Investigating the Principle of Adaptive Plasticity in Variably Epistatic Systems

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The goal of this research project is to demonstrate how evolutionary path dependencies and population-level epistasis affect the adaptive plasticity of populations of artificial organisms. In so doing, it aims to present new insight into the risks embedded in niche ecosystems confronted by global change. In response to this research goal, this project investigated how a population's ability to adapt to sudden environmental change varies with its level of genomic interdependence. Simply put, how does the level of epistasis present within a population affect that population's ability to survive and thrive in the face of environmental change? To simulate evolution through artificial life, this project employed a forward-time simulation program written in C. The experimental setup involved initial populations representing different baseline population epistasis characteristics. These populations of artificial organisms then evolved through several parallel paths. Each path incorporated unique environmental transitions and transition timeframes. The ability of each of these populations to avoid extinction and maintain measures of health throughout the various evolutionary scenarios was compared. Data analysis was completed using MATLAB. Sharp population losses often followed environmental transitions, reflecting genomic properties poorly aligned for survival in the new environment. Occasionally environmental changes proved beneficial to the population. While evolving within transitional environments, populations often underwent drastic changes, assuming dramatically different trends of population growth after being reintroduced into their original pre-transition environment. Results also showed a pronounced tendency for population-level epistasis to increase over time.

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