

Notes on organisms as Agents of Evolution

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Abstract

This is an summary of an article “[Notes on organisms as Agents of Evolution](#)” from Philip Ball.

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1 What is agency?

- the capacity to act or exert power
- biological agency is “the capacity of a system to participate in its own **persistence, maintenance** and function by regulating its own structures and activities in response to the conditions it encounters.”
- Even bacteria can be considered decision-making entities (Ben-Jacob et al. 2014) whose behaviour depends not just on external circumstances but on their own internal state, informed by external data gathered through sensory systems.
- One answer to the question of what a theoretical framework for conceptualizing agency might bring to biology is that it might foster more predictive capability.
- Example on agent and non-agent: pigeon and cannonball → This manifests its agency by virtue of having goals.
- Walsh (2015) distinguishes object theories, which describe the behaviour of objects according to laws external to the system (typically Newton’s laws), and agent theories, in which actions are events “that occur as a consequence of agents’ pursuit of their own purposes” and are internal to the system.
- How understanding agent helps further: controlling cancer cell better – > *this is a good motivation why we need to investigate agent design*
- Sultan et al. (2021) argue that an understanding of agency would allow the role of the environment to be better incorporated into biology. … They might restructure the environment in more profound ways, altering local climate or geomorphology.

- For example, **an agent intent on self-preservation and maintenance** might conceivably respond to environmental change (a rise in temperature or salinity, say) in several ways:
 - By developing a capacity to buffer its internal states against external fluctuations or shifts.
 - By activity that restores the previous environmental conditions in a homeostatic manner (Dyke & Weaver 2013).
 - By migrating to a different environment with more amenable conditions (as in chemotaxis).

2 Agency as Goal-Directed Autonomy

- This **self-sustaining nature is, indeed, often considered the agent's ultimate goal** (Veloz 2021). → *does this mean maximizing the reward? The typical goal is defined over an environment and reward hypothesis mathematically formalizes “attaining goal behavior”. The agent has its own goal of “self-sustaining”. This raises a questions of 1) what is the definition of agent's goal 2) since the goal should be a goal, how goal within agent's defintion can be transferred to the environment's goal, which is maximizing the reward?*
- Moreno (2018) argues that a true agent does not simply persist in an environment but does so by altering the environment for that purpose.

3 How to theorize about goal-directness and agency

- Typically they consider goals as emergent properties of generic complex systems, such as the ability of reactive networks to develop self-contained and self-sustained dynamical states.
- The “goal” of such a system is often considered to be simply to keep existing. ... the question becomes about “**what properties**” enable such self-sustaining dynamics.
- How such goals arise from the interaction of a historically situated organism with its environment.
- The whole point about the agency is that it can be versatile, adaptive, and improvisational.
- If the environment changes, only those organisms that happen to have a beneficial adaptation survive.
- **What characterizes an agent?**

- Agents must be separable from their environment with a boundary, and the boundary must be permeable.
- Agent must persist for some meaningful duration of time
- Agent must have endogenous activity, meaning that it does things “for its own reasons”, and not just in a stimulus-response manner.
- Agent must have some internal complexity.
- Agents must also show “holistic integration”: they are more than the sum of their parts
- Agents experience the world as a genuine web of meaning, which might be best expressed in terms of affordances (Gibson 1979; Walsh 2015): how, given this state of affairs, might I best achieve my goal?

References