

Quantum Approaches to Consciousness

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- 3 Quantum Mind
- 4 Dual-Aspect Monism
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Three Ways to Use Quantum Theory

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- quantum physics in brain activity:
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- plato.stanford.edu/entries/qt-consciousness/

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- **Entanglement:**
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complement \neq negation, tertium datur
- All three of them are formal concepts and independent of their target application.

QUANTUM BRAIN

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(Wigner 1967, Stapp 1993, 2007, 2015)
- quantum processes at the synaptic cleft
(Beck/Eccles 1992, Beck 2001, Fisher 2015)
- quantum processes in microtubuli
(Penrose 1989, Penrose/Hameroff 1996, 2014, Sahu et al. 2013,
Craddock et al. 2017, Li et al. 2018, Burdick et al. 2019)

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- each reduction of such a state is an **elementary act of (proto-) consciousness**
- many such acts are **collectively orchestrated to yield human consciousness**

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- pieces of support through **recent results (theor./exp.)**:
decoherence times long enough for cognitive relevance
quantum effects in microtubules (vibrations, conductivity)
microtubular processes are affected by anesthetics
anesthetics in microtubuli can cause memory disorders

QUANTUM MIND

Observational processes are **interactions** of an observing system O with an observed system S (state ψ , observables A, B, \dots):

- (i) weak interaction: no significant effect of O on S ,
- (ii) strong interaction: effect of O on S makes a difference.

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Physics:

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Psychology:

Almost every action of O entails a significant effect on S .
Non-commutativity is the rule rather than the exception.

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(Gabora/Aerts 2002, 2009, Bruza et al. 2015)
- bistable perception, temporal nonlocality
(HA et al. 2004, 2008, HA/Filk 2010, 2013)

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- observables are questions, answers are measurement results
- binary questions: two states
 n -scaled questions: n states
- asking a question (typically) changes the subject's state
- responding to a question (typically) changes the subject's state
 - strong measurement interaction
 - observables do not commute
 - order effects to be expected

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Wang et al. (2014): **QQ covariance for 70 samples.**
- **Bradburn 1992**: One of the factors that inhibited our progress in understanding order effects has been the lack of a theoretical structure within which to investigate the mechanisms by which they might occur.

DUAL-ASPECT MONISM

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- for a comprehensive account of version 2 see: **Atmanspacher and Rickles 2022**

Motivation by Analogy

quantum
physics

$$\Phi_1 \text{ — } \textit{acausal correlation} \text{ — } \Phi_2$$

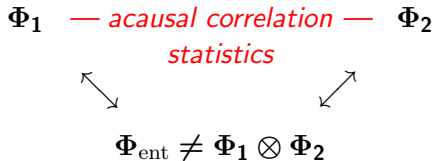
statistics

The diagram illustrates the concept of acausal correlation. At the top, two states, Φ_1 and Φ_2 , are connected by a horizontal line. Above this line, the text "acausal correlation" is written in red. Below the line, the word "statistics" is also written in red. Two diagonal arrows point downwards from Φ_1 and Φ_2 towards a central equation. The equation states that the entangled state Φ_{ent} is not equal to the tensor product of the two individual states, $\Phi_1 \otimes \Phi_2$.

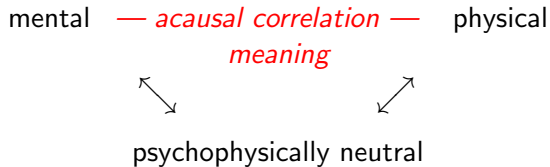
$$\Phi_{\text{ent}} \neq \Phi_1 \otimes \Phi_2$$

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- P → how to conceive and operationalize **meaning**?
- P → how to characterize the **psychophysically neutral**?

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