Integrative Promise

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Outline

1. Explanatory and Theoretical Virtues
2. Finding Patterns in Explanatory Virtues
    - Horizontal and Vertical Integration
    - Stringency and Opportunism
    - Non-Epistemic Values
3. Bringing it Together: Integrative Promise
4. A Few Objections
5. A Case Study: Natural History in the 21st Century

The take-home: Explanations in the life sciences are often defended for or evaluated on their **integrative promise**.

Explanatory Virtues

> What are the characteristics of a theory which scientists value and which guide them in their choice to adopt one theory or another? In other words, what are the virtues of a scientific theory? (Schindler 2018, 5)

Explanatory virtues are values which explanations (or potential explanations) exemplify, that lead to those explanations being preferred (or sought) by scientists.

All else equal, we will tend to prefer theories that produce explanations bearing these qualities – there is thus a tight link between **theoretical** and **explanatory** virtues.

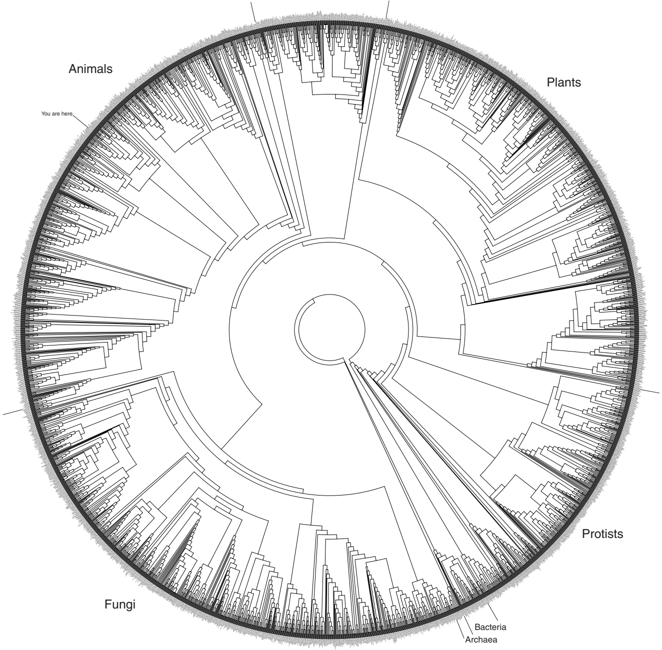
> These five characteristics—accuracy, consistency, scope, simplicity, and fruitfulness—are all standard criteria for evaluating the adequacy of a theory. (Kuhn 1977, p. 322)

A Few Others

- testability
- lack of ad-hoc components
- symmetry
- visualizability
- conservativeness

Patterns of Explanatory Virtue

Integration


Animals
Plants
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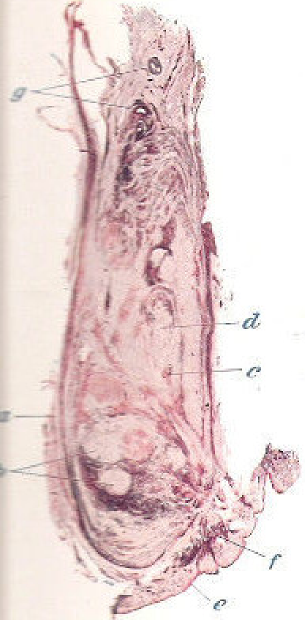
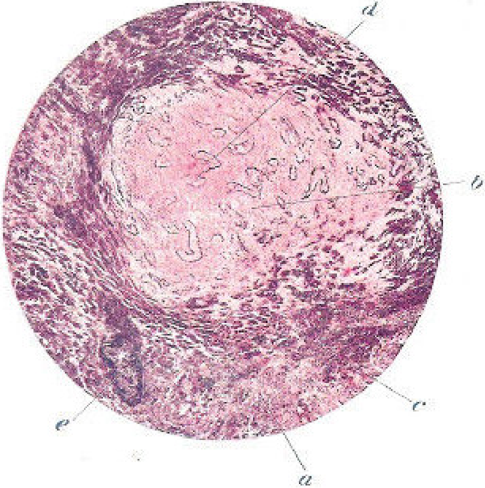
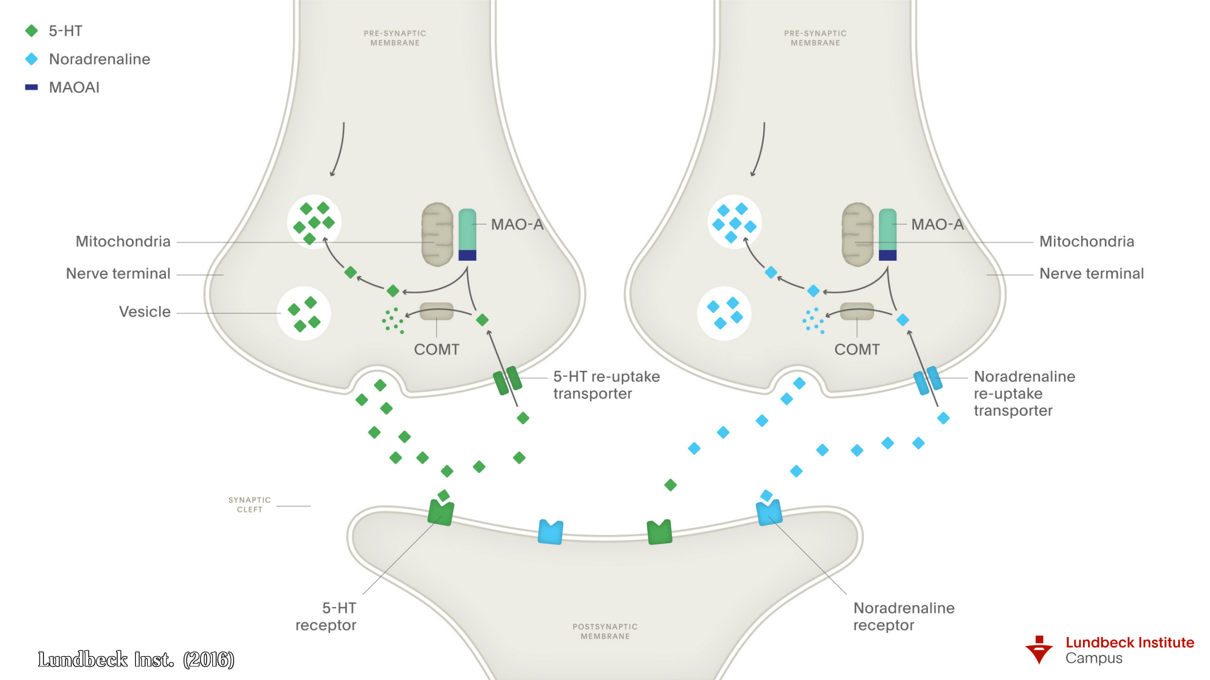
Protists
Fungi
Bacteria
Archaea

Hillis (2003)

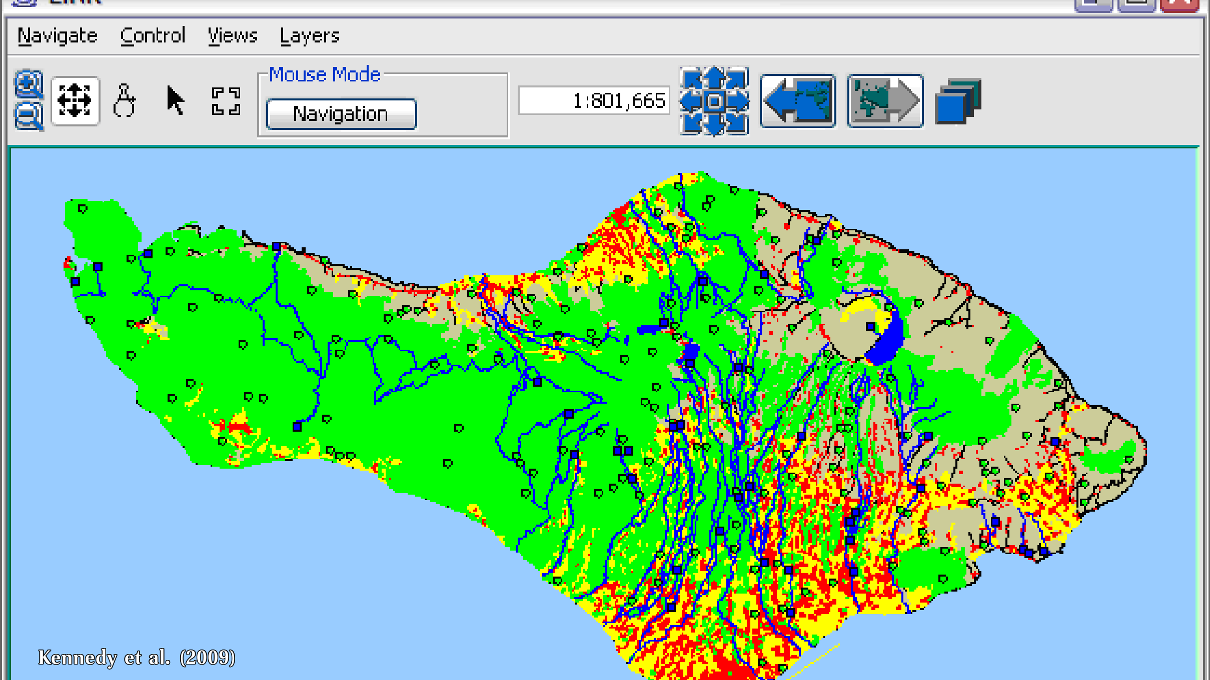




Christeller (1927)



Lundbeck Inst. (2016)


Navigate
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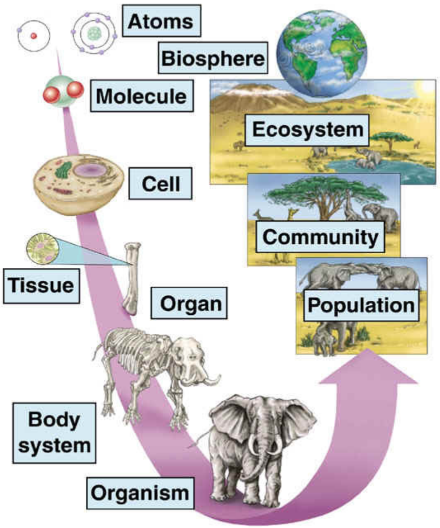
Kennedy et al. (2009)

Raven/Berg, Environment, 3/e
Figure 4.1



Integration

The question of **hierarchical levels of organization** is much disputed in biology; **horizontal integration** across the tree of life is less directly discussed.

What's Different?

The choices made in the search for integration seem to also involve other explanatory virtues. Namely, they are:

1. stringent
2. opportunistic
3. value-laden

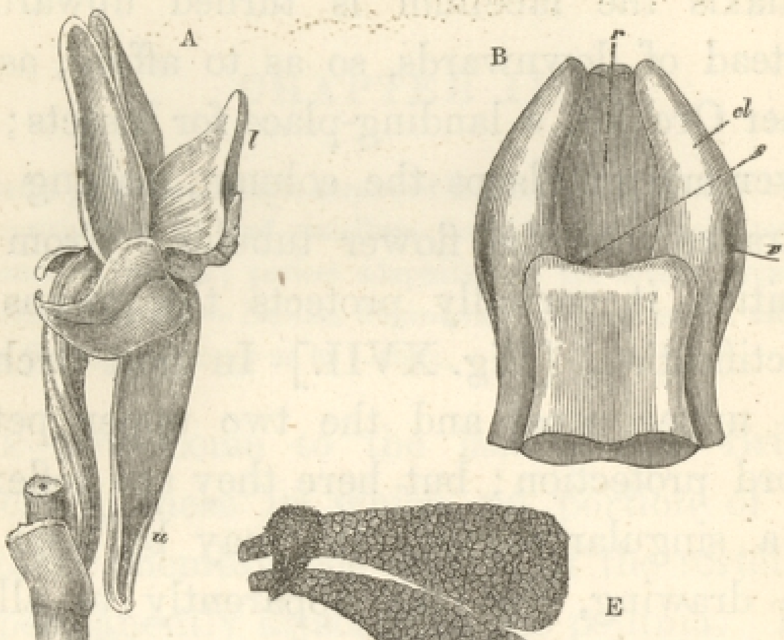
Stringency and Opportunism

Stringency

In pursuing integrative promise, integration is tempered by two factors.

First: the **stringency** of tests required for making the case for integration. Successful integrations are hard to come by, and need to be put to severe test.

Fig. XVII.



Opportunism

Second: these choices have a lot to do with what **other work is already going on** – think of the literature on the use of model organisms – or with particular integrations **between extant bodies of knowledge.**

Eco-Evo-Devo: The Time Has Come

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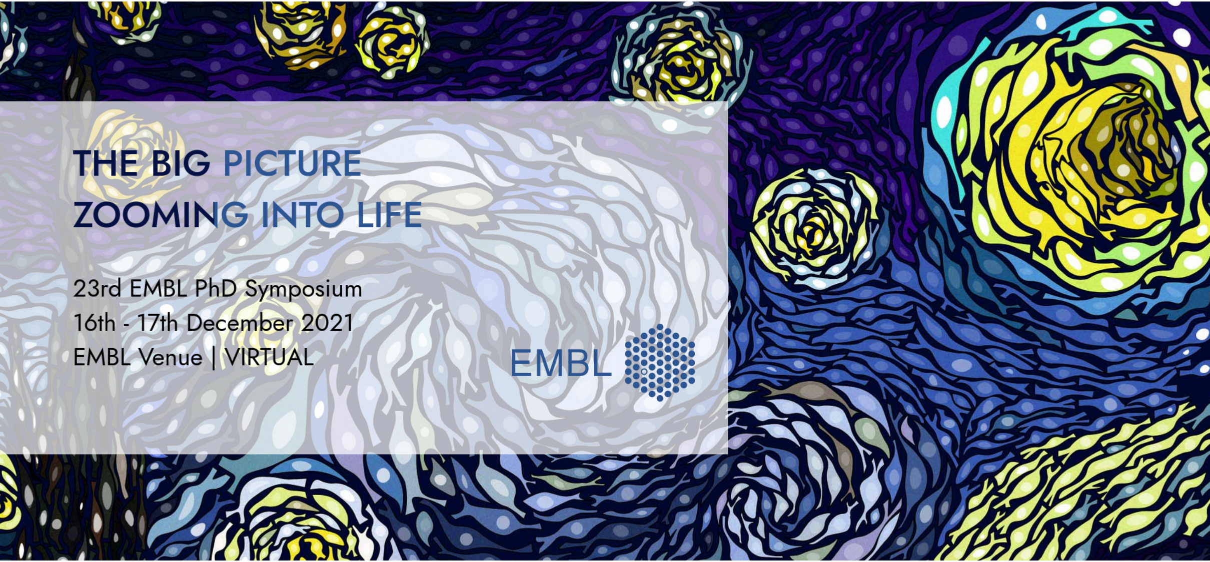
Ehab Abouheif, Marie-Julie Favé, Ana Sofia Ibarrarán-Viniegra, Maryna P. Lesoway, Ab Matteen Rafiqi, and Rajendhran Rajakumar

Abstract

The major goal of ecological evolutionary developmental biology, also known as "eco-evo-devo," is to uncover the rules that underlie the interactions between an organism's environment, genes, and development and to incorporate these rules into evolutionary theory. In this chapter, we discuss some key and emerging concepts within eco-evo-devo. These concepts show that the environment is a source and inducer of genotypic and phenotypic variation at multiple levels of biological organization, while development acts as a regulator that can mask, release, or create

Value-Laden

Perhaps most importantly, these choices seem to reflect **non-epistemic value commitments** – understanding those values can be key for realizing why scientists make the promise-based choices that they do.


THE BIG PICTURE
ZOOMING INTO LIFE
23rd EMBL PhD Symposium
16th - 17th December 2021
EMBL Venue | VIRTUAL
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Each year, the life sciences are becoming more and more interdisciplinary in nature. No better example can be given than the current pandemic, where researchers in different fields have collaborated to bring about a rapid research-driven response against the novel coronavirus. We are dedicated to creating a symposium that brings together researchers who study life sciences at different scales and explore the interdisciplinary approaches utilized to link the different scales of life. (EMBL PhD Symposium: About)

The goal of the book as a whole: this **pattern of invocation of explanatory virtues** – the ways in which **integration**, **stringency**, **opportunism**, and **non-epistemic value commitments** travel together – is a phenomenon important enough to deserve its own name and independent study, which I'm calling **integrative promise**.

commence handwaving

Other Case Studies

1. “Theory-free” biology
2. Big data in the life sciences
3. Model organisms as integrative

conclude handwaving

Some Objections

Is promise just a way of talking about fruitfulness?

Is promise just a way of talking
about generalization or idealization?

Is promise just a pragmatically useful tool for responding to a certain class of critics?

Case Study: Natural History

What Is Natural History?

> For our purposes, *natural history* is the observation and description of the natural world, with the study of organisms and their linkages to the environment being central. (Tewksbury et al. 2014, p. 300)

What Is Natural History?

> At its most stereotyped, natural history has been, and is, strictly phenomenological. This is unexciting but not totally evil. (Bartholomew 1986, p. 326)

What Happened?

> Suddenly, [naturalists] found themselves being told that what they had all along been accustomed to think of as useful and even in some cases valuable scientific work was no longer of very much moment and, worse, ought for preference to be abandoned and a quite different approach adopted in its stead. (Allen 1998, p. 361)

What Happened?

> In contemporary biology, much of the glamour and most of the funding go to research on the lower levels of integration. At these levels active researchers generally agree on the key questions. This consensus is so complete that we see large numbers of highly intelligent investigators with a trasure trove of instrumentation and techniques all concentrating on a few questions. (Bartholomew 1986, p. 328)

Why is this Bad?

> Knowing natural history allows an investigator to phrase questions with precision. It facilitates synthesis from lower to higher levels of integration and can help orient those biological sectors that focus on physiological mechanisms and issues far removed from the organisms they make up. (Bartholomew 1986, p. 328)

Why is this Bad?

> Organisms themselves embody genetics, development, morphology, physiology and behavior, and they are the fundamental components of populations, communities and ecosystems. An understanding of organisms in nature is thus integral to studies at both lower and higher levels in the hierarchy of biological complexity... (Greene 2005, p. 24)

Do We Really Disagree?

> The crux of the natural history tradition is the search for order in nature. The goal of the tradition is, and always has been, to formulate concepts that allow us to perceive order in nature. It is the pursuit of the goal, rather than the tools of employment, that defines the tradition and hence the naturalist. The tools of the naturalist are equations and sequencers, as well as binoculars and notebook. (Arnold 2003, p. 1067)

Do We Really Disagree?

> The dispute among us thus looks to be a red herring, an emotional but largely inconsequential misunderstanding that has perhaps been fueled in part by fuzzy, interchangeable use of the words ‘theory,’ ‘models’ and ‘concept building’ on the one hand and ‘natural history,’ ‘organism-focused’ and ‘empiricism’ on the other. (Greene 2005, p. 25)

What's Left?

> Second, Arnold expressed no concerns for the empirical and educational aspects of natural history *[sensu] stricto*... Futuyma, Dayton and I are particularly concerned that we lack sufficient empirical reference points to move reliably among scales of time, space and biological organization, and that science therefore cannot adequately address environmental dilemmas. (Greene 2005, p. 25)

What's Left?

> The importance of systematics and natural history thus lies in defining the boundaries and contours of organismic diversity.
>
> [...]
>
> It is because of phylogenetic systematics that we can place special value on the coelacanth, the tuatara, and other "living fossils," and that we hypothesize that chimpanzees, not gorillas, are our closest relatives. (Greene and Losos 1988, pp. 458–459)

What's Left

The defense of natural history by Tewksbury et al. (2014) is structured into the following sections:

1. Human health
2. Food security
3. Conservation and management
4. Recreation

And it's summed up in a section titled "Natural history in academia: Connecting science and society."

What's Left?

A **debate about integrative promise.**

What's Left?

A **debate about integrative promise.**

Pitting certain kinds of **non-epistemic values,** on the one hand, against certain kinds of **opportunistic use of tools** (like sequencing and molecular-biology approaches) on the other, in the service of **integrative biological knowledge**.

Questions?

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Integration and Scope

1. It's not the pursuit of **empirical scope,** because we find complex reasons and arguments for scientists' choices.
2. And it's not the pursuit of **unifying power,** because the explanations invoked here are often *radically* disunified.

In short: scientific practice doesn't seem to be directed at scope, in either of its guises.