



Stephen Heap and Mikael Puurtinen

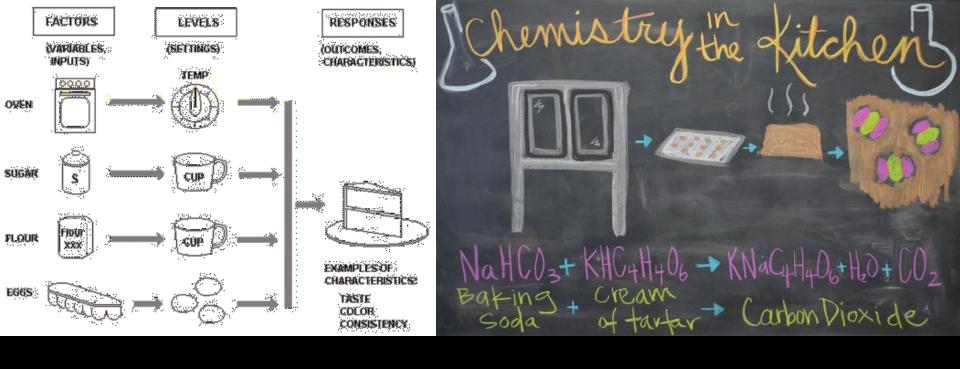
How to bake a cooperative social system

How do you bake a cake?





Pre-made cakes can only tell so much



To understand the cake, we must make the cake







How do cooperative social systems build themselves?

The same problem exists for the evolution of cooperative social systems

THE FORMATION OF A BIOFILM

Biofilms occur when individual bacteria, in a way not fully understood, organize into a community that behave like a single organism.



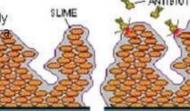
METAL SURFACE ATTACHMENT

Bacteria fasten on to a variety of surfaces using specialized tal-like structures. This can occur in pipes and water filters, in the human intestine, and on implants such as heart values.



EXPANSION

The cells grow and divide, forming a dense mat many layers thick. The bacteria communicate with each other using specific signals. At this stage, the biofilm is still too thin to be seen.



MATURATION

When there are enough bacteria in the developing biofilm - a quorum the microhes secrete a sugary glue and form mus broom-shaped structures that look like futuristic

RESISTANCE

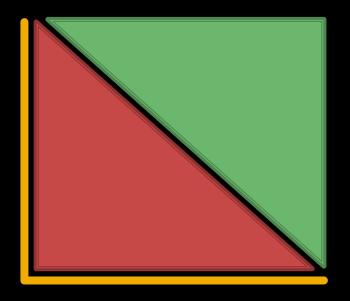
The glue protects the bacteria in the biofilm from the harsh environment outside, shielding them from antikiotics, toxic chemicals, and the body's immune system.





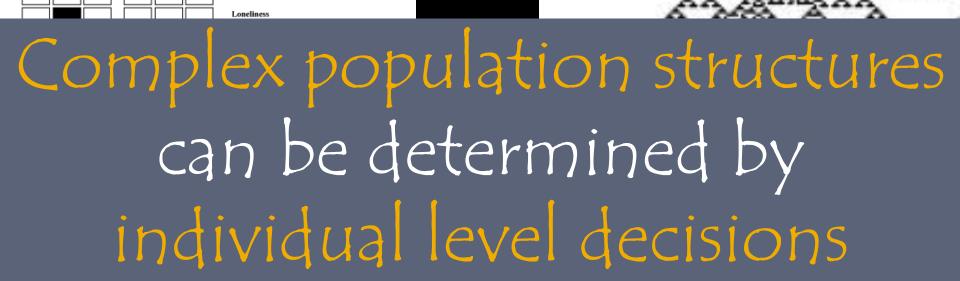
'Pre-cooked' social environments describe the range of conditions that can support cooperation

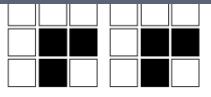
Environmental Variable



Environmental Variable

But we don't know how cooperative social systems can structure themselves

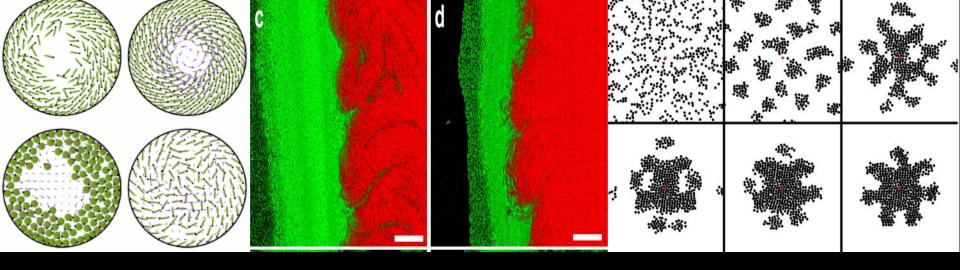




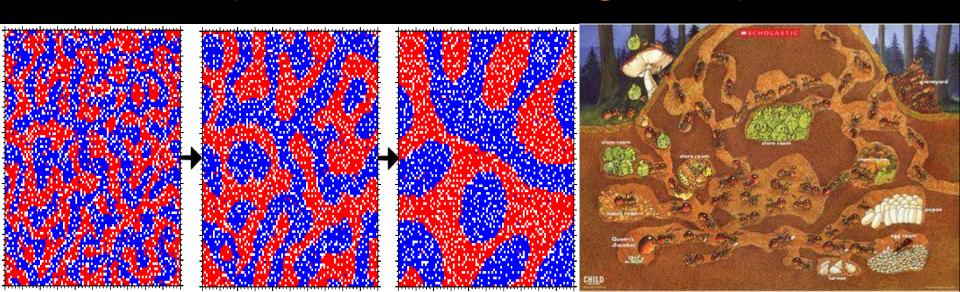
Stasis

A cell with exactly 2 adjoining cells remains the same.



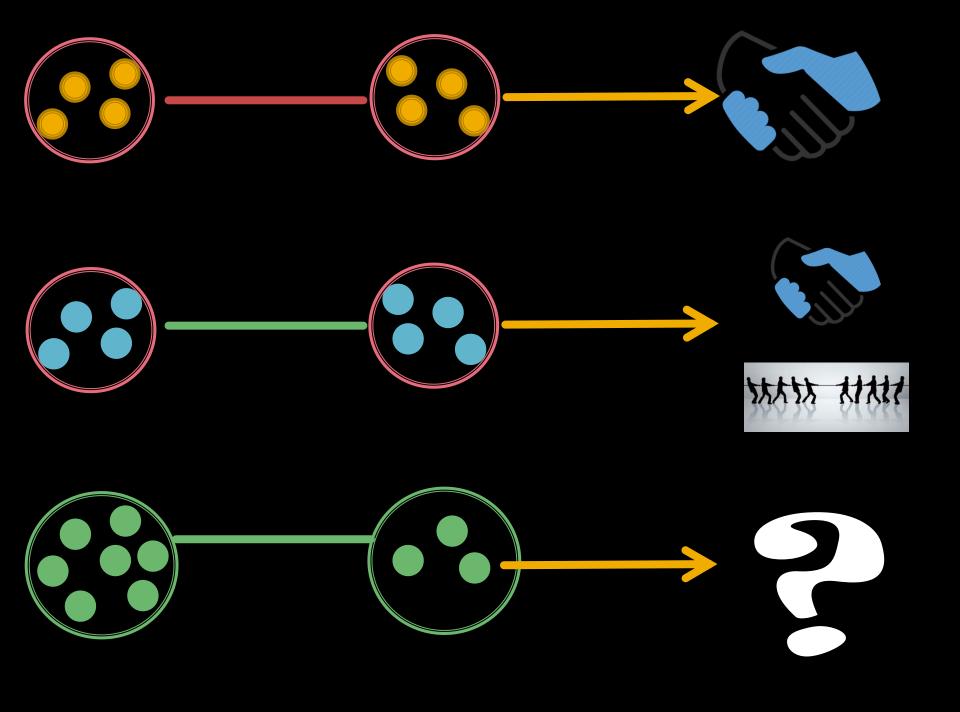


We need to study the principles, processes and conditions that allow cooperative social systems to form endogenously



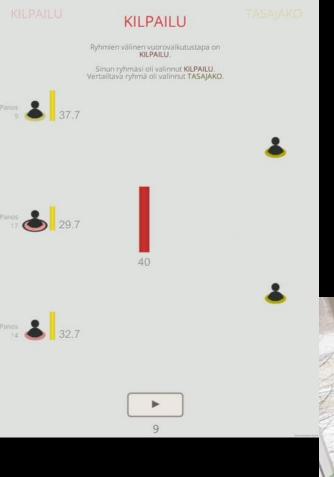
What is the role of between-group competition?





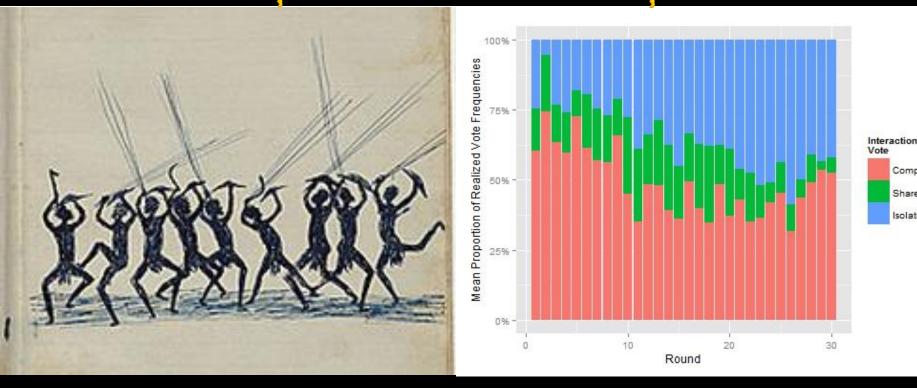








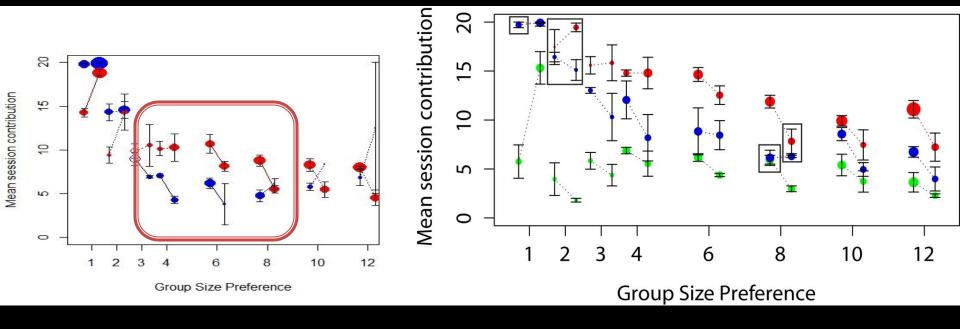
Spontaneous Emergence of Group-Based Competition



Individual decisions that promote betweengroup competition generate a competitive social environment

Competition Promotes Group Formation

Within-Group Cooperation Supported by Between-Group Conflict



Cooperation can be sustained in mid-sized groups and is greatest for competitive groups

Group Competition in Coevolutionary Scenarios

Group competition
may alter
Co-evolutionary dynamics
in important ways

Group size faced by the average individual

No Group Interactions





Group Interactions Allowed

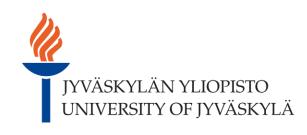




Take-Home Message

A special ingredient for baking a cooperative social system is a pinch of conflict











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