

Scientific Explanation

University of Rochester, Fall 2007

Course Details

Code: PHL552: Selected Topics in History and Philosophy of Science
Location: 531 Lattimore Hall
Dates: 4 September to 11 December.
Times: Tuesdays, 2:00pm to 4:40pm.
Final Due: Tuesday 18 December.
URI: <http://mail.rochester.edu/~bweslake/teaching/explanation/>

Instructor

Brad Weslake
519 Lattimore Hall
bradley.weslake@rochester.edu
<http://mail.rochester.edu/~bweslake/>
Office hours: Mondays 2:30pm to 4:30pm.

Prerequisites

I will assume that students have taken a general course in philosophy of science. Some knowledge of the basic debates concerning causation, laws, and probability would be useful but not required.

Assessment

Requirements:

- Weekly papers 2-3 pages in length focussing on exposition of the primary readings. To be sent by email by 5:00pm Monday each week. Two may be missed without losing marks.
- A 30-40 minute presentation of a paper in progress, followed by discussion.
- A 12-20 page final paper incorporating feedback from the presentation discussion.

The final grade will be determined as follows:

Weekly Papers:	15%
Presentation:	15%
Final Paper:	70%

Textbooks

Salmon (1989a), Woodward (2003a). All readings that are not available in electronic format will be distributed in class.

Overview

The aim of this seminar is both to introduce the essential background to contemporary debates on explanation, and to engage with some of these debates as they are playing out right now. We will survey accounts of scientific explanation from the logical positivists to the present, focussing on three interrelated themes:

- The role of laws in explanation;
- Explanation in the special sciences;
- Explanatory asymmetries.

The seminar will be divided roughly into two parts. The first part will be a selective survey of the classical views in the literature, including the deductive-nomological view of explanation articulated by the positivists, probabilistic and causal theories of explanation, and unificationist and pragmatic theories of explanation. The survey will be selective insofar as I will be emphasising advantages and disadvantages of these accounts with respect to the three themes above.

The second part will be an introduction to the interventionist theory of explanation in the form advocated by James Woodward (2003a). This will include an examination of the recent (and some forthcoming) critical discussion surrounding Woodward's book, and an exploration of applications of the interventionist view to the special sciences.

Schedule

Primary readings are compulsory, and are to form the basis for the weekly papers and discussion. I will provide photocopies of any of these that are not available online. **Secondary** readings contain further developments of the theme of the week, and are provided as signposts to the literature in order to assist research for the final paper. Some weeks I may choose to present a summary of the secondary readings before we discuss the primary readings. *Note:* The accuracy of this schedule may well decrease exponentially with time. An up to date version will always be available here: <http://mail.rochester.edu/~bweslake/teaching/explanation/syllabus.pdf>.

TUESDAY 4 SEPTEMBER

Background

Primary: Salmon (1989a, "Introduction").

Secondary: Woodward (2003b), Strevens (2005).

THURSDAY 11 SEPTEMBER

The DN Account and the Standard Counterexamples

Primary: Hempel and Oppenheim (1948), Salmon (1989a, §1.0–§1.2 and §2.0–§2.3).

Secondary: Woodward (2003b, §1–§2.5). *Technical Issues:* Eberle, Kaplan, and Montague (1961), Kaplan (1961), Kim (1963). *A Linguistic Turn for the Worse:* Bromberger (1966), Teller (1974).

TUESDAY 18 SEPTEMBER

Laws, Prediction, and Explanation I: The Symmetry Requirement

Primary: Hempel (1959), Scriven (1959), Salmon (1989a, §1.3).

Secondary: Scheffler (1957).

TUESDAY 25 SEPTEMBER

Laws, Prediction, and Explanation II: The Nomothetic Requirement

Primary: Scriven (1962, especially §4.1), Woodward (2003a, Chapter 4).

Secondary: Davidson (1967), Mitchell (1997), Woodward (2000).

TUESDAY 2 OCTOBER

From DN to Statistical Explanation I: DS and IS Explanation

Primary: Hempel (1965a, §3), Salmon (1989a, §2.4–§2.5).

TUESDAY 9 OCTOBER

From DN to Statistical Explanation II: The Inferential Requirement

Primary: Jeffrey (1969), Coffa (1974), Salmon (1989a, §3.0–§3.6).

Secondary: *The Nomothetic Requirement Revisited:* Railton (1981).

TUESDAY 16 OCTOBER

From DN to Statistical Explanation III: The Statistical Relevance Account

Primary: Salmon (1970), Salmon (1971), Woodward (2003b, §3).

Secondary: Cartwright (1979), Strevens (2000).

TUESDAY 23 OCTOBER

Post-DN Explanation I: Causal Theories of Explanation.

Primary: Lewis (1986), Hitchcock (1995), Woodward (2003b, §4).

Secondary: Woodward (1989).

TUESDAY 30 OCTOBER

Excursus: Non-Causal Explanations in Physics

Primary: Sober (1983), Lange (2007).

Secondary: Nickel (2007).

TUESDAY 6 NOVEMBER

Post-DN Explanation II: Unificationist Theories of Explanation.

Primary: Friedman (1974), Kitcher (1981), Kitcher (1989), Woodward (2003b, §5).

Secondary: Strevens (2004).

TUESDAY 13 NOVEMBER

Post-DN Explanation III: Pragmatic Theories of Explanation.

Primary: van Fraassen (1980), Kitcher and Salmon (1987).

Secondary: Bromberger (1965), Achinstein (1984).

TUESDAY 20 NOVEMBER

Interventionism I: A Counterfactual Theory

Primary: Woodward (2003a, Chapters 5 and 8).

Secondary: Woodward and Hitchcock (2003a).

Thanksgiving Break

TUESDAY 27 NOVEMBER

Interventionism II: Invariance

Primary: Woodward (2003a, Chapter 6).

Secondary: Woodward and Hitchcock (2003b).

TUESDAY 4 DECEMBER

Interventionism III: Criticisms and Alternatives

Primary: Strevens (2007), Psillos (2007), Jackson and Pettit (1992).

Secondary: Woodward, Humphreys, and Sober (2006).

TUESDAY 11 DECEMBER

Interventionism IV: Applications

Primary: Campbell (2006), Steel (2006).

Secondary: Woodward (2006). *Biology:* Sterelny and Kitcher (1988), Sober (1990), Kitcher, Sterelny, and Waters (1990), Sterelny (1996), Reisman and Forber (2005).

References

- Achinstein, Peter. 1984. "The Pragmatic Character of Explanation", in *Proceedings of the Biennial Meeting of the Philosophy of Science Association*, Vol. 2, pp. 275–292.
- Bromberger, Sylvain. 1965. "An Approach to Explanation", in R. J. Butler (Ed.), *Analytical Philosophy*, 2nd edition, Oxford University Press, Oxford, pp. 72–105. Reprinted in Bromberger (1992, pp. 18–51). URL: http://socrates.berkeley.edu/~fitelson/290/bromberger_2.pdf.
- . 1966. "Why-Questions", in Robert G. Colodny (Ed.), *Mind and Cosmos: Essays in Contemporary Science and Philosophy*, University of Pittsburgh Series in the Philosophy of Science, Volume 3, University of Pittsburgh Press, Pittsburgh, pp. 86–111. Reprinted in Bromberger (1992, pp. 75–100). URL: <http://socrates.berkeley.edu/~fitelson/290/bromberger.pdf>.
- . 1992. *On What We Know and What We Don't Know: Explanation, Theory, Linguistics, and How Questions Shape Them*, University of Chicago Press, Chicago. URL: <http://cslipublications.stanford.edu/bromberger-corpus/On-What-We-Know-We-Dont-Know.pdf>.
- Campbell, John. 2006. "An Interventionist Approach to Causation in Psychology", in Alison Gopnik and Laura Schulz (Ed.), *Causal Learning: Psychology*,

Philosophy, Computation, Oxford University Press, New York. URL: <http://philosophy.berkeley.edu/file/59/Causation.pdf>.

- Cartwright, Nancy. 1979. "Causal Laws and Effective Strategies", in *Noûs*, Vol. 13, No. 4, November 1979, pp. 419–437.
- Coffa, J. Alberto. 1974. "Hempel's Ambiguity", in *Synthese*, Vol. 28, No. 2, October 1974, pp. 141–163. URL: <http://dx.doi.org/10.1007/BF00485232>.
- Colodny, Robert Garland, and Grover Maxwell. 1970. *The Nature and Function of Scientific Theories: Essays in Contemporary Science and Philosophy*, University of Pittsburgh Series in the Philosophy of Science, University of Pittsburgh Press, Pittsburgh.
- Davidson, Donald. 1967. "Causal Relations", in *The Journal of Philosophy*, Vol. 64, No. 21, November 1967, pp. 691–703. Reprinted in Davidson (2001, pp. 149–162).
- . 2001. *Essays on Actions and Events*, 2nd edition, Oxford University Press, Oxford. URL: <http://dx.doi.org/10.1093/0199246270.001.0001>.
- Eberle, Rolf, David Kaplan, and Richard Montague. 1961. "Hempel and Oppenheim on Explanation", in *Philosophy of Science*, Vol. 28, No. 4, October 1961, pp. 418–428.
- Friedman, Michael. 1974. "Explanation and Scientific Understanding", in *Journal of Philosophy*, Vol. 71, No. 1, January 1974, pp. 5–19.
- Hempel, Carl Gustav. 1959. "The Logic of Functional Analysis", in Llewellyn Gross (Ed.), *Symposium on Sociological Theory*, Harper, Row, New York, pp. 271–287. Reprinted with revisions in Hempel (1965b, pp. 297–330).
- . 1965a. "Aspects of Scientific Explanation", in Hempel (1965b), pp. 331–496.
- . 1965b. *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*, Free Press, New York.
- Hempel, Carl Gustav, and Paul Oppenheim. 1948. "Studies in the Logic of Explanation", in *Philosophy of Science*, Vol. 15, No. 2, April 1948, pp. 135–175.
- Hitchcock, Christopher. 1995. "Discussion: Salmon on Explanatory Relevance", in *Philosophy of Science*, Vol. 62, No. 2, June 1995, pp. 304–320.
- Jackson, Frank, and Philip Pettit. 1992. "In Defense of Explanatory Ecumenism", in *Economics and Philosophy*, Vol. 8, No. 1, pp. 1–21. Reprinted in Jackson, Pettit, and Smith (2004, pp. 163–186).
- Jackson, Frank, Philip Pettit, and Michael Smith. 2004. *Mind, Morality, and Explanation: Selected Collaborations*, Oxford University Press, Oxford.

- Jeffrey, Richard C. 1969. "Statistical Explanation vs. Statistical Inference", in Nicholas Rescher (Ed.), *Essays in Honor of Carl G. Hempel*, Reidel, Dordrecht, pp. 104–113. Reprinted in Salmon, Jeffrey, and Greeno (1971, pp. 19–28).
- Kaplan, David. 1961. "Explanation Revisited", in *Philosophy of Science*, Vol. 28, No. 4, October 1961, pp. 429–436.
- Kim, Jaegwon. 1963. "On the Logical Conditions of Deductive Explanation", in *Philosophy of Science*, Vol. 30, No. 3, July 1963, pp. 286–291.
- Kitcher, Philip. 1981. "Explanatory Unification", in *Philosophy of Science*, Vol. 48, No. 4, December 1981, pp. 507–531.
- . 1989. "Explanatory Unification and the Causal Structure of the World", in Kitcher and Salmon (1989), pp. 410–505.
- Kitcher, Philip, and Wesley Salmon. 1987. "Van Fraassen on Explanation", in *The Journal of Philosophy*, Vol. 84, No. 6, June 1987, pp. 315–330.
- . 1989. *Scientific Explanation*, Volume 13, Minnesota Studies in the Philosophy of Science, University of Minnesota Press, Minneapolis.
- Kitcher, Philip, Kim Sterelny, and C. Kenneth Waters. 1990. "The Illusory Riches of Sober's Monism", in *The Journal of Philosophy*, Vol. 87, No. 3, March 1990, pp. 158–161.
- Lange, Marc. 2007. "Dimensional Explanations". Unpublished manuscript. 2007.
- Lewis, David. 1986. "Causal Explanation", in *Philosophical Papers*, Volume II, Oxford University Press, Oxford, pp. 214–240. URL: <http://dx.doi.org/10.1093/0195036468.003.0007>.
- Mitchell, Sandra D. 1997. "Pragmatic Laws", in *Philosophy of Science*, Vol. 64, Supplement, 1997, pp. S468–S479.
- Nickel, Bernhard. 2007. "How General Do Theories Of Explanation Need To Be?". 2007. URL: <http://www.people.fas.harvard.edu/~bnickel/papers/explanation.pdf>.
- Pitt, Joseph. 1988. *Theories of Explanation*, Oxford University Press, Oxford.
- Psillos, Stathis. 2007. "Causal Explanation and Manipulation", in Johannes Persson and Petri Ylikoski (Ed.), *Rethinking Explanation*, Volume 252, Springer, Dordrecht, pp. 93–107. URL: http://dx.doi.org/10.1007/978-1-4020-5581-2_6.
- Railton, Peter. 1981. "Probability, Explanation, and Information", in *Synthese*, Vol. 48, No. 2, August 1981, pp. 233–256.

- Reisman, Kenneth, and Patrick Forber. 2005. "Manipulation and the Causes of Evolution", in *Philosophy of Science*, Vol. 72, No. 5, December 2005, pp. 1113–1123. URL: <http://dx.doi.org/10.1086/508120>.
- Salmon, Wesley C. 1970. "Statistical Explanation", in Colodny and Maxwell (1970), pp. 173–231. Reprinted in Salmon, Jeffrey, and Greeno (1971, pp. 29–87), Pitt (1988, pp. 75–119). URL: http://socrates.berkeley.edu/~fitelson/290/salmon_sec.pdf.
- . 1971. "Introduction", in Salmon, Jeffrey, and Greeno (1971), pp. 3–17.
- . 1989a. "Four Decades of Scientific Explanation", in Kitcher and Salmon (1989a), pp. 3–219. Reprinted as Salmon (1989b) and Salmon (2006a).
- . 1989b. *Four Decades of Scientific Explanation*, University of Minnesota Press, Minneapolis.
- . 2006. *Four Decades of Scientific Explanation*, University of Pittsburgh Press, Pittsburgh.
- Salmon, Wesley C., Richard C. Jeffrey, and James G. Greeno. 1971. *Statistical Explanation and Statistical Relevance*, University of Pittsburgh Press, Pittsburgh.
- Scheffler, Israel. 1957. "Explanation, Prediction, and Abstraction", in *The British Journal for the Philosophy of Science*, Vol. 7, No. 28, February 1957, pp. 293–309.
- Scriven, Michael. 1959. "Explanation and Prediction in Evolutionary Theory: Satisfactory Explanation of the Past is Possible Even When Prediction of the Future is Impossible", in *Science*, Vol. 130, No. 3374, 28 August, 1959, pp. 477–482. URL: <http://dx.doi.org/10.1126/science.130.3374.477>.
- . 1962. "Explanations, Predictions, and Laws", in Herbert Feigl and Grover Maxwell (Ed.), *Scientific Explanation, Space, and Time*, Minnesota Studies in the Philosophy of Science, Volume 3, University of Minnesota Press, Minneapolis, pp. 170–230. URL: <http://socrates.berkeley.edu/~fitelson/290/scriven.pdf>.
- Sober, Elliott. 1983. "Equilibrium Explanation", in *Philosophical Studies*, Vol. 43, No. 2, March 1983, pp. 201–210. URL: <http://dx.doi.org/10.1007/BF00372383>.
- . 1990. "The Poverty of Pluralism: A Reply to Sterelny and Kitcher", in *The Journal of Philosophy*, Vol. 87, No. 3, March 1990, pp. 151–158.
- Steel, Daniel. 2006. "Methodological Individualism, Explanation, and Invariance", in *Philosophy of the Social Sciences*, Vol. 36, No. 4, December 2006, pp. 440–463. URL: <http://dx.doi.org/10.1177/0048393106293455>.

- Sterelny, Kim. 1996. “Explanatory Pluralism in Evolutionary Biology”, in *Biology and Philosophy*, Vol. 11, No. 2, April 1996, pp. 193–214. Reprinted in Sterelny (2001, pp. 129–151). URL: <http://dx.doi.org/10.1007/BF00128919>.
- . 2001. *The Evolution of Agency and Other Essays*, Cambridge University Press, Cambridge.
- Sterelny, Kim, and Philip Kitcher. 1988. “The Return of the Gene”, in *The Journal of Philosophy*, Vol. 85, No. 7, July 1988, pp. 339–361. Reprinted in Sterelny (2001, pp. 29–52).
- Strevens, Michael. 2000. “Do Large Probabilities Explain Better?”, in *Philosophy of Science*, Vol. 67, No. 3, September 2000, pp. 366–390.
- . 2004. “The Causal and Unification Approaches to Explanation Unified—Causally”, in *Noûs*, Vol. 38, No. 1, March 2004, pp. 154–176. URL: <http://dx.doi.org/10.1111/j.1468-0068.2004.00466.x>.
- . 2005. “Scientific Explanation”, in Donald M. Borchert (Ed.), *Encyclopedia of Philosophy*, 2nd edition, Macmillan, London. URL: <http://www.strevens.org/research/simplexuality/Expln.pdf>.
- . 2007. “Review of Woodward, *Making Things Happen*”, in *Philosophy and Phenomenological Research*, Vol. 74, No. 1, January 2007, pp. 233–249. URL: <http://dx.doi.org/10.1111/j.1933-1592.2007.00012.x>.
- Teller, Paul. 1974. “On Why-Questions”, in *Noûs*, Vol. 8, No. 4, November 1974, pp. 371–380.
- Van Fraassen, Bas C. 1980. “The Pragmatics of Explanation”, in *The Scientific Image*, Clarendon Press, Oxford, pp. 97–157. URL: http://socrates.berkeley.edu/~fitelson/290/vanfraassen_pte.pdf.
- Woodward, James. 1989. “The Causal Mechanical Model of Explanation”, in Kitcher and Salmon (1989), pp. 357–383.
- . 2000. “Explanation and Invariance in the Special Sciences”, in *The British Journal for the Philosophy of Science*, Vol. 51, No. 2, pp. 197–254. URL: <http://dx.doi.org/10.1093/bjps/51.2.197>.
- . 2003a. *Making Things Happen: A Theory of Causal Explanation*, Oxford University Press, New York. URL: <http://dx.doi.org/10.1093/0195155270.001.0001>.
- . 2003b. “Scientific Explanation”, in Edward N. Zalta (Ed.), *Stanford Encyclopedia of Philosophy*, Stanford University, Stanford. URL: <http://plato.stanford.edu/entries/scientific-explanation/>.

- Woodward, James. 2006. "Sensitive and Insensitive Causation", in *The Philosophical Review*, Vol. 115, No. 1, January 2006, pp. 1–50. URL: <http://dx.doi.org/10.1215/00318108-115-1-1>.
- Woodward, James, and Christopher Hitchcock. 2003a. "Explanatory Generalizations, Part I: A Counterfactual Account", in *Noûs*, Vol. 37, No. 1, March 2003, pp. 1–24. URL: <http://dx.doi.org/10.1111/1468-0068.00426>.
- . 2003b. "Explanatory Generalizations, Part II: Plumbing Explanatory Depth", in *Noûs*, Vol. 37, No. 2, June 2003, pp. 181–199. URL: <http://dx.doi.org/10.1111/1468-0068.00435>.
- Woodward, James, Paul Humphreys, and Elliott Sober. 2006. "Review Symposium: Invariance, Explanation, and Understanding", in *Metascience*, Vol. 15, No. 1, March 2006, pp. 39–66. URL: <http://dx.doi.org/10.1007/s11016-006-0001-6>.

Scientific explanations can be contrasted to other, nonscientific types of explanation (Babbie 1989; Kerlinger 1973; Cohen and Nagel 1934). Some explanations obtain their validity because they are offered by someone in authority, for example, a police officer, the president, or parents. Validity also may rest on tradition. For instance, the correct way to do a folk dance is the way it has always been danced, handed down over the generations. An explanation is a set of statements usually constructed to describe a set of facts which clarifies the causes, context, and consequences of those facts. This description may establish rules or laws, and may clarify the existing rules or laws in relation to any objects, or phenomena examined. Explanation, in philosophy, is a set of statements that makes intelligible the existence or occurrence of an object, event, or state of affairs. Among the most common forms of explanation are causal explanation and Scientific Explanation. The Structure of Explanations. Next, we consider the basic structure of the most comprehensive and effective deployment of inductive reasoning in human history. Since its development during the Renaissance, modern science has contributed significantly to our ability to perceive, understand, and manipulate the natural world. The most productive model for the structure of a scientific explanation is that of a valid deductive argument whose conclusion is the event to be explained. When beginning work on scientific explanations early in the school year, middle school teachers may model the development of a scientific explanation for students. As students begin to work on developing their own scientific explanations, it is helpful to have students work together in collaborative groups and to critique one another's explanations. One strategy that may prove helpful in critiquing explanations is Praise, Question, Polish. In this strategy, students comment on something they like and ask a question. Scientific explanations can be contrasted to other, nonscientific types of explanation (Babbie 1989; Kerlinger 1973; Cohen and Nagel 1934). Some explanations obtain their validity because they are offered by someone in authority, for example, a police officer, the president, or parents. Validity also may rest on tradition. For instance, the correct way to do a folk dance is the way it has always been danced, handed down over the generations.