Sex and cooperation in digital communities

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Over the past three decades artificial life approaches have made numerous contributions to computer science, engineering, art, design, chemistry, and biology. I will discuss how two major *in silico* experimental platforms, Avida and Aevol, advanced the research into the evolution of sex, the evolution of cooperation, and the interactions between the two. Sex and cooperation remain two of the most widely debated evolutionary topics, affecting communities of species ranging from microorganisms to humans. Both present a similar dilemma of evolving and maintaining a trait with long-term benefits and short-term costs. Large number of theories offer explanations for the two processes, but experimental evidence, or a unifying theory, are largely absent. In my research I use artificial life platforms Avida and Aevol, in which large populations of digital organisms compete, mutate and evolve over tens of thousands of generations. Digital individuals may evolve genetic information transfer either via recombination (Avida) or plasmid conjugation (Aevol). In Aevol they may also evolve costly genes for secretion of a beneficial public good molecule. Our results show that recombination rescues populations from accumulation of deleterious mutations caused by Muller's ratchet and can also be selected for in changing environments. We described a novel genetic mechanism for the evolution and maintenance of cooperation, based on entangled genetic architecture of metabolic and cooperation genes. Finally, we have shown that sex can promote cooperation and vice versa, potentially leading to coevolution of the two traits. I will conclude by drawing parallels between artificial life and microbial experimental evolution, a field that has frequently inspired artificial life research. In the near future, the increase in the power and sophistication of genomic and computational tools is likely to strengthen the synergy of *in silico* and *in vivo* model systems, leading to exciting new results.