Bell's theorem refuted irrefutably on Bell's own terms

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Abstract Using elementary mathematics to refute Bell's famous inequality at its source, we refute Bell's theorem irrefutably on Bell's own terms.

Introduction

1. (i) Bell's theorem has been described as one of the most profound discoveries of science and one of the few essential discoveries of 20th-century physics. (ii) However, despite this fame (and like many of his supporters), Bell (1990:7) lived on the horns of a dilemma re the physical significance of his theorem. (iii) On the 90th anniversary of Bell's birth, this brief note refutes Bell's theorem by refuting Bell's famous inequality at its source: thus is the Bellian dilemma resolved. (iv) For additional details, including the consequent refutation of other Bellian impossibility theorems and the advancement of Einstein's ideas re quantum theory, see Watson (2018e).

Analysis

2. (i) Bell (1964) is available free-online, see References; it will be helpful to have it on hand. (ii) Let Bell-(1) be short for Bell 1964:(1); etc. (iii) Let Bell-(14a), (14b), (14c) identify the three unnumbered mathematical-expressions after Bell-(14). (iv) Then, via Bell-(1) and LHS Bell-(2), we see the functions required to analyze Bell's work: (v) Result A is given by $A(\vec{a},\boldsymbol{\lambda}) = \pm 1$, etc. (vi) The expectation value for $A(\vec{a},\boldsymbol{\lambda})B(\vec{b},\boldsymbol{\lambda})$—ie, the average over the product of an adequate number of paired-results from such tests—is given by $P(\vec{a},\vec{b})$, etc. (vii) So—recalling a fact: given $\mathrm{x} \leq 1$ and $0 \leq \mathrm{y}$, then $\mathrm{xy} \leq \mathrm{y}$—we find,

via Bell-(1): $A(\vec{a},\boldsymbol{\lambda})$	$=$	$\pm 1, B(\vec{b},\boldsymbol{\lambda}) = \pm 1, C(\vec{c},\boldsymbol{\lambda}) = \pm 1$ are the result functions;	(1)
with $-1 \leq P(\vec{a},\vec{b})$	$\leq$	$1, -1 \leq P(\vec{a},\vec{c}) \leq 1, -1 \leq P(\vec{b},\vec{c}) \leq 1$ the related expectations.	(2)
$\therefore P(\vec{a},\vec{b})[1 + P(\vec{a},\vec{c})]$	$\leq$	$1 + P(\vec{a},\vec{c})$ is a fact [others also] for all a, b, c – see ¶2(vii).	(3)
Thus, reworking (3)	–	ready for Bell's use of absolute values (we don't need them) –	(4)
we have another fact: 0	$\geq$	$\lvert P(\vec{a},\vec{b}) - P(\vec{a},\vec{c}) \rvert - 1 + P(\vec{a},\vec{b})P(\vec{a},\vec{c})$.	(5)
Then, from Bell-(15): 0	$\geq$	$\lvert P(\vec{a},\vec{b}) - P(\vec{a},\vec{c}) \rvert - 1 - P(\vec{b},\vec{c})$. So, via this inequality and (5),	(6)
Bell needs $P(\vec{a},\vec{b})P(\vec{a},\vec{c})$	$\geq$	$-\,\mathrm{P}(\vec{b},\vec{c})$ for (6) to be true for all a, b, c. [If not, then	(7)
LHS (6) would be	$>$	0 for some a, b, c (contrary to its claimed Bellian generality).]	(8)
So here's the mission	:	show (7) to be often false for some a, b, c.	(9)
And here's a strategy	:	from one of many options, let $b = c$, let a be any. So, via (7),	(10)
Bell now needs: $P^2(\vec{a},\vec{b})$	$\geq$	$-P(\vec{b},\vec{b})$ for all a, b. However,	(11)
from Bell-(13): $P(\vec{b},\vec{b})$	$=$	-1. So now, from (11),	(12)
Bell requires: $P^2(\vec{a},\vec{b})$	$\geq$	1 for all a, b. ▲ Which is absurd, given this next fact	(13)
from (2): $P^2(\vec{a},\vec{b})$	$\leq$	1 for all a, b. Thus, as required, Bell-(15) is often false. *QED.*	(14)
Moreover, Bell-(14b)	$\neq$	Bell-(14a), so Bell's theorem is refuted at its source. *QED.* For,	(15)
from Bell (1964:196-7)	:	Bell's "not possible" and "contradiction" are also false. *QED.*	(16)
Also: Bell's conclusion	–	Bell (1964:199) – is baseless; see Watson (2018e). nb: for all	(17)
a, b, c – under our (3): 0	$\geq$	$P(\vec{a},\vec{b}) - P(\vec{a},\vec{c}) - 1 + P(\vec{a},\vec{b})P(\vec{a},\vec{c})$ [for us, Bell-(2) = Bell-(3)]	(18)
whereas, for Bell (15): $\frac{1}{2}$	$\geq$	$\lvert P(\vec{a},\vec{b}) - P(\vec{a},\vec{c}) \rvert - 1 - P(\vec{b},\vec{c})$, as anticipated at (6)-(8) above.	(19)

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Conclusions

3. (i) Whatever the justification for Bell's (14b), it is unphysical in the context of Bell (1964): and akin—see Watson (2018e)—to the presumption that naive-realism might succeed in a quantum context. (ii) Moreover, whatever the assumption, it is also unwarranted: for, against Bell—via true locality and true realism; and also in the context of Bell (1964)—Watson (2018e) delivers the same results as quantum theory and observation; thus showing that Bell-(2) = Bell-(3), as used in (18) above. (iii) Under *true locality*: no influence propagates superluminally (after Einstein). (iv) Under *true realism*: some beables may change interactively (after Bohr). (v) Bell's theorem is thus refuted irrefutably here, on Bell's own terms. (vi) Or, to put it another way: with Bell's famous inequality internally contradictory, Watson (2018e) goes on to show that Bell's theorem is self-refuting. (vii) Thus, as Bell (1990:9) contemplated, he and his supporters were being rather silly.

References: [DA = date accessed]

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2. Bell, J. S. (1990). "Indeterminism and nonlocality." Transcript of 22 January 1990, CERN Geneva. Driessen, A. & A. Suarez (1997). Mathematical Undecidability, Quantum Nonlocality and the Question of the Existence of God. A. 83-100. http://www.quantumphil.org./Bell-indeterminism-and-nonlocality.pdf [DA20180728]

3. Watson, G. (2018e). "Einstein was right, Bell wrong: a simple constructive (truly local and truly realistic) foundation for quantum theory." To be posted at viXra.org.