



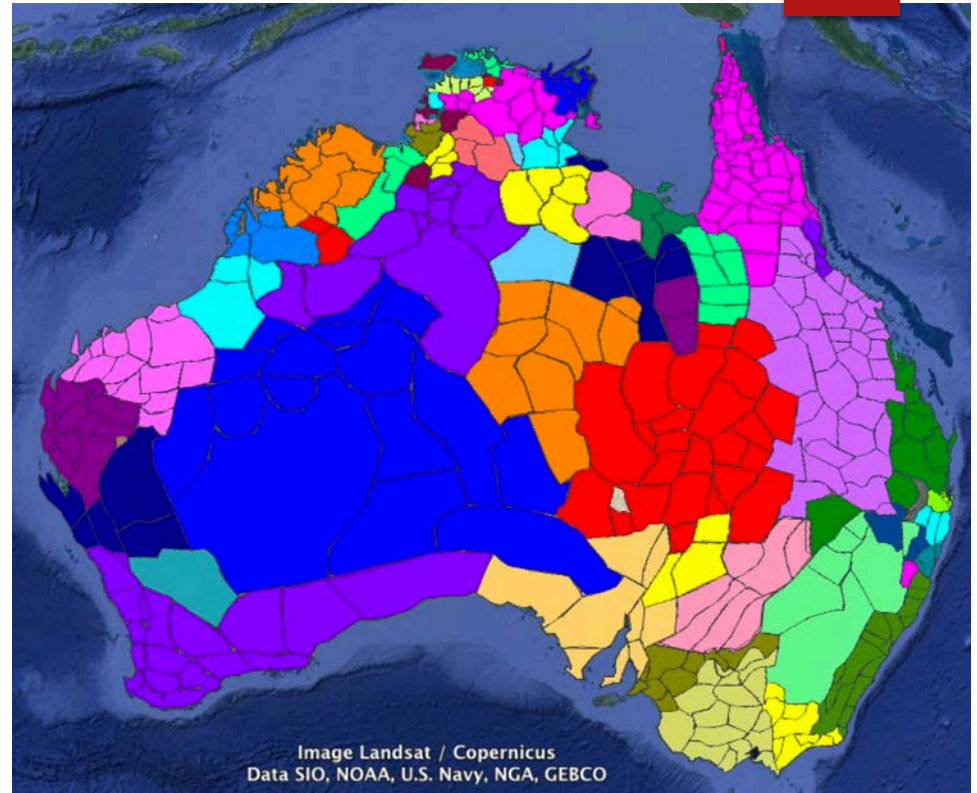
Universals: Some key questions for phonetic typology

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SIGTYP 2021 “@” NAACL ~ DIVERSITY VS. UNIVERSALISM

What I do

- ▶ Language Documentation
- ▶ Language Change
- ▶ Cultural Evolution
- ▶ (Focused on Australia and Australia in global perspective)



How to get from



to



Today

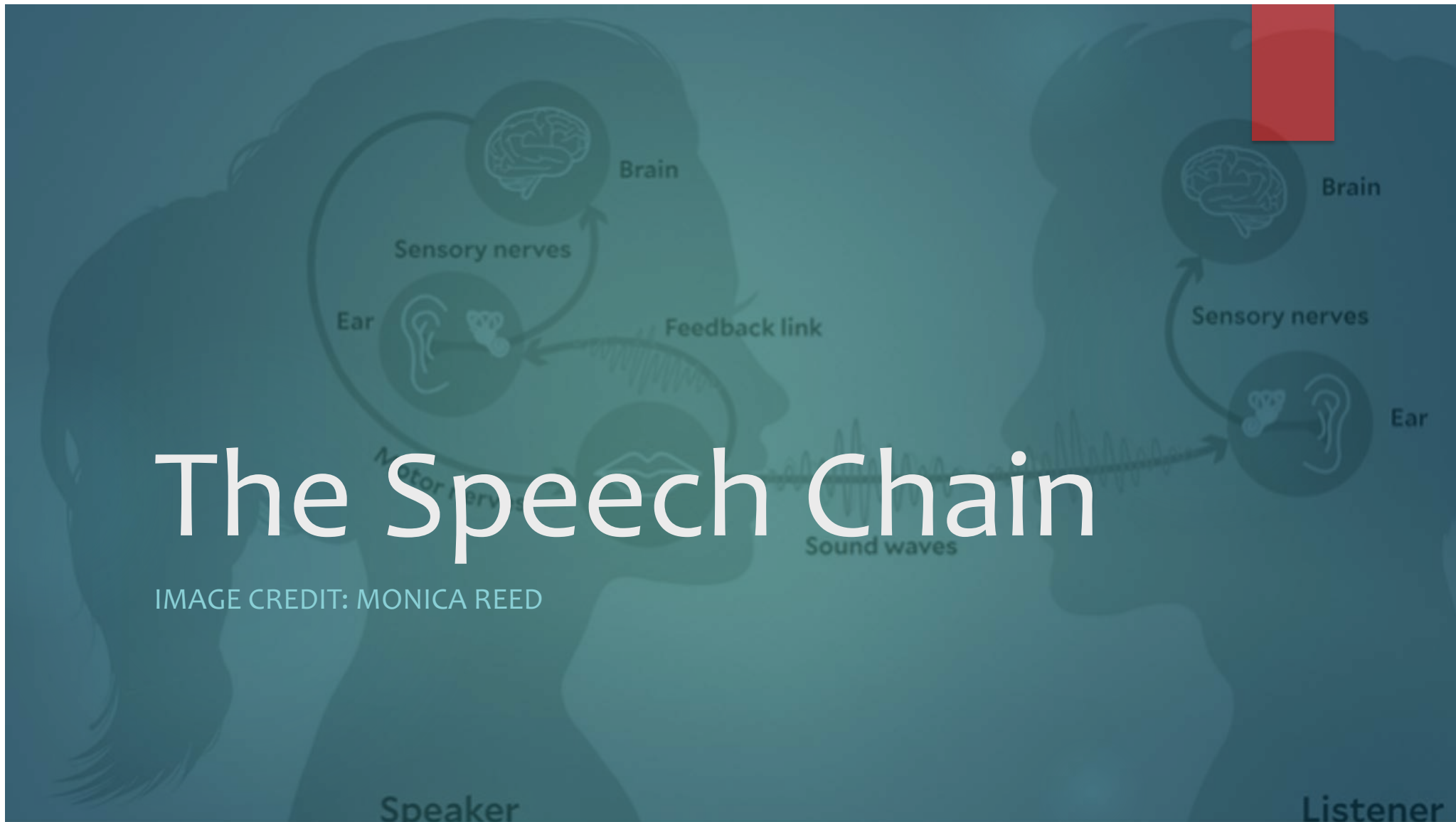
- ▶ Thoughts around **phonetic typologies** and universals
 - ▶ motivated by relationship to sound change, documentation, and stability
 - ▶ Contribution to the debate discussed by Haspelmath and Dahl (2020); Haspelmath (2019); Maddieson (1998, 1999)
 - ▶ Thinking through the implications for computational work; e.g. Chodroff et al (2020) and large-scale phonetic corpora

Roadmap

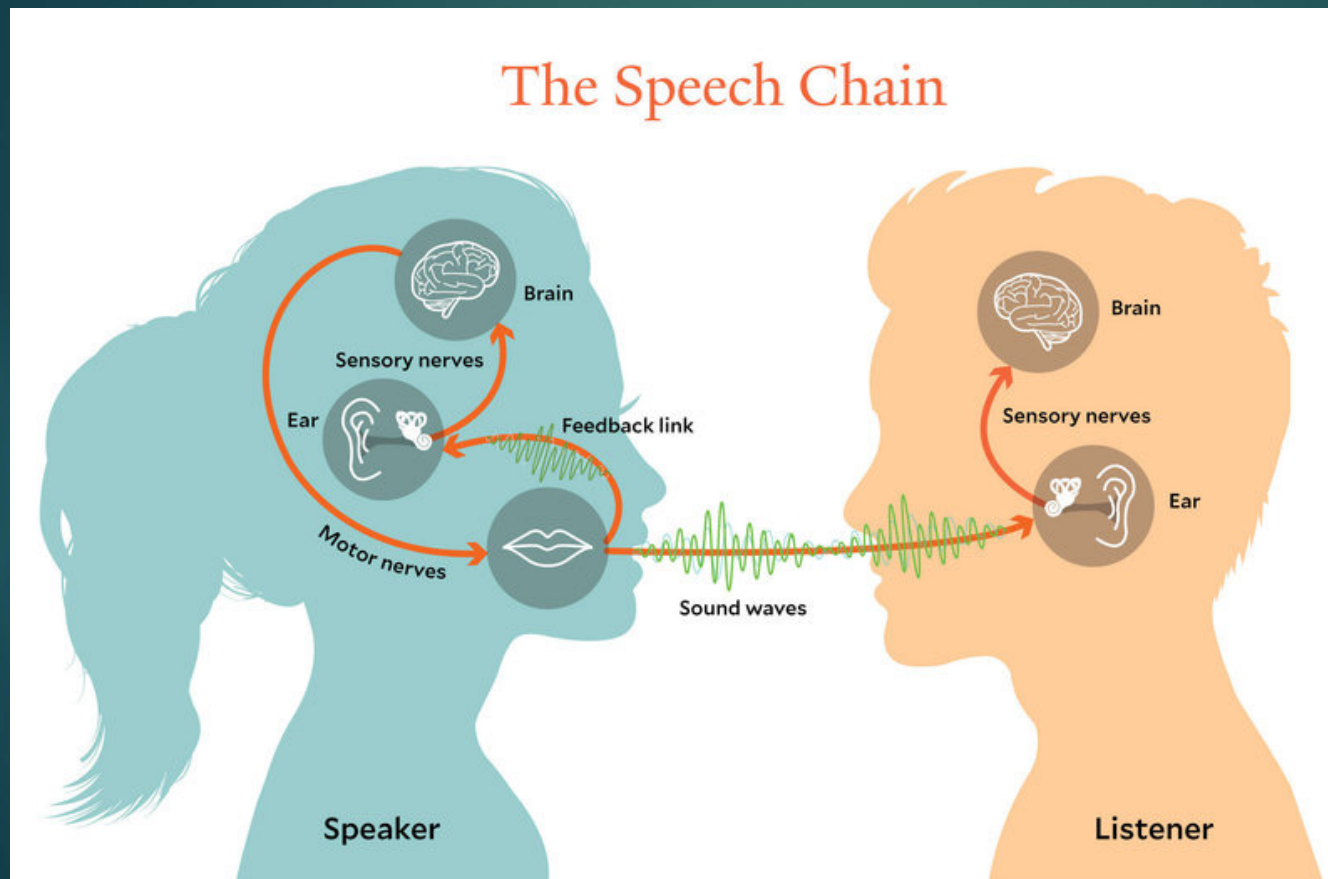
- ▶ Overview of the speech chain
- ▶ Thinking through universals and defining the language-specific vs the “universal”
- ▶ The impact of variation
- ▶ Key questions

The Speech Chain

IMAGE CREDIT: MONICA REED



Brief overview of the speech chain



Mental representations
Motor planning
Production
Speech signal (sound waves)
Audition
Perception, decoding

Image credit: Monica Reed

Phonetics comprises:

► Components:


- Neural/Psychological
 - Physiological
 - Social
 - Linguistic
 - Signals processing
-
- Individual
- Language
- Recording/Device/Software

► Change over time

- Lifespan, individuals
- Social marking
- Linguistic change
- Technological innovation



Universals



“ For linguists the demonstration of *similarities* between languages functions at the same time as one of the ways by which the proposition of equality is supported and as one of the reasons why linguists hold this view. **We feel justified in constructing general theories within which the peculiarities of individual languages can be described, rather than taking it as our task to build quite separate theories for different languages.** ”

MADDIESON (1999: 2521), EMPHASIS MINE

P-universals and G-Universals



Properties shared by all languages




Properties shared by some
independent languages

What are universals?

- ▶ Properties of speech shared by all
 - ▶ Brains
 - ▶ [Humans]
 - ▶ Modalities [?]
 - ▶ Languages
 - ▶ Societies

How speech is realized

What speech encodes
- ▶ Limits on variation ('design space of language')
- ▶ Dependencies between parts of the system that always hold (e.g. between phonetics and phonology)
- ▶ Pathways of change
- ▶ Properties shared by all complex dynamic evolutionary systems (variation, transmission, selection)



How do these universals arise?

- ▶ Innate language capacity
- ▶ Acquisition 'filter'
- ▶ Identical (or minimally varying) physiology
- ▶ Common processes of interaction

Some phonetic universals

- ▶ Properties inherent to speech because of properties of the vocal tract (or more broadly, the speech chain) => ‘mechanistic universals’ (cf. Maddieson 1998)
 - ▶ vowel height and Fo [intrinsic Fo]
 - ▶ vowel height and vowel duration
 - ▶ vowels before voiced consonants are longer than vowels before voiceless ones
 - ▶ Fo is lowered after voiced consonants
 - ▶ ...

Some phonetic universals

- ▶ How speech sounds are **structured** (language-specific), e.g. in allophony
 - ▶ Presence of allophony
- ▶ Perceptual **cues** that humans pay attention to [variation in implementation but “universal” in the feature set(?)] e.g. for stops
 - ▶ VOT
 - ▶ duration
 - ▶ (lenition)
 - ▶ subglottal pressure
 - ▶ glottalization
 - ▶ effects on surrounding vowels
 - ▶ ...

Some phonetic universals

- ▶ Objects of study [e.g. 5 formants, VOT; can't have a stop without having some value for VOT]
- ▶ Universals that come from phonology?
 - ▶ consonants and vowels
 - ▶ [gets into what's phonetics, what's phonology]
- ▶ Sound changes
 - ▶ [e.g. naturalness, unidirectionality]

A Caveat

- ▶ 120 years of recordings
 - ▶ Very shallow time depth
 - ▶ Very hard to use recordings made before 1960 for most acoustic measurements
- ▶ Very asymmetric phonetic records of the world's languages
- ▶ Half the world's languages endangered

The image features a teal background. A white waveform, resembling an audio signal, is positioned in the upper half. A solid red rectangle is located in the upper right corner. The word "Variation" is written in white, serif font, centered in the lower half of the image.

Variation

Variation

- ▶ Haspelmath & Dahl
- ▶ Is the point of interest what all {languages|brains|etc} share?
- ▶ Or what they don't share?
- ▶ E.g. why are some language families more internally similar than others?
[e.g. Pama-Nyungan vs Austroasiatic]

Variation

- ▶ Speaker
- ▶ Situation
- ▶ Utterance
- ▶ Language

- ▶ PLUS
 - ▶ Recording device differences
 - ▶ Measurement errors

Speaker

- ▶ Physiology
- ▶ Identity
- ▶ Life-stage (age)
- ▶ Psychology (individual-difference)

Situation

Social context

- ▶ Interlocutor [accommodation]
- ▶ Ambience [e.g. in car vs outside]
- ▶ Task
- ▶ Style

Utterance

(linguistic context) Position of

- ▶ Phoneme in the word
- ▶ Word in the utterance
- ▶ Utterance in the phrase

Measurement

- ▶ Device differences
 - ▶ Compression
 - ▶ Sampling
 - ▶ Bit depth
 - ▶ Etc
- ▶ Measurement errors
 - ▶ E.g. through Praat; octave jump, formant tracking

Literature on these types of variation

Utterance	✓✓ [lots! Of work]
Situation	(✓) [lots of lab speech; lots of small-scale sociolinguistic work, little xlinguistic work]
Speaker	(✓) [lots of work on well-studied languages, insufficient xling depth]
Language	✓ [patchy for some areas of the world]
Speaker * Situation	
Utterance * Language	
Measurement	✓✓

Take-home points

- ▶ Many points of variation are also points of universals: the same aspects of language that provide a “universal” framework for phonetics *also* are the sources of its variation.
- ▶ Some of these areas have been investigated well but others have not.
- ▶ How people talk about phonetic properties as properties of languages. Any search for phonetic universals needs to be careful about what is a property of a language vs what is a property of a speaker. E.g.
 - ▶ Fo values are properties of speakers
 - ▶ Fo ranges conditioned by gender are properties of communities (or maybe languages)

PUTTING IT ALL
TOGETHER

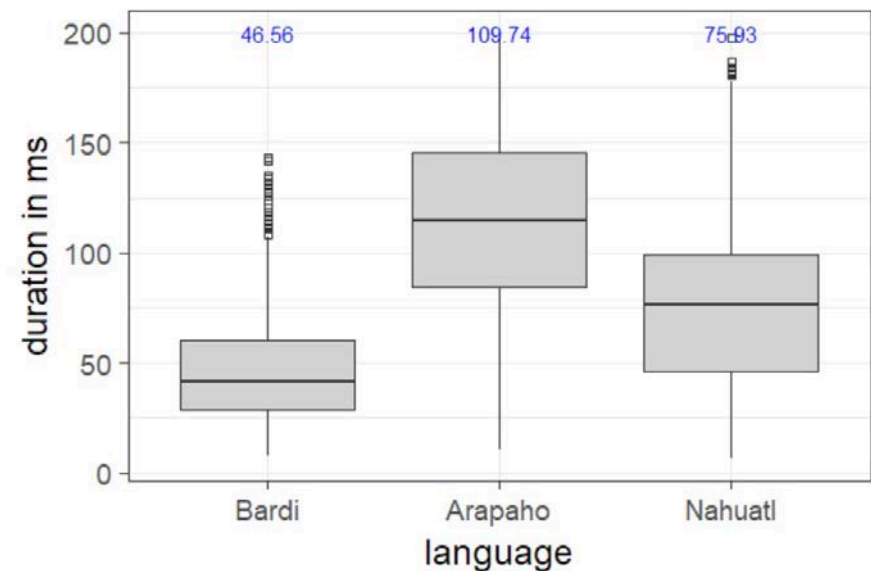
Key questions

Variation and contrast

- ▶ Variation around contrast maintenance [phonetics <> phonology interface]
- ▶ But what about variation among non-contrasting segments? [cf. Kakadelis 2018; Babinski 2020, 2021]
- ▶ Structured variation at the “language” level (consistency between speakers, differences between languages)




Figure 7-1. Average oral stop duration by language



Kakadelis (2018:260)

Variation and contrast

- ▶ Babinski (2020): 16 Australian languages and cues to initial, non-contrastive stress
- ▶ (all results held between speakers of the same language)



Language	Vowel duration	Intensity	F0 (pitch)	Periph.
Bardi				
Burarra				
Dalabon				
Gija				
Gunnartpa				
Gunwinggu				
Kayardild				
Kunbarlang				
Malak Malak				
Murrinh Patha				
Ngan'gi				
Wanyjirra				
Warnman				
Warlpiri				
Yannhangu				
Yidiny				

Phylogenetic signal in phonetics?

- ▶ Cf. in phonotactics [Macklin-Cordes et al 2021]
- ▶ "heritability" and variability => no information yet? [Functional phylogenies group (2012)]
- ▶ between language vs within language variation [no appropriate datasets (yet)?]
- ▶ Can't simply treat the phonetics as a continuous trait
 - ▶ E.g. if VOT is +ve in Lang A and -ve in Lang B, ancestor lang probably didn't have 0 VOT
- ▶ Can't treat all the features as properties of languages

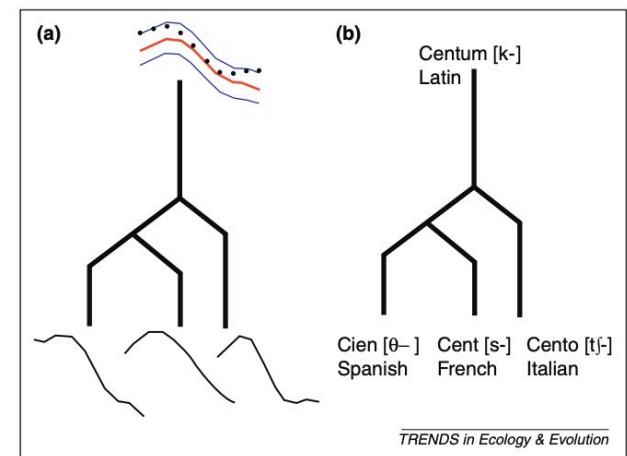
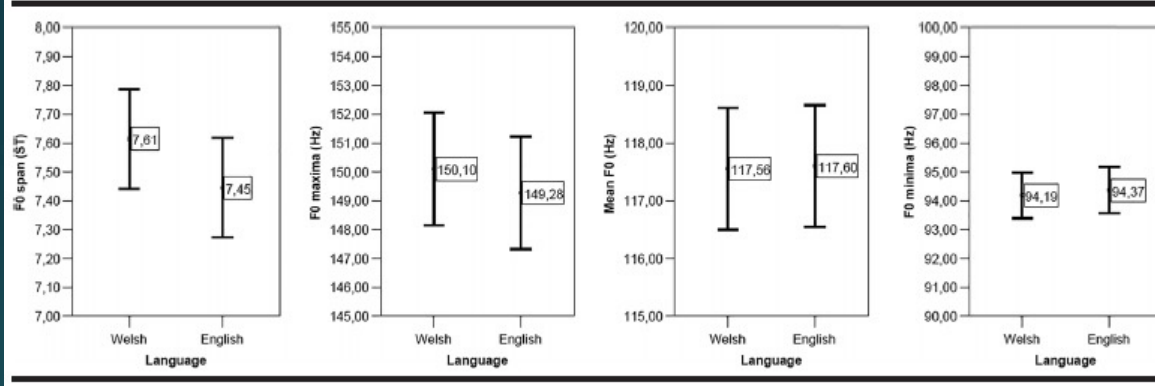


Figure 1. Making inferences about unseen data pertaining to an ancestral function-

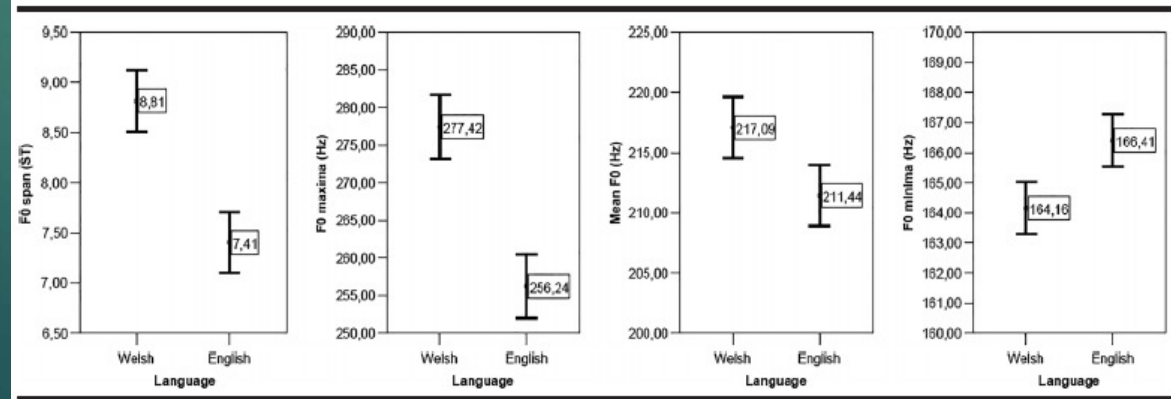
Comparative interpretation of social

Figure 2. Cross-linguistic differences in fundamental frequency range (FFR) between Welsh and English in male bilinguals' speech. Error bars stand for ± 2 SE. ST = semitones.



information and what
degrees of

Figure 1. Cross-linguistic differences in fundamental frequency range (FFR) between Welsh and English in female bilingual speech. Error bars stand for ± 2 SE. ST = semitones.



- ▶ M. Ordin and I. Mennen, "Comparison of fundamental frequency in Welsh and English in bilingual speech," 2015.



Conclusion

Where does this leave universals?

- ▶ There are universals in phonetics: more than we've tended to discuss
- ▶ But the same aspects of the speech chain that lead to universality also lead to variability
- ▶ Separating the language-specific from speaker-specific
- ▶ Many prospects for investigating such questions further
- ▶ BUT constrained by bottlenecks around language resources

