



Comment

Articulating biological and cultural evolution  
Comment on “Surname distribution in population genetics and in  
statistical physics” by Paolo Rossi

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Not surprisingly, widespread interest in human genealogies was triggered in modern times when the implications of the theory of biological evolution by natural selection began being broadly realized—often with concern (*‘My dear, descended from the apes! Let us hope it is not true, but if it is, let us pray that it will not become generally known.’* [1]). In the academic milieu, Darwin’s hypotheses elicited compelling questions on the origin, development, and the ultimate fate of human lineages. Theoretical and empirical inaccessibility to the biological ingredients of genetic inheritance led however to rely upon the study of other characters transmitted along genealogical lines, specifically, of certain cultural traits. As stated in Rossi’s historical review [2], within the first few decades after the publication of *On the Origin of Species*, the study of the distribution and extinction probabilities of surnames—typically, a trait of patrilinear transmission—was already recognized as a mathematical approach to such questions. The quantitative description of the evolution of cultural traits by themselves developed later, by the mid twentieth century, when similarities and differences with biological evolution became well understood [3], and after a solid mathematical formulation for the dynamics of biological evolution had been established [4].

Rossi’s detailed bibliographical compilation suggests that, in the case of surnames, the most coherent corpus of quantitative results regards the statistics of their frequency distribution—namely, the distribution of the number of people with the same surname. Theoretical predictions obtained through several methods have been satisfactorily compared with empirical data. Moreover, whereas a rigorous analysis of the mutual compatibility of such methods might be lacking, the consistency of their results has been demonstrated in significant limits. Further developments along the same lines may explore the effects of relaxing the assumptions of the underlying models. For instance, over the time scales relevant to the evolution of surname frequency distributions (hundreds of years) birth, death, and migration rates are not constant as assumed in the models. On the other hand, efforts to correlate the distribution of surnames with genetic features—especially, from the empirical viewpoint—seem to be still in an incipient stage. It would be encouraging to witness, for instance, extensive analyses of the mono- vs. polyphyletic nature of a large number of surnames, providing highly valuable information on their historical origin. In connection with linguistic evolution, moreover, the process of surname mutation—which, in the Western world, has been the main source of novel family names over the last few centuries—has apparently remained unattended [5].

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A handful of other cultural traits share with surnames the property that they are mainly transmitted by genealogical lines. Their evolution and distribution are therefore candidates to be studied with the same theoretical and empirical tools as for surnames. No doubt, the most conspicuous instance in this class of cultural traits is the mother tongue. The tight correlation between genetic data and the mother tongue was demonstrated, at a rather early stage, in the classical work by Cavalli-Sforza's group [6]. Their results were illustrated by the overall congruence of the phylogenetic tree and the language taxonomy of a few dozen populations of disparate geographical origins. More recently, the same kind of models used to predict surname distributions was applied to the case of languages [7]. In contrast with the power-law dependence found for surnames [2], languages exhibit log-normal distributions, a result obtained in the singular limit where the probability of appearance of new languages is neglected. Along similar lines, the adherence to religions has also been examined [8]. These contributions should pave the way to broader quantitative evolutionary theories of human culture.

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