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**Slowly switching between environments facilitates reverse evolution in small populations** LONGZHI TAN, JEFF GORE, Department of Physics, Massachusetts Institute of Technology — The rate at which a physical process occurs usually changes the behavior of a system. In thermodynamics, the reversibility of a process generally increases when it occurs at an infinitely slow rate. In biological evolution, adaptations to a new environment may be reversed by evolution in the ancestral environment. Such fluctuating environments are ubiquitous in nature, although how the rate of switching affects reverse evolution is unknown. Here we use a computational approach to quantify evolutionary reversibility as a function of the rate of switching between two environments. For small population sizes, which travel on landscapes as random walkers, we find that both genotypic and phenotypic reverse evolution increase at slow switching rates. However, slow switching of environments decreases evolutionary reversibility for a greedy walker, corresponding to large populations (extensive clonal interference). We conclude that the impact of the switching rate for biological evolution is more complicated than other common physical processes, and that a quantitative approach may yield significant insight into reverse evolution.

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