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Logical difficulty from combining counterfactuals in the GHZ-Bell theorems LOUIS SICA, Chapman University, Orange, CA — Since it depends on predictions of single sets of measurements on three particles, the Greenberger, Horne, Zeilinger (GHZ) theorem eliminates the sampling loophole encountered by the Bell theorem that requires a large number of observations to obtain a relatively small number of useful joint measurements. In evading this problem, the GHZ theorem is believed to have confirmed Bell's historic conclusion that local hidden variables are inconsistent with the results of quantum mechanics. The GHZ theorem depends on predicting the results of sets of measurements of which only one may be performed, i.e., counterfactuals. In the present paper, the non-commutative aspects of these unperformed measurement sequences are critically examined. Three classical examples and the logic of the GHZ construction are analyzed to demonstrate that combined counterfactual results of non-commuting operations may be logically absurd, and in general are logically inconsistent with performed measurement sequences that take non-commutation into account. The Bell theorem is also revisited in the light of this result. It is concluded that negative conclusions regarding local hidden variables do not follow from the GHZ and Bell theorems as historically reasoned.

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