Sonority as a Primitive: Evidence from Phonological Inventories
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1. Introduction
   • The nature of sonority is controversial.
   • Previous discussions have generally been situated in syllable structure, natural classes, or phonetics (physical correlates to sonority).
   • This paper will examine sonority in a new dimension – the relationship between sonority and inventory structure.
   • Implications: understanding sonority as a phonological phenomenon, understanding factors that affect inventory formation

2. Goals
   1) Present a phenomenon present in phonological inventories that has yet to be examined in previous literature and cannot be explained by current theories of inventory formation.
   2) Suggest implications of this phenomenon as evidence for sonority as a grammatical primitive.

3a. The structure of phonological inventories
   • Previous research – various principles governing structure of inventories

3b. The structure of phonological inventories
   • Feature Economy (Clements 2003) and consonant inventories
     • Maximize ratio of segments to features
     • Mutual attraction of segments which share features
   • This project will contribute: factors that control inventory size

4. The sonority scale
   • Phonological hierarchy of segments ranking sounds (generally) on relative loudness
   • Existence and importance of the scale contested:
     • “‘Sonority’… (does) not exist and should be abandoned for the sake of explaining universal sequential constraints.” (Ohala 1990)
     • “Sonority is not a single, multivalued property of segments, but is derived from more basic binary categories.” (Clements 1990)
   • This investigation: new and different support for the importance of sonority

5. The finding
   • Sonority is a determining factor in inventory structure.
   • Inventories are composed of three distinct subdivisions: obstruents, sonorants, vowels.
   • Within subdivisions sonority distance has an effect on class size predictability. Between subdivisions there is no effect on class size.

6. Methods: The database
   • Data from phoneme inventories of P-base (Mielke 2008), 628 varieties of 549 languages
• Sound Pattern of English features (Chomsky and Halle 1968) used to distinguish classes based on Parker (2002) who used intensity measurements as a physical correlate
• Exact ordering of the scale is still debatable, but classes of obstruents, sonorants, and vowels are well established.

7. Methods: Sonority classes
• Database scanned for number of segments in each sonority class in every language
• Number of segments of each type compared against number of segments of every other type in the language
• Simple linear regression model determined correlation coefficient between each pair of segment classes.

8. Results
The number of segments in adjacent classes along the sonority hierarchy serves as best predictor of class size EXCEPT upon crossing the sonorant/obstruent and consonant/vowel boundaries.

Correlation coefficients with voiced fricatives
The circled point represents a correlation where $r = 0.63$ between the number of voiced fricatives and the number of voiceless fricatives in phonological inventories.

Correlations gradually decrease with distance along scale within the obstruents. No correlations within sonorants even though they are adjacent.

Sonority distance can be used as a predictor of class size but only within the obstruents.

9. Results: Correlations among sonorants
Correlations between laterals and nasals/rhotics are higher than correlations with obstruents or vowels.

10. Results: Correlations with vowels
Vowels do not correlate with any other class of sounds in the inventory.
11. Results: Correlations between all classes
   - Highest correlations only within groups of obstruents, sonorants or vowels
   - Inventories composed of three classes which independently determine the number of segments in the system

Discussion and implications

12. The nature of the relationship between consonant and vowel inventories
   - Correlations between vowels and any consonants equally low.
   - Completely separate systems governed by separate rules (dispersion vs. economy)
   - Relation of total vowel inventory size to total consonant inventory size is less significant than previously thought
   - Maddieson (1984) UPSID (317 languages) $r = 0.38$ between inventories, $P$-base $r = 0.15$
   - Any size vowel inventory can be paired with any size consonant inventory in the formation of a natural language sound system.

13. The relationship between sonorants and obstruents
   - Not as strong as the consonant/vowel boundary but still divided.
   - 70/30 breakdown discovered by Lindblom and Maddieson (1984) is only an average and not a strong cross linguistic tendency.
   - Total correlation between number of sonorants and obstruents only slightly better than consonants and vowels ($r = 0.23$ vs. 0.15).

14. Rejecting an Alternative Hypothesis:
The sonority effect is not caused by featural relatedness and economy (Clements 2003).
   - FE prediction: mutual attraction in inventories among segments which share features (including redundant features)
   - These effects are not predictable from an economy model since the feature $[+\text{son}]$ induces more drastic effects in determining number of segments.

15. An example
   - Voiced fricatives vs. Rhotics
     Share 5 features: $[+\text{cons}, +\text{cont}, -\text{lat}, -\text{nas}, +\text{voice}]$
     $r = 0.07$ between the two classes
   - Voiced fricatives vs. Voiced stops
     Also share 5 features: $[+\text{cons}, -\text{son}, -\text{approx}, -\text{lat}, -\text{nas}]$
     $r = 0.63$ between the two classes
   - $[+\text{son}]$ causes a bigger effect than a difference in other features.
16. Feature similarities with laterals

<table>
<thead>
<tr>
<th>0.10 Vlcs stops</th>
<th>0.19 Vcd Stops</th>
<th>0.21 Vcl fric.</th>
<th>0.06 Vcd fric.</th>
<th>0.50 nasals</th>
<th>0.55 rhotics</th>
<th>1 laterals</th>
<th>0.12 glides</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

- Feature similarity predicts similar correlations for nasals, voiced fricatives and voiced stops with laterals.
- Actual correlations with voiced fricatives and voiced stops much lower than those with nasals.

17. Feature similarities with nasals

<table>
<thead>
<tr>
<th>0.15 Vlcs stops</th>
<th>0.20 Vcd Stops</th>
<th>0.03 Vcl fric.</th>
<th>0.03 Vcd fric.</th>
<th>1 nasals</th>
<th>0.55 rhotics</th>
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<th>0.13 Glides</th>
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- Feature similarity predicts that voiced stops should have the highest correlation with nasals, but rhotics have the highest correlation with nasals.
- A feature similarity model also predicts that voiceless stops should have a high correlation, but they do not because they are obstruents.
- Shared features do play a role, but sonority is needed to fully explain the data.

18. Sonority as a primitive

- An analysis without the sonority hierarchy cannot predict the patterns seen here.
- If languages reference the sonority hierarchy in inventory formation, it should be considered a primitive feature of the grammar and not merely derived from other features.
- Syllable structure and natural classes may be explained by a feature derivation of sonority but the inventory data cannot: Inventories are pre-existing to phonological rules.
19. Conclusion

- This investigation has attempted to provide an explanation for a phenomenon present in phonological inventories that cannot be explained by current theories of inventory formation.
- Phonological inventories employ sonority as a factor in determining size and structure so that inventories contain three distinct systems: obstruents, sonorants, and vowels.
- Sonority is prominent in the formation of phonological inventories. This furthers evidence for its existence as a grammatical primitive.
- These findings have provided a new domain for exploring the effects of sonority and added to the current understanding of the processes that underlie the formation of phonological inventories.

References


Parker, Steve. *Quantifying the sonority hierarchy.* PhD Dissertation, University of Massachusetts Amherst, 2002.


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