Overview

1. Course Business
   a. Work day
   b. Presentations
   c. Papers

2. Up to now
   a. Tasks
      i. fragment monitoring (online)
      ii. segmentation (offline)
      iii. well-formedness (offline)
      iv. production (online)
   b. Conclusions
      i. Different factors in different tasks
      ii. These tasks support a “probabilistic” syllable

3. Today
   b. Hammond (to appear) - new
   c. Ohala (1999) - new

Hammond et al (to appear) – Spotlight on Sonority

4. Two markedness generalizations:
   a. Smaller onsets are present in a language before larger ones
   b. Appropriate sonority profiles precede reversed profiles

5. Domains to consider
   a. Grammar
   b. Frequency
   c. Acquisition
   d. Judgments

6. Grammar
   a. Both generalizations (4a-4b) true, except for sC clusters

7. Frequency (in corpora)
   a. Browncorpus.txt and clusters.pl on website
   b. Both generalizations true, except for sC clusters

8. Acquisition
   a. Coming up next (Ohala ‘99)
9. Judgments
   a. Effects of both types of markedness (4a-4b)
   b. What about typological markedness?

10. A model (different from what is in the article)
    a. Weighted Finite-State Automata (WFSA)
    b. Other possibilities
       i. Probabilistic Context-Free Grammar (PCFG)
          (sketched at end of handout)
       ii. Weighted Finite-State Transducer (WFST)

**Ohala (1999) - Cluster reduction and sonority**

11. Cluster Reduction (CR): omission of a consonant from a sequence of two or more consonants

<table>
<thead>
<tr>
<th>Cluster Type (Initial only)</th>
<th>Adult Target</th>
<th>Child's Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fricative-Stop</td>
<td>spoon</td>
<td>/pun/</td>
</tr>
<tr>
<td>Stop-Liquid</td>
<td>play</td>
<td>/pej/</td>
</tr>
<tr>
<td>Fricative-Liquid</td>
<td>fly</td>
<td>/faj/</td>
</tr>
<tr>
<td>Stop-Glide</td>
<td>tweet</td>
<td>/tit/</td>
</tr>
<tr>
<td>Fricative-Glide</td>
<td>swim</td>
<td>/sm/</td>
</tr>
<tr>
<td>Nasal-Glide</td>
<td>music</td>
<td>/muzik/</td>
</tr>
</tbody>
</table>

12. Traditional (wrong) Accounts: plenty of counter-examples
   a. Articulatory ease
   b. Linear order
   c. MOA
   d. POA

13. What seems to matter:
   a. Not linear order per se but position of cluster in the word
   b. Not MOA/POA but relationship of one sound in a cluster to the other

14. Theories of Sonority (any flavor) subsume both of these:
   a. Sonority cycle redux
   b. Predictions for CR

15. Two experiments:
   a. Experiment 1-English clusters varying in sonority
   b. Experiment 2-Non-occurring clusters varying in sonority and similarity (based on consonant class)
Method

16. Subjects: 16 children in each study (Mean age, Exp 1=2;5; Mean age, Exp 2=2;7)

17. Stimuli:
   a. Monosyllabic nonsense words and colored pictures of novel animals
   b. Clusters either initial or final (but not both in same word)
   c. Clusters varied in sonority profile (no plateaus)
      i. Exp 1: only occurring English clusters; liquid clusters later excluded from analysis
      ii. Exp 2: all non-occurring clusters in English but only three with no similar counterparts in English based on consonant class;

18. Task:
   a. Simple repetition task where child see a picture, hear a word, then repeat
   b. Random presentation of pictures and words
   c. Test items followed by a post-test several days later (same method, but new pictures) in order to ascertian child’s consonant inventory

19. Analysis and Coding
   a. Responses phonetically transcribed by experimenter and later tested for reliability by two independent coders
   b. Items in contention were excluded from analysis as were items containing sounds that could not be produced in singleton form (as determined by the post-test for each child)
   c. Responses coded as C1 produced, C2 produced or Other (note categorical responses collapsed to make proportions as in Treiman et al papers)
   d. In Exp 2, C1/C2 produced included same consonant class substitutions

20. Results-Exp 1
   a. Interaction between initial and final FS clusters
      i. Initial FS clusters lose the F and final FS clusters lose the S
   b. Interaction between initial FS and FN clusters
      i. Initial FS clusters lose the F but keep it in FN clusters
   c. Not all planned comparisons significant in this study but the general pattern of results (in which cluster reductions abide by sonority cycle) have since been replicated by Ohala and others

21. Results-Exp 2
   a. All comparisons except /fn/ were significant
b. All clusters with similar consonant class counterparts in English (except /fn/) were reduced per sonority
   i. Initial clusters reduced to less sonorous consonant of original cluster (or a consonant of similar class, Exp 2)
   ii. Final clusters reduced to more sonorous consonant (or a consonant of similar class, Exp 2)

c. All clusters with no consonant class counterparts were reduced to the second consonant of the cluster
   i. Children’s errors (in addition to CR) showed epenthetic vowels (e.g., *təmaud); further analysis indicated this strategy only employed with these three cluster-types
   ii. Consistent with a weak-syllable deletion strategy

d. FN clusters
   i. Behavior of FN clusters in both experiments (sn vs. fn) similar (no sonority preference in CR)
   ii. In both cases not many exemplars in that cluster category in English as compared to other cluster types

22. Discussion
   a. Children’s CRs default to universals as couched in sonority (as an aside, various aphasic populations show the same pattern)

   b. Although not framed as such at the time, phonotactic probability predicts the distinct pattern of results found in the CRs in Exp 2 and further supports the idea that children are aware of consonant class distinctions

   c. These results replicated by Barlow, Chen, Yavas, Gnanadesikan and others

   d. This shows that not only are children’s syllabifications sensitive to sonority but so are other productions, namely CR

   e. In support of a "probabilistic syllable", other work by Ohala & Ament looked at CR in VCCV within words and across word boundaries
      i. Effects of stress, sonority, consonant type all evident

PCFGs

23. What are they? Phrase structure rules with probabilities, e.g.
   a. A → B C

24. Probability distribution requirement
   a. Probabilities of all rules expanding some symbol A in a grammar must sum to 1
b. A syllable-based phrase-structure grammar
   i. Word
      1. w → s
      2. w → s w
   ii. Syllable
      1. s → o r
   iii. Onset
      1. o → Ø
      2. o → obs
      3. o → liq
      4. o → nas
   iv. Rhyme
      1. r → V
      2. r → V obs
      3. r → V liq
      4. r → V nas

25. Let's test how consonant sonority affects medial syllabification
   a. VC.V vs. V.CV
   
   b. Train the grammar on monosyllables only
      v. Same source data as last time (in source file on website: "newdic")
      vi. All R code on website

   c. Onset counts
      vii. o → 0 87512
      viii. o → obs 116665
      ix. o → liq 12681
      x. o → nas 27639

   d. Onset probabilities
      xi. \( p(o \rightarrow 0) = .36 = \frac{87512}{87512+116665+12681+27638} \)
      xii. \( p(o \rightarrow \text{obs}) = .48 = \frac{116665}{87512+116665+12681+27638} \)
      xiii. \( p(o \rightarrow \text{liq}) = .05 = \frac{12681}{87512+116665+12681+27638} \)
      xiv. \( p(o \rightarrow \text{nas}) = .11 = \frac{27639}{87512+116665+12681+27638} \)

   e. Rhyme counts
      xv. \( r \rightarrow V \) 126728
      xvi. \( r \rightarrow V \text{obs} \) 120301
      xvii. \( r \rightarrow V \text{liq} \) 46276
      xviii. \( r \rightarrow V \text{nas} \) 67350

   f. Rhyme probabilities
      xix. \( p(R \rightarrow V) = .35 = \frac{126728}{126728+120301+46276+67350} \)
      xx. \( p(R \rightarrow V \text{obs}) = .33 = \frac{120301}{126728+120301+46276+67350} \)
xxi. \( p(R \rightarrow V_{\text{liq}}) = \frac{46276}{(126728+120301+46276+67350)} = .13 \)
xxii. \( p(R \rightarrow V_{\text{nas}}) = \frac{67350}{(126728+120301+46276+67350)} = .19 \)

g. \( V \) \text{ Obs } \( V \) sequences
xxiii. \( V_{O}.V = p(r \rightarrow VO) \times p(o \rightarrow \emptyset) \)
    1. \( .12 \) (41%) = \( .33 \times .36 \)
xxiv. \( V_{O}.V = p(r \rightarrow V) \times p(o \rightarrow \emptyset) \)
    1. \( .17 \) (59%) = \( .35 \times .48 \)

h. \( V \) \text{ Nas } \( V \) sequences
xxv. \( V_{N}.V = p(r \rightarrow VN) \times p(o \rightarrow \emptyset) \)
    1. \( .07 \) (58%) = \( .19 \times .36 \)
xxvi. \( V_{N}.V = p(r \rightarrow V) \times p(o \rightarrow N) \)
    1. \( .05 \) (42%) = \( .35 \times .11 \)

i. \( V \) \text{ Liq } \( V \) sequences
xxvii. \( V_{L}.V = p(r \rightarrow VL) \times p(o \rightarrow \emptyset) \)
    1. \( .05 \) (71%) = \( .13 \times .36 \)
xxviii. \( V_{L}.V = p(r \rightarrow V) \times p(o \rightarrow L) \)
    1. \( .02 \) (29%) = \( .35 \times .05 \)

26. PCFG Conclusions
   a. A pcfg-trained on monosyllables gets the same results as Treiman
   b. This doesn’t explain why these patterns exist
   c. This does suggest that lexical distributions mirror judgments