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Effects of population size and social connectedness on cumulative cultural evolution: A gene-culture coevolutionary model

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The demographic hypothesis of cumulative cultural evolution claims that population size has been a crucial determinant of the rate of cumulative cultural evolution in humans rather than other factors such as environmental risk. The original version of this hypothesis does not distinguish the role of population size from that of social connectedness, i.e. the degree to which individuals in a population are socially connected with each other. Recently, one of our models showed that social connectedness may actually have a larger impact on the rate of cumulative cultural evolution than population size. However, these models all assume that the mode of learning which underlies cultural transmission is fixed and does not evolve, so that they cannot deal with the time scale of genetic evolution. In the present study, we extend previous models of cumulative cultural evolution by assuming that the allocations of the individual lifetime into two modes of learning, social and individual learning, co-evolve with the level of culture in the population. We derive the evolutionarily stable learning strategy, assuming that cultural evolution occurs on a faster time scale than genetic evolution. The results suggest that population size may have only a minor effect on the equilibrium level of culture realized by the evolutionarily stable learning strategy, while social connectedness may have a relatively large effect, conforming with the results of models without evolution of learning. These results indicate the importance of distinguishing different aspects of demography when modelling cumulative cultural evolution.

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