Ecological constraints on language diversity and evolution

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Understanding why languages are what they are and how they change requires an understanding of the many physical substrates which support them. Although it is possible to focus on internal constraints organizing linguistic systems, along paradigmatic and syntagmatic dimensions, without explicitly referring to these substrates, linguists have gradually explored issues such as:

i) how the human production and perceptual systems bear an impact on the sound systems of the world’s languages, with opposite constraints of ease of articulation and ease of perception (e.g. Lindblom et al., 1984; Oudeyer 2006);
ii) how our cognition shapes linguistic semantics and syntax (e.g. Talmy, 2000);
iii) how our genetic material (Pinker & Bloom, 1990), or more recently specific genes (Lai et al., 2001), relate to the physiological and cognitive features behind the use of language;
iv) how the intricacies of the web of social ties between speakers partly explain language variability and change (Labov, 2001; Milroy & Milroy, 1998; Nettle, 1999; Ke et al., 2008).

Aside from these factors, a range of more distant elements related to the physical environment inhabited by our species call attention. The expression “ecology of language” has been coined by Mufwene (2001) to refer to the diverse social frames in which languages change and compete – for example to give birth to creoles; it is tempting however to consider the term “ecology” in its more common acceptance, and to investigate whether factors such as climate or topography may influence linguistic systems.

A somehow direct impact of such physical parameters can be found for example in the linguistic and gestural representations of time in hilly environments such as the Yupno Valley of Papua New Guinea, where locals refer to past and future as down or up the slope (Núñez et al., 2012). Some scholars have also questioned the effect of topography or tree coverage on phonetic systems on the basis of sound transmissibility, with theories such as the *acoustic adaptation hypothesis* (Maddieson, 2011). A more indirect influence of ecological factors on linguistic variables can however be considered given i) how the first may lead to specific social configurations, and ii) how these configurations may in turn impact on linguistic features. The disputed relationships between group size and either phoneme inventory size (Pericliev, 2004; Hay & Bauer, 2007; Bybee, 2011) or language complexity/structure (Lupyán & Dale, 2010; Dahl, 2011) illustrate the second implication, i.e. how a social dimension may be connected to linguistic phenomena. Bridging the gap with environmental considerations, Nettle demonstrated how ecological risk in equatorial Africa reduced linguistic diversity. He explained this trend by showing that ecological risk, which is closely related to the duration of the growing periods for plants, leads people to enter into long-distance relationships to reduce the consequences of severe ecological problems like droughts (Nettle, 1996; 1998). Jacquesson (2001, 2003) also attempted at relating rates of linguistic change to specific environmental areas like ‘quasi-deserts’.

An outcome of such studies is a better understanding of macro- or meso- patterns of current linguistic diversity. These studies may also inform the way we address past linguistic situations, and the dilations and contractions different languages went through before reaching the linguistic landscape we know today. This requires the possibility to push back in time the current “ecology” of languages; such an assumption seems however reasonable at least for the last hundreds of years, provided differences between various modes of subsistence are not left out of the equation (like farming, raising animals, hunting and gathering).

Following Nettle’s pioneering approach, we rely on a nomothetic approach to investigate the relationship between ecological variables and social and linguistic ones. More precisely, we take advantage of the ever growing body of high-resolution digital datasets to investigate the impact of i) elevation and ground rugosity (Amante & Eakins, 2009), ii) distance to fresh water (Kummu et al., 2011), iii) tree and herbaceous coverage (Hansen et al. 2003), iv) duration of the growing season (FAO & IIASA, 2000) on a) population density (CIESIN & CIAT, 2005) and b) number of speakers per language and spatial quantitative measures of linguistic diversity (GMI & SIL, 2012). Relying on a geographic information system, we conduct statistical analyses of the relationships between the previous variables within regularly distributed geographic cells.

We first applied our approach to the African continent (Coupé & Hombert, 2012). Using stepwise linear regressions, we especially found that the density of population, as well as the number of languages in a region...
and the size of their geographic areas, could be well predicted by ecological factors. Additionally, regions where the linguistic diversity was the highest above the prediction interestingly corresponded to the putative cradle of the Bantu languages (Ehret, 2001). Finally, we also confirmed and expanded Nettle’s conclusions regarding ecological risk and the duration of the growing period.

We are now conducting similar investigations for the East Asian region. We will present similar analyses as those previously described regarding the sociolinguistic features of the region, and will compare this context to the African one. We will also pay closer attention to the issue of dealing with non-independent statistical units (because of the spatial contiguity of the cells in which measurements of the variables are done) (following Jaeger et al., 2011). Finally, we will attempt at discussing past linguistic evolution in the Eastern Asian region in the light of available palaeoclimatic data (e.g. Chen, 2008).

(887 words)

References: