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BEATS-AND-BINDING PHONOLOGY REVISITED

1. Introduction. The aim of this contribution is to refine the phonological model proposed by Katarzyna Dziubalska-Kołaczyk, *Beats & Binding Phonology* (B&B henceforth) in Dziubalska-Kołaczyk 2002 and later developed in Dziubalska-Kołaczyk 2009, Dziubalska-Kołaczyk & Zielińska 2010. Compared to the previous approaches to phonotactics, B&B is somewhat innovative inasmuch as it is a syllable-less theory, or better, it considers the syllable as an epiphenomen of higher level relationships between single segments, grounded in universal preferences such as figure-ground opposition, perception contrast and minimum effort (Dziubalska-Kołaczyk 2009:55). In B&B, what is traditionally called nucleus corresponds to the *beat* (B) and everything else is just a *non-beat* (n). Relationships between beats and non-beats are called *bindings*. Phonotactics is governed by the NAD (Net Auditory Distance), which involves three factors: Manner of Articulation (MOA), Place of Articulation (POA) and voicing (Lx). In its classical form, NAD is defined in the following way: |MOA| + |POA| + |Lx|, "where |MOA|, |POA| and |Lx| are the absolute values of difference in the Manner of Articulation, Place of Articulation and Voicing of the neighboring sounds, respectively" (Dziubalska-Kołaczyk 2009:56). B&B makes finer predictions than traditional Sonority Hierarchy-based theories (SH henceforth), e.g., it shows that /brV/, /grV/ are better formed than, say, /drV/, because the NAD of the former is greater than the NAD of the latter (C1C2V is well-formed iff NADC1C2 ≥ NADC2V). Anyway, (1) some phenomena that couldn't be handled by SH aren't solved by B&B either, e.g., the frequency of /s/C clusters word-initially compared to other obstruent clusters, and (2), the model does not assign a POA to vowels, i.e., treats all vowels as they were the same, so it is unable to make important predictions, such as /pa/ > /pu/, /pi/ > /ti, ki/ (Ohala 1992). In this paper we modify the model in order to enhance its predictive power, always trying to motivate the proposed changes with phonetic and statistic factors.

2. A proposal: New B&B

1) B&B can predict that a sequence of sonorant+obstruent word-initially is bad only if the following V is considered, but analyzing, e.g., /lk/ and /kl/ in isolation, they appear to have the same NAD (=5). To avoid this incongruence, we assume that the value of the difference between MOA1 and MOA2 should not be considered absolutely. It is positive (as in /kl/) if the degree of "sonority" (openness of the vocal tract) increases, and negative (as in /lk/) otherwise. The new formula henceforth should then be: (MOA1 – MOA2) + |POA1 – POA2| + |Lx1 – Lx2|. This also shows the distance of well-formedness of the two sequences in a finer way: according to B&B, NAD/lko/ = -2 and NAD(klo) = 2, according to New B&B (NBB henceforth), NAD(lko) = -5 and NAD(klo) = 3.

2) In B&B it is not clear which criteria are taken into account to assign a numeric value to the different POAs. In NBB we assume that coronal is the unmarked POA. We therefore assign the value 0 to dental-alveolar (the most frequent POA according to the data collected by Maddieson 1984) and 1 to palatal. We assign then 2 to velar. These numeric values predict that palatal sounds are disfavored both after dental/alveolar and velar sounds since 1 is equidistant from 0 and 2. We assign the value 3 to labial. This might seem in contradiction with the actual shape of the vocal tract (the lips are closer to the teeth than to the velum) but a series of universal facts (velar Vs tend to be rounded, labiovelar co-articulations are frequent, labial sounds are less likely to undergo assimilation, etc.) justify our choice. Labiovelar sounds are assigned a value between 2 and 3, 2.5. These values are applied also to Vs, so that POA/i/= 1, POA/u/ = 2.5. Central Vs, such as /a/ and /ə/ tend to be transparent to phonotactics, i.e., they are not particularly disfavored before/after any C, so their value is 0. This allows the C to maintain its inherent salience without being modified by the adjacent V. NBB can therefore account for the fact that, for example, sequences of labial C + labiovelar V (pu, bu) are universally disfavored, as well as sequences of dental/alveolar C and palatal V (ti, di) (Ohala 1992:320-326).

3) In order to solve the well-known problem of the status of /s/C word-initially, we stop considering sibilants identical to other fricatives. The frication noise of sibilants makes them easily recognizable by listeners even in contexts where other obstruents lose perceptual salience (Wright 2004:37). So, as of MOA, sibilants are assigned 5, sibilant affricates 4.5, stops 4, affricates 3.5 and non-sibilant fricatives 3. According to these values, not only /s/C clusters result better formed than other obstruent clusters, but also than C/s/ clusters. As a matter of fact, it seems that if a language allows C/s/ initial onsets, it allows /s/C too, but not vice versa, e.g., Italian *psicologia*, *xilofono, *ts* vs. *spazio, scudo, studente,* French *psychologie, xylophone, mouche tsé tsé* vs. *sport, ski, style.* English **ps, *ks, tse tse fly* vs. *space, skull, student,* Spanish **ps, *ks, *ts* and **sp, *sk, *st,* Ancient Greek: *psyché, ksenos, *ts* (it is not clear whether letter <Z> stood for /zd/ or /dz/) vs. *spanis, skafé, stadion.*

4) The design of B&B assumes that it is always a good thing for two adjacent segments to differ in voicing (|1 – 0| and |0 – 1| = 1 whereas |0 – 0| and |1 – 1| = 0, thus only difference in voicing contributes to a greater NAD). This is true in many cases and reflects the universal preference for CV (with C being voiceless). But an important fact is neglected here: voicing is hard for obstruents and it is inherent for sonorants. A model that does not take these facts into account ends up predicting absurdities, such as /zpa/ > /spa/. We must then assume that, given C1C2, if both Cs are obstruents, |Lx1 – Lx2| must be equal to 0. Assign then one point to the NAD iff |Lx1 – Lx2| = 0, otherwise assign 0. A problem of this analysis could be the existence in some Germanic languages of initial /kv/ (German *Quelle,* Swedish *kvinna*), but in these cases there are good reasons to consider /v/ an approximant rather than a fricative (Maddieson 1984:49, Anderson 2002:274).

5) Dziubalska-Kołaczyk (2009:63) suggests that medial clusters have to be treated somewhat differently from initial and final clusters. We assume that, given C1V1C2C3V2, C2 binds with V1 unless NAD(C2C3V2) – NAD(C1V1) < NAD(C3V2) – NAD(C1V1C2). This is explained by the fact that, if we accept the idea that the optimal structure for a word is CVCV, the difference between the NAD of the two CV sequences should be as close to 0 as possible. This predicts that in Italian, for example, in the words *costo, conto* and *copro,* /s/ and /n/ bind with the preceding V /o/ whereas /p/ does not.

3. Conclusion

The NBB model we propose here, albeit still bound to be improved, is able to account for a series of phenomena without having to resort to abstract concepts such as sonority/strength or extrasyllabicity, since every aspect of the theory is grounded either in perceptual facts or in direct observation of crosslinguistic preferences. Moreover, it is one of the first systematic attempts to refine B&B, a theory that, despite its evident merits, is still unknown to many phonologists.

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