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Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 40(0)

Authors

Livingston, Nicholas
Tidswell, Ben
Willcoxon, Meghan
et al.

Publication Date

2018

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Gene Duplication, Modularity, and the Evolution of Intelligence in Simulated and Real Robots

Nicholas Livingston
Vassar College, Poughkeepsie, New York, United States

Ben Tidswell
Vassar College, Poughkeepsie, New York, United States

Meghan Willcoxon
Vassar College, Poughkeepsie, New York, United States

Theresa Law
Vassar College, Poughkeepsie, New York, United States

Gabriel Dell'Accio
Vassar College, Poughkeepsie, New York, United States

Mackenzie Little
Vassar College, Poughkeepsie, New York, United States

John Long Jr.
Vassar College, Poughkeepsie, New York, United States

Josh Bongard
University of Vermont, Burlington, Vermont, United States

Ken Livingston
Vassar College, Poughkeepsie, New York, United States

Abstract

A growing body of research suggests that modularity of both gene networks and behavioral phenotypes increases robustness and efficiency of the evolution of intelligence by natural selection. It remains far less clear how modularity itself evolves in the first place. A smaller body of research points to the importance of considering the co-evolution of morphology and control systems in autonomous agents. We report research using both simulated and real robots that tests the hypotheses that (1) genotype to phenotype (G-P) maps that allow for gene duplication evolve more modular structures than those that do not, and (2) more modular agents evolve more rapidly. We also provide preliminary evidence related to the positive effects of morphology-controller co-evolution as compared with the evolution of controllers alone. An new, process rather than part based G-P map is also introduced.