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Logical fallacies are an essential foundation of today's quantum mechanics

Research article

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Abstract

Background:

How can we be sure that what we regard as confirmed scientific knowledge is in the end also confirmed and valid scientific knowledge?

Methods:

We are equipped with proof methods to test the truth of theories, theorems, statements, and so on. But have these proof methods themselves been tested for their degree of truth?

Results:

Experimental data of even very valuable experiments, which are analysed with the help of a logical fallacy, even if the same is hidden behind a lot of very complicated mathematical formalism, unfortunately prove nothing.

Conclusion:

Logical fallacies, as identified very often in today's quantum mechanics, are dangerous weapons of nebulizing and blurring scientific knowledge and turn science into pure ideology.

Keywords: Indeterminism; Quantum mechanics; Cause; Effect; Causal relationship k; Causality; Causation

1. Introduction

There are various seductively but deceptively bad arguments hidden behind the mathematical formalism of quantum mechanics and other false even if very popular beliefs which do not only challenges our imagination but seems to violate some fundamental principles of human common sense. In fact, it is of extraordinary urgency to account for these violations of human experience, of human thinking and of some basic ontological principles on which human science (principle of causality) is resting upon. Once a reader or an author has fallen victim to a logical fallacy (see Bentham, 2015), he will free himself and escape from the same only with the greatest difficulties. Therefore, the capability to unerringly recognise logical fallacies as such and, and as a result, to avoid these dangerous black holes of human reasoning, is of extraordinary relevance. A firm knowledge of errors of human reasoning as such is necessary to arm authors against the most dangerous missteps committed with arguments and chains of arguments, consciously or unconsciously. Concerning the analysis of logical fallacies it is very often helpful to rely on the symbolic language of formal logic, but this is not always mandatory. A simple method to recognise invalid logical forms of reasoning and to show their weaknesses by analysis, is the presentation of a suitable counterexample. A single, logically proper counterexample is sufficient enough to overthrow a whole theory once and for all in reducing the same **ad absurdum**. Unfortunately, the knowledge about logical fallacies (see Johnson and Blair, 1977) is not equally well known and disseminated through all sciences. In particular, the extent and the way, how logical errors found their way and have been included and incorporated (see Biro and Siegel, 2006) into the Copenhagen Interpretation of Quantum Mechanics dominated theory of quantum mechanics is frightening and worrisome. A more appropriate overview of some recent research on logical fallacies and other errors of human reasoning can be found in relevant secondary literature. In this publication, we aim to prove beyond any reasonable doubt that the most essential foundations of today's Copenhagen Interpretation of Quantum Mechanics dominated theory of quantum mechanics are based on logical fallacies.

2. Material and methods

2.1. Definitions

2.1.1. Wave function

Definition 2.1 (Wavefunction). *Let $p({}_{R}X_{t})$ represent the probability from the point of view of a stationary observer R for finding a certain particle X at a given point in space at a given time / Bernoulli trial / **run of a single experiment** t. Let $E({}_{R}X_{t})$ denote the expectation value of ${}_{R}X_{t}$, i. e. quantum correlation, **at one single run of an experiment** t. Let $E({}_{R}X_{t}{}^{2})$ denote the expectation value of ${}_{R}X_{t}{}^{2}$. Let $\sigma({}_{R}X_{t})$ denote the standard deviation of ${}_{R}X_{t}$ **at one single run of an experiment** t. Let $\sigma({}_{R}X_{t})^{2}$ denote the variance of ${}_{R}X_{t}$ **at one single run of an experiment** t. Let the wavefunction represent the probability amplitude (Born, 1926) of an event or of finding an event (i. e. a particle) at a given point in space at a given (period of) time / Bernoulli trial (Uspensky, 1937) $_{t}$, at one single run of an experiment t. In general, it is*

$$
\begin{aligned}
p\left({}_{R}X_{t}\right) &\equiv \frac{E\left({}_{R}X_{t}\right)}{{}_{R}X_{t}} \\
&\equiv \frac{E\left({}_{R}X_{t}\right)^{2}}{E\left({}_{R}X_{t}{}^{2}\right)} \\
&\equiv \frac{p\left({}_{R}X_{t}\right)^{2}\times\left({}_{R}X_{t}\right)^{2}}{p\left({}_{R}X_{t}\right)\times\left({}_{R}X_{t}\right)^{2}} \\
&\equiv \Psi\left({}_{R}X_{t}\right)\times\Psi^{*}\left({}_{R}X_{t}\right)
\end{aligned}
\tag{1}
$$

From this definition follows that

$$\begin{aligned}\Psi({}_{R}X_{t}) &\equiv \frac{1}{\Psi^{*}({}_{R}X_{t})} \times p({}_{R}X_{t}) \\ &\equiv \frac{p({}_{R}X_{t})}{\Psi^{*}({}_{R}X_{t} \times f({}_{R}X_{t}))} \times f({}_{R}X_{t}) \\ &\equiv \underbrace{\frac{p({}_{R}X_{t})}{\Psi^{*}({}_{R}X_{t}) \times f({}_{R}X_{t})}}_{{}_{R}A_{t}} \times f({}_{R}X_{t}) \\ &\equiv {}_{R}A_{t} \times f({}_{R}X_{t}) \\ &\equiv \frac{1}{\Psi^{*}({}_{R}X_{t})} \times \frac{E({}_{R}X_{t})}{{}_{R}X_{t}} \\ &\equiv \frac{1}{\Psi^{*}({}_{R}X_{t}) \times {}_{R}X_{t}} \times E({}_{R}X_{t})\end{aligned} \tag{2}$$

Lemma 2.1. *It is*

$${}_{R}A_{t} \equiv \frac{\Psi({}_{R}X_{t})}{f(X_{t})} \tag{3}$$

Proof. Multiplying the equation

$$\Psi({}_{\mathrm{R}}X_{\mathrm{t}}) \equiv \Psi({}_{\mathrm{R}}X_{\mathrm{t}}) \tag{4}$$

by the term $\mathbf{f({}_{R}X_{t})/f({}_{R}X_{t})}$ it is

$$\Psi({}_{\mathrm{R}}X_{\mathrm{t}}) \equiv \frac{\Psi({}_{\mathrm{R}}X_{\mathrm{t}})}{f({}_{\mathrm{R}}X_{\mathrm{t}})} \times f({}_{\mathrm{R}}X_{\mathrm{t}}) \tag{5}$$

At the same time it has to be that $\Psi({}_{\mathrm{R}}X_{\mathrm{t}}) \equiv {}_{\mathrm{R}}A_{\mathrm{t}} \times f(X_{\mathrm{t}}) \equiv \frac{\Psi({}_{\mathrm{R}}X_{\mathrm{t}})}{f({}_{\mathrm{R}}X_{\mathrm{t}})} \times f(X_{\mathrm{t}})$ and it follows that

$${}_{\mathrm{R}}A_{\mathrm{t}} \equiv \frac{\Psi({}_{\mathrm{R}}X_{\mathrm{t}})}{f(X_{\mathrm{t}})} \tag{6}$$

□

2.1.2. The variance

Definition 2.2 (The variance). *Sir Ronald Aylmer Fisher (1890 – 1962), an English statistician, "the single most important figure in 20th century statistics"(Efron, 1998) coined the term variance as follows: "It is therefore desirable **in analysing the causes** of variability to deal with the square of the standard deviation as the measure of variability. We shall term this quantity the Variance ... "(see Fisher, 1918, p. 399) Again, let $p({}_{R}X_{t})$ represent the probability from the point of view of a stationary observer R for finding a certain particle X at a given point in space at a given time / Bernoulli trial t.*

Let E($_RX_t$) denote the expectation value of $_RX_t$. The expectation value of $_RX_t$ at one single run of an experiment t is defined as

$$E\left({}_RX_t\right) \equiv p\left({}_RX_t\right) \times \left({}_RX_t\right) \equiv \Psi({}_RX_t) \times {}_RX_t \times \Psi^*({}_RX_t) \tag{7}$$

*The expectation value of the other of $_RX_t$, of 'the local hidden variable' of $_RX_t$, of the complementary of $_RX_t$, of the opposite of $_RX_t$, of **the anti $_RX_t$**, denoted by $_R\underline{X}_t$, is defined as*

$$E\left({}_R\underline{X}_t\right) \equiv \left(1 - p\left({}_RX_t\right)\right) \times \left({}_RX_t\right) \tag{8}$$

Let E($_RX_t{}^2$) denote the expectation value of $_RX_t{}^2$. The expectation value of $_RX_t{}^2$ is defined as

$$E\left({}_RX_t{}^2\right) \equiv p\left({}_RX_t\right) \times \left({}_RX_t{}^2\right) \equiv p\left({}_RX_t\right) \times \left({}_RX_t \times {}_RX_t\right) \tag{9}$$

Let σ($_RX_t$) denote the standard deviation of $_RX_t$. Let σ($_RX_t$)^2 denote the variance of $_RX_t$. In general, the variance (see Kolmogorov, 1956, p. 42) is defined as

$$\begin{aligned}
\sigma({}_RX_t)^2 &\equiv \sigma\left({}_RX_t\right) \times \sigma\left({}_RX_t\right) \\
&\equiv E\left({}_RX_t - E\left({}_RX_t\right)\right)^2 \\
&\equiv E\left({}_RX_t{}^2\right) - \left(E\left({}_RX_t\right)\right)^2 \\
&\equiv \left({}_RX_t{}^2 \times p\left({}_RX_t\right)\right) - \left(p\left({}_RX_t\right) \times {}_RX_t\right)^2 \\
&\equiv \left({}_RX_t{}^2\right) \times \left(p\left({}_RX_t\right) - p\left({}_RX_t\right)^2\right) \\
&\equiv \left({}_RX_t{}^2\right) \times \left(p\left({}_RX_t\right) \times \left(1 - p\left({}_RX_t\right)\right)\right) \\
&\equiv {}_RX_t \times \left(p\left({}_RX_t\right) \times {}_RX_t \times \left(1 - p\left({}_RX_t\right)\right)\right)
\end{aligned} \tag{10}$$

From equation 10 follows that

$$\begin{aligned}
p\left({}_RX_t\right) \times \left(1 - p\left({}_RX_t\right)\right) &\equiv \frac{\sigma({}_RX_t)^2}{{}_RX_t{}^2} \\
&\equiv \frac{E\left({}_RX_t{}^2\right)}{{}_RX_t{}^2} - \frac{\left(E\left({}_RX_t\right)\right)^2}{{}_RX_t{}^2} \\
&\equiv p\left({}_RX_t\right) - p\left({}_RX_t\right)^2
\end{aligned} \tag{11}$$

2.1.3. The complex conjugate

Definition 2.3 (The complex conjugate). *The conjugate of a complex number denoted as $conjugate\left(a\left({}_RX_t\right) + \left(i \times b\left({}_RX_t\right)\right)\right)$, where i^2≡ -1 is the imaginary (Bombelli, 1579), is defined as*

$$\begin{aligned}
&conjugate\left(a\left({}_RX_t\right) + \left(i \times b\left({}_RX_t\right)\right)\right) \\
&\qquad \equiv \left(a\left({}_RX_t\right) - \left(i \times b\left({}_RX_t\right)\right)\right)
\end{aligned} \tag{12}$$

As proofed somewhere else, any complex number multiplied by its complex conjugate is a real number. It is

$$\begin{aligned}
&\left(a\left({}_RX_t\right) + \left(i \times b\left({}_RX_t\right)\right)\right) \times \left(a\left({}_RX_t\right) - \left(i \times b\left({}_RX_t\right)\right)\right) \\
&\qquad \equiv \left(a\left({}_RX_t\right)^2\right) - \left(i^2 \times b\left({}_RX_t\right)^2\right) \\
&\qquad \equiv \left(a\left({}_RX_t\right)^2\right) + \left(b\left({}_RX_t\right)^2\right)
\end{aligned} \tag{13}$$

3. Results

3.1. Theorem. Non strict inequality I

Simplest and elementary mathematics should be able to contribute to the family of Bell's inequalities.

Theorem 1. *It is*

$$+5 = +2 + (X = 3) \tag{14}$$

Proof by direct proof. An author asserts with conviction and without even a hint of doubt that, regardless of any reasons, ideologies, convictions, etc., the not strict inequality

$$+5 \geq +2 \tag{15}$$

is generally valid and true. However, do other readers simply have to accept such an attitude without contradicting at all or do we possess methods to check the truth of such an assertion very precisely? Following Einstein, it is possible to check theories for logical consistency.

> **"Eine Theorie kann also wohl als unrichtig erkannt werden,**
> **wenn in ihren Deduktionen**
> **ein logischer Fehler ist . . . "**
> (Einstein, 1919)

Equation 15 possess two sides. In other words, equation 15 demand us to accept that **either**

$$+5 = +2 \tag{16}$$

is true **or** that

$$+5 > +2 \tag{17}$$

The strict inequality (see inequality 17) can be transferred into an equality. It is

$$+5 = +2 + X \tag{18}$$

The non strict inequality 15 demands that

$$X = +5 - 2 = +3 \tag{19}$$

At the end, equation 18 becomes

$$+5 = +2 + (X = 3) \tag{20}$$

□

3.2. Theorem. Non strict inequality II

Theorem 2 presented in the following lines is hold relatively simple thus that anyone with even the slightest mathematical background is able follow each step of the evidence provided.

Theorem 2. *Equation 15 is based on a logical contradiction*

$$+1 = +0 \tag{21}$$

Proof by direct proof. Axiom 1 or

$$+1 = +1 \tag{22}$$

is true and generally valid. Therefore, it is equally true that

$$+5 = +5 \tag{23}$$

Equation 23 becomes (see equation 20)

$$+2 + (X = 3) = +5 \tag{24}$$

Equation 16 changes equation 24 too

$$+2 + (X = 3) = +2 \tag{25}$$

In other words, the non strict inequality 15 demands that

$$+(X = 3) = +0 \tag{26}$$

or that

$$\frac{+(X=3)}{+(X=3)} = \frac{+0}{+(X=3)} \tag{27}$$

In general, the non strict inequality 15 is grounded on the logical contradiction

$$+1 = +0 \tag{28}$$

□

To put it in a nutshell. It is possible to derive a logical contradiction out of the non strict inequality 15. Following Aristotle and many other authors, including Popper himself, this is not acceptable, and rightly too. Reason:

> "A theory which involves a contradiction is ... entirely useless as a theory "
> (Popper, Karl Raimund, 2002, p. 429)

The previous theory was kept very simple and can be checked for sure by anyone without great difficulties. The situation changes, however, if authors operate with several conditions and highly abstract stuff. In this case it is extremely difficult to check the logical content of statements. However, this need not mean that it is impossible.

3.3. Theorem. Einstein's theory of special relativity

Theorem 3 (Einstein's theory of special relativity)**.** *There are circumstances where Einstein's theory of special relativity (see Einstein, 1905) can lead to the logical contradiction*

$$+1 = +0 \tag{29}$$

in case that the authors are not attentive enough.

Proof by direct proof. Einstein's theory of special relativity is correct and especially the non strict inequality

$$_{R}E_{t} \geq {}_{0}E_{t} \tag{30}$$

where $_{R}E_{t}$ is the total or relativistic energy of a certain system and $_{0}E_{t}$ is the rest energy of the same system or the energy as found by a co-moving observer 0. This non strict inequality is true and generally valid. Therefore, based on equation 30, it is possible that

$$_{R}E_{t} > {}_{0}E_{t} \tag{31}$$

and that

$$_{R}E_{t} = {}_{0}E_{t} + ({}_{0}\underline{E}_{t} = 0) \tag{32}$$

We now want to ask the question whether both can be valid at the same (period of) time t, $_{R}E_{t} = {}_{0}E_{t}$ and $_{R}E_{t} > {}_{0}E_{t}$. In this sense, we transfer equation 31 can be transferred into an equality. It is

$$_{R}E_{t} = {}_{0}E_{t} + ({}_{0}\underline{E}_{t} > 0) \tag{33}$$

In general, it is

$$_{R}E_{t} = {}_{R}E_{t} \tag{34}$$

We consider conditions where $+({}_{0}\underline{E}_{t} > 0)$ is given at a certain (period of) time t. Equation 34 becomes (see equation 33)

$$_{0}E_{t} + ({}_{0}\underline{E}_{t} > 0) = {}_{R}E_{t} \tag{35}$$

Furthermore, at the same (period of) time t it is given that $_{R}E_{t} = {}_{0}E_{t}$. Under these assumptions, equation 35 becomes (see equation 32)

$$_{0}E_{t} + ({}_{0}\underline{E}_{t} > 0) = {}_{0}E_{t} \tag{36}$$

Equation 36 has to be rearranged as

$$+({}_{0}\underline{E}_{t} > 0) = +0 \tag{37}$$

Dividing equation 37 by $_{0}\underline{E}_{t}$, it is

$$\frac{+({}_{0}\underline{E}_{t} > 0)}{+({}_{0}\underline{E}_{t} > 0)} = \frac{+0}{+({}_{0}\underline{E}_{t} > 0)} \tag{38}$$

and at the end it follows that

$$+1 = +0 \tag{39}$$

□

Even Einstein's theory of special relativity can lead to contradictions in case that the authors are not attentive enough. **To be clear, Einstein's theory of special relativity has not been refuted!** Theorem 3 shows only a way that anyone can fall under the non-inescapable influence of the black hole of human thinking, the logical fallacy. Theorem 3 has provided evidence that it is not possible at the same (period of) time t that $({}_{0}\underline{E}_{\mathrm{t}} > 0)$ and that $({}_{0}\underline{E}_{\mathrm{t}} = 0)$, otherwise we would and up at a logical contradiction. However, in equation 32 and in equation 33, we require just that. No wonder that under these circumstances we have to end up with a logical contradiction. We are asking for something that cannot be. In contrast to this, at time t it is possible that $({}_{0}\underline{E}_{\mathrm{t}} = 0)$ is valid, whereas at a later time $({}_{0}\underline{E}_{\mathrm{t+z}} > 0)$ may very well be valid. It depends very much on the details.

3.4. Theorem. Bell's inequality / theorem - refuted!

Theorem 4 (Bell's inequality / theorem - refuted)**.** *Bell's inequality / theorem is based on the logical contradiction*

$$+1 = +0 \tag{40}$$

Proof by direct proof. Bell's inequality / theorem has been derived (see Bell, 1964) in the form of a non-strict inequality as

$$+1+E(b,c) \geq |E(a,b)-E(a,c)| \tag{41}$$

whatever the meaning of the single terms inside the non strict inequality (see inequality 41) might be and is provisionally referred to as true and generally valid. Bell's inequality/theorem is valid for a series of measurements. However, the expectation values are defined for one single measurement too and therefore Bell's inequality/theorem is also valid for each individual measurement. In the continuation of this theorem, we will re-investigate the logical foundations of Bell's inequality/theorem at one single measurement. Without changing Bell's inequality/theorem in any way, at one single measurement Bell's inequality demands hat

$$+1+E(b,c) = |E(a,b)-E(a,c)| = |E(a,b)-E(a,c)| + (B=0) \tag{42}$$

where B denotes an unknown Bell's term and equally that

$$+1+E(b,c) > |E(a,b)-E(a,c)| \tag{43}$$

The strict inequality of equation 43 has at least one important implication. The same can be transferred into an equality by adding an unknown Bell's term B, which in this case need to be greater than zero. This is a straightforward logical consequence of the strict inequality 43. It is

$$+1+E(b,c) = |E(a,b)-E(a,c)| + (B>0) \tag{44}$$

We have no evidence so far that Bell or his successors consider equation

$$+1 = +1 \tag{45}$$

to be wrong. This equation is true and need fully to be respected by Bell's inequality / theorem too. Adding the term $+E(b,c)$, it is

$$+1+E(b,c) = +1+E(b,c) \tag{46}$$

Equation 46 changes (see equation 44) too

$$|E(a,b)-E(a,c)| + (B>0) = +1+E(b,c) \tag{47}$$

Equation 47 changes (see equation 42) too

$$|E(a,b)-E(a,c)| + (B>0) = |E(a,b)-E(a,c)| + (B=0) \tag{48}$$

Equation 48 becomes

$$+(B>0) = +(B=0) \tag{49}$$

Dividing equation 49 by Bell's term B, which itself is greater than zero, it is

$$\frac{+(B>0)}{+(B>0)} = \frac{+(B=0)}{+(B>0)} \tag{50}$$

At the end, it is possible to derive a logical contradiction out of Bell's inequality/theorem as

$$+1 = +0 \tag{51}$$

□

Theorem 4 has investigated the behaviour of Bell's inequality at one single measurement. We can't help but notice that a clear logical contradiction can be derived from Bell's inequality. No matter how you turn it around,

> "A theory which involves a contradiction is ... entirely useless as a theory "
> (Popper, Karl Raimund, 2002, p. 429)

Bell's inequality / theorem may be a highly complex and complicated formulation of a very simple scientific issue. In the end, however, Bell's inequality / theorem is nothing else but a simple either or logical fallacy and completely worthless as such. In other words, objective reality, seen through glasses clouded by a logical fallacy, might appear either glorious or horrible to an individual. Regardless of all, under these circumstances, objective reality does not appear as it really is.

3.5. Theorem. CHSH inequality - refuted!

Another inequality is called CHSH inequality (see Clauser et al., 1969) after Clauser, Horne, Shimony, and Holt, and as a generalization of Bell's theorem it is one popular way of presenting the original inequality from Bell.

Theorem 5 (CHSH inequality - refuted!)**.** *CHSH inequality is based on the logical contradiction*

$$+1 = +0 \tag{52}$$

Proof by direct proof. CHSH inequality (see Clauser et al., 1969) is given in the usual form of a non-strict inequality as

$$\underbrace{E(a,b) + E(\underline{a},b) + E(\underline{a},\underline{b}) - E(a,\underline{b})}_{CHSH} \leq +2 \tag{53}$$

The terms E(a, b) etc. are the quantum correlations, where the quantum correlation is defined to be the expectation value of the 'outcomes'of an experiment. The CHSH inequality (see inequality 53) is provisionally referred to as true and generally valid. This CHSH inequality is regularly violated by the so-called Bell-test experiments and other real world devices in the sense that (CHSH = 3) $>$ 2 or something similar. Where is the error? What is wrong, the CHSH inequality, the experiments performed or both or none? The CHSH inequality is valid for a series of measurements. Nonetheless, the CHSH inequality is valid at every single run of an experiment too, for each individual measurement. In general, the expectation values are defined for one single measurement too. In the further of the evidence, we will re-investigate the logical foundations of the CHSH inequality at one single measurement. Without changing the CHSH inequality in any way, at one single measurement, the CHSH inequality demands that

$$E(a,b) + E(\underline{a},b) + E(\underline{a},\underline{b}) - E(a,\underline{b}) + (C = 0) = +2 \tag{54}$$

where C denotes an unknown CHSH term and equally that

$$E(a,b) + E(\underline{a},b) + E(\underline{a},\underline{b}) - E(a,\underline{b}) < +2 \tag{55}$$

The strict inequality (see inequality 55) can be transferred into an equality by adding an unknown CHSH term, denoted as C, which in this case need to be greater than zero. This necessarily results from the strict inequality (see inequality 55). Therefore, it is equally true that

$$E(a,b) + E(\underline{a},b) + E(\underline{a},\underline{b}) - E(a,\underline{b}) + (C > 0) = +2 \tag{56}$$

In general, it is true that

$$+1 = +1 \tag{57}$$

and that

$$+2 = +2 \tag{58}$$

Equation 58 becomes (see equation 56)

$$E(a,b) + E(\underline{a},b) + E(\underline{a},\underline{b}) - E(a,\underline{b}) + (C > 0) = +2 \tag{59}$$

Equation 59 becomes (see equation 54)

$$E(a,b)+E(\underline{a},b)+E(\underline{a},\underline{b})-E(a,\underline{b})+(C>0)=E(a,b)+E(\underline{a},b)+E(\underline{a},\underline{b})-E(a,\underline{b})+(C=0) \tag{60}$$

The CHSH demands that equation 60 is valid at every single run of an experiment. Simplifying equation 60, it is

$$+(C>0)=+(C=0) \tag{61}$$

Dividing equation 61 by $+(C>0)$, it is

$$\frac{+(C>0)}{+(C>0)}=\frac{+(C=0)}{+(C>0)} \tag{62}$$

At the end, it is

$$+1=+0 \tag{63}$$

□

Anti CHSH - 'inequality ' The causal relationship k has been derived at every Bernoulli trial / at every single run of an experiment t as

$$\begin{aligned} k(U_t,W_t) &\equiv \frac{\sigma(U_t,W_t)}{\sigma(U_t)\times\sigma(W_t)} \\ &\equiv \frac{p(U_t\wedge W_t)-p(U_t)\times p(W_t)}{\sqrt[2]{(p(U_t)\times(1-p(U_t)))\times(p(W_t)\times(1-p(W_t)))}} \end{aligned} \tag{64}$$

where σ (U_t , W_t) denotes the co-variance between a cause U_t and an effect W_t *at every single Bernoulli trial t*, σ (U_t) denotes the standard deviation of a cause U_t at the same single Bernoulli trial t, σ (W_t) denotes the standard deviation of an effect W_t at same single Bernoulli trial t. The range of the causal relationship k is

$$-1 \leq \frac{p(A_t\wedge B_t)-p(A_t)\times p(B_t)}{\sqrt[2]{(p(A_t)\times(1-p(A_t)))\times(p(B_t)\times(1-p(B_t)))}} \leq +1 \tag{65}$$

where p(A_t , B_t) denotes the joint probability i. e. distribution between A_t (outcome on Alice' side) and B_t (outcome on Bob's side) *at every single Bernoulli trial t*, p (A_t) denotes the probability of an event at Alice's side A_t at the same single Bernoulli trial t and p(B_t) is the probability of an event at Bob's side B_t at the same single Bernoulli trial t. It is possible that p(A_t , B_t) = 0. Equation 65 can be rearranged as

$$-2 \leq \frac{2\times(p(A_t\wedge B_t)-p(A_t)\times p(B_t))}{\sqrt[2]{(p(A_t)\times(1-p(A_t)))\times(p(B_t)\times(1-p(B_t)))}} \leq +2 \tag{66}$$

To establish a definitive calm in the Kindergarten of today's logical fallacy dominated quantum mechanics i do invite publicly those scientist who want to violate something at any cost, to violate the following Anti CHSH - 'inequality '(see also Barukčić, 2021, equation: 64, p. 19)

$$\text{Anti CHSH} = \left|\frac{2\times\sigma(A_t,B_t)}{\sigma(A_t)\times\sigma(B_t)}\right| \leq +2 \tag{67}$$

in their hunt for either locality or realism and for entanglement where A_t denotes the output of measurement on Alice side at a single run of an experiment t and B_t denotes the output of measurement on Bob's side at the same single run of an experiment t at the same (period of) time, $\sigma(A_t)$ is the standard deviation at a single run of an experiment t on Alice side, $\sigma(B_t)$ is the standard deviation at a single run of an experiment t on Bob's side, $\sigma(A_t, B_t)$ it the covariance between Alice and Bob at the same (period of) time or run of an experiment t. It goes without saying that e.g. for spin up +1 and for spin down +0 et cetera must be used and not +1 and -1. That scientist who dares to make this attempt, will cut his teeth for nothing. There is nothing there that could be violated. The only one thing that might be violated is the reputation of the scientist who needlessly embarks on such a senseless path. Thus far, if the data of the so called Bell-test experiments which are on the way to be honoured publicly should be re-analysed according to the above mentioned inequality (see inequality 67), there will be nothing that will be violated.

3.6. Theorem. Heisenberg's uncertainty principle - refuted!

Theorem 6 (Heisenberg's uncertainty principle - refuted!)**.** *Heisenberg's uncertainty relation for position and momentum is based on the logical contradiction*

$$+1 = +0 \tag{68}$$

Proof by direct proof. Heisenberg's celebrated uncertainty principle (see Heisenberg, Werner Karl, 1927) has been mathematized by the famous inequality (see Kennard, 1927) for position and momentum as

$$\sigma(X) \times \sigma(p) \geq \frac{h}{4 \times \pi} \tag{69}$$

where X denotes position, p denotes momentum, σ denotes the standard deviation, h is Planck's constant h and π is Archimedes constant. Heisenberg's uncertainty principle is considered at this point for preliminary reasons as true and as generally valid. Heisenberg's uncertainty principle is treated as generally valid because Heisenberg himself is claiming that his uncertainty principle has refuted the principle of causality.

> "Weil alle Experimente den Gesetzen der Quantenmechanik und damit der Gleichung (1) unterworfen sind, so wird durch die Quantenmechanik **die Ungültigkeit des Kausalgesetzes definitiv festgestellt**. "
> (Heisenberg, Werner Karl, 1927, p. 198)

In English: Because all experiments are subject to the laws of quantum mechanics and thus to equation (1), so by quantum mechanics the invalidity of the causal law is definitely proved. As known, Heisenberg's uncertainty inequality is valid for a series of measurements. Nonetheless, the standard deviation is defined for one single measurement too and therefore Heisenberg's uncertainty inequality is also valid for each single measurement too. In the continuation of this theorem, we will re-investigate the logical foundations of Heisenberg's uncertainty inequality at one single measurement. Without changing Heisenberg's uncertainty inequality in any way, at one single measurement Heisenberg's uncertainty non strict inequality demands hat

$$\sigma(X) \times \sigma(p) = \frac{h}{4 \times \pi} = \frac{h}{4 \times \pi} + (H = +0) \tag{70}$$

where H denotes an unknown Heisenberg's term and equally that

$$\sigma(X) \times \sigma(p) > \frac{h}{4 \times \pi} \tag{71}$$

Heisenberg's uncertainty principle formulated as strict inequality (see inequality 71) has at least one important implication. The same strict inequality can be transferred into an equality by adding an unknown Heisenberg's term H, which in this case need to be greater than zero. This is a straightforward logical consequence of the strict inequality 71. We obtain

$$\sigma(X) \times \sigma(p) = \frac{h}{4 \times \pi} + (H > +0) \tag{72}$$

Heisenberg himself, did not accepted logical contradictions at all. Heisenberg demanded that a physical theory should not contain any logical contradictions.

> ""Eine physikalische Theorie ... niemals **innere Widersprüche** enthält. "
> (Heisenberg, Werner Karl, 1927, p. 172)

It is therefore reasonable to assume that Heisenberg himself accepted the correctness of the following equation.

$$+1 = +1 \tag{73}$$

Equation 73 becomes

$$\sigma(X) \times \sigma(p) = \sigma(X) \times \sigma(p) \tag{74}$$

We are still at one single measurement. Equation 74 changes (see equation 72) to

$$\frac{h}{4 \times \pi} + (H > +0) = \sigma(X) \times \sigma(p) \tag{75}$$

As next, equation 75 becomes (see equation 70)

$$\frac{h}{4 \times \pi} + (H > +0) = \frac{h}{4 \times \pi} + (H = +0) \tag{76}$$

Equation 76 simplifies. Heisenberg's uncertainty principle demands at one single measurement that the following equation must hold true:

$$+(H > +0) = +(H = +0) \tag{77}$$

Dividing equation 77 by Heisenberg's term $+(H > +0)$, it is

$$\frac{+(H > +0)}{+(H > +0)} = \frac{+(H = +0)}{+(H > +0)} \tag{78}$$

Finally, Heisenberg's uncertainty principle is grounded on a logical contradiction

$$+1 = +0 \tag{79}$$

□

You can derive a logical contradiction from Heisenberg's uncertainty relation for position and momentum. However, we are not allowed to do this.

Heisenberg's uncertainty principle as one of the most famous aspects of the so-called Copenhagen interpretation of quantum mechanics played an central role in various publications on the philosophical implications of quantum mechanics. And it comes as no surprise that Heisenberg's uncertainty principle taught for decades many students and scientists the fear and detained to many of them and to long unjustifiably in logical captivity.

Theorem 6 has put an sudden end to the whole affair. Heisenberg's uncertainty principle is refuted.

4. Discussion

Scientific progress is not a one-way journey. There are also periods of massive setbacks. In the end it is formal logic and systematic experiment which bring us time and again to new and higher epistemological spheres.

> ""Development of Western **science** is based on two great achievements: the invention of the formal **logic**al system (in Euclidean geometry) by the Greek philosophers, **and** the discovery of the possibility to find out **causal relationships** by systematic **experiment** (during the Renaissance). " (Hu, 2005) "

Unfortunately, even the best experiment is probably of little use and importance i.e. if the data obtained by such an experiment are analyzed with inadequate statistical-mathematical methods.

Likewise, the attempts of scientists to approach the problem of quantum entanglement experimentally are similar. Schrödinger (see Schrödinger, 1935) himself coined the term "entanglement"to describe a possible relationship between separated quantum systems using the tools of probability theory. Meanwhile and in contrast to Schrödinger, Bell's theorem is used for confirmation that quantum entanglement can persist over long distances, thus falsifying Schrödinger's supposition of the spontaneous decay of quantum entanglement and generated an ongoing debate on the foundations of quantum mechanics and of science as such. Are quantum systems entangled with each other and how are separated quantum systems related to each other was not the subject of this investigation. Furthermore, whether quantum entanglement might be a feature of objective reality may remain an open question until further notice. The main purpose of this study was to examine the mathematical foundations on which the current concept of quantum entanglement is based. In this publication we have been able to prove beyond any reasonable doubt, by the means of simplest and elementary mathematics, that neither Bell's inequality / theorem nor CHSH inequaliy nor Heisenberg's uncertainty principle are logically sound and mathematically correct. Wherever the truth will be found in the end, quantum entanglement cannot be derived neither from Bell's inequality / theorem nor from CHSH inequaliy nor from Heisenberg's uncertainty principle and has nothing to do with those logical fallacies.

5. Conclusion

In toto, it seems necessary to think about reworking the foundations of today's quantum mechanics.

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Erratum

None.

Private note

I do believe that the continued, factually unjustified public glorification of clearly proven logical fallacies by the Nobel Committee for Physics of the Royal Swedish Academy of Sciences as done on December 10, 1933 for Heisenberg's uncertainty principle[1, 2, 3], and later in the year 2022 for Bell's inequality [4, 5, 6] and the CHSH inequality [7, 8] is historically without comparable misperformance, disgusting and inexcusable.

[1] Barukčić, Ilija. Anti Heisenberg—Refutation Of Heisenberg's Uncertainty Relation. AIP Conference Proceedings 1327, 322 (2011); https://doi.org/10.1063/1.3567453

[2] Ilija Barukčić, "Anti Heisenberg – Refutation of Heisenberg's Uncertainty Principle," International Journal of Applied Physics and Mathematics vol. 4, no. 4, pp. 244-250, 2014.

[3] Barukčić, Ilija. (2016) Anti Heisenberg—The End of Heisenberg's Uncertainty Principle. Journal of Applied Mathematics and Physics, 4, 881-887. doi: 10.4236/jamp.2016.45096.

[4] Ilija Barukcic. Anti-Bell - Refutation of Bell's theorem. AIP Conference Proceedings 1508, 354 (2012); https://doi.org/10.1063/1.4773147

[5] Barukčić, I. (2016) Anti Chsh—Refutation of the Chsh Inequality. Journal of Applied Mathematics and Physics, 4, 686-696. doi: 10.4236/jamp.2016.44079.

[6] Barukčić, I. (2019) "Aristotle's law of contradiction and Einstein's special theory of relativity", Journal of Drug Delivery and Therapeutics, 9(2), pp. 125-143. doi: 10.22270/jddt.v9i2.2389.

[7] Ilija Barukcic. Anti-Bell - Refutation of Bell's theorem. AIP Conference Proceedings 1508, 354 (2012); https://doi.org/10.1063/1.4773147

[8] Barukčić, I. (2016) Anti Chsh—Refutation of the Chsh Inequality. Journal of Applied Mathematics and Physics, 4, 686-696. doi: 10.4236/jamp.2016.44079.

References

Ilija Barukčić. The causal relationship k. *MATEC Web of Conferences*, 336:09032, 2021. ISSN 2261-236X. doi: 10.1051/matecconf/202133609032. CSCNS2020. Web of Science. Free full text: EDP Sciences.

John S Bell. On the einstein podolsky rosen paradox. *Physics*, 1(3):195, 1964.

Jeremy Bentham. *The book of fallacies*. Oxford University Press, Oxford, UK, collected works of jeremy bentham. editor: philip schofield edition, 2015. ISBN 0198719817.

John Biro and Harvey Siegel. In defense of the objective epistemic approach to argumentation. *Informal Logic*, 26(1):91–101, 2006.

Raffaele Bombelli. *L' algebra : opera di Rafael Bombelli da Bologna, divisa in tre libri : con la quale ciascuno da se potrà venire in perfetta cognitione della teorica dell'Aritmetica : con una tavola copiosa delle materie, che in essa si contengono*. per Giovanni Rossi, Bolgna (Italy), 1579. Free full text: e-rara, Zurich, CH.

Max Born. Zur Quantenmechanik der Stoßvorgänge. *Zeitschrift für Physik*, 37(12):863–867, December 1926. ISSN 0044-3328. doi: 10.1007/BF01397477. URL `https://doi.org/10.1007/BF01397477`.

John F Clauser, Michael A Horne, Abner Shimony, and Richard A Holt. Proposed experiment to test local hidden-variable theories. *Physical review letters*, 23(15):880, 1969. APS Physics.

Bradley Efron. R. A. Fisher in the 21st century (Invited paper presented at the 1996 R. A. Fisher Lecture). *Statistical Science*, 13 (2), May 1998. ISSN 0883-4237, 2168-8745. doi: 10.1214/ss/1028905930. URL `https://projecteuclid.org/euclid.ss/1028905930`. Publisher: Institute of Mathematical Statistics.

Albert Einstein. Zur Elektrodynamik bewegter Körper. *Annalen der Physik*, 322(10):891–921, 1905. ISSN 1521-3889. doi: https://doi.org/10.1002/andp.19053221004. Wiley Online Library.

Albert Einstein. Induktion and Deduktion in der Physik. *Berliner Tageblatt and Handelszeitung*, page Suppl. 4, December 1919. URL `https://einsteinpapers.press.princeton.edu/vol7-trans/124`. Berliner Tageblatt and Handelszeitung.

R. A. Fisher. XV.—The Correlation between Relatives on the Supposition of Mendelian Inheritance. *Transactions of The Royal Society of Edinburgh*, 52(2):399–433, 1918. ISSN 2053-5945, 0080-4568. doi: 10.1017/S0080456800012163. URL `https://www.cambridge.org/core/journals/earth-and-environmental-science-transactions-of-royal-society-of-edinburgh/article/xvthe-correlation-between-relatives-on-the-supposition-of-mendelian-inheritance/A60675052E0FB78C561F66C670BC75DE`. Publisher: Royal Society of Edinburgh Scotland Foundation.

Heisenberg, Werner Karl. Über den anschaulichen Inhalt der quantentheoretischen Kinematik und Mechanik. *Zeitschrift für Physik*, 43(3):172–198, March 1927. ISSN 0044-3328. doi: 10.1007/BF01397280. URL `https://doi.org/10.1007/BF01397280`. Springer.

Danian Hu. *China and Albert Einstein: the reception of the physicist and his theory in China 1917-1979*. Harvard University Press, Cambridge, MA, 2005. ISBN 978-0-674-01538-8.

Ralph Henry Johnson and J. Anthony Blair. *Logical Self-Defense*. Mcgraw-Hill, Toronto, Canada, 1977. ISBN 0070823480.

Earle Hesse Kennard. Zur quantenmechanik einfacher bewegungstypen. *Zeitschrift für Physik*, 44(4):326–352, 1927. Springer.

Andreĭ Nikolaevich Kolmogorov. *Foundations of the theory of probability*. Chelsea Publishing Company, New York, second english edition. translated by nathan morrison edition, 1956. ISBN 978-0-486-82159-7.

Popper, Karl Raimund. *Conjectures and Refutations: The Growth of Scientific Knowledge*. Routledge, London ; New York, Überarb. a edition, May 2002. ISBN 978-0-415-28594-0.

Erwin Rudolf Josef Alexander Schrödinger. Discussion of probability relations between separated systems. In *Mathematical Proceedings of the Cambridge Philosophical Society*, volume 31, pages 555–563. Cambridge University Press, 1935. Cambridge University Press.

J. v. Uspensky. *Introduction To Mathematical Probability*. McGraw-Hill Company, New York (USA), 1937. Free full text: archive.org, San Francisco, CA 94118, USA.

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I was born October, 1st 1961 in Novo Selo, Bosnia and Herzegovina, former Yogoslavia. I am of Croatian origin. From 1982-1989 C.E., I studied human medicine at the University of Hamburg, Germany. Meanwhile, I am working as a specialist of internal medicine. My basic field of research since my high school days at the Wirtschaftsgymnasium Bruchsal, Baden Württemberg, Germany is the mathematization of the relationship between a cause and an effect valid without any restriction under any circumstances including the conditions of classical logic, probability theory, quantum mechanics, special and general theory of relativity, human medicine et cetera. I endeavour to investigate positions of quantum mechanics, relativity theory, mathematics et cetera, only insofar as these positions put into question or endanger **the general validity of the principle of causality**.

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