Crosslinguistic correlations between size of syllables, number of cases, and adposition order[1]

Gertraud Fenk-Oczlon & August Fenk

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Previous crosslinguistic studies by the authors have shown that a small number of phonemes per syllable is associated with a high number of syllables per word and per clause, and, moreover, with Object-Verb (OV) order and agglutinative morphology. And since OV order is often connected with a tendency to postpositions (e.g. Greenberg 1966) and agglutinative morphology with both a tendency to postpositions and a tendency to a higher number of cases, the present study investigates the assumption of crosslinguistic correlations between these two tendencies and between them and our „metric" variables mean size of syllables in terms of phonemes and mean size of clauses in terms of syllables.

The results: All correlational coefficients showed the expected tendency, i.e. the expected sign (+ or −). And a high number of morphological cases turned out to be correlated with low syllable complexity (almost significant) and with a tendency to postpositions (highly significant). Our interpretation focuses on the association between syllable complexity and rhythmic organization, e.g. an association of stress-timed rhythm with a tendency to higher syllable complexity and fusion of morphemes.

1. Introduction

The title of this paper names three relevant variables that will be connected in the following sections. In order to characterize the theoretical background of the study, we will address to three other, rather abstract concepts:

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[1] This is an extended version of a paper presented at the Fifth International Conference of the Association for Linguistic Typology in Cagliari (Fenk-Oczlon & Fenk 2003).

- The program and goals of a „holistic", or „systemic", or „natural"(?) typology.
- The central role of „rhythm" within a holistic view of language.
- Cognitive constraints are effective in the sense of constraints of language variation: the concepts of „cognitive costs" and „cognitive economy" have explanatory power with respect to language universals and language evolution (Fenk-Oczlon & Fenk 2002).

„Cognitive costs" are a central issue in Naturalness Theory. For Mayerthaler „'more or less natural'" with respect to universal grammar and/or single languages' grammar „boils down to 'more or less easy for the human brain'" (Mayerthaler 1987:27)……"At this point 'more or less natural' (with respect to universals) corresponds to 'more or less easy for the human brain'" (Dressler & Mayerthaler 1987:11).

Systemic Typology (Fenk-Oczlon & Fenk 1999) also tries to explain constraints of language variation by constraints of relevant resources, in particular by limits of our cognitive capacities. In this respect it corresponds to Naturalness Theory. Thus it was tempting to call it „Natural Typology" (Fenk-Oczlon 1997). From our point of view this term might still be tempting in two other respects as well:

- With respect to the „natural" role of frequency: the more frequent, the more familiar, and the lower the cognitive costs of processing! In terms of Zipf's (1949**)** tool analogy: The artisan refines and rearranges the tools in a way so that frequently used tools are multifunctional, smaller, and nearer to him. Lower distance and small size mean shorter access time and reduced (cognitive) effort. Applied to the unit „word": Frequently used words are more familiar; they tend to get shorter, better retrievable, and rather polysemous.
- With respect to the „natural" interdependencies between different levels of language or different levels in the description of language: Systemic Typology suggests systematic interactions between sound structure, morphology and syntax. Several authors (e.g. von der Gabelentz 1901, Skalička 1935, Lehmann 1978, Donegan & Stampe 1983, Gil 1986, Plank 1998) already have assumed, stated or described co-variations between prosodic, phonological, morphological, and syntactic properties:

  In recent times, typologists have often confined themselves to seeking dependencies among variable language-parts WITHIN syntax, WITHIN morphology, or WITHIN phonology. As to dependencies BETWEEN levels

> or modules, syntax and morphology were considered essentially the only candidates showing some real typological promise. Dependencies between sound structure on the one hand and word, phrase, clause, sentence, and discourse structure, or also lexical structure, on the other were something respectable main stream typology has steered clear of. /…/ Nonetheless, the temptation to link phonological parameters of crosslinguistic variation on the one hand and morphological and syntactic ones on the other has now and again proved irresistible to the more adventurous, perhaps encouraged by the ever popular all-encompassing master maxim that languages are *systèmes où TOUT se tient*……(Plank 1998:195f)

The aim of linking phonological parameters of crosslinguistic variation with morphological and syntactic parameters is the demanding program of systemic or holistic typology, or, according to von der Gabelentz (1901), of typology as such. Von der Gabelentz suggests that some of the components interacting within the system language might be more decisive than others. According to Donegan & Stampe (1983: 350) such a decisive factor might be accent: „What but accent could be behind such holism? Accent is the only factor pervading all the levels of language". The languages's accent, or more generally, the languages's rhythm will play a key role in the interpretation of our empirical results.

2. The starting point

In a previous crosslinguistic study (Fenk-Oczlon & Fenk 1999) native speakers of 34 typologically different languages translated a certain German „text" (a set of 22 unconnected simple declarative sentences) into their mother tongue.[2] Crosslinguistic computation revealed a pattern of significant correlations between the „size" of syllables (in phonemes), of words (in syllables), and of sentences (in syllables, in words). For instance: the fewer phonemes per syllable,

[2] Actually, the translations by 27 native speakers are already documented in a doctoral dissertation (Fenk-Oczlon 1983) supervised by Willi Mayerthaler. This study showed that Miller's (1956) "magical number seven" is also efficient in natural language processing and in the sense of a language universal. The above mentioned 1999-study includes already 34 languages, 18 Indoeuropean and 16 non-Indoeuropean. And meanwhile, during a 2004 Fulbright research grant for Fenk-Oczlon at the University of Hawaii at Manoa, the sample could again be extended (15 predominantly Austronesian languages; statistical evaluation is in progress).

the more syllables per sentence. This was, as far as we can see, the first really „crosslinguistic" correlation, i.e. a computation where each one of the data-pairs (mean n of phonemes/syllable – mean n of syllables/sentence) represents one of the languages of the sample. The results reported in this study form a set of mutually dependent correlations:

a) The more syllables per clause, the fewer phonemes per syllable:
   $r = - 0,75$ ($p<0,1\%$)
b) The more syllables per word, the fewer phonemes per syllable:
   $r = - 0,54$ ($p<0,1\%$)
c) The more syllables per clause, the more syllables per word:
   $r = + 0,47$ ($p<1\%$)
d) The more words per clause, the fewer syllables per word:
   $r = - 0,66$ ($p<0,1\%$)

Additional results: Languages with simple syllables showed a tendency to Object-Verb (OV) order (and to syllable-timed rhythm and agglutinative morphology), while languages with more complex syllables tended to Verb-Object (VO) order (and to stress-timed rhythm and fusional or isolating morphology).
Agglutinative morphology is, moreover, often assumed to be associated with a rather high number of cases and postpositions. And OV order is not only associated with less complex syllables, but also with a tendency to postpositions (e.g. Greenberg 1966 and our sample, where 72 % of the postpositional languages showed OV and 90 % of the prepositional languages VO.)

3. A set of new hypotheses

These results and considerations were the starting point for the following correlational assumptions generated and examined in the present paper. In the following hypotheses two of our metric variables – size of sentence in syllables (A), size of syllable in phonemes (B) – are linked to the non-metric variables number of cases (C) and predominant adposition order (D). Correlations r_{AC} and r_{AB} are coupled to their partners r_{CD} and r_{BD} by the above mentioned significant negative correlation between the number of phonemes per syllable and the number of syllables per sentence.

Hypothesized correlations with C (n of cases):

r_{CD} the fewer phonemes per syllable (D),
the higher the number of cases (C)
r_{AC} the more syllables per sentence (A),
the higher the number of cases (C)

Hypothesized correlations with B (prepositional versus postpositional):

r_{BD} a low number of phonemes per syllable (D)
is associated with a tendency to postpositions (B)
r_{AB} a high number of syllables per sentence (A)
is associated with a tendency to postpositions (B)

The tendency to suffixing is generally stronger than the tendency to prefixing (e.g. Greenberg 1966). If postpositions get more easily attached to the stem, thus forming a new semantic case (e.g. a local case), then we may assume that

r_{BC} a tendency to postpositions (B) is associated
with a tendency to a higher number of cases (C)

4. Method and results

The following pattern of „inductive reasoning" is running through the generation of the hypotheses (of the former and of the present study), their statistical evaluation, and the diagrammatic representation of the results: If a certain variable (lets say A) is known or assumed to be correlated with two other variables (B, C), then it is not implausible – and the more plausible the higher the correlations A-B and B-C - to expect a correlation between B and C as well. Correlations A-B and A-C together are at least a useful indication to search for a correlation B-C. The most plausible expectation regarding the sign (+ or −) of the correlation B-C depends on the signs of the correlations A-B and A-C: If these correlations have the same sign, the prediction of the positive sign is more plausible than the prediction of a negative sign: If an increase (or decrease) of A corresponds to an increase (or decrease) in both partners (B an C), this favours a positive correlation between these two partners. Correspondingly, in the case of different signs it is more plausible to expect a negative sign of the third correlation (Figure 1).

Figure 2 illustrates our theoretical model. It is, first of all, inspired by the empirical and hypothetical arguments mentioned in the last paragraphs of section 2. And it claims internal consistency, interlocking se-veral triangles – i.e.: inductive inferences – of the sort explicated in Figure 1: If, for instance, all correlations forming the square are negative, then it is plausible to expect positive rather than negative correlations in both diagonals. And if all the correlations, with the exception of r_{BC}, are already given with the signs as illustrated in the figure, then we may expect a negative coefficient r_{BC}.

But what about the empirical validity of this model?

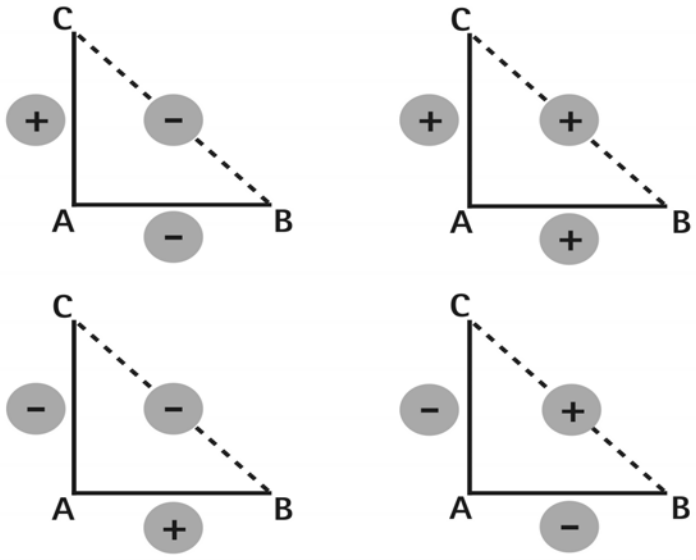

Figure 1: Two given correlations (between A and B, between A and C) indicating a third correlation (between B and C) and the sign of the third correlation: If the edges A-B and A-C represent correlations with different signs (left panel), the most valid prediction regarding a possible correlation B-C is a negative sign. In cases of equal signs in A-B and A-C (right panel) the most valid prediction regarding B-C is a positive sign.

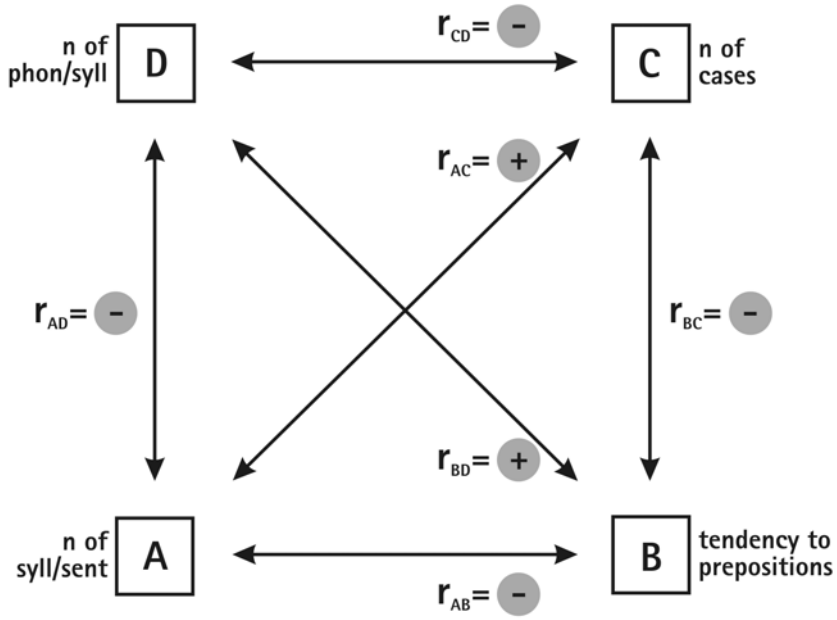

Figure 2: Statistical arguments forming a „plausibility square" by interlocking four triangles of the type shown in Figure 1. The pattern of inductive reasoning is the same as in the triangles of Figure 1 (see text).

Assumptions were tested on a database of 32 languages. (In 2 of our 34 languages - Annang and Ewondo - no sufficient grammatical information was available so far.) In all these assumptions the respective crosslinguistic correlations showed the expected tendency, i.e. the expected sign. Only correlations r_{CD} (- 0.145) and r_{AC} (+ 0.056) were far from statistical significance. Coefficients regarding r_{BD} (- 0.208) and r_{AB} (+ 0.314) were somewhat higher, and correlation r_{BC} (- 0.494) turned out to be highly significant despite the relatively small sample of languages. And correlation r_{CD}, when computed only in those 20 languages having case, was r = - 0.371. This is rather promising: Given the same coefficient in a sample with about ten more languages, this coefficient would already be significant.

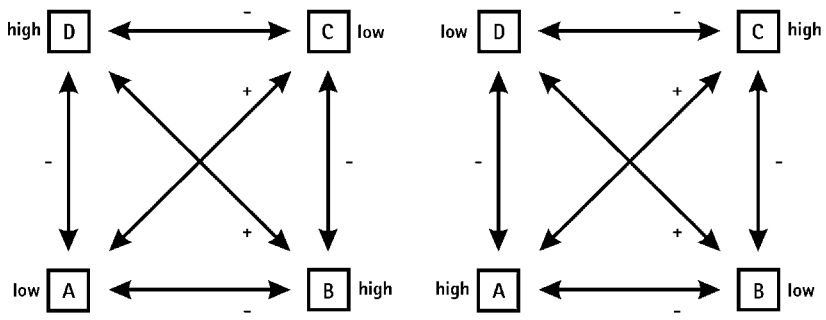

Figure 3: A comparison between stress-timed languages (left panel) and syllable-timed languages (right panel) with respect to the parameters
A: mean number of syllables per sentence
B: tendency to prepositions
C: number of cases
D: mean number of phonemes per syllable

Thus we may say that the new statistical results match with our theoretical construction illustrated in Figure 2 – either highly significant (r_{BC}), or almost significant (r_{CD}), or at least with respect to the sign (+ or −) of the correlational coefficient.

A good indication regarding the external validity and prognostic value of our model are the facts

- that all the six correlational assumptions tested – all the six lines forming this theoretical model (Figure 2) – show the expected tendency (+ or -) and
- that two of these correlations (r_{AD} and r_{BC}) are highly significant despite the rather small sample of languages.

If we connect, regardless of their significance, the present results with our previous results, the division is into languages with syllable timed rhythm and languages with stress-timed rhythm (see Figure 3 and Table 1). In Figure 3, comparing stress-timed with syllable-timed languages, the pattern of correlations is the same in both cases and the same as in Figure 2. But high parameters in the left panel correspond with low parameters in the right panel, and vice versa:

Stress-timed rhythm is associated with a low number of complex syllables per word and per clause, a high number of words per clause, and non-metric properties such as the tendency to prepositions and to a low number of cases.
Syllable-timed rhythm is associated with a high number of simple syllables per word and per clause, a low number of words per clause, and non-metric properties such as the tendency to postpositions and to a high number of cases.

Table 1: A comparison between languages with stress-timed rhythm versus languages with syllable-timed rhythm

stress-timed rhythm	**syllable-timed rhythm**
metric properties:	*metric properties:*
high n of phonemes per syllable	low n of phonemes per sylla-
ble low n of syllables per clause	high n of syllables per clause
low n of syllables per word	high n of syllables per word
high n of words per clause	low n of words per clause
non-metric properties:	*non-metric properties:*
fusional or isolating morphology	agglutinative morphology
VO order	OV order
tendency to prepositions	tendency to postpositions
low n of cases	high n of cases
cumulative case exponents	separatist case exponents

5. Interpretation

Some aspects of our interpretation are already anticipated in Table 1: Our empirical findings suggest that it is first of all the rhythm which discriminates, or makes differences, between languages. The languages' rhythmic organization seems to be rather the determinant than a consequence or a specific aspect of different morphological types (isolating, agglutinative, fusional). And the variability and size of the beats, of the basic measure of this rhythm, reflect first of all the respective languages' syllable complexity. For instance: A language

having exclusively V- and CV-syllables represents the absolute minimum of both, size and variability of beats.

So far the interpretation only deals with characteristics of segmentation, especially with the syllable complexity going hand in hand with characteristic rhythmic patterns. But how should we imagine the association of such metric properties with other properties such as adposition order and number of cases?

Stress-timed languages are often (e.g. Dauer 1983, Auer 1993) characterized by their proneness to reduction processes such as the deletion of unstressed vowels, which results in relatively complex syllables. Such reduction processes will, of course, also affect (grammatical) morphemes. And if stress-timed rhythm also favours the fusion, cumulation and deletion of morphemes, this will result in fusional and/or isolating morphology. This means, moreover, that cumulative exponents will predominantly occur in stress-timed languages. According to Plank (1986:32) „*cumulative* exponents simultaneously express at least two co-occuring inflexional categories without being formally segmentable into two or more parts, while *separatist* exponents express only one inflexional category of a word form." And languages with cumulative exponents tend to a lower number of cases than languages with separatist exponents (Plank 1986). These tendencies taken together might „explain" the associations found between certain phonological traits like syllable complexity and morphological traits such as the number of cases.

But why do languages with cumulative case exponents tend to a lower number of cases? And why are cumulative exponents, as reported by Plank (1999), associated with variance and separatist case exponents with invariance?

We would argue (Fenk-Oczlon & Fenk 2000) that frequency (token frequency) is a key concept that offers a rather simple explanation: If a language has predominantly multifunctional cases (one case „accumulates" two or more functions), then this language will manage with a rather low number of case forms but will need and use each one of these case forms very often. And signs with high token frequency tend to both high variability and short coding for obviously economic reasons (e.g. Zipf 1949). This explanation should also hold for „split morphology" – cumulation/variance and separation/invariance – within languages: the most frequent cases in a given language will tend to cumulation and variance.

Let us again take up Mayerthaler's idea that „natural", when applied to (grammatical) language universals, boils down to „easy for the human brain". Language has to meet cognitive constraints, such as short-term memory limits in terms of elements or chunks of elements that can be kept within the focal attention, and the time limit known as the „psychological present". All languages, irrespective of their typological character, have to adapt to these constraints. According to the „holistic" or „systemic" approach of typology, each language goes through „natural" selfregulatory processes optimizing the interaction between its phonology, morphology, and syntax and the interaction with its „natural" environment, e.g. the articulatory and the cognitive system.

References

Auer, Peter (1993). *Is a rhythm-based typology possible? A study of the role of prosody in phonological typology.* KontRI Working Paper (University Konstanz) 21.

Dauer, Rebecca M. (1983). Stress-timing and syllable-timing reanalysed. *Journal of Phonetics* 11, 51-62.

Donegan, Patricia & Stampe, David (1983). Rhythm and the holistic organization of language structure. In J.F. Richardson et al. (eds.), *Papers from the Parasession on the Interplay of Phonology, Morphology and Syntax*, 337-353. Chicago: CLS.

Dressler, Wolfgang U. & Mayerthaler, Willi (1987). Introduction. In Wolfgang U. Dressler, Willi Mayerthaler, Otto Panagl & Wolfgang U. Wurzel (eds.), *Leitmotifs in Natural Morphology*, 3-20. Amsterdam/Philadelphia: John Benjamins.

Fenk-Oczlon, Gertraud (1983). *Bedeutungseinheiten und sprachliche Segmentierung. Eine sprach-vergleichende Untersuchung über kognitive Determinanten der Kernsatzlänge.* Tübingen: Gunther Narr.

- (1997). Thesen zu einer natürlichen Typologie. *Papiere zur Linguistik* 56, 1, 107-116.

Fenk-Oczlon, Gertraud & Fenk, August (1999). Cognition, quantitative linguistics, and systemic typology. *Linguistic Typology* 3-2, 151-177.

- (2000). The magical number seven in language and cognition: empirical evidence and prospects of future research. *Papiere zur Linguistik* 62/63, 3-14.

- (2002). The clausal structure of linguistic and pre-linguistic behavior. In T. Givón & Bertram F. Malle (eds.), *The evolution of language out of pre-language*, 215-229. Amsterdam: John Benjamins.

- (2003). Crosslinguistic correlations between size of syllables, number of cases, and adposition order. Paper presented at the Fifth International Conference of the Association for Linguistic Typology. Cagliari, September 2003.

Gabelentz, Georg von der (1901). *Die Sprachwissenschaft: Ihre Aufgaben, Methoden und bisherigen Ergebnisse.* 2nd edition. Leipzig: Tauchnitz.

Gil, David (1986). A prosodic typology of language*. Folia Linguistica* 20, 165-231.

Greenberg, Joseph H. (1966). Some universals of grammar with particular reference to the order of meaningful elements. In Joseph H. Greenberg (ed.), *Universals of Language*, 73-113. Cambridge, Mass: MIT Press.

Lehmann, Winfred P. (1978). English: A characteristic SVO language. In W. P. Lehmann (ed.), *Syntactic typology: Studies in the phenomenology of language,* 169-222. Austin: University of Texas Press.

Mayerthaler, Willi (1987). System-independent morphological naturalness. In Wolfgang U. Dressler, Willi Mayerthaler, Otto Panagl & Wolfgang U. Wurzel (eds.), *Leitmotifs in Natural Morphology*, 25-96. Amsterdam/Philadelphia: John Benjamins.

Miller, George A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review* 63, 81-97.

Plank, Frans (1986). Paradigm size, morphological typology, and universal economy. *Folia Linguistica* 20, 29-48.

- (1998). The co-variation of phonology with morphology and syntax: A hopeful history. *Linguistic Typology* 2, 1998, 195-230.

- (1999). Split morphology: How agglutination and flexion mix. *Linguistic Typology* 3-3, 279-340.

Skalička, Vladimír (1935). *Zur ungarischen Grammatik.* Praha: Náklad Filosofické Fakulty University Karlovy 1935.

Zipf, George K. (1949). *Human behavior and the principle of least effort. An introduction to human ecology.* Cambridge, Mass.: Addison-Wesley [2nd ed. New York: Hafner 1972].

Authors' adresses:

Gertraud Fenk-Oczlon
Department of Linguistics and Computational Linguistics
August Fenk
Department of Media and Communication Studies
University of Klagenfurt, Universitaetsstrasse 65-67, 9020 Klagenfurt, Austria.

gertraud.fenk@uni-klu.ac.at
august.fenk@uni-klu.ac.at