

Complexity and possible emergence of intelligence in bacterial collectives

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Commentary

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Bacteria are often described as unicellular organisms but they are often found, in the wild and in the laboratory, in highly organized structures containing a large number of cells. These include macro-colonies and biofilms that can display highly complex structures (Ben-Jacob et al., 1998, Serra et al., 2013).

The complex structures appearing within large colonies or biofilms can display increased functional complexity and exhibit hints of functional differentiation (Serra et al., 2013). This is made possible by complex biochemical cell-cell interactions. Interestingly, ion channel signaling activities were recently shown to lead to electrical bursts, within bacterial biofilms, that may be reminiscent of those occurring in the brain (Prindle et al., 2015). Together these phenomena suggest similarities with the information processing ability of higher organisms.

Demonstrating unambiguously some form of biological mentality or intelligence in bacteria is neither obvious nor unimaginable. However, given the functional similarities that exist in highly organized networks of interacting cells, it is possible to imagine the existence of processes that are

highly reminiscent of mentality-like properties in bacterial collectives. As others have proposed, by harnessing complex interactions within their biomolecular networks, microorganisms can perform information processing and display higher-level functions such as memory, learning, anticipation, decision making, and adaptation, processes that are hallmarks of intelligent systems (Westerhoff et al., 2014).

Whether these complex dynamical processes, happening in microorganisms or in brains, rely simply on ordinary biochemical exchanges or also on less trivial or even yet to be characterized processes is worth investigating further (Robert, 2012).

References

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