Causal Inference in Quantum Mechanics: A Reassessment

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Abstract

There has been an intense discussion, albeit largely an implicit one, concerning the inference of causal hypotheses from statistical correlations in quantum mechanics ever since John Bell ' s first statement of his notorious theorem in 1966. As is well known, its focus has mainly been the so-called Einstein-Podolsky-Rosen (" EPR ") thought experiment, and the ensuing observed correlations in real EPR like experiments. But although implicitly the discussion goes as far back as Bell ' s work, it is only in the last two decades that it has become recognizably and explicitly a debate about causal inference in the quantum realm. The bulk of this paper is devoted to a review of three influential arguments in the philosophical literature that aim to show that causal models for the EPR correlations are impossible, due to Bas Van Fraassen, Daniel Hausman and Huw Price. I contend that all these arguments are inconclusive since they contain premises or presuppositions that are false, unwarranted, or at least controversial. Five different common cause models are outlined that seem perfectly viable for the EPR correlations. These models are then employed to illustrate various difficulties with the premises and presuppositions underlying Van Fraassen ' s, Hausman ' s and Price ' s arguments. In all these cases it is argued that the difficulties cut deep against these authors ' own theories of causation and causal inference. My conclusions are that causal models for the EPR correlations remain viable, that philosophical work is still required to assess their relative virtues, and that in any case the mere theoretical conceivability and empirical possibility of these models sheds doubts over Van Fraassen ' s, Hausman ' s and (important elements in) Price ' s theories of causation and causal inference.

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