Phonetic Universals – Abstraction vs detail and -etics vs -ology

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Whence universals?

Universal(ist)s come in all shapes and sizes – from strong Chomskyan to the weakest of statistical tendencies. Whence do they arise?

- unambiguously physiological (e.g. human pitch range)
- artefacts of motor development (prevalence of labials?)
- apparently phonetically motivated (([p^h] $\rightarrow$ [f])
- based on general cognitive motivations such as maximise difference between distinct entities

Universals of vowel systems

Where on the scale are the universal tendencies in vowels?

Is detailed phonetics of vowels important?

Or are they a consequence of abstract principles?

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Question: is the detail necessary?

Abstracting de Boer's model

- Adopt the general framework (imitation games etc.) – but throw away phonetic detail.
- Vowels are simply points in 3-D space shaped like the printed vowel chart. (i.e. less front/back space for low vowels, rounding less important)

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- After many interactions, look at agents' 'vowel spaces'.

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But what about more complex vowel systems? Future work...

Now for something different ...

Phonetic vs phonological universals

Many universalist phonologists believe in features (*à la SPE*).

Features are phonology . . .

Recent study by Boersma and Chládková connected feature structure and vowel perception maps.

Boersma and Chládková 2010

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- In reality, the latter happens (Savela 2009).
- They suggest this is evidence for features.

Moreover . . .

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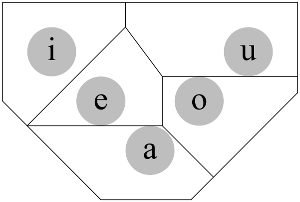

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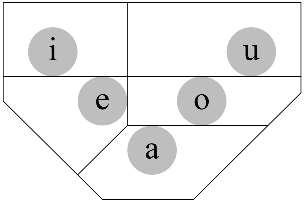

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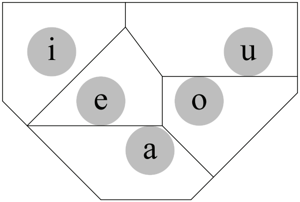

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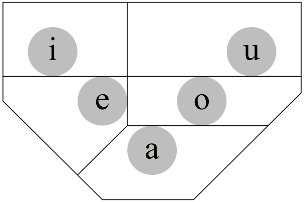

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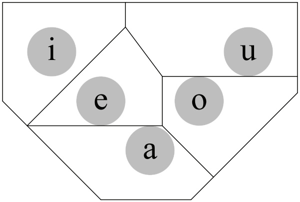

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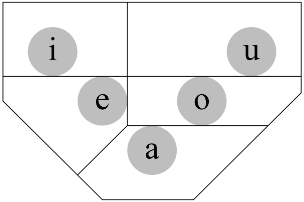

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- It's also what B&C find in real speakers!

But is there a phonetic explanation?

We set up a simulation using learning via imitation game again, but:

- We distinguish children from adults (don't learn) and have a dynamic population.
- The agents have a richer notion of vowel: articulatory prototype, and perceptual regions (convex polygons extended as they hear new exemplars).
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We seed the initial adult population with Czech or Spanish articulatory prototypes, and ask:
Is it stable? What are the perceptual boundaries do the agents develop?

Four simulations

All specified by initial articulatory prototypes:

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- with slightly raised e,o Run.
- A Spanish 5-vowel system Run.
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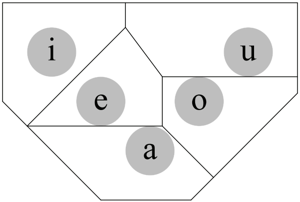

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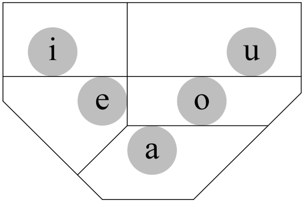

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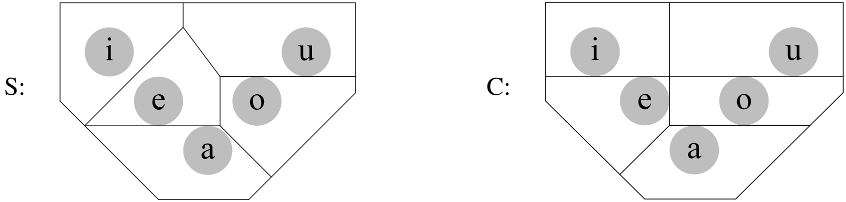

appropriate different perceptual boundaries can arise as purely emergent phonetic consequences of vowel positions – no features in sight!