

Limiting Idealizations in the Inferential Account of the Applicability of Mathematics

Shane Steinert-Threlkeld

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Outline

- 1 The Inferential Account
 - Mapping Accounts
 - Inferential Account as an Extension
- 2 Limiting Idealizations
 - Where Mapping Accounts Fail
 - Batterman's Counterexamples
 - Explanatory Power
- 3 Limiting Idealizations in the Inferential Account
 - Bueno and French
 - My Proposal

Framing the Dialogue

Wigner 1960, “The Unreasonable Effectiveness of Mathematics in the Natural Sciences”

The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning.

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Pincock's Mission

- Theoretical indispensability vs. metaphysical dispensability
- Truth conditions of mixed statements
- Structural mappings, not direct embeddings
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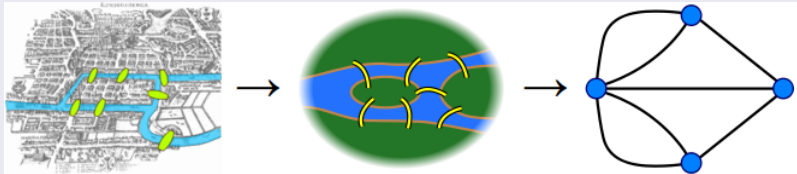
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Seven Bridges of Königsberg

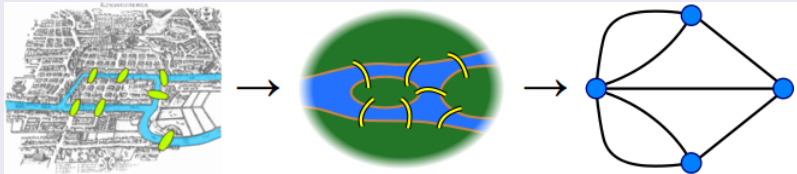
Euler, 1735



- Explanation without nominalistic content or appeal to microphysical structure

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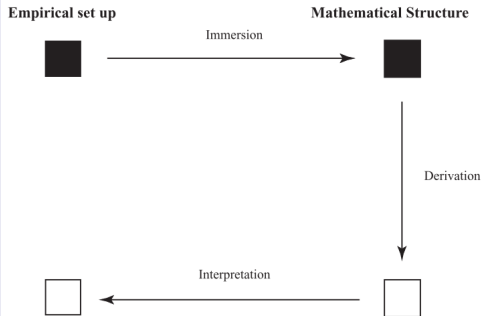
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The Basic Model

- Importance of inferential relations

Bueno and Colyvan, forthcoming



Partial Structures and Partial Homomorphisms

- Allow for information loss, incomplete models
- $\langle D, R_i \rangle_{i \in I}$ as usual, but (n -ary) relations are partial:
 $R_i = \langle R_{i1}, R_{i2}, R_{i3} \rangle, R_{i1} \cup R_{i2} \cup R_{i3} = D^n$
- Examples from economics: fully rational agents and incomplete information
- Unification and explanation

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Failure of Structural Explanations

- Existence of representation does not offer explanatory power

Batterman 2010 "On the explanatory role of mathematics in empirical science"

To put this slightly differently, mapping accounts focus on 'static' relationships between mathematical models and the world. My view is that this misses, in many cases, what is explanatorily relevant about idealizations; namely, that they often involve processes or limiting operations.

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Background

The Inferential Account

Limiting Idealizations

Limiting Idealizations in the Inferential Account

Summary

Where Mapping Accounts Fail

Batterman's Counterexamples

Explanatory Power

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Dripping Water

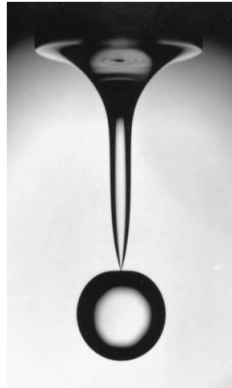


Figure: From 2005 “Critical phenomena and breaking drops: Infinite idealizations in physics”

Thermodynamic Limit

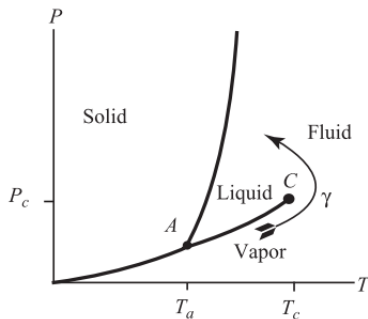


Figure: From 2009 “On the Explanatory Role of Mathematics in Empirical Science”

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Asymptotic Reasoning

- Mathematical operations (such as limit-taking) ineliminable in many explanations
- No appeal to mathematical entities or their properties
- Importance of singularities
- Universality of critical phenomena

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Attempts by Pincock, Bueno, Colyvan, and French

- Pincock: idealizations are representations believed to be false
- Bueno and Colyvan: choice of immersion map depends on context of inquiry
- Bueno and French (unpublished): No adaptation necessary

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Modifying the Inferential Account

- Operations as derivations
- Non-structural mappings
 - Batterman: “And if we describe the drop using continuum hydrodynamics, there are mathematical singularities that develop in finite time, *corresponding to the breaking of the drop.*”
- Is this different? Bueno and Colyvan’s set-theoretic commitments

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Concluding Remarks

- Mistaking the forest for the trees: Pincock vs. Batterman
- Batterman on the direction of influence
- The Embodied Mind View

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The End

Questions?