

Week 10

Global reduction

Oppenheim & Putnam, Wilson, Garfinkel

Slides for the lecture *Philosophy of Science* on 2 December 2014

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Outline

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1 Preview

Preview of this lecture

- The subject is reduction.
- Belief in reduction is old. It often features in semi-scientific, philosophical, and pop cultural discussions.
- We want to see what the positivists had to say, and what their critics replied.
- Along the way we'll be introduced to the subject of explanation.

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Declarations of ontic reduction

Question: What is the fundamental element (substance) in the world?

- Thales: all is water.
- Anaximenes: all is air.
- Pythagoras: all is number.
- Democritus: all is atoms.
- Aristotle: all is four elements (plus one).
- Descartes: all is mind and body.
- Spinoza: all is God.
- Boyle: all is corpuscles.
- Leibniz: all is monads.
- Modern science: all is subatomic particles (or maybe not).

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Declarations of global reduction

Question: What is the fundamental enquiry? Here the situation is historically much more ambiguous:

- Plato: ultimate reality is discovered by philosophy.
- Descartes: material reality is discovered by geometry.
- Boyle: corporeal world is discovered by mechanistic physics.
- Leibniz: reality is discovered by metaphysics and theology.
- The Vienna circle: reality is discovered by physics.
- *Notable dissident: Aristotle.*

Generally, however, only rarely a question arises before the 19th-20th centuries, no doubt because the division of sciences was not much articulated. Although Leibniz, for one, seems to take interest in it.

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2 Unity

Senses of unity

- Often different branches of science are said to have overarching unity.
- Also, some of these branches are said to be reducible to others.
- And sometimes reduction was taken in epistemic sense: All predicates were said to be reduced to (or constructed out of) sensationalist predicates (as in Carnap's *Aufbau*).
- Oppenheim and Putnam distance themselves from these kinds of reduction.
- They examine reduction in the sense of the *unity of language* and the *unity of laws*.

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Unity of language and laws

Unity of language

Science has unity of language if every sentence of every discipline can be paraphrased into a sentence of one unique discipline. For example: Let S to be any sentence of psychology. Then S is true if and only there is a sentence x of physics such that x is true. Oppenheim and Putnam announce that their sense of unity of language is more general. OK, let's see.

Unity of laws

Science has unity of laws if every law of every discipline can be reduced to a law of one unique discipline. What is 'reduced'? We'll see.

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3 Microreduction

Reduction

Definition of reduction

A theory T_2 is reduced to a theory T_1 if and only if the following conditions hold:

1. The vocabulary of T_2 has terms not in the vocabulary of T_1 .
 2. Any observational data of T_2 is *explainable* by T_1 .
 3. The ratio of simplicity and explanatory power of T_1 is at least as great as that of T_2 .
- The reduction of branches of science (disciplines) is done analogously, since they are supposed to consist of theories.
 - Observe that this presupposes the separation between observational and theoretical parts of the theories.

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Microreduction

Definition of microreduction

Assume that each branch has its own domain—the objects it ‘talks about’. A branch B_2 is microreduced to a branch B_1 if and only if the following conditions hold:

1. B_2 is reduced to B_1 .
 2. The objects in the domain of B_1 are proper parts of the objects in the domain of B_2 .
- Microreduction increases the unity of language.
 - It also increases the unity of laws.

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Properties of microreduction

Transitivity: $[B_1 \text{ microreduces } B_2, B_2 \text{ microreduces } B_3] \Rightarrow [B_1 \text{ microreduces } B_3]$.

Irreflexivity: B_i does not microreduce B_i .

Asymmetry: $[B_1 \text{ microreduces } B_2] \Rightarrow [B_2 \text{ does not microreduce } B_1]$.

Exercise

Shew that microreduction indeed has the three properties.

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4 Reductive levels

Reductive levels

- Can we really believe in reducing sociology to physics?
- We have to use the property of transitivity: the reduction will go in stages.
- There will be intermediate stages between sociology and physics.
- The authors call them ‘reductive levels’: see page 409.
- The levels roughly correspond to disciplines: social sciences, evolutionary biology/zoology, molecular biology, chemistry, physical chemistry/thermodynamics, quantum physics.
- (By the way, where is mechanics, for example?)
- Each microlevel is necessary: there is no skipping levels.

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Can unitary science be attained?

- The authors treat microreduction as a working hypothesis.
- As such, it should be evaluated as any other hypothesis.
- Among evaluative criteria we name simplicity, the variety of evidence, and factual support.
- The last two criteria are met (or not met) by the presence of past successes of microreduction.
- In addition, the authors cite pragmatic factors.
- The most interesting among them is ‘Democritean tendency’ (later discussed by Garfinkel).
- Let us look at *simplicity* and the *variety of evidence*.

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Simplicity

- Here the authors reveal their positivist inclinations.
- Who is opposed to microreduction?
- Typically people who have beliefs incompatible with scientific spirit.
- Psychism and vitalism are named.
- We can add: astrology, yoga, all sorts of New Age pseudo-intellectualist views.

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Variety of evidence: past successes

- Economics: study of groups is done in terms of the theory of individual psychology.
- Study of individuals is done in terms of the theory of nervous system.
- The same approach is observed in Marxism and in Weberian sociology, otherwise dissimilar views.

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5 Sociobiological reduction

Wilson's two 'dilemmas'

- Wilson starts from afar, formulating two 'spiritual dilemmas' (though better called simply 'problems') he identifies in human predicament.
- One is that humanity has no final goal, no purpose, beyond a purely biological goal.
- Human brain has evolved to ensure the survival and multiplication of the very genes that created it.
- Traditional religions and secular religions (Marxism) promote fantasies and fairy-tales ungrounded in the biological nature of things.
- Despite their sinister agenda, many of them have been largely discredited. (Well, not enough.)
- Second dilemma: the choice between alternative moral precepts.
- Since morality is rooted in emotional responses (literally so: in 'emotional centers' of the brain), this is the choice between emotional impulses.
- The choice should not be blind, but informed by our biological knowledge.

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Disciplinary interactions

- Study of human nature should absorb biological knowledge.
- That is, social sciences should integrate biology.
- But their interaction will not be easy, as shown by the example of biochemistry and cytology (study of cells).
- At some point in history, biochemistry was an 'antidiscipline' to the discipline of cytology.
- As it studied more basic elements than cells, it regarded cytology as spurious.
- With time, both disciplines converge: biochemistry occupied itself with the study of DNA and proteins, while cytology morphed into molecular biology.
- Observe the crucial role of technology in this transformation.

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Prospects for reduction

- One sense of reduction is in the use of fewer brute facts (as Friedman would put).
- This is the universal principle of scientific method.
- But as for another sense of reduction, Wilson is more circumspect.
- At each level of organisational complexity (from atoms to molecules to cells to organisms) we encounter different laws governing the emergent phenomena.

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6 Critique: reducibility

Garfinkel: The meaning of reducibility

- 'Reducibility' sometimes means that: X s are just Y s.
- On the face of it, this is an ontological claim.
- For example: 'People are just combinations of cells', 'Societies are just people.'
- However, Garfinkel immediately interprets these claims as claims about explanation.
- To reduce X s to Y s is to be able explain the behaviour of X s with the same explanations originally reserved for Y s.

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Remark on ontology and explanation

- Garfinkel's move is far from obvious.
- Why should an ontological claim entail a claim about explanation?
- Is it even clear, at the outset, *what* explanation is?
- Shouldn't it belong with epistemology?
- I can plausibly say: 'I really believe that people consist of atoms, but no one can explain human affairs as motions of atoms.'
- So, someone can be an ontological reductionist, but not an explanation reductionist.
- Nevertheless it is true that if reductionism is a programme in scientific methodology, then (as with Oppenheim and Putnam) ontological reductionism will eventually have to be linked to explanation.

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Objects of reduction

- In Oppenheim and Putnam the objects of reduction are observation sentences (see the condition (2) in page 406 and our slide above).
- But how can we be sure that observation sentences have the same meaning across different reductive levels?
- We cannot, therefore, take sentences as objects of explanations.
- The objects of explanation must be the phenomena themselves.
- A quick fix, perhaps: replace sentences with propositions.
- But if meaning is holistic, then no proposition will be the same in two different theories.
- In any case we can simplify: T_2 is reducible to T_1 if T_1 can explain all the phenomena in the domain of T_2 .
- (Philosophically, this is still sloppy, but let's carry on.)

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Determinism

- Reductionism involves a claim of causal determinism.
- What happens at the lower level causally determines what happens at the upper level.
- In other words: The behaviour of the whole is causally determined by the behaviour of its parts.
- But should it follow that the explanations at the upper level are dispensable?
- Garfinkel claims that they are not dispensable.

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7 Macroexplanation and microexplanation

Foxes and rabbits

- Suppose we have populations of foxes and rabbits in the vicinity.
- Let $X(t)$ be level of fox population at time t .
- Let $Y(t)$ be level of rabbit population at time t .
- Fox population negatively depends on competition among foxes.
- Rabbit population negatively depends on the activity of the predator.
- Then the two populations can dynamically be described thus:

$$\frac{dX}{dt} = aXY - bX$$

$$\frac{dY}{dt} = cY - dXY.$$

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Macroexplanation

- Using this dynamics, we can create various explanations.
- We can explain a microstate by a macrostate: The rabbit Ricky was killed because of the high fox population in the area.
- Or we can explain a macrostate by a macrostate: The rabbit population is falling because of the high level of the fox population in the area.
- These explanations are perfectly acceptable.

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Microexplanation

- But if reductionism goes through, there must be microexplanations available.
- At the microlevel, we'll have a highly complex theory taking into account properties and behaviour of individual rabbits and foxes.
- So we could say: Ricky got eaten under the tree Tr at time t because he got too close to the fox Frankie under the tree Tr at t .
- Can we then discard macroexplanations altogether?
- This depends, above all, on whether they explain the same thing.
- It seems they do not: the macroexplanation explains the 'death of Ricky', but the microexplanation explains the 'death of Ricky at the hands (paws?) of Frankie under Tr at t .'

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Why and how

- Behind this semantic discrepancy lies a more serious problem.
- The microexplanation tells us that if Frankie were not there, then Ricky would have survived. ("If only I were driving slowly, I wouldn't have the accident!")
- But suppose the population of foxes is huge.
- Then presumably if Frankie were not there (too full to move), then Fred would have been there to hunt Ricky.
- So the microexplanation can explain the Frankie-Ricky encounter, but cannot even explain the very specific event of Ricky's death (there, then), let alone the more general event of his death (without the spatial and temporal specifications).
- We can summarise this by saying that the microexplanation delivers the answer to how Ricky died, while the macroexplanation tells us why he died.

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Questions

1. Why should an explanation involve reference to counterfactuals?
2. What is redundant causality?

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8 Causality and understanding

Causality and understanding

- Microexplanations exhibit the causal mechanism responsible for the occurrence of a particular event.
- But if this were all there is to explanations, then, for example, chronicles would offer us the best explanations of historical events.
- But apparently they do not.
- They name sufficient causes, but not (or not always) the necessary causes of events.
- Some of their descriptions will be trivial as explanations (and thus non-explanatory), although rich in detail.

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Local determinism, global structure

- Consider the rabbit-fox example again.
- We have the microexplanatory formula: $X_0 \xrightarrow{V} Y_0$.
- The evolution of rabbit behaviour is microexplained in terms of the evolution of fox behaviour.
- It works well in the conditions of stability.
- It will fail, however, to explain the sudden changes in Y_0 .
- That is, the smooth transitions can all be microexplained.
- But the sudden instabilities are ‘structural’ in origin: they have to be macroexplained.

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Instability

Traffic lights

Suppose the car is stopped at the red lights. The lights change, the car begins to move. How to picture it from the perspective of a *purely* physical system? A negligible change in energy distribution led to a massive change in mass and energy distribution. This anomaly must be explained at an upper level. Therefore, the lower level will never be able to fulfil all the purposes of explanation.

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Quiz 2

Garfinkel claims: ‘In many cases, the micorlevel is inadequate, and we must construct upper-level explanations.’ Why?

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