The Science of Talking:

Speech is highly variable

Rachel Baker
Speech Hearing and Phonetic Sciences, UCL
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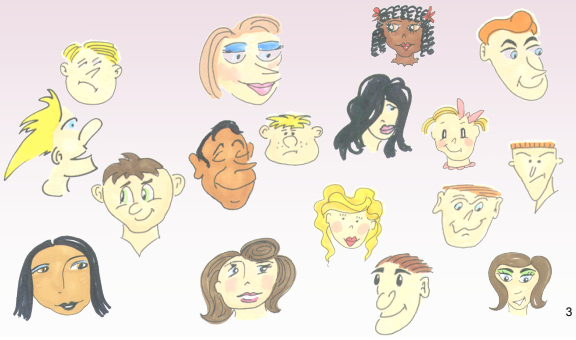
Today's class

- Presentation with short tasks
- Further reading

Variability in speech

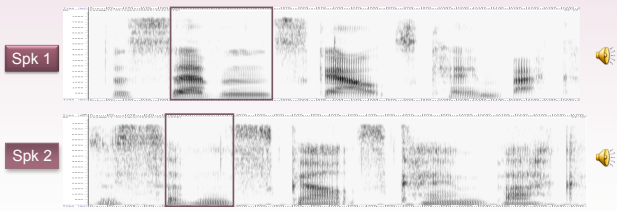
Between-speaker variability



Variability in speech

At the sentence level these differences become even more striking….

'The seven scouts came back'



Variability in speech

- **Between-speaker variability**
  - Anatomical factors
    - Vocal tract dimensions
    - Vocal fold length/thickness
  - Sociolinguistic factors
    - Regional accent
    - Other speech production differences linked to gender, age, 'social group' membership etc…
  - Idiosyncratic/individual differences in production
    - 'jaw-movers' vs. 'non jaw-movers' when producing high/low vowels

Variability in speech

- **Within-speaker variability**
  - Speech rate
  - Physical health
  - Mental health
  - Speaking style: who speaking to, topic of conversation etc..
  - Pathologies (e.g. glossectomy)

Communication is a highly dynamic process…

Maximising communication ease ⟷ **Minimising speaker effort**

Different **speaking styles** reflect this trade-off

1st attempt

black and white

2nd attempt

Today's topic

Clear speech

Why bother investigating this?

Speaking style: CLEAR SPEECH

In what situations do we need to speak clearly??

- Noisy background
- Hearing impairment
- Formal occasion, e.g. presentation, lecture
- To children
- Non-native speaker of a language

Reasons for communication difficulties

Degraded audition	Reduced language knowledge	Reduced attention
- Noisy background - Hearing impairment -Public speaking	- To children - Non-native speaker - Public speaking?	- Noisy background - To children - Public speaking

What are the acoustic-phonetic characteristics of 'clear speech'?

Approach 1: Inherently clear speakers

Approach 2: 'casual' vs. 'clear' speaking styles

Clear speech?

Approach 1: 'Inherently clear speakers'

Can we find specific acoustic-phonetic features of a voice that make it particularly clear?

1. Recordings of 45 speakers of South-Eastern British English
2. Listening tests:
   - Intelligibility of words in noise
   - Subjective ratings of the voice
3. Acoustic-phonetic measurements
4. Correlation between acoustic-phonetic measures and speech intelligibility

[Hazan and Markham, 2004]

Rate the speakers….

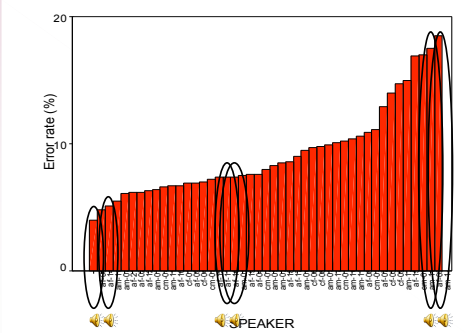
Female speakers

af-03 af-06 af-16

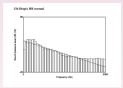
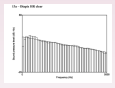
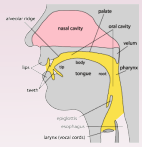
Male speakers

am-14 am-10 am-05

Overall Error rates



What aspects of the voice are correlated with speech clarity?

- Amount of energy in mid frequency regions
- Degree of vowel articulation
- Speech rate

But ‘clear speakers’ can achieve ‘clarity’ in different ways…

Speaker	Intelligibility	Energy in voice	Articulation	Speech rate
Af-06	1st	1st =	6th	3rd
Af-14	2nd =	19th =	11th	16th
Am-10	2nd =	9th	40th	17th

Can we make our speech clearer?

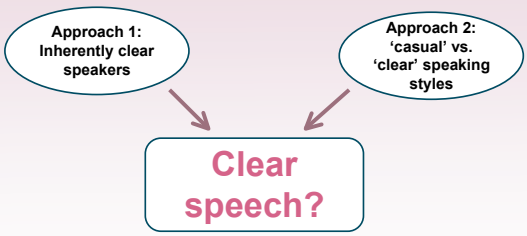
Voice coaching

- Drama students recorded before and after voice training

Year 1 Year 3

[CDD/RADA/LAMDA SAVEP project, Shewell and colleagues]

What are the characteristics of ‘clear speech’?



Approach 2: comparing speaking 'normally' and 'clearly'

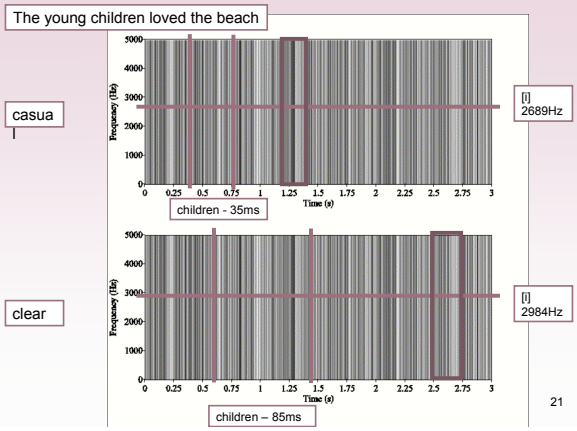
- Read sentence normally
- Read sentence as it talking to someone who is hearing impaired

Your turn

Record the following sentence:

"The young children loved the beach"

- once speaking normally
- once as if speaking to someone who is hearing impaired



What features are enhanced in 'clear' speaking styles, relative to 'casual' speech?

- Similar features to 'inherently-clear' speakers

Clearer vowel articulation
Slower speech rate
Higher energy in mid frequency range
+ Higher pitch and pitch range

What are the drawbacks of collecting data like this?

Why is it important to collect interactive spontaneous clear speech data?

- Read speech might be over/under-estimating clear speech in an interaction
- Trade-off between communication ease and lack of effort
- Different types of clear speech?

Focus: investigating clear speech with 'communicative intent'

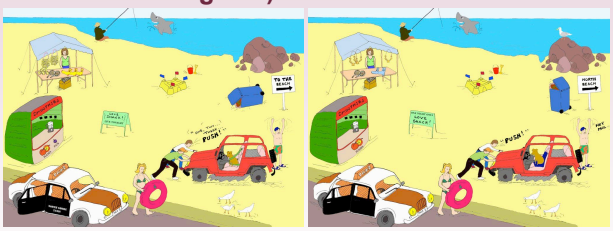
What ways do people modify their speech when they are in a situation where they are not easily understood?

How can we collect spontaneous speech?

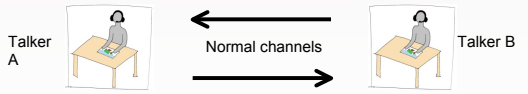
A collaborative task for two people is useful if you need:

- Clear and casual speaking styles for each participant
- Similar topics and words in both styles
- High quality recordings

One type of task: Diapix task (interactive spot the difference game)



- Pairs communicate via headsets to find 12 differences



Communication barriers to encourage clear speech

- **Talking to someone with a hearing impairment**

Simulation of a cochlear implant

3 channel noise vocoder

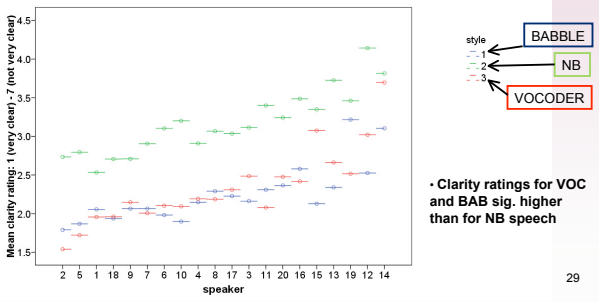
- **Talking to someone in a noisy background**

Multi-talker babble

- **Talking to someone who cannot speak or understand English well**

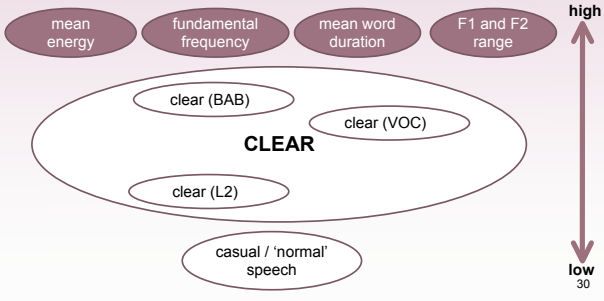
Native Chinese/Korean speaker with low score on English test

Do listeners perceive the 'communication barrier' speech as clearer than casual speech?



- Clarity ratings for VOC and BAB sig. higher than for NB speech

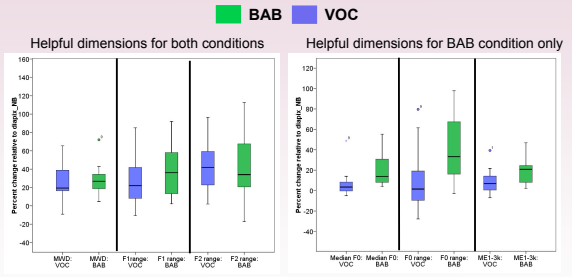
Are there acoustic-phonetic differences between the 'communication barrier' clear speech and casual speech?



What adaptations might be expected from different communication barriers?

'Barrier'	Effect of barrier on listener	Helpful clarifications	Unhelpful clarifications
Babble	• Masking of key acoustic cues • Heightened thresholds	• Higher mid-frequency energy • Higher F0/F0 range • Enhanced vowel space • Slower speech rate	
Noise-excited Vocoder	• Poor spectral resolution • Loss of voicing information	• Enhanced vowel space • Slower speech rate	• Higher mid-frequency energy • Higher F0/F0 range

Do the data support these predictions?



No significant differences in % change between BAB and VOC

% change significantly greater in BAB than VOC

Can we make our speech clearer?

Artificial enhancements

- Normal sentence
  - Slowed-down
  - With more mid-frequency energy
  - With extended pitch range/mean

Further investigations of clear speech

- Clear speech in languages other than English
- At what age are we able to produce clear speech?
- Comparisons of child directed speech and pet directed speech….