Emergence: laws and properties.
(On Noordhof)

Simone Gozzano
Università di L'Aquila - Italy

Any philosopher who wants to avoid reductive physicalism, while maintaining a form of physicalism, is committed to defend the following three theses:

1) Mental properties are different from physical properties (hence not reducible to them)
2) Mental properties are causally efficacious (so not epiphenomenal)
3) There is no systematic causal overdetermination between mental and physical properties.

However, holding these three theses has proved to be difficult, because:

A) 1 *and* 2 run against the so-called Principle of Causal Closure of the physical domain, according to which if a physical event has a cause at time *t* it has a physical cause at time *t*, and

B) 1 *and* 2 *and* 3 may condemn physical properties to epiphenomenalism since if on a given type of causal relation mental properties are efficacious (by 2) and different from the physical properties occurring at that type of causal relation (by 1) and there is no systematic overdetermination in that type of causal relation (by 3), then physical properties are causally inert on that type of causal relation.

One way to solve at least problem A, consists in construing mental properties as emerging from physical properties. Emergent properties have to be causally efficacious and different from the properties on which they emerge. This is a very minimal requirement on emergent properties, so it is important to provide further characterizations of them, and one of the main goal of the paper by Noordhof is how to individuate emergent properties, an issue that originates from the three theses stated at the outset of this comment. My aim in this comment is to provide a sketch of Noordhof's strategy (section 1), to evaluate how it fares with other emergentists approaches (section 2) and to set some sceptical remarks on its viability (section 3).

1 *Noordhof's main points*

To begin with, Noordhof distinguishes between narrowly physical properties, those identified by physical sciences and mentioned in strict laws of the form (x) Fx → Gx, and broadly physical properties, that stand in some relation to the narrow ones. Emergent properties could be broadly physical, with respect to some set of narrow physical properties, or may fail to supervene on the narrowly physical. However, emergent properties will be determined by the narrowly physical ones, and the central question is whether the properties so determined are *new* in any sense or not. Emergentists think they are while nonreductive materialists deny this, and Noordhof thinks that the contrast between these two view can be traced in different construal of his preferred formulation of Strong Supervenience (thesis **S**).[1]

Let's say that A-properties strongly supervene on B-properties just in case:

(**S**): □ (x) (F) (Fx *and* F∈ A → (∃G) (Gx *and* G∈ B) *and* □ (y) (Gy → Fy))

That is: necessarily, if x has F and F belongs to properties of level A then there is a property G, belonging to level B, such that x has G and necessarily if anything has G it has F. Now, the crucial problem is how to interpret the modal operators of necessity, that is, if one has to read them in the nomological ($\Box_n$) or in the metaphysical ($\Box_m$) reading. If one is taking the following reading of the modal operator s/he is committed to non reductive physicalism:

[1] This way of expressing strong supervenience is due to Kim (1984), but see Horgan (1982) for a similar formulation.

(nRP-**S**): $\Box_n$ (x) (F) (Fx *and* F∈A → (∃G) (Gx *and* G∈B) *and* $\Box_m$ (y) (Gy → Fy))

If one is taking the following reading s/he is committed to emergent (property) dualism

(ED-**S**): $\Box_n$ (x) (F) (Fx *and* F∈A → (∃G) (Gx *and* G∈B) *and* $\Box_n$ (y) (Gy → Fy))

Both nRP-**S** and ED-**S** are ways to make explicit thesis 1. However, holding **S** in either form, but in particular in the ED reading, must be confronted with some objections, such as the view that properties are individuated through causal roles and the causal theory of properties. Noordhof thinks he can resist the attacks, but another problem that lures behind **S** is how it fares with the counterfactual theory of property instance causation. Noordhof admits that it seems that emergent properties fares better than broadly physical properties.

The counterfactual theory, though, is construed for instances of property causation. If it can be generalized, it would show that are properties as such, and not their instances, that are efficacious (meeting thesis 2 above). If a property is a supervenient one (not narrow), then its efficacy must be preserved in the passage from token to type. To this end the Transmission of Causality principle must hold:

(**TC**): if an instance of A(p_i, p_{i+1}, p_{i+2} …) is a cause of *e* and $\Box_m$ (x) (A(p_i, p_{i+1}, p_{i+2} …)*x* →bp) then the instantiation of bp is a cause of *e*

TC is supported by consideration involving micro-macro relations and, to some extent, determinables-determinate relations with respect to property causation. As with thesis **S**, Noordhof provides a defence of the import such a relation has on causation in general. The purpose of **TC**, as it is defended in the paper, is to support the view that determinates' efficacy is derived from that of their determinables (p. 27) However, the relation is tighter than this, so Noordhof qualifies it with a requirement that has to preserve efficacy while allowing for generality. This is the minimal base requirement: in a nutshell, a property F causes a property G just in case the minimal supervenience-base of F causes the minimal supervenience-base of G in some causal circumstances C. If such a requirement is met, then the flowing of causal efficacy is secured at each occasion by a different minimal supervenience-base, so the only way to preserve property causation is to consider the macro-property (determinable), instead of the micro-realizers of it (determinate property).

As a final point, Noordhof argues that emergent properties and emergent causation are partially independent on each other: if there are emergent properties in causal relation then there is emergent causation; however, if there is emergent causation there should not necessarily be emergent properties.

2 *Emergentism*

Noordhof main concern is to qualify the modal operators of the supervenience thesis, a crucial step of clarification, as it has already been noted by Lewis (1986). Kim (1984) recognizes that specifying such point is an important hallmark of any supervenience thesis: "different reading of the modal terms will generate different supervenience theses" (p. 166). On the same score Stalnaker (1996) stresses that the force of the concept of necessity has direct consequences on the force of the reductionist thesis. The difference between nRP-**S** and ED-**S** reduces to different views of the second modal operator: metaphysical or nomological necessity? Let's consider ED-**S**. Since in it both operators have the same strength, it is possible to operate the following derivation, made explicit by Kim:

"If A strongly supervenes on B, then for each property F in A there is a property G in B such that necessarily (x) (Gx↔Fx), that is, every A-property has a *necessary coextension* in B." (Kim 1984, pp. 170)

Here the necessity is nomological, so every A-property has a nomologically necessary coextension in B. Some emergentists are willing to accept such a consequence. Beckermann, for instance, notes that Broad was one of them: "… according to Broad, emergent properties must strongly supervene on microstructural properties. For otherwise the presence of such properties could in no way be explained by reference to the corresponding microstructure" (Beckermann 1992, p. 103) but this does not entail that emergent properties can be deduced from the complete knowledge of the microstructure, and this is the crucial feature of emergent properties according to Broad. So, if **S** is accepted for this reason, emergence would be nothing but an epistemical feature, and the ontological difference between mental and physical properties is lost.

At the opposite end of the emergentists spectrum there is Humphreys (1997) who takes emergent properties to be the product of physical fusion processes, which cannot be captured by any supervenience relation. His positive example is quantum entaglement, where the state of the compound system determines the states of the constituents. However, it must be said, Humpherys makes explicit appeal to our ignorance, because he cannot be sure that such a case is relevant for the main reason emergent properties are discussed: that is, the mental (Perhaps, Penrose could use such a strategy).

Others, O'Connor and Wong (2005), who figure among the polemical targets of Noordhof, isolate emergent properties as those properties that are wholly nonstructural, that is, that cannot be analysed in decompositional terms. These properties are basic of composite individuals. Their strategy is somewhat analogous to that of Humphreys, in that both deny that emergent properties strongly supervene on basic properties. They diverge in that O'Connor and Wong accept global supervenience, whose autonomy from strong supervenience has been proved by Paull and Sider (1992). So, some emergentists reject Noordhof's strategy from the beginning. It is on Noordhof to show that they cannot escape to agree on strong supervenience in the nomological reading.

3 *Laws and properties*

In case of nRP reading of thesis **S**, the derivation presented by Kim should be strengthened, if metaphysical necessity entails nomological necessity (something I would like to leave open). In that case, in fact, there is nomologically necessary coestension *and* the supervenient properties are the metaphysically necessary condition for the subvenient ones (remember, the second part of thesis **S** states that (y) $Gy \rightarrow Fy$).

This construal of the supervenience relation is, in Noordhof's view, consistent with the inclusion, in the supervenience base, of laws concerning narrow causal properties, a qualification imposed by objections concerning ED-**S** with respect to the supervenient base. As he says: "The supervenience base should not just include narrowly physical properties causes but also any laws concerning them alone" (p. 7). It should be kept in mind that this is the weaker reading of **S**, so such qualification holds *a fortiori* for the stronger case.

The relation between properties and laws is a crucial one in devising whether there are emergent properties, because the individuation conditions of properties can be, in some interpretation of them, interdependent on scientific laws. In particular, I would like to cast some doubts on Noordhof's idea of having laws in the supervenience base. As you may remember, the second conjunct of strong supervenience states that there can not be variations in the supervenient properties without variations in the subvenient ones. Suppose there is a supervenient variation and we accept Noordhof qualification: then either there are variations in the subvenient properties, or in the subvenient laws, or in both. The only way in which there can be interesting variations in the subvenient laws is by having modifications in what they state (Taking laws to be universally quantified expressions of the form $(x)\ (Px \rightarrow Qx)$). But if there are such modifications, then the supervenience base is changed and the supervenient relation is not secured any more. For, suppose that the mass of an object has changed. Then, there must be changes in the masses of its parts, or in their relations or, Noordhof ads, in one of the laws concerning mass. However, it is in virtue of what

these laws state that we can figure it out whether there have been changes in the mass of the whole object or in any of its parts. So, if laws are in the supervenience base these cannot be taken for granted any more, and the supervenience relation is lost.

The relation between laws and properties surfaces again, as an annoying thorn in Noordhof's reasoning, when he defends his demarcation against the causal theory of properties by appealing to counterpart relations. He says that as the shape of a particular is intrinsic to it even if it is accidental, given that that very particular may have different shapes in other worlds, so "by the same token we can allow that the laws are intrinsic to a property, while the causal role for which they are responsible is accidental, because it is counterparts to that property which possess different causal roles in different worlds" (p. 9). Now, I think that we can accept the intrinsic/accidental distinction with respect to particulars only on the background of a more robust view of laws.

Consider an object O: it has spherical shape in virtue of its atomic or molecular structure. So, it is intrinsic to it to have a shape, even if it is accidentally spherical. However, if causal roles are somewhat disconnected from the laws that intrinsically applies to a particular, then it is possible that in other possible worlds the laws governing the causal roles of the atoms and molecules that compose object O are such to determine the causal role typical of gases. So shape cannot be counted as one of O's intrinsic properties any more, and the distinction between O's intrinsic and accidental properties is lost, given that a property is intrinsic if it is invariant under possible worlds' transformations.

The importance of this point with respect to the general issue of emergentism can be made clear in some other ways. One of the common intuition behind the idea of emergence, is the view that a property is emergent if it is somewhat *new*, an idea that Noordhof himself embraces. For instance, when my daughter was born, she was the bearer of many new properties: her DNA token have never been manifested before. Hardly any emergentist would be satisfied by considering her never expressed DNA as an interesting instance of an emergent property. Now, suppose she, for the first time in human kind, was born with the left iris partially blue and partially yellow. This bi-coloured iris has some specific causal powers: it reflects light thus and so, causes her some excitement in sunny days and bad mood in the cloudy ones. Such a property would be a new type of property, but it would not satisfy the emergentist, I dare to say, for two reasons. First, even if new it would be the result of the combination of known properties, not an entirely new manifestation. Secondly, having a bi-coloured iris is an unstable property, one that we do not know how to have again, a result by chance, so to say. These two features can be considered as prominent in the analysis of property emergence: an emergence property is a *stable* and *new* property, but this is not enough.

One possibility is to conceive novelty in terms of unpredictability, but this cannot be the case. Lottery results are typically unpredictable, though not unexpectable given that, say, the winning number is included in the set ranging from 1 to 90. Another option, advanced by Chalmers, insists on the notion of deducibility. Here is Chalmers: "We can say that a high-level phenomenon is *strongly emergent* with respect to a low-level domain when the high-level phenomenon arises from the low-level domain, but truths concerning that phenomenon are not *deducible* even in principle from truths in the low-level domain" (Chalmers 2006, p. 244). Here is quite important to have the notion of level clearly formulated, as otherwise there are important counterexamples to such a view. The reason why it is necessary to clarify such a notion is that Chalmers characterizes weak emergence, as opposed to strong emergence, just as the unexpectability of high level phenomena given the principles governing the low-level domain from which they arise. Clearly, as the case of my daughter left iris shows, weak emergence does not entail strong emergence, as Chalmers himself notes. So, the sense in which a phenomenon is weakly or strongly emergent is equivalent to it not being expectable or deducible, respectively, given the contrast between low-level domain and high-level phenomena. How should we consider levels here?

Consider what happened when Neptune was discovered. Newtonian laws of motion plus the initial conditions of the heavenly bodies whose presence was recorded at the time did not allow the

deduction of the orbit of Uranus. It needed further facts, that is, the hypothesis concerning the presence of another planet behind it, Neptune. Clearly, we are facing phenomena that are at the same level, in a very intuitive sense, but not everybody would agree with such a notion.[2] This seems to force toward major strength in the definition by saying something like: not deducible from a complete knowledge of all the relevant facts on a given level. So, when Chalmers says: "… if there are phenomena whose existence is not deducible from the facts about the exact distribution of particles and fields throughout space and time (along with the laws of physics), then this suggests that new fundamental laws of nature are needed to explain these phenomena", he says something incomplete. The non deducibility must be from *all* the *relevant* facts. Whether such a conditions entails new laws is a further matter.

The classical view of reduction holds that a theory (A) can be reduced to another theory (B) if it can be deduced from such theory plus bridge laws connecting the terms of the reducing theory (B) to those of the to-be-reduced one (A). How can a phenomenon be declared not deducible with respect to the laws appearing at a lower level if no bridge connection between the phenomenon and the terms comprised in the reducing law can be established? So, we must suppose that such a bridge could be established[3]. This would make the above definition of strong emergence stronger indeed. In fact, the truths concerning the higher-level phenomenon would be not deducible from all the relevant truths concerning the lower-level domain notwithstanding the presence of conditional or (even stronger) bi-conditional statements linking the two domains with respect to the phenomenon. This way of strengthening the definition may prove fatal for the emergence relation.

In the history of science, in fact, the introduction of new fundamental laws is ubiquitous, so would be emergence. For instance, Mendel and subsequently genetic laws are fundamental given the problem they provide an explanation to, but they cannot be derived from any physical laws plus knowledge concerning genetic facts. Moreover, very often new fundamental laws are formulated at lower level that those of the phenomena they have to explain. In order to explain the behaviour of electrons, new fundamental entities, such as quarks and other particles, and laws are introduced at a lower level. The same holds for biological sciences: isolating new diseases triggers the quest for a bio-molecular search. Science, so to say, passes from higher-level phenomena, whatever these are, to lower level laws. None of the previous cases, though, has been considered as a positive example of emergence.

All these considerations apply to the supervenience reading provided in ED-**S**. In fact, as we saw, from that construal was possible to derive that every higher-level property has a necessary nomological coextension in a lower-level property. If this is the case, then there is no ontological novelty in the passage from one level to the next one, at most an epistemological novelty. I wonder whether any emergentists would be satisfied by such a result.

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[2] For instance, not Kim (1998).

[3] I am indebted for this point to Ausonio Marras, whom I thank.

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