

REGULAR MORPHOLOGY AS A CULTURAL ADAPTATION: NON-UNIFORM FREQUENCY IN AN EXPERIMENTAL ITERATED LEARNING MODEL

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One approach to explaining the origins of structure in human language sees cultural transmission as a key mechanism driving the emergence of that structure (e.g., Deacon 1997). In this view, universal features of language such as compositionality are an adaptation by language to the pressure of being successfully passed on from generation to generation of language users. Crucially, this adaptation is *cultural* rather than biological in that it arises from languages changing rather than language users.

The support for this has mainly come from computational and mathematical modelling as well as observations of the distribution of compositionality in real languages. In particular, in morphology there appears to be a connection between high frequency forms and non-compositionality (i.e. irregularity). Kirby (2001), in a computational simulation, demonstrates that this is just what one would expect of a cultural adaptation. If compositionality arises from the need for reliable transmission of forms for particular meanings then we would expect that need to be greater if those meanings were low frequency. An irregular form for a particular verb, for example, can only be acquired if that particular form is seen enough times by a learner. A regular form, on the other hand, is more reliably acquired because it is supported in part by evidence from all the other meanings that participate in the regular paradigm. Kirby, Dowman & Griffiths (2007) give further support for this result using a generalised mathematical model of cultural transmission.

Despite this, there is still understandable skepticism about the realism and therefore applicability of such models. Can we be sure, for example, that the differential take-up of particular errors in linguistic transmission that drives adaptation in the models mirrors what happens in reality? In this paper we respond to these concerns by replicating the models of cultural transmission of regular and irregular morphology using real human subjects.

Using the methodology pioneered by Cornish (2006), we examine the evolution of a verbal morphology in an artificial language. Experimental subjects were asked to learn 24 verbs in a simple language. Each verb was presented with a picture signifying its meaning. These denoted either a man or a woman performing some action allowing us to present a language whose verbs

marked gender. In the initial language we constructed, half of the verbs marked gender using a regular suffix attached to an invariant stem form (e.g. *sagilir* vs. *sagilar*), and the other half indicated gender through completely different forms for the masculine and feminine verbs (e.g. *fuderi* vs. *vebadu*). We further divided both sets of verbs into high frequency and low frequency types. In training, each low-frequency verb (whether regular or irregular) appeared 3 times, whereas the high-frequency verbs each appeared 10 times.

After training, subjects were asked to try and recall the verb forms for all 24 actions. To implement cultural evolution, the output of each subject at test formed the language which the subsequent subject was trained on. We observed the evolution of the languages for 5 “generations” and repeated the experiment with 8 different initial randomly constructed languages (with different experimental subjects, of course).

The initial languages are constructed to show no relationship between frequency and regularity - both frequent and infrequent verbs are equally likely to be irregular. However, the experiment confirms the modelling work: languages rapidly adapt so that infrequent forms become regular. We confirm this with statistical analysis of the emergent languages, and descriptive analysis of the process of language change and regularisation in the experiment.

Our experiment confirms a) infrequent forms are harder to learn than frequent forms and b) regular forms ameliorate this difficulty. An adaptively structured language will ensure that infrequent meanings will participate in regular paradigms. The primary contribution of the experiment is c) a demonstration that just such an adaptive language can emerge in a very short time even when the initial state does not have these features. This occurs without any apparent conscious design on the part of the participants (whose native language, incidentally, does not inflect verbs for gender) and is instead a natural consequence of the cultural evolution of the artificial languages.

References

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