Review of: "Bell's theorem is an exercise in the statistical theory of causality"

T.N. Palmer[1]

1 University of Oxford

Potential competing interests: No potential competing interests to declare.

Richard Gill uses causal inference modelling to derive Bell's inequality. However, there is a problem with this approach, right from the get-go. Causal inference theory is based on the notion that one can apply small counterfactual interventions to space-time without restriction. These interventions allow you to infer what would have happened had something been different in space-time. We use these interventions all the time in classical physics, and with great success. However, can we be sure that, in a quantum context, these interventions are consistent with the laws of quantum physics? In https://arxiv.org/abs/2308.11262 (Superdeterminism Without Conspiracy) I develop a model, based in part of the geometry of fractal attractors and in part on a discretisation of complex Hilbert Space, where the interventions needed to apply causal inference models to Bell's inequality would indeed violate the laws of quantum physics. In particular, critical interventions needed to derive Bell's inequality take a state of the world off the invariant set, and hence to a state that is undefined. These violations vanish under any coarse-graining of the invariant set, and hence do not apply to classical approximations of the model.

Understanding the experimental violation of Bells' inequality is important, so Gill's paper is welcome. However, his paper implicitly assumes things that should not be assumed. In my view, the violation of Bell's inequality has nothing to do with physics being indeterministic or nonlocal, or states somehow being unreal. It has ultimately to do with the notion that the laws of physics are more holistic that we currently assume (a fractal attractor is a holistic concept). Certainly conventional classical hidden-variable models have none of this holism and are therefore completely unsuitable for describing the violation of Bell's inequality. I think these matters will be especially important when attacking the problem of quantum gravity - general relativity being a deterministic, nonlinear geometric, locally causal theory.

I recommend that Richard Gill revises his paper making explicit his assumption that causal interventions - needed to apply causal inference models in the first place - are consistent with the laws of physics.