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Complementarity cannot resolve the emergence–reduction debate: Reply to Harré

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Abstract Rom Harré thinks that the Emergence–Reduction debate, conceived as a *vertical* problem, is partly ill posed. Even if he doesn't wholly reject the traditional definition of an emergent property as a property of a collection but not of its components, his point is that this definition doesn't exhaust *all* the dimensions of emergence. According to Harré there is another kind (or dimension) of emergence, which we may call—somewhat paradoxically—"horizontal emergence": two properties of a substance are horizontally emergent relative to each other if they cannot be displayed in the same conditions. Contrary to vertical emergence, horizontal emergence is a symmetrical relation. Harré endorses horizontal emergentism. I argue that this position faces a principled difficulty: it makes it impossible to *bind* different horizontally emergent discourses in an interesting way. Physics and biology for example become "island" discourses, each speaking of a distinct kind of entities. The only way to ensure that two different discourses can relate to the same entity is to reintroduce verticality into the picture.

Keywords Affordance · Bohr · Complementarity · Emergence · Harré · Reduction

1 Summary: Bohr's complementarity principle

The keystone of Harré's enterprise is the generalisation of Niels Bohr's Principle of Complementarity, initially from Bohr's interpretation of quantum mechanics, to all scientific discourses. The Principle of Complementarity is a rule that constrains joint ascriptions of certain classes of predicates to the same thing. Two predicates A and B belonging to different classes—being determinates falling under different determinables such as a determinate wave and a determinate particle—are complementary if and only if:

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(1) First, the conditions of manifestation of *A* are *incompatible* with the conditions of manifestation of *B*. For example, something can be a particle under one procedure and a wave under another, but can never be both a wave and a particle in the same procedure. (This is what I call "horizontal" emergence.)
(2) Second, the two complementary predicates give a *complete* description of the thing to which they apply. There is nothing to be known about the thing apart from its complementary properties.

There are then two conditions for complementarity: *incompatibility* of procedures and *completeness* of descriptions. Because of the completeness condition, we may worry about the nature of the "substance" to which complementary predicates are applied. In order to reassure us, Harré introduces the Gibsonian notion of affordance. The same substance affords particles under one procedure and waves under another. These affordances are the only things that we can predicate of it. I shall explain why I am not exactly reassured by this explanation based on affordances. But before going on to some more critical comments, let us take note of a couple of things.

First, it is not always clear to what extent Harré intends to revise the vertical emergent–reduction debate sometimes he seems to want to *dissolve* it in order to replace it with the horizontal debate—which seems to be the case at the beginning of the paper when he speaks of the traditional debate as relying on some grammatical mistake which is to be superseded by Bohr's complementarity—; at other times he seems to be willing to *complement* it with *another dimension* of emergence, namely horizontal (or Bohrian) emergence. Nevertheless, even if we choose the second weak interpretation, it seems clear that Harré considers that there is some form of primacy of horizontal emergence over vertical emergence. I will claim, on the contrary, that we cannot make sense of horizontal emergence without vertical emergence. The priority should be given to vertical emergence.

Second, it is the complementarity principle, more precisely the incompatibility condition, that allows the (partial) dissolution of the vertical version of the reduction and emergence problem. This is because the very formulation of this problem relies on joint ascription of predicates, say, biological and chemical predicates, to the same entity *in the same material conditions*. That is precisely what the incompatibility side of complementarity forbids. Therefore, the question "Are biological properties reducible to chemical ones" has no sense for the upholder of complementarity: we do not have to try to reduce one to the other because each affords in quite different, incompatible, conditions. To attempt the reduction would be as absurd as to try to reduce the colour of a bronze bell under the full moon to the sound it emits when we strike it with a wooden stick.

The reason why Bohr's complementarity is such a powerful weapon against the vertical view of emergence is that it is impossible for a property to be *both* vertically and horizontally emergent relatively to one other property. Then if two properties, predicates or discourses are shown to be in a relation of horizontal emergence, they cannot be in a relation of vertical emergence. The reason is that it is impossible for two entities to enter in a part-whole relation (which is required by vertical emergence) if they never exist together (which is implied by horizontal emergence). This is not to say, however, that one cannot accept both kinds of emergence: let P'' and P' be horizontally emergent from each other, and let P'' and P' be each vertically emergent from P. This is a coherent picture. The point is only that vertical and Bohrian emergences cannot concern the same pairs of properties. Bohr's complementarity can then

be used in a moderate way, for local dissolutions of the old emergence and reduction problem, vertical emergence remaining valid for other areas.

Third, the complementarity principle does not *explicitly* forbid binding different discourses. The incompatibility condition forbids the joint predication of complementary predicates in the *same* experimental procedure, but it allows such predication in *different* procedures. This permissive aspect of the principle allows us for example to bind the discourses of neuroscience and psychology: since properties of organisms and properties of persons are displayed in different procedures, we are entitled to bind them as properties of the same kind of things, in this case human beings. But note that such a binding presupposes our ability to *re-identify* the human being in question from one procedure to another. My main objection will be that *the completeness condition threatens our re-identification ability*.

2 Critical remarks

I come now to some more critical remarks. Harré's argument, I believe, faces a dilemma: either it fails to give an acceptable account of the substance to which complementary predicates are ascribed; or else it succeeds in giving such an account, but in a way that drives us back to the old vertical emergence and reduction problem.

2.1 The intractability of the binding problem

In order to bind two complementary predicates, we need three things: the two complementary predicates and the common substance to which they apply. According to the completeness condition of the complementarity principle, we have no access to the common substance independently of the complementary predicates; thus, knowing when two predicates—or properties—are complementary predicates of the same substance becomes a real problem. I call this problem the "binding problem" (in a different, but not unrelated sense from the binding problem in cognitive sciences). To put it another way, the completeness condition states that the only predicates we can apply to a substance are procedure-dependent, or response-dependent predicates. But the only way we can re-identify a thing between two procedures is by having recourse to a procedure-*independent* description of the thing. Harré says that an organism affords anatomical properties in the context of laboratory and ethological properties when observed in the wild. But how do we know that the thing we observe in the laboratory is the very same as the one we observe in natural conditions? However trivial the question sounds, the fact is that no response will comply with the completeness condition of the complementarity principle. Suppose we say "It's easy to see it's the same organism: it has the same shape or there is a spatiotemporal continuity between the anatomical organism and the ethological one." The reply is clear: we are misleadingly assuming that, switching from one procedure to another, the organism has some reachable constant spatial properties besides its complementary affordances, which clearly violates the completeness condition.

The ability to re-identify a thing through different procedures is necessary if we want to bind incompatible properties in an interesting way. Otherwise, following the complementarity principle, one could argue that the blue of the sky and the rumbling of the subway are complementary properties of a common thing, say, a "rumblue". Properties of the rumblue meet the incompatibility condition: they are never observed in the same conditions; and they meet the completeness condition: we have no idea of

the rumblue apart from the fact that it affords blue in a sunny procedure and rumbling in an underground procedure.

Harré's answer consists in the introduction of the Gibsonian concept of affordance. Affordances are *manifestations of dispositional properties*: they are displayed by underlying powers under certain circumstances.[1] Those manifestations are said to be the only properties of the substance we are acquainted with. Harré's suggestion seems to be that it is a misleading question to ask about the substance since, following the field tradition, the substance is nothing else than the *power* to display certain affordances in certain conditions. We need not wonder what the substance is apart from the fact that it is a power to afford such and such properties in such and such conditions. Nevertheless it is not clear at all how affordances are to answer the present objection. The question recurs: how do we know that two complementary affordances are manifestations of the *same* power? Either we simply assume that it is the case, but then we have no means of banishing such strange entities as the rumblue from our ontology. Or we postulate, on the contrary, that the two affordances are manifestations of two distinct powers; but in this case, the science of position and the science of momentum have distinct objects because they are studying wholly distinct powers and their being linked becomes a mystery. Either luxuriant ontology, or "island discourses".

So, as far as I can see, the introduction of affordances just restates the point: complementary manifestations are the only entities we can access. Whatever we call the hidden entities that display these properties, whether substances or powers, the point is that they remain inaccessible to us because of the completeness condition. From the point of view of the observer, if complementarity is true, a thing cannot be anything else than a *bundle of affordances*, perceived in different incompatible conditions. It is no wonder then that the difficulties faced by the upholders of complementarity are closely analogous to the difficulties against which bundle theorists come up. For the bundle theorist, there is nothing behind properties that could bear or ground them: a particular thing is nothing more than a bundle of properties. As Van Cleve (1985) points out, a difficulty for bundle theories is to specify which bundles are acceptable and which must be rejected. If bundles of manifestations are no more than conjunctions or sets of manifestations, we have no reason to prefer one bundle to another: any conjunction of affordances will do (including the rumblue). The binding problem remains. The only way to avoid this consequence for the bundle theorist is to introduce a direct relation between properties, like Russell's "compresence", Husserl's "mutual foundation", or Goodman's "togetherness". But contrary to Russell or Goodman, Harré cannot resort to such a strategy. He cannot say that compresence or togetherness is what binds affordances together because of the incompatibility condition:

[1] There is some indecision here: Harré first defines affordances as dispositions, but afterwards in the paper, he speaks of them as manifestations of dispositions (for example, he says that affordances are displayed by the universe, or that they are evoked by humanly devised probe). Here I rely on this second use: affordances are manifestations of dispositions. This allows us to make sense of Harré's claim that affordances are complementary properties of a substance while maintaining the crucial role of dispositions in his picture: a substance is a power to afford such and such affordances depending on the context. Moreover this definition seems to be in accordance with Gibson's own definition: "The affordances of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill" (1986, p. 127, emphasis Gibson's). Gibson doesn't use modal expressions in this definition: affordances are what the environment actually provides to the observer, not what it can provide. Anyway, this terminological issue doesn't affect my point. If you think that affordances deserve to be called dispositions, just replace the occurrences of "affordance" by "manifestation of affordance" and the occurrences of "disposition" and "power" by "affordance".

complementary affordances are never presented to us together. So there seems to be a tension, if not a contradiction, between the completeness and the incompatibility conditions. Note that despite the analogy with the bundle theory, the present difficulty is epistemological rather than ontological: there may be one single multi-track power for each pair of afforded manifestations; there may also be two single-track powers linked together by a relation of mutual dependence. In these cases, the complementary affordances are indeed ontologically linked, either as manifestations of a same power, or are as manifestations of distinct but linked powers. But the point is that even so, these ontological bonds are *ex hypothesi* beyond our reach. Then, to say that two affordances are complementary manifestations of a same power, or of two distinct but linked powers, remains entirely arbitrary. (Note in passing that Gibson may also be embarrassed by the question "Am I swimming in the same water as that on which the water bug is walking?"). Consequently the appeal to affordances cannot solve the binding problem: it only substitutes hidden powers for hidden substances. To describe the noumenal reality in terms of powers rather than of substances makes it sound more acceptable, but the binding problem remains as long as binding powers are out of reach.

It is worth pointing out that this epistemological difficulty is relatively independent of the realism/anti-realism issue. Bohr's complementarity has often been thought to lead to anti-realism or to operationalism. However, if realism is the admission of mind-independent entities, Harré is not necessarily committed to anti-realism because of his acceptance of complementarity. The whole issue depends on the ontological status of the powers that display affordances. Harré certainly endorses a realist view of them: only affordances are observer-relative. The powers themselves are perfectly real, mind-independent and actual entities in the world. Realism is safe. But note, *first*, that not any kind of realism about powers will do. Comparing affordances with fields, Harré rightly suggests that the powers that underlie affordances must be *multi-track* powers, that is, powers that can manifest themselves in many different ways. The other option would be to claim they are single-track powers: there would be a distinct power for each kind of affordance. But this would lead to the admission of a huge number of powers. Consider a wooden stick. It affords "use me as a walking cane", "as a spoon", "as an arm", "as a backscratcher", "as a splint", "as a combustible", "as a table-leg" etc. to the human. It affords also "eat me" to the woodworm and "walk on me" to the ant. The list of the affordances seems all the more infinite, as it must contain all *possible uses* of the stick that can be made by all possible beings. If affordances were displayed by single-track powers, there would be as many powers as kinds of affordances. This view turns out to be too costly. It is far more promising to adopt the view that affordances are displayed by multi-track powers. *Second*, it is true that completeness is not incompatible with realism as such. Completeness is an epistemological thesis about what can be known. It states that only observer-relative or procedure-relative properties can be known. This doesn't forbid realism. But, since all that we can know depends on our knowledge of it, the only realism it allows is *noumenal* realism: what truly exists, independently of us, is irremediably inaccessible.

In conclusion, whether or not powers are real, whether affordances are displayed by single-track or by multi-track powers, the question of explaining how the observer can bind different affordances remains. To repeat: there are many affordances presented to us. *Why say that some given pair of affordances is complementary, rather than any other pair*? My point is that we can give no response as long as we concede that only affordances are accessible to us. We need a procedure-independent access to what binds these manifestations together, that is, to the powers (or substances) themselves.

2.2 The return of the vertical emergence and reduction problem

So much for the affordances: they may have interest in themselves but they don't solve the binding problem. The only way I can see to break the deadlock is to weaken the complementarity principle by granting that complementary predicates do not give a *complete* description of the entity (substance or power) to which they are ascribed. Such a solution is costly for Harré: it reintroduces the old vertical emergence and reduction problem.

Let us suppose that the complementarity of two affordances is reduced to the incompatibility of their conditions of manifestation. We have given up the completeness of complementary predicates. We are now allowing procedure-*in*dependent access to the underlying substance or power, that is, to the glue that binds complementary properties. We take the affordances away and describe what is binding them: the power or the substance itself.

There are some complications here if we take powers, rather than categorical substances, to be the underlying bonds of incompatible properties. But these difficulties disappear as soon as we recognize that these powers must be *grounded*. *First*, it may sound strange to claim that we become acquainted with a mere power to display some manifestations. Arguably, we cannot perceive a power *qua* power. What we can perceive of a power, aside from its manifestations, is only its *categorical basis*. If powers are to be accessed independently of their manifestations, then they must be categorically grounded. *Second* there must be something else to know about a multi-track power than the fact that it displays the properties it does. What we need to access, if we are to solve the binding problem, is the very numerical identity of the power. One cannot hope to individuate a multi-track power only with the help of its huge variety of manifestations: it is the numerical identity of the power that is supposed to explain what its many manifestations have in common. So one cannot explain this numerical identity with help of the multiple manifestations only. Without a single accessible basis for the power, the grouping together of different affordances would remain arbitrary. The only way to individuate a multi-track power then, is to rely on its basis. Consequently, it seems that any multi-track power must have a single basis, on pain of scattering. The hypothesis now to be considered is that, leaving aside the completeness condition, we have a procedure-independent access to the (presumably categorical) basis of the power that displays incompatible affordances.

Objects, places, bare particulars, states of affairs or even relations are among the candidates for the role of basis, the only condition being that they must be accessible independently of the procedure we are employing. The question here is not whether the basis is mind-independent or not. The only important point is that the switch from one procedure to another does not affect our access to the basis of incompatible manifestations. Thus we can re-identify (or keep track of) the same thing through different manifestation conditions. Note that even Bohr should agree with this: he needs procedure-independent access to what binds two displayed properties. It is the wave function that determines which physical states are genuinely superposed and which are not. So *Bohr must concede that we have procedure-independent access to the wave function*. Otherwise he wouldn't have any reason to assert that the results of two incompatible measurements (say a determinate position and a determinate momentum) are qualifying the same physical state.

Well, this may solve the binding problem, but what of the claimed return of the vertical emergence–reduction problem? This problem, I suggest, reappears when we

consider the relation between the manifested properties and their basis. There is no way to understand this relation with the help of complementarity: the dispositional basis is *ex hypothesi* not complementary to the manifestation (if it were, the binding problem would reappear: why say that *this* manifestation is linked with *that* basis?). The relation between the affordance "red" and its basis—say, the reflectance of a surface—cannot be captured with the concept of complementarity. My point is that the only concepts we possess that can account for such a relation are emergence and reduction. Either the affording red emerges from the reflectance, or it is reducible to it. Complementarity was introduced to replace emergence and reduction. When it fails to apply, it is natural to come back to emergence and reduction.

So the only way to solve the binding problem is to give up the idea that complementary predicates give a complete description of the common thing to which they apply. Then we can answer the question "why say that any two affordances, discourses or language games are bound while any other two are not?" The answer is: because only bound affordances or discourses have a common basis, and that basis is accessible to us independently of the procedure we are employing. This has the consequence of reviving vertical emergence and reduction in order to capture the relation between manifested properties and their basis. There is then a strong primacy of the vertical version of the emergence-reduction debate over its horizontal version: if P'' and P' are horizontally emergent relative to each other, then each must be vertically emergent on another underlying entity P. Otherwise, there would be no reason to bind P'' and P' together. We cannot make sense of horizontal emergence without vertical emergence. In short: incompatibility entails the falsity of the completeness principle. Falsity of the completeness principle leads back to the vertical emergence and reduction problem.

To conclude, I would like to mention briefly a second difficulty with complementarity. I have argued that the completeness condition of the complementarity principle has to be given up. Now, I think that even the remaining incompatibility condition is problematic. According to incompatibility, complementary properties cannot be manifested in the same conditions. Where quantum mechanics is concerned, incompatibility seems to designate a strong form of necessity: there is no way to reveal the particle aspect and the wave aspect of an entity in the same procedure. But when we consider the relation between anatomy and ethology, this incompatibility seems to designate a far weaker form of necessity. All in all, it seems pretty contingent. For example, it is conceivable that a radioscopic apparatus could be installed in the natural environment of gnus to observe their inner anatomical organisation in the wild. So finally, the extension of the complementary principle outside physics, in order to understand the relation between different sciences, may be more problematic than useful.[2]

References

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