CAUSALITY: FROM HUME, VIA SCHLICK TO LEWIS*

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Hume

There are two modes of reasoning: reasoning a priori and causal reasoning.

'All the objects of human reason or enquiry may naturally be divided into two kinds, to wit, *Relations of Ideas*, and *Matters of Fact.*' (Enquiry, p. 14/sec. IV)

'All reasoning concerning matter of fact seem to be founded on the relation of *Cause and Effect.*' (p. 15/sec. IV)

'the knowledge of this relation is not, in any instance, attained by reasoning *a priori*; but arises entirely from experience, when we find that any particular objects are constantly conjoined with each other.' (ibid)

Kant

Causality is neither the form of empirical judgments nor are causal statements a posteriori at all.

There are two forms of causal laws:
(1) the general law that every event B has a cause A and
(2) special laws (e. g. laws of nature), telling that every event of type B is caused by an event of type A.

Both are statements of an aprioristic kind (synthetic judgments a priori).

☞ According to Hume causal statements are empirical statements, according to Kant they are synthetic judgments a priori.

Russell

'The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm.' (On the Notion of Cause, p. 180)

'the uniformity of nature is not known *a priori*, but is an empirical generalisation, like "all men are mortal." ' (p. 197)

Schlick 1[a]

'if we [...] contemplate any given volume of space bounded by a closed surface, and inquire into the causes of what goes on within it, we no longer require to take into account all the processes situated outside [...]; if the "initial conditions" and "boundary conditions" are given, everything that occurs in the area under consideration is univocally determined and calculable by means of the differential equations of physics.' (Schlick 1920, p. 462/297)

'the principle that the micro-laws, in conjunction with the initial and boundary conditions, determine univocally the course of all processes in the bounded region, is identical with the causal principle.' (p. 462/298)

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[a]Cf. Moritz Schlick, 'Naturphilosophische Betrachtungen über das Kausalprinzip', in: *Die Naturwissenschaften* 8, 461-474, 1920.

☞ Schlick 1 is a rather **strong conception of causality**, based on Einstein's theory of relativity.

☞ Unfortunately, this strong conception is incompatible with the fundamental principles of **quantum mechanics**, especially with Heisenberg's uncertainty principle.

☞ In consequence of this argument, Schlick rejected his first theory and formulated a **weaker conception of causality** (Schlick 2).

Schlick 2[a] / Hong Qian[b]

'*every* ordering of events in the temporal direction, of whatever kind it may be, is to be viewed as a causal relation. Only complete chaos, an utter lawlessness, could be described as non-causal occurrence, as pure chance; every trace of order would already signify dependence, and hence causality.' (Schlick 1931, p. 146/179)

'the true criterion of regularity, the essential mark of causality, is the *fulfilment of predictions*.' (Schlick 1931, p. 150/185)

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[a]Cf. Moritz Schlick, 'Die Kausalität in der gegenwärtigen Physik', in: *Die Naturwissenschaften* 19, 145-162, 1931.

[b]Cf. Hong Quian's PhD thesis 'Das Kausalproblem in der heutigen Physik', University of Vienna, 1934.

☞ For Schlick, causality and determinism are practically equivalent.

☞ According to **Schlick 1** *determinism* is the idea that *everything* that happens in the physical world can be described via differential equations.

☞ According to **Schlick 2** *indeterminism* is the idea that *everything* that happens in the physical world happens without regularity of whatever kind; determinism (very roughly) is not much more than the idea that indeterminism is false.

What is causality?

Hume: the form of empirical statements — causal knowledge is empirical knowledge about empirical regularities

Kant: a synthetic judgment a priori — causal knowledge is knowledge a priori about empirical regularities

Russell: an empirical generalisation — the existence of empirical regularities is an empirical hypotheses in itself

Schlick 1: the sort of empirical regularities which are described by the differential equations of physics

Schlick 2 / Hong Qian: the existence of empirical regularities in nature. (and this, of course, is a position, very close to Hume's point of view)

How can we describe / formalize the notion of empirical regularity / determinism / causality?

Remember Schlick's definition for empirical regularity:

'the true criterion of regularity, the essential mark of causality, is the *fulfilment of predictions*.'

But what is prediction, seen from a more formal point of view?

☞ **Prediction establishes a formal connection between classes of events.**

This reminds us of Hume's classic approach to causality:

Hume's definitions

'we may define a cause to be *an object, followed by another, and where all the objects similar to the first are followed by objects similar to the second.* Or in other words *where, if the first object had not been, the second never had existed.*' (Enquiry, p. 48f/sec. VII)

From Hume, via Schlick to C. I. and David Lewis

The proper formalism for causality (P is the cause of Q) are not differential equations à la Schlick 1 but a modal logic approach in the sense of

- C. I. Lewis' strict implication (Hume 1):

In every possible world similar to the actual $P \rightarrow Q$ is the case.

- or David Lewis' 'counterfactual' definition (Hume 2):

either (1) there is no possible P-world or (2) some P-world where Q holds is closer to the actual than is any P-world where Q does not hold. (cf. Lewis, Causation, p. 164)