Quantum versus classical physics and their possible relationship to cognitive phenomena such as music

http://tph.tuwien.ac.at/~svozil/publ/2021-CICC-DICTA-PIA-UTalca-pres.pdf

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Scientific modelling – a caveat

The bigger question wrt scientific modelling is that of what is an acceptance “truth” or “fact”.

Often issues are multi-layered and appear to be an ambiguous, even inconsistent patchwork rather than a consistently woven carpet.

We have in our minds a model, a narrative – Hertz calls it an “image” – of the world. This model is rather stable in many areas, and weakly determined and sketchy in others. It is based on our own experience, on deductive reasoning relative to believes in grounding axioms, and on acceptance of “ecclesial authority”.

Usually it is easy to corroborate or falsify certain junks of this model, in particular, if phenomena are empirically reproducible: think of “switching on the lights”.

Scientific modelling – a caveat cntd.

But there exist other situations when certain phenomena are not reproducible at will; or lack what we consider "explanation" (telos) or appear to be confusing and contradictory.

Think of ball lighting, or certain astronomical events – such as meteorites or gamma-ray bursts – which occur sporadically and cannot be (re)produced, which took some time to enter science proper.

When it comes to claims of ESP or UFO/UAP/AAP the situation gets blended with personal emotions, anxieties and even evangelical aspirations.

This is also true for "interpretations" of the quantum mechanical formalism. In particular, beware of the quantum "hocus pocus"!

And keep in mind that all theories are temporal, and science is a historic process far from "completion".

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- state evolution is a generalized (unitary) permutation/rotation of some orthonormal basis aka "frame" into another one;
- probability is defined in terms of generalized projections (Gleason's "derivation of the Born rule): take a state vector $|\psi\rangle$, take some elementary observable $|\phi\rangle$, then the probability of the occurrence (frequentist)/expectation (Bayesian) of observable ϕ given ψ is $|\langle\phi \mid \psi\rangle|^2$, where $\langle\cdot \mid \cdot\rangle$ stands for the scalar/inner product.

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- Wrt the basis/frame in which $|\psi\rangle$ is an element, the quantized system is value definite: any measurement of $|\psi\rangle$ yields $|\psi\rangle$ with certainty;
- Wrt the continuum of other bases/frames in which $|\psi\rangle$ is not an element, the quantized system is value **in**definite: any measurement of $|\psi\rangle$ yields the occurence of $|b_i\rangle$ given $|\psi\rangle$ with the respective frequency/expectation $|\langle b_i \mid \psi\rangle|^2$; and because of Pythagoras & exclusivity & completeness $\sum_i |\langle b_i \mid \psi\rangle|^2 = 1$.

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- Entangled states lack individual value definiteness of its constituent (particle) parts;
- Entangled states show value definiteness wrt relational properties, such as, for instance in one (the singlet) of the Bell basis states $|\Psi^-\rangle = \frac{1}{\sqrt{2}}(|+_1 -_2\rangle - |-_1 +_2\rangle)$ "one particle has opposite spin/polarization wrt the other particle in all spatial directions"; any constituent particle has a 50:50 chance to be in either state $|+\rangle$ or $|-\rangle$.

Brains are quantized

Just like “classical” computers, (human) brains are ultimately – that is, on the “deepest level” (cf Anderson) of physical description – quantized physical systems.

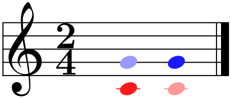
Whether quantization – and, in particular, coherent superpositions and entanglement – play an important part in cognition is a question of huge importance.

It can be either seen as deficiancy (lack of value definiteness) or as an opportunity.

Music as a quantum cognitive process

Quantum music (cf Putz & Svozil `https://doi.org/10.1007/s00500-015-1835-x`) may present more freedom due to multiplicity of expression; in particular,

- superposition:



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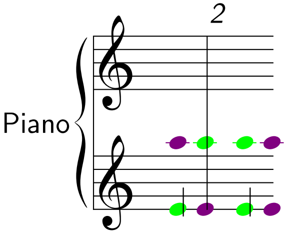

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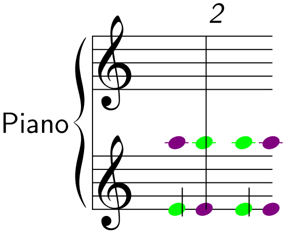
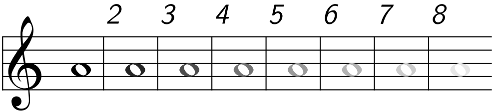


- complementarity



Thank you for your attention!