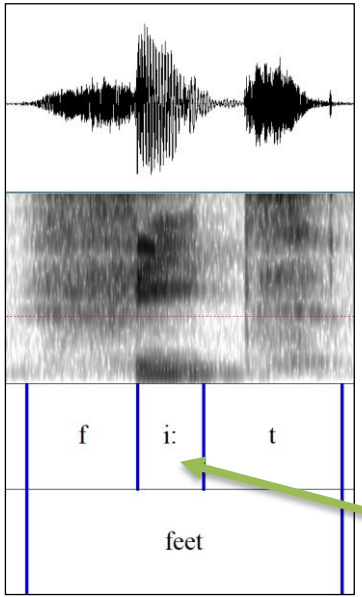
I did hopping beer rder.



Received Pronunciation (RP) speaker

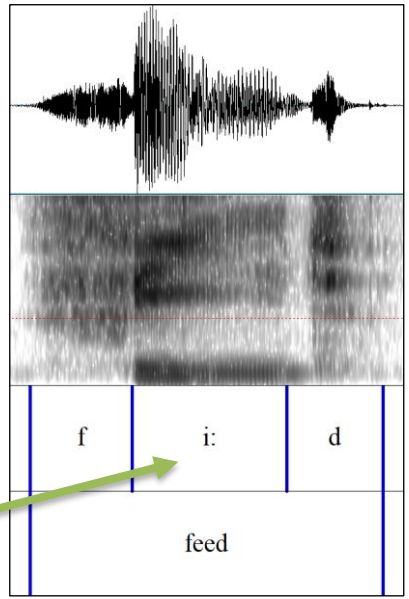
Multicultural London English (MLE) speaker

Speech production research: acoustic analysis



feet

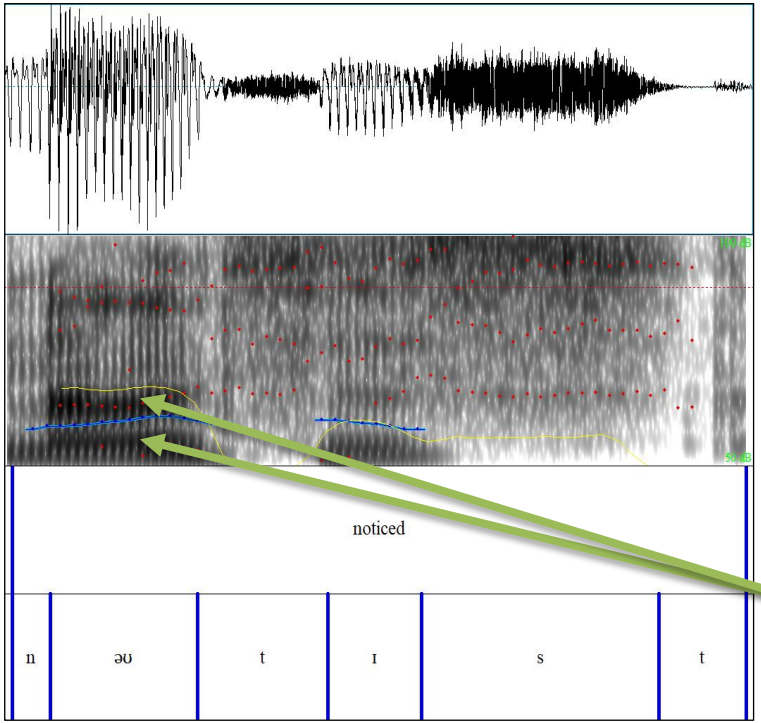
feed



vowel duration:
~ 130 ms

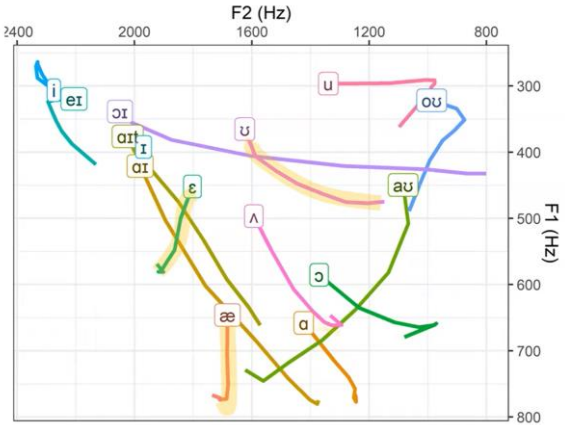
vowel duration:
~ 300 ms

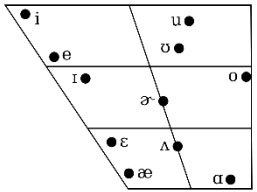
Speech production research: acoustic analysis



Normalization

Formant measurements



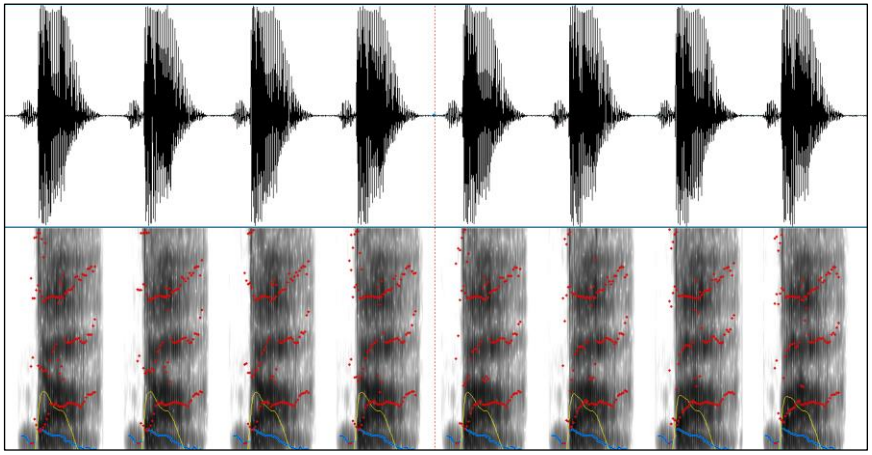


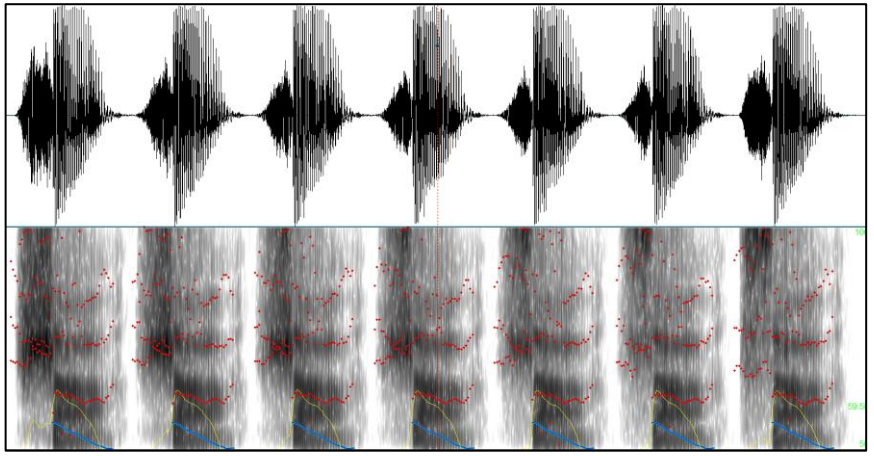
Speech perception research

… let‘s have a short experiment!
→ Get out your smartphones

→ Go to www.menti.com and type in the code 2162 1776

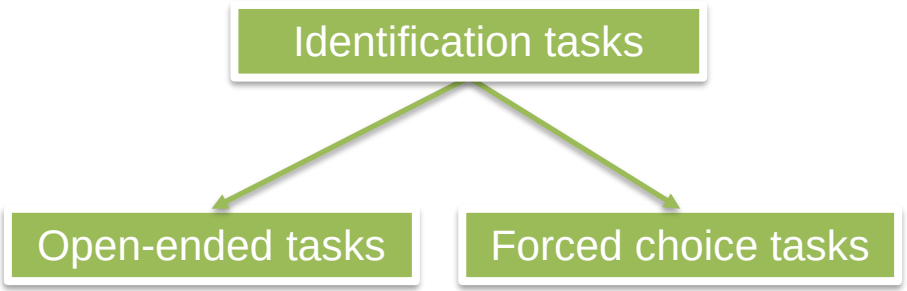
Speech perception research

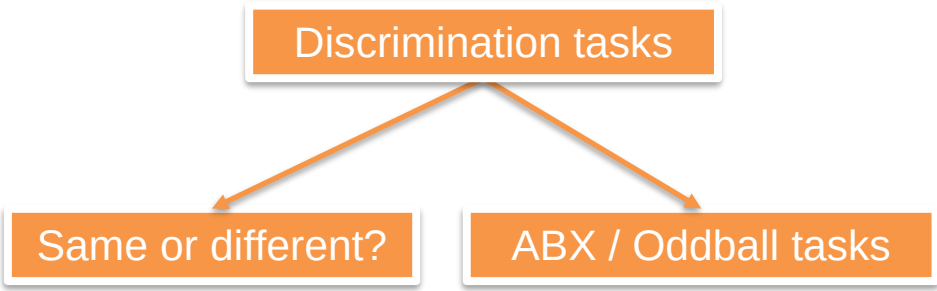




Categorical perception

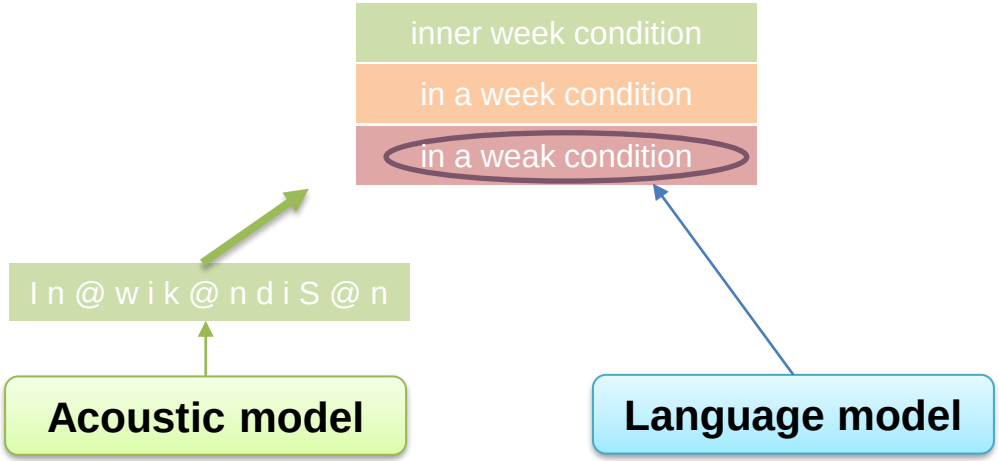
Speech perception research





03 SPEECH TECHNOLOGY & TRANSCRIPTION

Automatic speech recognition

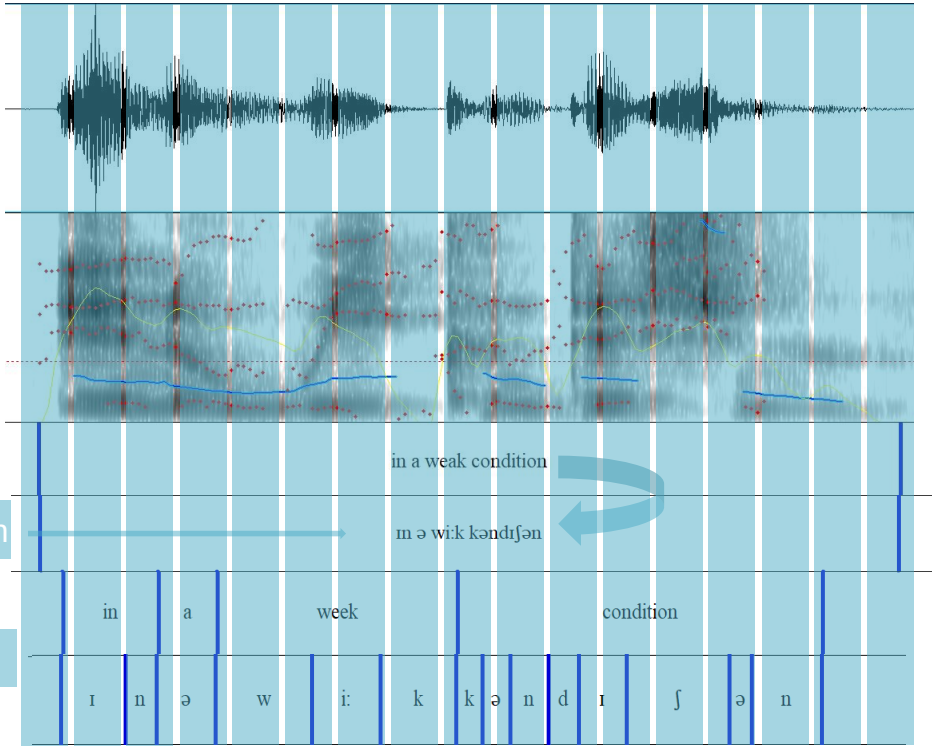


More info

(Yu and Deng 2015: 4)

Forced alignment

The automatic identification and segmentation of phones based on the input audio and a corresponding broad transcription.



Waveform

Spectogram

Broad transcription

Forced aligner

G2P conversion

Acoustic model

04 REFERENCES & RESOURCES

References

Boersma, P., Weenink, D. (2021). *Praat: doing phonetics by computer* [Computer program]. Version 6.1.42. Retrieved from http://www.praat.org/

Gut, U. (2009): *Introduction to English Phonetics and Phonology*. Frankfurt am Main: Peter Lang.

IBM Watson STT [Software]. (2022). IBM Cloud. Retrieved from https://www.ibm.com/cloud/watson speech to text

Ladefoged, P., Johnson. K. (2015). *A Course in Phonetics*. Stamford: Cengage Publishing.

Levon, E., Sharma, D., Watt, D. J. L., Cardoso, A., & Ye, Y. (2021). Accent Bias and Perceptions of Professional Competence in England. *Journal of English Linguistics*, *49*(4), 355–388.

Meyerhoff, M. (2019). *Introducing Sociolinguistics*. 3rd ed. London/New York: Routledge.

McAuliffe, M., Socolof, M., Mihuc, S., Wagner, M., & Sonderegger, M. (2017). Montreal Forced Aligner: trainable text-speech alignment using Kaldi. *Proceedings of Interspeech 2017*, 498–502.

Lawson, E., J. Stuart-Smith, J. M. Scobbie, S. Nakai (2018). *Seeing Speech: an articulatory web resource for the study of Phonetics*. University of Glasgow. 27th June 2022. Retrieved from: https://seeingspeech.ac.uk

Trudgill, P. (1974). *The social differentiation of English in Norwich*. Cambridge: Cambridge University Press.

Yu, D., Deng, L. (2015). *Automatic Speech Recognition: A Deep Learning Approach*. London: Springer Publishing.

Summary of useful resources

Speech processing / forced alignment:

BAS Webservices (WebMAUS) https://clarin.phonetik.uni-muenchen.de/BASWebServices/

DARLA http://darla.dartmouth.edu/cave

Montreal Forced Aligner https://github.com/MontrealCorpusTools/Montreal-Forced-Aligner

FAVE Aligner https://github.com/JoFrhwld/FAVE

Summary of useful resources

Toolkits:

HTK https://htk.eng.cam.ac.uk

CMUSphinx https://cmusphinx.github.io/

Kaldi ASR https://kaldi-asr.org/