Social Learning Errors and the Evolution of Material Culture:

Cognitive Factors Affecting Forms of Granny and Reef Knots

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Research into the evolution of material culture has focused on the cognitive capacities that enable the high fidelity transmission of complex knowledge and skills between individuals and across generations. However, the causes and consequences of copying error remain relatively poorly understood. We focus on variation in micro-structure (forms of granny and reef knots) within the ancient and ubiquitous technology of knot tying. We apply a mathematical model to experimental data to make quantitative estimates from three classes of cognitive factors that can affect the production of cultural variation during the process of social learning. In particular, despite a high fidelity of copying or imitation, we find evidence for an absolute learning bias towards an un-observed cultural variant (handedness), a relative transformation of the observed cultural variant (mirroring), and a propensity to repeat a previously performed chunk of behaviour in a sequence. Our analysis shows how these cognitive factors interact to affect cultural evolutionary dynamics, revealing steady state frequencies that are consistent with the prevalence of granny over reef knots and the mathematical equivalence of reef knot forms. We discuss how parameterisation of cognitive factors involved in social learning can be used to assess their effects on the unintended production of cultural variation and evolutionary dynamics.