

Non-reductionism: Explanation and methodology in developmental biology

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Beyond dichotomies

False dichotomy

- ***Anti-reductionism:*** Higher level field possesses principles of its own and does not benefit from molecular biology.
- ***Reductionism:*** Molecular biology can in principle fully explain all biological facts.

Non-reductionism:

- Good biological explanations appeal to entities/processes from **several** levels of organization.
- It is an **empirical** question as to which entities (and thus levels) are causally more salient.

Higher level modules can be more stable and causally relevant

- Version of multiple realization argument tied to explanation in developmental biology.
- Aim of developmental biology:
 - Account of development as process in time
 - Explaining development of larger groups of organisms
 - study of model organisms just a methodological tool

Higher level modules can be more stable and causally relevant

- The same structure (homologue) can develop based on different developmental processes and different genes in different species.
 - Example: congeneric direct and indirect developers
- Same gene can be involved in the development of different structures in different species.
- Dissociation of levels: Molecular, developmental, morphological module on one level can be stable across evolution while modules on other levels undergo substantial change.

Higher level modules can be more stable and causally relevant

- **More general** descriptions and explanations of development attach to those entities and processes that are stable across individuals and species, some of which are on higher levels
- This point about explanation does not deny ontological fact that structure has a certain molecular basis in each individual.
- Point is not that reduction would be cognitively too complicated.

Generality as ***epistemic virtue***

Higher level modules can be more stable and causally relevant

- Causal influence of a higher level module can be more stable across species and an individual's developmental time than molecular constituents.
 - Example: Knock-out experiments and genetic redundancy. Gene is causal factor in normal development yet turns out to be non-essential.
- Insensitivity to perturbation: Operation of mechanism not certain depend on the presence of certain lower level factors, but of higher level factors.

Higher level modules can be more stable and causally relevant

- Causal influence of developmental module is always realized by certain molecular features.
- Yet it is an *epistemic virtue* of explanations to appeal to the *most stable causal* features: those that are stable across time and individuals (while lower level basis varies), and less sensitive to perturbation.

Higher level modules can be more stable and causally relevant

- It is an *empirical* question as to which features (on which levels) are causally more salient.
- Developmental biology studies the *interaction* of entities and processes at *several* levels of organization, and explains in these terms:
 - explaining how molecular features causally influence higher level features
 - explaining how higher level modules influence lower level features (at a later point in time)

What the philosopher should do

- Stop developing philosophical arguments for reductionism / anti-reductionism
- Focus on actual biological practice rather than 'in principle' considerations
Focus on explanation and methodology rather than ontological issues
- Acknowledge that there are different legitimate fields, theories, concepts, modes of explanation, which address several levels of organization

What the philosopher should do

- Develop account of how different fields, theories, concepts, modes of explanation are related and in fact effectively integrated
- Develop account of how biologists study the interaction of entities on different levels and explain in these terms
 - Particular philosophical case studies already exist
 - Develop more general philosophical account / notions
 - Contribute to solving challenges that stem from existence of different language, fields, approaches

Relevant references

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