COHERENTISM COMPLICATES COMPOSITION; MONISM MINIMIZES MYSTERY

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This work forms part of the project A Framework for Metaphysical Explanation in Physics (FraMEPhys), which received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreement no. 757295).
• Explore Calosi & Morganti’s metaphysical coherentism.

• Propose an alternative account of coherentist dependence relations.

• Raise some problems for coherentism more generally.

• Defend holism from Calosi and Morganti’s criticisms.

• Sketch an argument that supports holism over coherentism.
• Schrödinger: entanglement is the characteristic feature of quantum theory.

• Strikingly displayed in Bell correlations: statistical correlations between spacelike separated events that resist a common-cause explanation.

• Debate is at least partially neutral on interpretation of quantum theory.

• Exciting testbed for naturalistic approaches to metaphysics.
METAPHYSICAL COHERENTISM: SUMMARY

• “entangled particles are mutually ontologically dependent—this being understood in the sense that physical objects are fundamental and at the same time constitutively dependent on each other.” (Calosi & Morganti p.35)

• For coherentists, entanglement consists of dependence relations that are:
  • Symmetric
  • Non-mereological
  • Identity-determining
  • Property-determining
METAPHYSICAL COHERENTISM: DEPENDENCE

• The sort of dependence Calosi and Morganti have in mind is Kit Fine’s essential dependence.
  • “the existence of the latter (as the very entity it is) is a necessary condition for the existence of the former (as the very entity it is)” (ibid. p.9)

• The notion of essence is controversial even within in metaphysics, so we may wonder if it’s a wise choice for understanding quantum entanglement.

• In particular, essential dependence brings in awkward questions about identity and essence that maybe are better avoided.
A peculiar feature of Calosi and Morganti’s coherentism: when two particles interact and become entangled, their essence changes.

Since essences characterize what a thing is, the entangled objects after the interaction are different objects from the non-entangled objects before it.

A dilemma for essentialist coherentists:
- Either: we have temporary, contingent, identities and distinctnesses amongst things. What logic do Calosi and Morganti propose to make sense of that?
- Or: no object ever survives becoming entangled; new objects exist instead.
METAPHYSICAL COHERENTISM: GROUNDING

• An alternative option here is metaphysical grounding between facts:
  • A’s being F depends on B’s being G (and vice versa).
  • A is measured x-spin-up because B is measured x-spin-down (and vice versa).

• Symmetric grounding has been explored in recent work (Thompson, Bliss).

• A major advantage of theorizing in terms of grounding: we can leave the identity and essence of the objects out of the picture.
  • We have the same objects before and after an interaction, but with new dependencies between their properties.
METAPHYSICAL COHERENTISM: GROUNDING-THEORETIC OPTIONS

• Calosi and Morganti actually use grounding terminology in a footnote:
  • “Using the grounding terminology for just a moment, the claim is not, say, 'a grounds b', but rather 'the fact that a exists and possesses features P, Q, ..., S grounds the fact that b exists and possesses features W, X, ..., Z, where P, Q, ... X, and Z stand for the qualitative profile of a and b.” (ibid p.10)

• But this approach still makes the existence of objects dependent on one another, and makes them subject to the dilemma I have outlined.

• Why not just formulate the view in terms of grounding between property instances (conceived as facts, states of affairs, or tropes?)
Where we have symmetric dependence, there is a threat of circular explanation. Avoiding this presents another dilemma:

- Either we now have reflexive dependence:
  - A depends on itself, by depending on B which depends on A.

- Or dependence is non-transitive:
  - A depends on B, and B depends on A, but A doesn’t depend on A.

Both options look worrisome: which do Calosi and Morganti prefer?
METAPHYSICAL COHERENTISM: HIERARCHY REDUX?

• Calosi and Morganti reject the familiar picture of reality as ordered in a vertical hierarchy of metaphysical dependence relations.

• But why? Nothing in the picture seems to rule out the dependency of (say) temperatures of gases on facts about the fundamental level.

• Better to say that at the fundamental level, all dependencies are horizontal.
  • But this is common ground with views that posit no such dependencies at all!

• Final worry: how to distinguish horizontal from vertical in a relativistic setting, or indeed in an emergent spacetime setting?
Where spacelike separated measurements are performed on entangled particles, the order of the measurement becomes frame-dependent.

This is a special problem for causal accounts of Bell correlations.
- Faster-than light signals are needed to mediate the causal connection.
- The direction of causation becomes frame-dependent.

Metaphysical coherentists however are still faced by this problem:
- Does measuring A x-spin-up cause B to be measured x-spin-down, or vice versa?
- Even though the dependency isn’t itself mediated by any signal, there is still a causal relation between the measurements.
Calosi and Morganti remark that their project is motivated by Hume’s dictum: no necessary connections between distinct existences. (ibid p.3)

They suggest that this necessity be understood as nomological, but the account they give seems to render it as metaphysical necessity: essences are usually considered to constrain metaphysical possibilities for things.

Of course there is a much simpler way to preserve Hume’s dictum: a Humean account of entanglement!
COMPARISON: HUMEAN APPROACHES

- A simple Humean approach denies the reality of entanglement connections, regarding them as merely nomological constraints.
  - This is the approach of ‘super-Humeans’ such as Callender, Esfeld, Miller.

- A sophisticated Humean approach recognizes entanglement connections and regards them as new primitive external relations.
  - Like spatiotemporal relations (cf. the triangle inequality), entanglement relations constrain possibilities and are not reducible to intrinsic properties of the relata.

- A question for Calosi & Morganti: what advantages does metaphysical coherentism have over sophisticated Humeanism?
In what seems to be the ‘official’ statement of Calosi and Morganti’s view, there is an additional dependence claim:

- “a, b, c, … n and their properties collectively ground the whole or plurality P with such and such properties (the entangled system), and the latter makes it possible for a, b, c, … , n to exist and/or to exemplify certain properties/relations” (ibid p.36)

What is the nature of this ‘making it possible’?

- It looks like a symmetric holism: essential dependence on the whole system, which at the same time is collectively grounded in the parts.

If so, then metaphysical coherentism turns out to be a version of holism!
HOLISM / MONISM: FALSE BECAUSE ANTI-INTUITIVE?

• “the cost of not attributing seemingly fundamental properties such as, say, the minimal amount of electric charge to what intuitively would look as their natural bearers, such as point-like particles.” (ibid. p.23)

• But we already know that the intuitive picture is false in quantum field theory!
  • Bosons are uncontroversially modes of excitation of a field.
  • Fermions in all likelihood are also.
  • Even spacetime is potentially reducible to excitations of some fundamental field.

• In the quantum-field-theoretic setting, our intuitive attachment to particles with intrinsic monadic properties looks quaint at best.
• Calosi and Morganti formulate holism using the notion of proper parthood (ibid. p.14).

• I suggest replacing the whole/part distinction with system/subsystem.

• Especially in the case of quantum field theory where objects and even spacetime may be emergent, it is unwise to tie holism to familiar metaphysical mereology.

• Instead, for holists everything is grounded in the universal quantum state: the most inclusive system rather than the mereological sum of everything.
MAKING SENSE OF HOLISM

- Calosi and Morganti criticise holist descriptions as opaque:
  - “On the other hand, the holist reading seems less satisfactory, for it should say something like ‘the whole is one metre long, and this is prior to the existence of two parts that are one metre apart from each other’, which is far from transparent.” (ibid. p.24)

- Holist account of state (19): there is a quantum system that decomposes into two subsystems such that their spins and locations are opposite.

- Holist account of state (20): there is a quantum system that decomposes into four subsystems such that they are ordered on the x-axis.
Holism always provides a clear underlying picture: a function on the high-dimensional state space.

Antisymmetric wavefunction for a (fermionic) 2-particle state in an infinite square well potential.

(source: Wikimedia)
HOLISM/MONISM: DEFENDING WAVEFUNCTION REALISM

- “The holist owes us a story concerning the connection between the whole in configuration space and the local objects, properties and facts that we experience” (ibid p.26-27)

- Response: no special problem for the holist/monist here! The preferred basis problem is your problem too.

- Any move to privilege e.g. 3-space in a normal metaphysics can be mirrored by the wavefunction realist.
  - e.g. relying on naturalness and/or best-systematizing.
HOLISM/MONISM: SPACETIME STATE REALISM

• A popular alternative to wavefunction realism: spacetime state realism (Wallace and Timpson).

• Quantum theory is about spacetime regions bearing quantum states.
  • Holist version of spacetime state realism: two entangled spacetime regions depend on the union of the two regions.
  • Monist version of spacetime state realism: fundamental object: the whole of spacetime.

• Deciding between the wavefunction realist and spacetime state realist options will probably have to draw on a future theory of quantum gravity.
HOLISM / MONISM:
CAPTURING DILUTION/DISTILLATION

• “Equation (21) entails that 1 depends rigidly on 12, not on 1234.” (ibid. p.28)

• Response: dependence is transitive, so these are not exclusive options.
  • The monism derives from the quest to to find an ultimate ground.

• In distillation and dilution the patterns of dependencies amongst the subsystems rearranges, but the whole system is still the source of them.
  • There’s no information lost here!

• In any case: nothing ever completely disentangles itself with everything else in a realistic quantum cosmology.
Recall that coherentism faces problems with making the identity of subsystems contingent on what entanglement relations they stand in.

Fundamental entities either have temporary and contingent identity, or fail to persist through entangling / disentangling interactions.

Monist holism on the other hand can handle this kind of situation very nicely.
- The identity of nothing at the fundamental level ever changes.
- All we have in entangling interactions is a change in higher-level ontology, analogous to clouds or eddies coming into and out of existence.
HOLISM/MONISM: COMMON GROUNDS

• So: why endorse holism in the first place?

• Schaffer/Ismael ‘master argument’:
  • As common cause explanations are methodologically superior to ad-hoc direct causal connections, so common ground explanations are methodologically superior to ad hoc direct grounding connections.

• Only if a common ground explanation is unavailable should we resort to direct grounding explanations.
VIRTUES OF COMMON GROUND

• Comparison - temperature and pressure of a gas.
  • Any gas with a temperature also has a pressure.
  • Any gas with a pressure also has a temperature
  • What explains this?

• One option: temperature and pressure for a gas are mutually dependent.
  • The gas has a temperature because it has a pressure, and vice versa.

• A better option: temperature and pressure have a common ground.
  • The gas has temperature and pressure because of underlying molecular motion.
CONCLUSION

• Calosi and Morganti could make use of grounding theory to avoid some problematic features of their coherentism, and to make it more flexible.

• Metaphysical coherentism faces concerns arising from:
  • Special relativity
  • Contingent identity / failures of persistence
  • Circular explanations
  • Shadows of holism

• Holism is defensible, ontologically flexible, and methodologically preferable to coherentism.