Bell's inequality refuted easily: nonlocality *non est.*

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Abstract *Experiments* violating a Bell inequality lead some to conclude: the world is nonlocal. *Elementary mathematics* violating a Bell inequality leads us conclude: the world is locally causal; nonlocality *non est*. Via similar classical analysis, this result is backed elsewhere. So, against Bell generally, and with certainty: local causality prevails.

Keywords Bell's inequality, classical analysis, elementary mathematics, local causality, refuted.

1 Analysis

1.0. 'Experiments violating a Bell inequality leave ["realists"] with no option: the principle of relativity is false. The world is nonlocal,' Wiseman and Cavalcanti (2015:9). 'The moral (Bell's theorem): quantum correlations falsify the hypothesis that, in any laboratory, nature carries the answer to any question which may be put to it, and answers without knowing which questions are being put elsewhere,' Wiseman (2014:469).

1.1. This essay is a footnote to Watson (2020E). Our focus is on Bell (1964), which is free-online (see References), and taken as read. We replace Bell's expectation $P(\vec{a},\vec{b})$ with its identity $E(a,b)$.

1.2. Thus, from Bell 1964:(15), here's Bell's inequality (BI) in our terms:

$$\text{BI: } |E(a,b)-E(a,c)|-1-E(b,c)\leq 0 \text{ [sic]}. \tag{1}$$

1.3. So, from (1) and with their limits, we have the following expectations:

$$-1\leq E(a,b)\leq 1,\ -1\leq E(a,c)\leq 1,\ -1\leq E(b,c)\leq 1. \tag{2}$$

$$\therefore E(a,b)[1+E(a,c)]\leq 1+E(a,c), \tag{3}$$

$$\because \text{ if } V\leq 1, \text{ and } 0\leq W, \text{ then } VW\leq W. \tag{4}$$

$$\therefore E(a,b)-E(a,c)\leq 1-E(a,b)E(a,c). \tag{5}$$

$$\text{Similarly: } E(a,c)-E(a,b)\leq 1-E(a,b)E(a,c). \tag{6}$$

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1.4. Therefore—irrefutably from (5)-(6), and thus *never false*—here is our inequality (say, WI):

$$\text{WI: } |E(a,b)-E(a,c)|-1+E(a,b)E(a,c)\leq 0. \tag{7}$$

1.5. Now, to facilitate comparisons of BI (1) with WI (7), we seek continuous functions of angles $(.)$ that satisfy (4). By observation, such functions include $E(.)=\pm\cos(.)$ and $E(.)=\pm\sin(.)$, *and all of these show*: (i) WI is *true* for any a,b,c combination; (ii) BI is *false* for many such combinations.

1.6. Simplifying, let the test-settings be $(b,c)=2(a,b)$, and $(a,c)=3(a,b)$. And let $E(.)=-\cos(.)$ be the test-function: for it maximizes WI's falsity and can be derived classically (see Watson (2020E) and quantumly for the EPR-Bohm experiment in Bell (1964). Then:

$$\text{For } (a,b)=\tfrac{\pi}{4}, \text{BI (1) delivers } 0\leq\sqrt{2}-1 \text{ [sic]: while WI (7) delivers } 0\leq\sqrt{2}-\tfrac{3}{2}. \tag{8}$$

$$\text{For } 0\leq(a,b)\leq\pi,\ \text{BI (1) is false over } 0<(a,b)<\tfrac{\pi}{3} \text{ and } \tfrac{2\pi}{3}<(a,b)<\pi. \text{ QED.} \tag{9}$$

1.7. To see BI (1), WI (7) and (9), enter this string in the free app at WolframAlpha.com:
Plot:|-cos(x)+cos(3x)|-1+cos(x)cos(3x) and |-cos(x)+cos(3x)|-1+cos(2x); 0<x<π.

2 Conclusions

2.1. Here, showing that BI is mathematically false, we support the conclusion in Watson (2020E): BI is classically false. For there, based on local causality *alone*, our wholly classical analysis refutes both BI and Bell's theorem. So it can now be said, with certainty, that Bell (1964)—and his definitions of local causality—are mathematically, classically, quantumly and experimentally false. Thus, consistent with special relativity and Einstein's world-view, we conclude that the world is locally-causal; that quantum correlations can be explained classically; that nonlocality *non est*; that §1.0 is false.

3 References

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