Journal of Language Evolution, 2016, 30–32
doi: 10.1093/jole/lzv007
Commentary

Overview: Debating the effect of environment on language

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If languages do indeed evolve then they must show the three crucial aspects of an evolving system: variation of traits, inheritance of those traits, and the differential survival—that is selection—of those traits (Lewontin 1970). We know that languages vary (otherwise the fields of linguistic typology and sociolinguistics would be boring). We know that variation is passed through speech communities and inherited from parent language to its daughters (otherwise historical linguistics would likewise be boring). However, whether linguistic traits are selected for is much less clear (Ramsey and De Block 2016). Nor is it clear just where selection might operate (Dediu et al. 2013).

Despite these issues, many possible candidates for selective effects have been proposed in the linguistic literature. Selection might operate at the level of the *speech act*. For example, the more lexical items are used, the more stable they are over time, which may be consistent with frequency-dependent selection (Pagel et al. 2007; Calude and Pagel 2011), while the length of these more frequent words appears to be shorter to increase communication efficiency (Piantadosi et al. 2011). Alternatively, perhaps rate of speech is constrained as there is a trade-off between the efficiency of information transfer between people and the effort needed to en- and decode information (Pellegrino et al. 2011). Selection might act to reduce the distance between syntactically linked words in a sentence (Futrell et al. 2015), or make the neural processing of information easier (Bickel et al. 2015). Or maybe the need for easy to learn grammatical rules leads to increased regularity in forms over time (Lieberman et al. 2007).

Selection might also operate at the level of the *sociolinguistic group*. This is, unsurprisingly, the preferred locus of action for linguists, and little review is needed here (see e.g. Evans 2003, Michael 2014 or Bowern 2010). However, possible selection effects here include prestige biases selecting for certain favored token variants in different subgroups (Labov 2007), while processes like word tabooing act to remove certain lexical items (Elmendorf 1970). Selection might stabilize and reduce variation within populations by speakers accommodating to others (Giles et al. 2010). Alternatively language ideologies (Irvine and Gal 2000) might act to enforce directional change by shifting affiliation for example Kulick's (1997) work showing why Gapun speakers in the Sepik of Papua New Guinea are shifting to the creole Tok Pisin.

Other work, outside of sociolinguistics, has pointed to other speaker-level effects caused by learning constraints. For example, increasing the numbers of non-native speakers reduces the morphological complexity of a language (Lupyan and Dale 2010), while increasing contact between languages might lead to lower lexical diversity (fewer words to encode information) (Bentz et al. 2015). Perhaps contact between languages causes deliberate differentiation in languages as an outcome of group formation (Atkinson et al. 2008) or social group identification (Cohen 2012). And there are effects of just group size (Trudgill 2011) where, perhaps, smaller populations lose traits faster while larger populations gain faster (Bromham et al. 2015). Maybe even the genetic makeup of a languages' speakers might play a role in shaping their language (Dediu and Ladd 2007).

All of these processes and levels have generated hypotheses and results within linguistics. But it is at the level of the *environment* where linguistics finds itself in

unfamiliar and unexplored territory. As many of our commentaries note the importance that environmental effects may play in shaping languages is poorly understood, if not actively proscribed within linguistics. While there has been some work by anthropologists (e.g. Ember and Ember 2007; Fought et al. 2004), linguistics has, to date, seen little value in looking for environmental effects on language. This omission is surprising as there do appear to be strong effects of environment on the distribution of languages themselves (see Greenhill 2014), with more languages in more ecologically rich regions (Nettle 1998) and toward the equator (Mace and Pagel 1995; Gavin and Stepp 2014), and a tendency for languages to 'fill' an environmental niche like an island (Gavin and Sibanda 2012). This omission is probably due to a number of reasons—discussed in our commentaries—ranging from an (understandable) hang-up from early racist theories of language, to fears of environmental determinism, to concerns that this locus of action is too far removed from the language speakers themselves.

However, despite this lack of studies there seems to be a recent shift toward investigating the potential effects that environment might play in shaping language (e.g. De Busser and LaPolla 2015; Everett 2013; Everett et al. 2015). Our target article by Everett et al. (2016) and commentaries debate the general point that human languages have adapted to their ecological niche, and the specifics of how dry environments might select against tone languages. This debate is especially apt for the first issue of the *Journal of Language Evolution* as it raises many issues important to a science of language evolution. First and foremost, is the question of selection—what factors shape languages over time? And at what level? This question is entangled with others: how can we operationalize broad-scale hypotheses into testable entities without doing injustice to language-specific causes? How can we encode and delimit our data to accurately give us the raw material suitable for testing these hypotheses? How do we see through the profound variation in the world's languages to infer the common patterns behind the mess of counterexamples? I hope that this debate will help lay the ground work for the future exploration of all these questions. As many of our commentators note it is refreshing that these questions—for so long off limits—can now be approached critically and carefully.

Funding

This research was supported under Australian Research Council's Discovery Projects funding scheme (project number DE120101954).

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