Modeling Patterns of Macroevolution in Modern and Ancient Technologies

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Humans display astonishing diversity in their material culture. Although archaeologists have spent decades painstakingly describing this diversity, we continue to lack a comprehensive understanding about the evolution of our technologies. This work takes a comparative perspective to examining macroevolutionary patterns of technological change by using a Bayesian modeling approach to estimate rates of diversification within various technological systems. This approach offers improvements over existing methodologies by providing a quantitative framework to estimate rates of technological innovation and extinction through continuous time, correlate the effects of various factors on technological diversity and assess whether technological diversification dynamics conform to existing hypotheses of technological change. Technologies that are examined in this work explore a range of domains including digital technologies (AppStore apps), highly regulated technologies (pharmaceutical drugs), large scale technologies (automobiles) and ancient technologies (pottery from the American Southwest). Results of this work highlight that modern technological systems exhibit a common pattern of higher innovation early in their life history with gradual slowing of origination rates later on, occasionally referred to as an adaptive radiation or dominant designs pattern. Ancient technologies do not exhibit these same dynamics, although I argue here that this is likely due to sampling biases and the inability to see novel and rare technological variants in the archaeological record. Broadly, this work contributes to a growing set of methods that provide greater opportunities for comparing and contrasting the dynamic patterns of technological change.