Comment on "Curious Properties of Quantum Ensembles Which Have Been Both Preselected and Post-Selected"

We are very much indebted to Bub and Brown[1] for their thoughtful elaborations of some points that were raised in an earlier Letter of our own[2]; but their Letter also contains a misconception, which we should like, here, very briefly, to put right.

First let us review the statistical facts with which our Letter was concerned. Consider an ensemble of quantum-mechanical systems (with zero Hamiltonian) all of which are found to have the property $A=a$ on Monday and all of which are found to have the property $B=b$ on Friday, and in all of which C was measured on Wednesday (these are the *defining* characteristics of this ensemble; systems for which $A\neq a$ on Monday or $B\neq b$ on Friday are, by definition, excluded). Formula (1) of Ref. 2 gives the fraction $[P(c_i)]$ of that ensemble wherein it turns out on Wednesday that $C=c_i$. Now, suppose that we should like to study the dependence of formula (1) on C and c_i. It turns out that formula (1) has the property that $P(a)=P(b)=1$, albeit A and B may not happen to commute; and consequently (in accordance with the theorem of Kochen and Specker) it must be the case that that formula (considered purely as a *formula,* not as a description of any particular physical situation) fails to satisfy what Bub and Brown call the "meshing" condition [that is, there must exist observables M and N such that $|M=m\rangle = |N=n\rangle$ and $P(m)\neq P(n)$]. These (Bub and Brown agree) are quite straightforward, verifiable, statistical properties of the results of certain sequences of experiments; and the intent of our Letter (on the technical level) was simply to point those properties out, and to produce explicit examples of the observables M and N.

Bub and Brown are mistaken in supposing that we intended to conclude anything about hidden-variables theories from these statistical facts, and they are quite right in arguing (and they are right, as well, in the *way* that they argue) that any such conclusions would be unjustified.

We did, however, have something else in mind. The questions which concerned us were these: Is it the case, in the ordinary and unaugmented formalism of quantum theory, that one can infer more of the pasts of quantum-mechanical systems (and, if so, precisely *what* more?) than one can ever be in a position to predict about their futures? What we were at pains to point out in that Letter is that the statistical facts described above are sufficient to establish that the answer to the first of these questions is yes. It *can* be said with certainty, after all, on the Friday of a week such as was described above, that *if* A was measured on Wednesday then the result *was* $A=a$ and that *if* B was measured on Wednesday then the result *was* $B=b$; and of course no pair of statements such as that, where $[A,B]\neq 0$, can *ever* be made about the future!

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[1] J. Bub and H. Brown, Phys. Rev. Lett. **56**, 2337 (1986) (this issue).

[2] David Z. Albert, Yakir Aharonov, and Susan D'Amato, Phys. Rev. Lett. **54**, 5 (1985).