Li6 Phonology and Morphology

Features and natural classes

Today’s topics

- Natural classes ⇔ features
- Evidence for features
Natural classes

- There is robust evidence from many domains that phonemes pattern in **natural classes**.
  - Quick example: glide suppression in AmE
    - Tune, dew, news, lute, suit…
    - Pure, bugle, cute, music…
  - **Hypothesis**: phonemes composed of features
    - Jakobson, Trubetzkoy, and Karcevsky 1928
    - Drawing on decompositional theories of Plato, Democritus
    - Analogous to elements being made of atoms, or more accurately atoms being made of electrons, protons, etc.
  - **Basic idea**: natural class behavior involved manipulation of simple feature combos (typically 1 feature)
  - **Analysis of glide suppression**: no glide / [coronal] _/u:/

Evidence for features

- **Conventional evidence**
  - Synchronic alternations, Historical change
- **Psycholinguistic evidence**
  - Speech errors, priming studies…
Synchronic alternations

- **Spanish spirantization**
  
<table>
<thead>
<tr>
<th>noun</th>
<th>definite</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>banca</td>
<td>la banca</td>
<td>[baŋka]</td>
</tr>
<tr>
<td>demora</td>
<td>la demora</td>
<td>[la δemora]</td>
</tr>
<tr>
<td>gana</td>
<td>la gana</td>
<td>[la γana]</td>
</tr>
</tbody>
</table>
  
  - Why {b d g} ~ {β δ γ}, not e.g. *{r m e}?
  - Spread of [+continuant]

- **English voicing assimilation**
  
  - e.g. plural /-z/ → [s] / {ptkθ(x)}

- **Place assimilation**
  
  - i[n]ept
  - i[n]decent
  - i[m]plausible
  - i[ŋ]capable

Historical change

- **Grimm’s Law**

<table>
<thead>
<tr>
<th>Latin</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>pater</td>
<td>father</td>
</tr>
<tr>
<td>ped-</td>
<td>foot</td>
</tr>
<tr>
<td>trēs</td>
<td>three</td>
</tr>
<tr>
<td>dent-</td>
<td>tooth</td>
</tr>
<tr>
<td>canis</td>
<td>hound</td>
</tr>
<tr>
<td>centum</td>
<td>hundred</td>
</tr>
</tbody>
</table>

IE

\[ *p \rightarrow p^* \rightarrow t^* \rightarrow k \]

Lat

\[ p \rightarrow t \rightarrow k \]

English

\[ f \rightarrow θ \rightarrow h \]

Innovation: *-[voice] > [+continuant]

Which is shorthand for:

“All voiceless phonemes become [+continuant]”
**Potential problem**

- One might argue that synchronic alternations are the residue of historical changes, which in turn are the result of physical constraints on perception and production, and therefore don’t need to be encoded in terms of features.
- This, however, doesn’t account for the wide range of psycholinguistic evidence…

**Psycholinguistic evidence**

- Disorders
- Neurolinguistic studies
- Speech errors
- Child and adult acquisition facts
- Priming and masking studies
Disorders

Language disorders

- **Stopping**
  - $f \ v \ s \ z \ \theta \ \delta \rightarrow p \ b \ t \ d \ t \ d$
  - [+continuant] $\rightarrow$ [-continuant]

- **Devoicing**
  - $b \ d \ g \rightarrow p \ t \ k$
  - [+voice] $\rightarrow$ [-voice]
[cons]: C-V dissociations

- Dysgraphic patients show strong tendency for substitution and transposition errors to preserve the C/V status of letters
  - E.g. 82% of AS’s substitutions and 62% of his transposition errors preserved CV status
- Cotelli et al. 2003
  - Patient recovered from fluent aphasia to selective dysgraphia
  - The spelling disorder was selective for vowels
- Ferreres et al. 2003
  - Patient with alexia secondary to cerebral lesion
  - Errors in the reading of non-words affect vowels more than consonants.
- (Cf. also Miceli et al. 2004, Buchwald and Rapp (forthcoming))
- A case study…

Caramazza, Miceli, and Chialant 2000

- Alicia, 41, failed to correctly produce vowels three times more often than consonants.
- Irena, 52, had the opposite problem; she failed three times more often on consonants.
- For example, instead of saying "leggere" ("to read" in Italian), Irena might say "seppere" and Alicia "loggiare." Both words are meaningless.
Mismatch fields and [voice]

\[\text{pæ tæ tæ kæ dæ pæ kæ tæ pæ kæ bæ tæ} \ldots\]

\[- - - - [+\text{voi}] - - - - [+\text{voi}] - \ldots\]

- Voiceless phonemes are in many-to-one ratio with [+voice] phonemes
- No other many-to-one ratio in this sequence

*Phillips, Pellathy & Marantz 2000*
Mismatch fields and [voice]

Speech errors
Speech errors (Fromkin 1971)

- **voicing** [±voice]
  - clear blue sky $\Rightarrow$ glear plue sky
  - big and fat $\Rightarrow$ pig and vat
  - is Pat a girl $\Rightarrow$ is bat a curl

- **place** [coronal, dorsal, labial...]
  - computation $\Rightarrow$ po[r]kutation

- **nasality** [±nasal]
  - Cedars of Lebanon $\Rightarrow$ Cedars of Lemadon

Speech errors (Jaeger 1992)

- Children as young as 1;7 make slips in which single consonants or single vowels are substituted or exchanged, implying segmental organization in phonological representations.
- Corpus of 366 consonant substitutions and reversals made by children aged 1;7-6;0 subjected to a multidimensional scaling analysis

- **Findings**
  - errors governed by patterns of phonetic similarity, suggesting that these segments have phonetic (feature) structure.
  - Errors by feature (in decreasing order of frequency):
    - place of articulation
    - [voice]
    - [nasal]
Acquisition

L1 Acquisition errors

- [continuant]
  - p for f [maip] ‘knife’
  - t for s, θ [tuwt] ‘suit’; [ba:t] ‘bath’
  - d for z, δ [dʌd] ‘does’; [ʌdʌ] ‘other’

- place of articulation
  - Dorsal harmony (English)
    - take → [gek]
  - Labial harmony (Dutch, English)
    - snoep ‘candy’ → [fup], zeep ‘soap’ → [fep]
  - Dorsal or coronal default
    - kiss → tiss (“positional velar fronting”)
    - Japanese children often replace t with k

16) change from velar to coronal
- [daɪn] /kɑːn/ (crane)
- [tæ.tɛɪ] /kæt/ (cat)
- [dɛt] /gɛt/ (money)

18) change in word intern velar
- [boi.dɛ] /ˈbɔɪdʒ/ (bridge)
- [te.tɛ] /ˈteɪkər/ (tractor)
- [ɡu.i.tɛ] /ˈɡʌɪkə/ (cucumber)
- [bu.i.tɛ] /ˈbʊɪkə/ (oak)
Acquisition of manner

- Jusczyk, Goodman, and Baumann 1999
  - Nine-month-old English-learners
  - Headturn Preference Procedure
  - Infants exposed to two types of lists of CVC syllables
    - Items in the experimental lists shared a particular phonetic property
    - Items in the control lists were unrelated
  - Results
    - 9-month-olds sensitive to shared features that occur at the beginnings, but not at the ends of syllables.
    - They had significant listening preferences for lists in which the items shared the same manner of articulation at syllable onsets.

Association

- Žagar and Locke 1986
  - Method
    - Ten children, aged 4;6 to 5;5, trained to associate consonantal features of voicing, manner, and place of articulation with cups of a particular location and color.
  - Results
    - Performance on untrained generalization trials exceeded chance on voicing and manner, but not on place of articulation.
  - Conclusion
    - Children store sounds with feature structure and can target these features in generalization formation.
Learning nonce words

- Anisfeld, Barlow, and Frail 1968
- **Method**
  - 1st and 2nd graders (i.e. 6-8 yrs old) given CVC singular nonce words (e.g. NAR) orally
  - Asked to choose between two plurals (e.g. NARF vs NARK)
- **Results**
  - Kids preferred final sounds agreeing with /z/ for [continuant] or [strident]
- **Conclusion**
  - Kids’ plural rules are formulated in terms of features, not segments
  - When forced to pick a new plural, they pick the option that shares the most features with their normal plural affix.

Adult acquisition

- Pycha et al. 2003
- **Is a less formally complex grammar** (with complexity computed in terms of features) easier to learn?
  - simple: \( X_\alpha \ldots X \rightarrow X_\alpha \ldots X_\alpha \)
  - complex: \( X_{\alpha,\beta} \ldots X \rightarrow X_{\alpha,\beta} \ldots X_\alpha \)
Adult acquisition

- **Design**
  - Subjects asked to learn patterns of non-local vowel interaction by listening to nonce words.
  - Subjects told they’re listening to singular-plural pairs in a new language, and their task is to learn how to make plurals in this language.
  - Each word consists of a CVC stem followed by a VC suffix whose vowel alternates according to the vowel of the stem.
  - Subjects listen to pairs of stem and suffixed forms exhibiting a particular pattern, and are then asked to make judgments about novel pairs of stem and suffixed forms.
  - Correct judgments taken as an indication of learning.

Adult acquisition

- **Experimental condition**
  - [+simple]
    - Stem and suffix V agree in backness
      - [-back] root: CiC-ɛk, CIC-ɛk, CæC-ɛk
      - [+back] root: CuC-ʌk, CUC-ʌk, CaC-ʌk
  - **Control condition**
    - [-simple]
      - Stem and suffix V may agree or disagree in [back], depending upon what the stem V is
        - CiC-ɛk, CUC-ɛk, CæC-ɛk
        - CuC-ʌk, CIC-ʌk, CaC-ʌk
**Adult acquisition**

- **Results**

![Bar chart showing percent correct responses for VH and ARB groups]

- **Interpretation**
  - Confirmation of Simplicity Hypothesis:
    - naïve listeners learned phonological processes that exhibited single-feature predictability significantly better than processes that did not.

**Priming and masking**
Priming and features

- Lukatela et al 2001
- **Question:**
  - Does the priming of a word (e.g. sea, film, basic) by a rhyming non-word depend on the non-word's featural similarity to the word?
- **Method**
  - mask--prime--target--mask sequence with both brief (57 ms in Experiments 1 and 2) and long (486 ms in Experiment 1) prime durations.
- **Results**
  - Non-word primes that differed from their targets by a single phonemic feature (initial voicing as in ZEA, VILM, PASIC) led to faster target lexical decisions than non-word primes that differed by more than a single phonemic feature (e.g. VEA, JILM, SASIC).
- **Conclusion**
  - Visual word recognition seems to involve a feature-based level of processing.

Backwards masking

- Bedoin and Chavand 2000
- **Question**
  - Does phonetic similarity improve performance in backward-masking experiments?
- **Method**
  - Subjects had to recall a briefly presented target that had been immediately replaced (masked) by another stimulus.
  - This task is difficult because target processing is disrupted by the mask.
  - This disruptive effect is reduced when the target and mask are orthographically or phonemically similar (Perfetti & Bell 1991).
- **Results**
  - Featural similarity reduced deleterious masking effects
    - e.g. DÉBUT /deby/ was better identified if masked by zévut (differs only in [cont]) than by séfut (which differs in [cont] and [voice]).
- **Conclusion**
  - The features [voice] and [continuant] appear to be involved in processing.
Intraword priming/masking

- Krifi et al 2003
- Method
  - Adult skilled readers and third graders with average reading level
  - Phonetic priming and masking effects were assessed within one briefly presented CVCV printed nonce stimulus. The consonant target (C1 or C2) was either similar or different in voicing to the other consonant.
  - DUBA, DUPA, TOBI, TOPI
  - C’s used: {dbqvzž}, {tpkfsš} (factors out gestalt)

Summary

- We’ve seen evidence for these features:
  - [voice]
    - vowels, glides, liquids, nasals, voiced stops, voiced fricatives
  - [continuant]
    - vowels, liquids, glides, fricatives
  - [nasal]
    - m, n, ň
  - [consonantal]
    - all but glides, vowels, and laryngeals (h, ?)
- As well as three places of articulation:
  - coronal, dorsal, labial
- Some other important features:
  - [sonorant]
    - nasals, liquids, glides, vowels
  - [high]
    - dorsal consonants, some vowels
References


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Conditioned Head Turn

**drumming bear**

- Infant (≥ 0:6) hears constant background stimulus, e.g. [ba], and target, e.g. [pa]
- Conditioned to turn head only to target set, not background set (correct response reinforced by flashing lights, drumming bears)
Glossary

- **Manner features**
  - [continuant], [nasal], [strident], [lateral], and (according to some, not including me) [approximant]