Phonotactic Preferences in Polish, English and German: Quantitative Perspective

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In this paper we want to reformulate selected claims of Beats-and-Binding phonotactics (Dziubalska-Kołaczyk 2002, 2003) and corroborate them by providing evidence from Polish, English and German.

Beats-and-Binding model of phonotactics proposed by the first author states that consonants tend to cluster according to some phonotactic preferences. These preferences specify the optimal shape of the cluster based on an phonetic distance between the sounds that constitute the cluster. In order to counteract the preference for a CV structure, the phonetic distance needs to be greater than a competing distance to a vowel in, e.g., a CCV sequence. Cohesion of clusters is thus a resultant of distance ratios dependant upon position in a word. E.g., word initially the greater the distance between C_1 and C_2 relative to the distance between C_2 and V, the more cohesive the C_1C_2 cluster. In its original formulation, Beats-and-Binding phonotactics defined the phonetic distance as a difference between sonority values of the neighbouring sounds. In this paper, the first author suggests a more comprehensive approach, Net Auditory Distance. NAD between two sounds can be defined in terms of a metric on three-dimensional space spanned by phonetic properties: manner of articulation (MOA), place of articulation (POA) and voicing characteristic (Lx). Within this space, each sound is represented as a point whose real-value coordinates describe its three phonetic properties.

To understand the idea of NAD, consider the phonotactic preference for word-final double clusters formulated as

(1) $NAD(V, C_1) \leq NAD(C_1, C_2)$ (c.f. Dziubalska-Kołaczyk 2002:115-127)

which reads: the Net Auditory Distance between a vowel and a following consonant is smaller than or equal to the Net Auditory Distance between the two consonants. Let us define the Net Auditory Distance between a sound S_1 with coordinates (MOA_1, POA_1, Lx_1) and the sound S_2 with coordinates (MOA_2, POA_2, Lx_2) in terms of the following metric: $|MOA_1 - MOA_2| + |POA_1 - POA_2| + |Lx_1 - Lx_2|$. Now, consider the English word *belt*. Let us assume the following simplified scale for the MOA parameter

vowels	approximants	nasals	fricatives	affricates	stops
0	1	2	3	4	5

and the following simplified scale for the POA parameter

vowels	bilabial	alveolar	palatal	velar	glottal
0	1	2	3	4	5

Then we obtain the following coordinates for three final sounds in the word ***belt***: V = (0, 0, 1), C_1 = (1, 2, 1) and C_2 = (5, 2, 0), which, after substitution into both sides of (1) gives

$NAD(V, C_1) = | 0 – 1 | + | 0 – 2 | + | 1 – 1 | = 1 + 2 + 0 = 3$ and

$NAD(C_1, C_2) = | 1 – 5 | + | 2 – 2 | + | 1 – 0 | = 4 + 0 + 1 = 5$.

This in turn meets our condition that $NAD(V, C_1) \leq NAD(C_1, C_2)$. In our paper we show that, from a sample of 1222 monomorphemic English words containing double-consonant word-final clusters, 88.13% meet the preference (1).

Similar tests are conducted for 5 other phonotactic preferences on English, Polish and German phonetic dictionaries obtained from the Festival Speech Synthesis System (Black and Taylor 1997). Various scales for phonetic properties are tested and the optimum scale is found by Simulated

Annealing optimisation method (Kirkpatrick, Gelatt, Vecchi 1983). Free online calculator is presented for testing various phonotactic models.

References

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