Protecting cognitive scientists from quantum theory

I find myself in close agreement with Ross and Spurrett (R&S) in the main claims of their paper; I shall confine my comments to some observations about the role which physics plays in their discussion.

R&S rightly criticise Kim's mereological definition of macroproperty for a general term like "water", but the criticism can be sharpened: even a particular object like a table cannot really be regarded as a simple composite of non-overlapping microscopic parts. It's a tempting idea, to be sure: an extended body is just the mereological sum of its top and bottom halves, so why not subdivide indefinitely until we get to the microconstituents? But a solid object is a cloud of vastly many overlapping electron and nucleon wavefunctions: it's not clear even what is *meant* by which electron is in which spatial subregion of the object. There are ways around this problem, but they rely on dangerously strong assumptions about the present or future state of physics. (There are interpretations of quantum mechanics, for instance (Bohm 1960) in which particles are something like the tiny billiard-balls which philosophers treat them as – but do we really want to rest our ontology on contentious claims in quantum mechanics?)

Furthermore, even the paradigmatically "physical" properties of the object are defined not in terms of the microconstituents, but dispositionally – even the mass(!) of a solid object can't really be defined as the sum of the masses of its atomic constituents. That algorithm gets the answer nearly right in most cases - but a helium nucleus weighs about 1% less than its constituents (that's why fusion works); a neutron star weighs about 10% less (Arnett 1996) than its constituents (that's why supernovas work). Our actual definition of mass is dispositional: something has mass *m* if it behaves thus-and-so on the scales, or creates such-and-such a gravitational field. It's not definitional that mass is additive; it's a physical law, and only an approximate one at that.

This raises the stakes a bit, I think. R&S argue that Kim's account cannot correctly handle the natural kinds of the special sciences. But it's actually worse: the account (I'm claiming) correctly handles *hardly any macroproperty at all.*

This makes the pattern-based view of ontology espoused by Dennett (1991), and defended by R&S, very attractive. Of course, there must be some sense in which macroscopic objects are built out of microscopic constituents, and in which their are indeed supervenient on the properties of the constituents. Dennett, by regarding macro-objects as *patterns in* the micro-ontology, rather than *mereological sums of* that micro-ontology, provides the sort of account of compositionality which is not hostage to contentious or downright false pictures of physics.

But of course, if such an account is adopted for the whole of macro-ontology then mental states are real in the same way that tables are real, and the causal power of the mental stands and falls with the causal power of almost everything. This would be close to a *reductio* of Kim's argument: if we are sure of anything about causation, we are sure that macroscopic objects causally influence other macroscopic objects. *Maybe* there is some

esoteric notion of "causation" which applies only to the ultimate microconstituents of nature, but that notion can have little to do with "mental causation" as ordinarily understood.

Having supported R&S thus far, I wish to make one cautionary remark about their project. At times, R&S write as though the goal of a pattern ontology is to find, once and for all, the correct notion of substrate, and then define real patterns as patterns in that substrate. (This seems to be the context for their approving citation of Nottale's "fractal spacetime" work.) This I find dangerous: it bets our metaphysical structure on the current state of fundamental physics, despite the fact that fundamental physics frequently changes. Are "real patterns" patterns in particle distributions? Then we implicitly bet against an underlying field ontology in which particles themselves are patterns. Are "real patterns" patterns in the distribution of properties over spacetime? Then we implicitly bet that spacetime is fundamental (*contra* the views of many workers in quantum gravity) and that its role in fundamental physics is roughly the same as its role in classical physics (*contra* at least some interpretations of quantum mechanics, such as the many-worlds theory (see Wallace 2003)). The danger is only heightened if we try to base metaphysics on speculative physics such as Nottale's.

One way around this problem may be to look for a sufficiently abstract characterisation of pattern as to be immune to revisions in microphysics. R&S's proposed information-theoretic approach may well succeed here, though I worry about its appeal to thermodynamic concepts like entropy: thermodynamics itself is an emergent phenomenon, so there is some danger of circularity here. Another, more modest, proposal, would be to adopt a hierarchical view of pattern ontology: if we accept some stuff into our ontology, we should also accept patterns in that stuff. If the stuff itself turns out to be patterns in sub-stuff, so be it. Thus particles are patterns in the quantum field, humans are patterns in the particles, stock-market crashes are patterns in the people, etc. Such an metaphysics would be robust against, and relatively uninterested in, the discovery that the quantum field itself is just a pattern in something deeper.

My intention in this Response is not to argue that cognitive scientists and philosophers of psychology should add quantum mechanics to the already formidable range of disciplines that they are required to learn. In a sense, the reverse is true: modern physics is so alien, and so changeable, that unless metaphysics is to be postponed until a completed physics is available then we need an ontology of macroscopic objects which is largely independent of microphysical detail. Surely such an ontology exists: the hard-won generalisations of psychology or economics cannot plausibly be hostage to details of spacetime structure at scales of 10^{-25} metres. But it is surprising how many superficially innocuous metaphysical ideas actually fail this test of independence.

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