Minimal Variation in the Typology of Stress

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Language change often progresses in minimal steps and graduality of change is then observable as minimal variation between related dialects. Although minimality of variation and change is observed often, in the literature, there is disagreement about whether it should be defined in terms of minimal *intensional* (grammatical) or *extensional* (surface form) variation, or whether both intensional and extensional factors play some role (cf. e.g. Kroch 2001, Kiparsky 2014 for overviews of the former, Ohala 1981, Mielke 2013 for the latter approach; see e.g. Hamann 2009, Cavirani 2015 for models integrating both factors).

An investigation of variation in the stress patterns of the world's languages shows that (a) variation inside the same language family is indeed almost exclusively minimal (b) that variation is predominantly minimal in the intensional, but not in the extensional sense.

To investigate variation in the typology of stress, the patterns of ~80 languages were collected from the relevant literature, organized by language family (following van der Hulst, Goedemans & van Zanten 2010) and then classified for the basic parameters of rhythmic word stress: foot-type (trochaic or iambic), foot-position (left- or right-aligning) and density of parsing (one stress per word, more than one stress, exhaustive parsing).

We define a measure of intensional minimality using nGX, a formal model of a typological system of stress in the framework of Optimality Theory (Alber & Prince 2017). The factorial typology of nGX is generated by the interaction of five basic stress pattern constraints, PARSE, TROCHEE, IAMB, AFL (all feet left-aligned) and AFR (all feet right-aligned). Typological analysis yields four *Typological Properties* (TPs, Alber & Prince, in prep.), i.e. ranking conditions defining the typological system:

(1) Typological Properties defining the typological system of nGX

Typological Property - values	**example contrast**	**Ranking conditions**
Ft-type - trochaic/iambic	-Xu- vs. -uX-	Trochee < > Iamb
Ft-Position - left/right	-Xu-o- vs. -o-Xu	AFL < >AFR
Mult(iplicity) - many stresses/one stress	-Xu-Xu- vs. -Xu-o-o-	Parse < > F.sub, A.dom
Un(arity) - (non) exhaustive parsing	-Xu-X- vs. -Xu-o-	Parse < > F.dom, A.dom

Notation: X = stressed syllable, head of a foot, u = unstressed syllable, parsed into foot, o = unstressed syllable, not parsed into foot; F.sub/dom = the subordinate/dominant Ft-type constraint (TROCHEE or IAMB) in a grammar, A.dom = the dominant alignment constraint (AFL or AFR) in a grammar.

Minimal intensional variation between two languages can then be defined as minimal variation in the values of the Typological Properties defining them.

As a measure for extensional minimality we use the Hamming distance (HD), measuring substitutions of elements in a string. In comparing stress patterns, we assign 1 HD point for every stressed syllable (X) corresponding to an unstressed syllable (-u- or -o-) and 1 HD point for every unstressed syllable corresponding to a stressed syllable.

Intensional and extensional minimality measured in these terms diverge rather radically from each other, for certain types of stress pattern variation. Compare e.g. the variation of pattern 2a. with pattern 2b. to variation of 2a. with respect to 2c.:

(2) Comparison of minimal intensional vs. minimal extensional variation

	in variation with	Typological Properties (TP)	Hamming distance (HD)
a. Xu-Xu-o	b. uX-uX-o	minimal Ft-type: trochaic→ iambic	high HD = 4
	c. Xu-Xu-X	not minimal Ft-position: left→ right Un: non-exhaustive → exhaustive	minimal HD = 1

Variation 2a. ~ 2b. shows a variation in foot-type (trochaic vs. iambic), considered minimal in intensional terms (1 TP), but with high HD value, since almost every syllable changes from stressed to unstressed or vice versa. Variation 2a. ~ 2c., on the other hand, is minimal in extensional terms (only one stress mark is added), while it involves the change of two TPs. Under the hypothesis of minimal intensional variation we would expect variation to be mostly of type 2a. ~ 2b., in the stress patterns of the world's languages, whereas the extensional approach would predict a predominance of variation of type 2a. ~ 2c, where the Hamming distance value is kept to a minimum.

Our survey of stress patterns reveals that inside one language family variation indeed is predominantly minimal in intensional terms:

(3) Intensional and extensional variation by language family

Lg. family	Ft-type	Ft-position	Un	Mult
Algonquin	**12**		**8**	
Numic	**12**			
Arabic	**12**			**2**
Pano	**12**	**6**	**8**	
Slavic		**6**	**4**	
Australian		**6**	**4-8**	**2**
Arawá	**6**	**6**	**8**	
Uralic		**2**	**2**	**2-4**

Numbers: Hamming distance of pairs of patterns, counted on strings from 1-5 syllables.

Of the overall 17 instances of variation along the given parameters of classification, 15 are minimal in intensional terms (light shading), involving minimal variation of the Typological Properties Ft-type (4), Ft-position (3), Un (5) or Mult (3). Only two language families exhibit more than minimal variation: Arawá, which has language pairs varying in Ft-type as well as Ft-position, but no pairs varying by one of these TPs, and Uralic, where variation involves Ft-position as well as Un (dark shading). While Arawá is a case where variation is not minimal, neither in intensional nor in extensional terms (HD=6), variation in the Uralic language family might be the single case where variation is determined by extensional factors: patterns vary between Xu-Xu-o and Xu-Xu-X, leading to a change both in Ft-position and Un, but totaling an extremely low HD value of 2 on strings from 1-5 syllables.

Apart from the Uralic pattern, it is not clear how the general pattern of variation in the database could be explained by any extensional definition of minimality: we find five cases of variation in foot-type, with highest Hamming distance (HD =12), we find a similar number of variation in foot-position and Un, with relatively high HD = 2/8/6 and we find, if anything, fewer (only three) cases of variation in Mult, where HD is lowest (HD = 2/4). Extensional factors appear to have no influence on the number or type of variation patterns, in the typology.

In order to illustrate in detail how languages easily vary along (minimal) intensional dimensions even when this involves massive restructuring of surface forms, in addition to the general typology, data from the Panoan language family is discussed, where variation in foot-type -- highly disruptive on surface forms - is common across languages and even inside the same language.

In sum, we can conclude that variation in the basic parameters of rhythmic word stress is (a) minimal in almost all known cases and that (b) while the type of variation encountered can easily be described as minimal in intensional terms, there is no clear correlation between extensional measures of minimality and the observed patterns.

Alber, B. & A. Prince. 2017. The Book of nGX. Rutgers Optimality Archive. roa.rutgers.edu, 1312.
Alber, B. & A. Prince, in prep. Typologies. Typologies. University of Verona and Rutgers University.