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Using memory to enforce stereotyped behavior in a bacterial community

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Bacteria communicate with each other by the exchange of chemical cues. I will describe a simple system in which bacteria form a one-dimensional community in which behavior in the community is enforced by trans-generational memory inherited from a founder cell rather than by intercellular signaling. The bacterium B. subtlis held under constant conditions of exponential phase growth switches between a unicellular, motile state and a sessile state in which individual cells are held together in a chain. I will show that cells enter the chaining state spontaneously by a stochastic competition mechanism involving tight binding between two proteins and remain in that state for a stereotyped number of generations due to the action of a third protein that is responsible for memory. The motile state, in contrast, is memoryless. Reconstruction of the principal features of the two states in an unrelated bacterium, E. coli, provides evidence that the three proteins are necessary and sufficient to account for the alternative behaviors. Thus, B. subtilis is capable of cell-cell communication by an epigenetic information is transmitted to progeny cells for a characteristic number of cell divisions.