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Workshop on Phonological Specification
and Interface Interpretation

1 Two forms of phonetic arson

- Hale & Reiss (2000) gave us the term 'substance-free phonology'—and the analogy it implies.

- But the idea is older than the name. For example:

> The logical conclusion of this is that phonologists (above all, generative phonologists) ought to burn their phonetic boats and turn to a genuinely abstract framework.
>
> Fudge (1967: 26)

1.1 Why go substance-free?

- apparent impossibility of providing elegant accounts of phonological patterns using substantive features—especially systems of putatively universal features (e.g., Jakobson et al. 1952; Chomsky & Halle 1968; Clements & Hume 1995)

- apparent redundancy in having UG stipulate in formal terms patterns that are derivable from physiological facts—e.g.:

  - Hale & Reiss (2000) argue (*contra* Beckman 1997) that we don't need to build positional faithfulness constraints into UG, because acquisition naturally produces the same patterns:

    > If the acoustic cues of a given contrast in the target language are correctly analyzed by the acquirer in a context where they are relatively weak, they will also be analyzed correctly in a context where they are relatively strong.
    >
    > Hale & Reiss (2000: 160)

  - Mielke (2008) argues against innate articulatorily based feature geometries:

    > The organization recapitulates anatomical information which is built into the definitions of the features. A more compelling case for innate feature organization could be made on the basis of features which pattern in a certain way *in spite of* their phonetic definitions.
    >
    > Mielke (2008: 27)

- More broadly, Hale & Reiss (2000, 2008) argue that:

  - At least *some* phonological patterns are phonetically arbitrary.
  - If the phonological computation can generate arbitrary patterns, then it can generate 'natural' patterns by the same formal mechanisms.

- Adding phonetic substance to the computation thus neither restricts nor expands the power of the computation in any useful or relevant way.

1.2   How to go substance-free?

Two current ways of burning the phonetic boats:

- Transparent features, arbitrary rules (e.g., Hale & Reiss 2008)

  - UG *must* provide features that allow learners to assign phonological representations to inputs before they have acquired the full adult grammar. (Cf. Dresher 2013 and Hall 2010a for rebuttals of this claim.)
  - But the formal computational system is completely oblivious to the phonetic content of those features.

    > Articulatory and acoustic substance *are* related to the representations we construct, but not within the grammar.
    >
    > Hale & Reiss (2008: 171)

- Arbitrary features, elegant rules (e.g., Odden 2006; Blaho 2008; see also Fudge 1967; Mielke 2008)

  - Features are not universal/innate, but rather induced by the learner.
  - Features are assigned on the basis of phonological behaviour, not acoustic or articulatory substance.

    > Features are indicators of the way members of an inventory behave, but they don't necessarily have any consistent phonetic characteristics even within the same system.
    >
    > Blaho (2008: 22–23)

  - Mielke (2008: 99): Emergent features don't necessarily have any content beyond identifying "the segments that do X."

(Another possibility discussed by Samuels (2011: §6.4): sensitivity to particular acoustic contrasts may be innate without being specific either to language or to human beings.)

2   Missing the boat

If we burn our phonetic boats, will we miss them?

In some ways, substance-free phonology ends up looking very much like substance-based phonology (e.g., Steriade 2001; Flemming 2002).

- Both approaches reject formal explanations for substantive phenomena.

- Phonetically based phonology places functional explanations directly in the synchronic grammar.

- Substance-free phonology posits that phonetics can influence phonology only indirectly, though diachrony and acquisition, but nonetheless relies on functional phonetic explanations to account for why so many phonological patterns are phonetically natural, much as in Evolutionary Phonology (Blevins 2004, 2006).

- Much of the burden of explanation is thus shifted away from phonology itself.

- If phonology is "a genuinely abstract framework," then the role of Phonology (as a component of the human language faculty) in shaping phonologies (as components of the grammars of particular languages) is quite limited.

- E.g., Hale & Reiss argue that what UG gives us is the distinction between humanly computable languages and statable languages, giving the following examples:

> (1) ATTESTED $\subset$ ATTESTABLE $\subset$ HUMANLY COMPUTABLE $\subset$ STATABLE
>
>   a. Attested: Cree-type grammars, English type grammars, French-type grammars
>
>   b. Attestable: "Japanese" in 200 years, Joe's "English"
>
> $\leadsto$c. Humanly computable: p $\rightarrow$ s / ___ r
>
>   d. Statable: V $\rightarrow$ V: in prime numbered syllables:
> $paka_2nu_3tipa_5fose_7 \rightarrow$ paka:nu:tipa:fose:
>
> <div align="right">Hale & Reiss (2008: 3)</div>

- If the formal structure of phonology just rules out things like sensitivity to prime numbers, then it's not all that interesting.

- This talk:

  - Banishing substance from phonology altogether gives up the possibility of offering formal explanations for substantive patterns.

  - This banishment has been based, in part, on unwarranted assumptions about the rigidity of phonological representations.

  - The moderate use of phonetic substance in phonology can allow us to explain certain kinds of patterns while still acknowledging that phonetics is not destiny.

3   The methodological case

- Mielke's case for emergent (and potentially arbitrary) features draws support from the existence of phonological patterns involving unnatural classes of sounds.

- (The same kinds of patterns could also be taken as evidence for the Hale & Reiss (2008) view, with universal features and arbitrary rules.)

- If phonology is purely abstract and substance-free, then there is little reason to be skeptical about such patterns. They may arise diachronically through uncommon combinations of phonetically natural changes, but the synchronic learner can easily represent them.

- But if we don't assume that anything is possible, that gives us reason to push on these cases. And if we push, then at least some of them give, as shown by Hall (2010b) and Godfrey (2012).

- E.g., Bukusu:

  - Mielke (2008: 66–67), citing Austen (1975): Nasals in Bukusu delete before fricatives (2) and before other nasals (3).

    (2)   Nasal deletion before fricatives:
         a.   /i+**n**+**f**ula/   →   [e:**f**ula]   'rain'
         b.   /**in**+**s**om+ij+a/ →   [e:**s**omia] 'I teach'
         c.   /i+**n**+**x**ele/   →   [e:**x**ele]   'frog'

    (3)   Nasal deletion before nasals:
         a.   /**in**+**m**eel+a/   →   [e:**m**eela]   'I am drunk'
         b.   /**in**+**n**uun+a/   →   [e:**n**uuna]   'I suck'
         c.   /i+**n**+**ɲ**aɲa/   →   [e:**ɲ**aɲe]   'tomato'
         d.   /i+**n**+**ŋ**uaŋua/ →   [e:**ŋ**waŋwa] 'camel'

- Before plosives (which would be included in any obvious natural class that encompasses both nasals and fricatives), nasals do not delete; instead, they assimilate in place:

  (4)   a.   /**in**+**p**im+a/ →   [e**mp**ima] 'I measure'
         b.   /**in**+**b**on+a/ →   [e**mb**ona] 'I see'
         c.   /i+**n**+**g**oxo/ →   [e**ŋg**oxo] 'hen'

- So Mielke (2008) claims that nasal deletion is triggered by the unnatural class of nasals and fricatives.

- But Bukusu systematically lacks geminates (Mutonyi 2000: 178). So we can say instead that:
  - Nasals delete before the natural class of fricatives.
  - Nasals undergo place assimilation to the natural class of stops and nasals.
  - Degemination eliminates sequences of identical consonants, including those generated by place assimilation of nasals to nasals.

  (5)

U.R.	/i+n+fula/	/in+meel+a/	/in+pim+a/
NASAL DELETION	ifula	—	—
PLACE ASSIMILATION	—	immeela	impima
DEGEMINATION	—	imeela	—
Other processes[1]	e:fula	e:meela	empima
S.F.	[e:fula]	[e:meela]	[empima]

- Methodologically, if we assume that any 'humanly computable' phonological system is possible, then our theory will seldom lead us to reject any observationally adequate description of any pattern—and if UG is more constrained than this, we won't discover it.

- Mielke (2008: 122–123), citing Thompson & Thompson (1992), presents /t/-deletion in Thompson as an example of a process involving two 'crazy' classes.

  (6)   t → ∅ /
  $$\left\{\begin{matrix} n \\ n' \\ ? \\ h \end{matrix}\right\} \underline{\quad} \left\{\begin{matrix} \int \\ x^w \\ n \end{matrix}\right\}$$

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1. Vowel lowering and compensatory lengthening.

- Suppose that there is an emergent feature in Thompson whose extension is /ʃ, xʷ, n/.

  - What would any of these segments turn into if we delinked this feature (or changed its value from $+$ to $-$)?

  - What would some other consonant of Thompson (such as /p/ or /x/ or /tɬ'/) turn into if we spread this feature onto it?

- As Mielke (2011) points out, the following are theoretical claims, not necessary properties of features:

> a. Claim: The distinctive features that define segmental contrasts also define changes in alternations.
>
> b. Claim: The same features also define classes of sounds that may be involved in alternations.
>
> Mielke (2011: 398)

- But they're claims worth pursuing, and admitting 'features' that correspond to classes of sounds that cannot be characterized intensionally makes it harder to do so.[2]
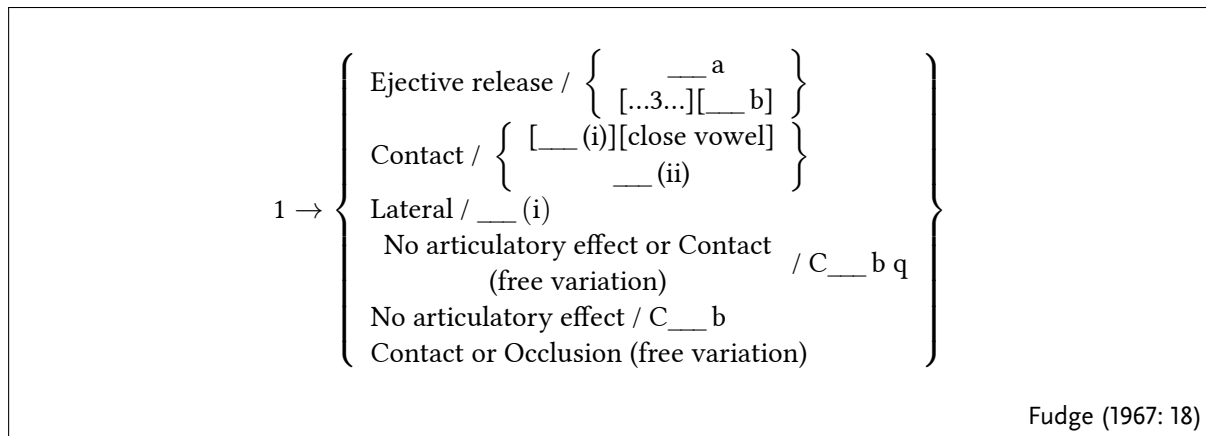
4 Assumptions about features

- Substance-free phonology is, in part, a reaction to the apparent failures of putatively universal systems of phonetically contentful features.

- But these failures are not necessarily the fault of substance *per se.*

- Fudge (1967), for example, cites Bloomfield (1933) and Nida (1949) in noting that organizing tables of phonemes according to their phonological behaviour is often analytically useful but at odds with phonetic reality.

- Rather than following them in dismissing such tables as mere conveniences for the researcher, he dismisses phonetic reality from phonology altogether.

- In his treatment of Tswana, a feature numbered 1 encompasses the odd-looking class of consonants in (7):

(7) p' t' tl' ts' tʃ' k' ʔ
     b   d   dʒ
             l

- The phonetic implementation of feature 1 is handled by the following realization rule:

---

2. This objection, of course, does not apply to Hale & Reiss's (2008) version of substance-free phonology, in which features have phonetic content that is simply irrelevant to phonology.

$$1 \rightarrow \left\{ \begin{array}{l} \text{Ejective release } / \left\{ \begin{array}{c} \underline{\quad} \ a \\ [...3...][\underline{\quad} \ b] \end{array} \right\} \\ \text{Contact } / \left\{ \begin{array}{c} [\underline{\quad} (i)][\text{close vowel}] \\ \underline{\quad} (ii) \end{array} \right\} \\ \text{Lateral } / \underline{\quad} (i) \\ \begin{array}{c} \text{No articulatory effect or Contact} \\ \text{(free variation)} \end{array} \\ \text{No articulatory effect } / \ C\underline{\quad} b \\ \text{Contact or Occlusion (free variation)} \end{array} \right\} / \ C\underline{\quad} b \ q$$

<div align="right">Fudge (1967: 18)</div>

- Considered against the backdrop of a full IPA chart, or even against the features proposed by Jakobson et al. (1952), the consonants in (7) seem like a phonetically arbitrary set.

- But if we consider them in the context of the Tswana inventory (shown in (8), based on Fudge 1967: 17), and allow that features can be different from those of *Preliminaries* without being completely arbitrary, they're not such a strange grouping.

(8)

p'	t'	tl'	ts'	tʃ'	k'	ʔ
b	d/l			dʒ		
pʰ	tʰ	tlʰ	tsʰ	tʃʰ	kx/kʰ	
ɸ			s	ʃ	x/h	
	r					
m	n			ɲ	ŋ	

- To the extent that they need to be identified as a class at all (they alternate with one another in postnasal fortition), they could be characterized by features like $\begin{bmatrix} -\text{sonorant} \\ -\text{spread glottis} \end{bmatrix}$ or $\begin{bmatrix} -\text{continuant} \\ -\text{nasal} \\ -\text{spread glottis} \end{bmatrix}$.

5   Contrast and content

- The proponents of substance-free approaches are entirely correct in observing that the phonetic properties of phonemes do not dictate their phonological behaviour. But there is a way of curtailing the role of substance without eliminating it altogether.

- The crucial factor is contrast. Phonological features are inherently relational, not absolute.

- This is important in several ways:

5.1   Intensions, extensions, and inventories

Least controversially, in any given language, a particular set of feature values will pick out natural **subsets** of the inventory—not necessarily a natural class of sounds in any broader context.

For example, ejectives and voiced plosives can be a natural class in an inventory like (8) that lacks plain voiceless plosives.

5.2 Dimensions *vs.* boundaries

In order to be described as phonetically contentful, a feature need only identify a phonetic dimension of contrast. It need not specify an absolute cutoff point, even within a given language. (See Hall (2011: §6.3) for further discussion.)

- What Fudge (1967) says about the term 'rounded' in a phonetic realization rule can just as easily be applied to [+round] as a feature value:

> Questions like 'How rounded is "rounded"?'will be answered fully in the next section; for the present we will content ourselves with the rough answer 'Rounded enough to be distinguished from "neutral"'.
>
> Fudge (1967: 12)

- In a language with a vowel inventory /i a u/, a feature that divides the inventory into /i u/ vs. /a/ can be characterized as a height feature, but we shouldn't necessarily expect to be able to say whether it is [±high] or [±low].

- Even consonant features, which typically lend themselves more readily to categorical definitions, need not have inflexible boundaries between + and −. E.g., Mielke (2005) points out that laterals and nasals pattern phonologically sometimes with [−continuant] segments and sometimes with [+continuant] ones.

5.3 Correlations and categories

Features can be emergent, and show cross-linguistic variation, without necessarily allowing for wholly arbitrary groupings of segments.

- Cowper & Hall (2013): Learners acquire features by identifying correlations. For phonological features, the relevant things to correlate are:

  - contrast in lexical meaning
  - contrast in phonetic realization
  - contrast in phonological behaviour

- Correlations between contrast in lexical meaning and contrast in phonetic realization tell the learner that there are phonemes that need to be distinguished by some feature, as in minimal pairs like *hat–hatch* or *laugh–lass.* Sometimes these correlations also align with differences in phonological behaviour (as in *hat*[s]–*hatch*[əz] and *laugh*[s]–*lass*[əz]).

- Contrasts in meaning can also correlate with contrasts in behaviour without necessarily also involving a contrast in realization. This allows the learner to posit abstract phonemes like those posited by Hyman (1970) for the vowel system of Nupe.

(9)   PALATALIZING   LABIALIZING
      [ēgʲī]   'child'   [ēgʷũ]   'mud'
      [ēgʲē]   'beer'   [ēgʷó]   'grass'
      [ēgʲà]   'blood'   [ēgā] 'stranger' [ēgʷā]   'hand'

- Among the phones realized as [a] in Nupe, there is one that palatalizes preceding consonants, one that labializes them, and one that does neither. These different behaviours correlate with (arbitrary) differences in lexical meaning.

- In such cases, the phonemes, even though they do not differ in their own phonetic realizations, can still be distinguished phonologically by features whose phonetic content can be identified by their effects on other segments.

## 5.4   Contrastive specification

Contrastive specification offers a principled explanation for the fact that phonemes that have a particular phonetic property are sometimes ignored by phonological processes that refer to the feature corresponding to that property.

> CONTRASTIVIST HYPOTHESIS:
> The phonological component of a language L operates only on those features which are necessary to distinguish the phonemes of L from one another.
>
> Hall (2007: 20)

- Dresher (2009) argues that the appropriate way to determine the contrastive or redundant status of a feature is by a contrastive hierarchy (as in Cherry et al. 1953; Halle 1959).

- Features are assigned by making successive divisions in the inventory; no feature is assigned unless it serves to mark some phonemic contrast.

- The hierarchical ordering of features can vary from one language to another.

- An example from Mackenzie (2013):

  - If a language has a three-way contrast among voiced pulmonic egressives, voiceless pulmonic egressives, and implosives, then the contrastive hierarchy approach permits two ways of using the features [±voice] and [±constricted glottis] to distinguish them:

a. [constricted glottis] > [voice]   b. [voice] > [constricted glottis]
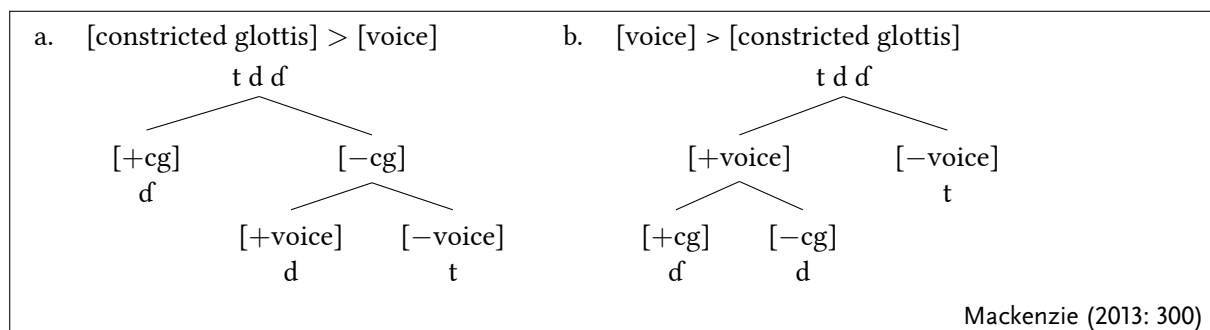
Mackenzie (2013: 300)

- Either (a) implosive /ɗ/ will be unspecified for voicing, or (b) voiceless /t/ will be unspecified for glottal constriction.

- Mackenzie (2013) shows that both possibilities are attested.

- In Ngizim, the phonetic voicing of implosives is phonologically irrelevant:

    (10)   Ngizim voicing harmony (Mackenzie 2013: 301, citing Schuh 1997)

        a.   Voiced pulmonic obstruents cannot follow voiceless ones:

            i.   [gâːzá]   'chicken'   *k…z

            ii.   [də́bâ]   'woven tray'   *t…b

            iii. [zə̀dú]   'six'   *s…d

            iv.   [kútə́r]   'tail'

            v.   [tásáu]   'find'

        b.   …but implosives can:

            i.   [kìːɗú]   'eat (meat)'

            ii.   [fə́ɗú]   'four'

            iii. [pə́ɗə́k]   'morning'

            iv.   [də̀ɓú]   'give water'

- In Hausa, the phonetic absence of glottal constriction on voiceless pulmonic obstruents is phonologically irrelevant:

    (11)   Hausa [constricted glottis] harmony (Mackenzie 2013: 302, citing Newman 2000)

        a.   Homorganic voiced obstruents may not mismatch in [±cg]:
             [ɗaɗa]   'to strike a blow'   *ɗada

        b.   …but a voiceless pulmonic egressive can coöccur with an implosive:
             [ɗata]   'a small, bitter, green tomato'

- In Mackenzie's analysis, the consonants that participate in the coöccurrence restrictions in each language are not an arbitrary set: they are defined by the *contrastive* presence of specific, phonetically contentful features.

5.5   Conclusions

- Under this view, the task of the learner in acquiring phonological representations is to set up a system of features that is just sufficient to differentiate the phonemic inventory and that allows for the encoding of observed patterns.

- If the features themselves must be phonetically interpretable, then the learner's job is simplified, and the analyst's hypothesis space is constrained.

- Representations are substantive enough to make 'natural' patterns the norm, but also abstract enough to account for the fact that phonetics does not determine phonological destiny.

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