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## WHAT ARE THE ANALOGUES OF GENOTYPE AND PHENOTYPE IN THE CULTURAL EVOLUTION OF LANGUAGE?

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Inspired by the assumption that all evolutionary systems are instantiations of the same process of random variation and differential retention of variants (Hull, 1988), a number of scholars have based their models of language change and evolution on evolutionary biology. The convention in evolutionary anthropology and archaeology tends to be that knowledge, skills and values residing in people's brains constitute the cultural genotype, while artifacts and behaviours constitute the phenotype (e.g. Boyd & Richerson, 1995). Some models of language evolution also see the genotype in mental entities such as rules (Kirby, 1999) or information in neural assemblies (Ritt, 2004). Others, however, define mental phenotypes: grammars, or sets of learned rules (Croft, 2000; Mufwene, 2008) and public, behavioural genotypes residing in usage data (utterances). This paper offers theoretical support and evidence for the latter option.

The relationship between phenotype and genotype is an asymmetric one: the central dogma of molecular biology (Crick, 1970) states that information cannot flow back from protein to gene. Generalising, phenotypic features, acquired during development, cannot be encoded in the genotype and therefore cannot be inherited. Genotypic information acquired during replication or mutation, on the other hand, is indeed heritable.

Let us consider two examples from language change: First, the ongoing collapse of a three-gender into a two-gender system in Dutch. Dutch masculine and feminine nouns take the definite article *de* (while neuter nouns take the article *het*), and speakers in some communities can't tell the gender of etymologically masculine or feminine words. When prompted to produce an utterance where a *de*-noun requires a (gendered) possessive, some speakers will apply the feminine possessive and others the masculine. This is evidence that, from the same usage data, some learners induce the masculine rule for a given noun while others induce the feminine rule. If the rules are the genotype, which replicate when speakers induce rules from data, and the data is the phenotype, we have here a case where genotypic information is not being faithfully

replicated from generation to generation: different people have different rules in their grammars, but this is not noticed during communication because *de*-nouns seldom have gendered modifiers. However, if the data is the genotype and the rules are the phenotype that develops from the interaction between the data and the learner's brain, the different rules induced by different learners are simply phenotypes with different developmental trajectories. These different rules, as expected, are nevertheless faithfully replicate the genotypic information (*de* followed by noun) in the data they produce.

Second, during the process of degemination where a double consonant becomes a single consonant (e.g. Latin *cuppa* becomes Spanish *copa*), speakers before the change had a rule that distinguished between double and single consonants. After the change, speakers have a new rule for pronouncing the consonants that does not include such distinction. During the transition, speakers with the distinction rule produced data where double and single consonants were barely distinguishable; learners exposed to such data must have induced the no-distinction rule. If the rule is the genotype and the data is the phenotype that develops from the interaction between the rule and the social communicative environment, the loss of distinction between double and single consonants is acquired during development of the phenotype (production of data). The central dogma would not allow that information from being encoded into the genotype (the learners' rule); yet here phenotypic information does precisely that and continues to be inherited over subsequent generations. This is why it has been proposed that cultural evolution is Lamarckian, as it allows inheritance of acquired characters. A solution to this problem that does not require appealing to Lamarckism is to take the data to be the genotype and the rule to be the phenotype that develops from the interaction between the data and the brain during social communication. Now, the loss of distinction is an error in replication of the genotype (a mutation), which is, as expected, heritable.

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