

## WHY THE TRANSITION TO CUMULATIVE SYMBOLIC CULTURE IS RARE

MÓNICA TAMARIZ

*Language Evolution and Computation, Linguistics and English Language, The University of Edinburgh, 14 Buccleuch Place, Edinburgh EH8 9LN, UK*

Boyd and Richerson (1996) observe that while cultural transmission is common in nature, cumulative culture is rare. We suggest an explanation for the low probability of the emergence of human-like cumulative culture, composed of increasingly complex form-function associations. The role of naturally selected socio-cognitive biases on the origins of human culture is well studied; we focus on the coevolution of those human biases and the cultural environment (Boyd & Richerson, 1985; Odling-Smee, Laland & Feldman, 2003).

Evolutionary transitions often involve the emergence of a new way to transmit information (Maynard Smith & Szathmáry, 1995) and are rare because of conflicts between the requirements of the existing and the emerging systems. The earliest human cultural traditions (Oldowan and Acheulean techniques) originate around 1.5-2.5 mya (transition 1) and persist for over one million years with negligible modification. Subsequent stable traditions are orders of magnitude shorter, suggesting a second transition around  $10^5$  years ago resulting in a dramatic increase in the rate of cultural complexification. We propose that symbolic cumulative culture is rare because the psychological biases favoured by the first transition are at odds with those required for the second transition.

1. The transition to cultural transmission results in the “common” kind of culture where whole behaviours (techniques, vocalisations etc) associated to whole functions are transmitted faithfully between individuals and persist, with little modification, over the generations. For language, this corresponds to Wray’s (1998) protolanguage stage. In natural evolving systems, the majority of transmission errors, particularly discrete or qualitative ones, result in disruption or loss of function. If extant cultural behaviours are advantageous, they will pose a selective pressure for the co-evolution by natural selection of cognitive biases for errorless transmission, such as faithful imitation including theory of mind.

2. The transition to “rare” cumulative culture occurs when not only whole behaviours for whole functions, but elements of those behaviours associated with sub-functions can be transmitted, in other words, when forms and meanings

can be subject to analysis. This transition requires flexible imitation so that elements of existing behaviours, which may or may not have a utility function as standalone units, can be perceived, learned and transmitted independently and, crucially, recombined in new ways – compositional or otherwise (see Wray & Grace, 2007) – to fulfill and to create novel complex functions.

A small collection of idiosyncratic form-function associations combined with a bias for rigid imitation would tend to prevent the generalization needed for noticing, processing and expressing the patterns within and between cultural items that characterize symbolic cumulative culture. However, increasingly conspicuous patterns emerging in a growing set of independently discovered cultural forms could help overcome this conflict. Social-group size increase and contact between groups may have facilitated this transition.

In sum, we propose that in the human lineage, a first cultural transition leading to the co-evolution of cultural innovations and faithful imitation allowed *holistic replication* of form-function pairs during the transmission of functions/meanings. A second transition involving analytic imitation led to *replication and recombination* of fractional form-function units, which allowed the transmission of form structure. Analytic replication could only have emerged when imitation stopped being exclusively holistic without ceasing to be faithful, perhaps in response to the increasingly complex structure of the cultural environment.

### **Acknowledgments**

The author holds a Leverhulme Trust Early Career Fellowship.

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