Scientific pragmatic abstractions

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1 <u>Abstract</u>

In the philosophy of biology, the dominant research program for several decades consisted of varieties of ontological reductionism combined with epistemological anti-reductionism. In this framework, biological property types, because they are multiply realized, are not identical with physical property types; and thus, biology would remain indispensable to explain these genuine biological properties.

However, there are strong arguments in favour of an eliminativism that would suggest that the supposed scientific value of biology is in conflict with the thesis of ontological reductionism, namely, the completeness of physics, since there is no systematic link between biological and physical concepts. However, I consider that this problem can be solved by establishing such a systematic link in order to show how biological abstractions can be scientific pragmatic ones even though they are not indispensable for scientific explanations. In this paper, I will describe just such a solution.

2 <u>I. Starting point</u>

As Kim argues (Kim 1998, Kim 2005), the causally efficacious property tokens considered by the special sciences are identical with tokens of physical property configurations. Thus, ontologically speaking, biological property tokens are identical with configurations of physical properties. Taking for granted token identity in what follows, one may wonder what the relationship between biological and physical property *types* is like.

Fodor and Putnam developed a famous argument in the late sixties and early seventies that hinged on what they called the possibility of 'multiple realization of property types' in order to exclude a bi-conditional connection or identity between property types of the special sciences, such as biological property types, and physical property types (Fodor 1974 and Putnam 1967/1975). In contrast to physical property types, they argued, it is possible that one and the same biological functional property type may be realized by configuration tokens coming under different physical types. In the case of biology, the possibility of multiple realization is ultimately based on natural selection, in accordance with the Paul Ehrlich's dictum – summarizing the work of biologist W.D. Hamilton - that "Selection operates when carriers of some genes out-reproduce carriers of other genes." (Ehrlich 2000, p. 38). In other words, the evolutionary salience of phenotypic effects of genes is defined by it contribution to the fitness of the organism in question in a given environment insofar as this has a positive effect on their proliferation. This is the essential point of biological evolution by natural selection – even though it is of course quite more complicated than illustrated here.

The following analysis presents a way of accounting for this evolutionary context within the functional definition of biological property types, which is a first step in sorting through the problems facing a reductionist theory that wants to grant biology scientific standing, yet ultimately seeks to defend the principle of ontological reduction.

A biological property is a functional property that is characterized in terms of fitness contribution or contribution to reproduction (for more details of the debate, cf. Weber 2005, especially pp. 38-41; for the argument to consider biological properties always in the light of evolution, cf. Dobzhansky 1973). Using this working definition, we can understand multiple realization as follows: let us say, for instance, that there is a functionally defined gene type (B) that is realized by different physical configurations (of type P_1, P_2, P_3, etc.). This multiple realization is possible since it is the phenotypic effect of the genes that characterises the gene type in question, whereas the different possible ways in which this phenotypic effect is physically produced – such that there are different physical types – is generally not important:

Functional type: B

Realizer types: P_1 P_2 P_3

Based on the possibility of multiple realization, theory reduction of biology is by and large supposed to fail since such a reductive approach to the special sciences is generally taken to require nomological bi-conditional connections (Endicott 1998, section 8). Therefore, the special sciences such as biology are generally taken to be *scientifically indispensable* in providing explanations of certain parts of the world – namely, those having to do with living systems.

II. The dilemma of a non-reductionist framework for biology

The multiple realization argument poses a fundamental challenge to the anti-reductionist position: if one takes the MR argument to be an ontological one, it leads to an epiphenomenalism as regards the properties of the special sciences. Alternately, one may take the multiple realization argument to operate purely on the epistemological level as an argument against theory reduction. However, this, too, is not satisfying.

Taking multiple realization as an ontological argument, it gives us the following asymmetry: on the one hand, we have tokens of one and the same functional biological property type, *B*. On the other hand, the possible realizer tokens of *B* may be of different physical types. Thus, *B* is not identical with any of these physical realizer types. From this it follows that there is also an ontological difference between each token of *B* and the respective physical realizer token because *B* is taken to be something ontological (for a contrary position see MacDonald & MacDonald 1986). However, to claim that there is a causal power of the property tokens of *B* *over and above* the causal power of its respective physical realizer tokens contradicts ontological reductionism. If, then, we insist on an ontological difference between property tokens of *B* and their physical realizer tokens, we must conclude that this ontological difference is causally impotent. At this point, the whole scientific status of law-like generalizations comes into question, insofar as they are couched in terms of concepts referring to *epiphenomena*.

The other approach to the problem is to take multiple realization merely as an epistemological issue consisting in multiple *reference*. On the one hand, there are property tokens that are *described* by the same functional concept *B* (capital letters will be taken as concepts in what follows). On the other hand, these property tokens are differently described in terms of physics (P_1, P_2, P_3, etc.).

Let us keep in mind that, ontologically speaking, the similarities homogenously brought out by the functional concept *B* are nothing that physics can't explain, since every token coming under *B* is identical with something physical and can be, because of the completeness of physics, described and explained in physical terms (Cf. Chalmers 1996, pp. 44). In considering a single property token, physics always provides more detailed causal explanations than biology does. However, abstracting from physical differences, only the functional concept *B* seizes salient similarities among the entities in question. Biology may thus provide explanations in an unificationist manner physics is not able to make, since physics does not dispose of the conceptual means to carry out such abstractions (cf. Kitcher 1981).

Yet this unification by abstraction from physical details remains opaque so long as we lack a systematic link to physics. If we adhere to ontological reductionism and the completeness of physics, everything causally efficacious can be considered in terms of physics; therefore, the inability to generate a *systematic link* between biological concepts (law-like generalizations) and physics is a major epistemological blow to biology. What this means is that biological concepts are fundamentally unintelligible from the physics standpoint. This, in turn, casts doubt upon the scientific credibility of biological concepts. In other words, even if we cast our problem in epistemological terms, in the end, we can't coherently construct a "soft" autonomy for biology without introducing conceptual incoherence into ontological reductionism.

Given this way of stating the problem, it is obvious that, in order to save our ontologically reductionist program, we are going to have to find a conceptual schema that allows for making systematic links between biology and physics. The two main reductionist approaches do just this, but, as I will show, they are both vulnerable to criticism. The two main approaches are: a, that suggested by Lewis and Kim, entailing the construction of concepts that are semi-physical-semi-functional ones, coextensive with physical concepts (see Lewis 1980, Kim 1998, 93-95); and, b., that suggested by Bickle, the construction of physical theories that are partly coextensive with the special science theory in question (Bickle 1998). For instance, one may construct a gene concept that includes physical criteria in order to be coextensive with the physical concept in question or one may construct a physical genetic theory that refers to all and only the entities described by genetics within a certain species. Evidently, the two approaches contain enough overlaps to be combined.

Let us take for granted for the purposes of argument that one can ascribe a scientific quality to the semi-physical-semi-functional concepts (something not trivial). Does this get us from the abstract concept B to terms of physics (P_1, P_2, P_3, etc.)? Since biology only works with functional concepts, but not with concepts specified by physical criteria, it is puzzling how Kim's semi-physical-semi-functional concepts could serve as bridge principles, since it only seems to repeat the problem in other terms. This is why it remains unintelligible, from the biological point of view, how the salient similarities brought out by B can be brought out by the semi-physical-semi-functional concepts without this resulting in a conflict with ontological reductionism and the completeness of physics. Kim does not give us a mechanism whereby it is possible to abstract from the physical part of the semi-physical-semi-functional concepts, and hence it remains unclear how B can causally explain something.

Against this background, we might want to make the radical move of replacing biology *tout court* with physical Ersatz theories. This is in fact Bickle's solution: the construction of physical theories that are, taking together, co-extensional with the biological theory in question. In other terms, one constructs several physical theories with applicable physical concepts (applicable in the sense that they cover target objects) that are co-extensional with biological concepts (which target the same objects). Since bridge-principles are still missing, this approach as well does not make intelligible how abstract biological concepts and law-like generalizations could be vindicated. This approach by Bickle (and Hooker) is more general than the approach of Kim (and Lewis), but it also ends up in suggesting the elimination of biology.

III. Reductionist framework without elimination

Because of multiple reference, the starting point is that tokens of physical property configurations that come under the functionally defined biological concept *B* may be described by different physical concepts (P_1, P_2, P_3, etc.). This implies that there is a causal difference among the physical configuration tokens coming under a single functional concept *B* (Kim 1999). In other words, there are different ways to bring about the effects on which the functional concept *B* focuses (Esfeld & Sachse 2007), as, for instance, in the difference created by a phylogenetic effect that elevates the rate of the reproduction of one gene over another. From the physical point of view, there is thus a difference in the production of side effects that are systematically linked with the main effects (characterizing *B*) in question.

The differences resulting from side effects can be detected from the biological point of view in a given physical environment, thus giving it standing as a scientific fact. This can be illustrated by, for instance, the empirical data with which genetics deals, which is often cited as a classical case of multiple realization (reference). It can be shown that differences between DNA sequences that come under a single gene concept (multiple reference) are linked to different molecular ways to bring about the effect on which the gene concept in question focuses (causal implication of compositional differences). These different ways to produce characteristic effects in question are systematically linked with side effects such as the speed or the accuracy of the protein production (see Bulmer 1991) that can be salient for selection. To put it in other terms, it is possible to construct purely *functionally* defined biological concepts that are nonetheless *coextensive* with the physical concepts. This means, for any concept *B*, it is possible to construct functional sub-concepts B_1, B_2, B_3, etc. coextensive with the physical concepts P_1, P_2, P_3, etc. Since any physical difference accounting for multiple reference leads to side effects that can be in principle detected from the biological perspective, there thus is a *nomological* coextensionality

(Sachse 2007, 138-152). The following figure may help to illustrate the most important steps in this argument.

2. Definition of a functional concept to refer to the entities in question — B

4. Construction of functional sub-concepts that are coextensive with the constructed physical concepts such that the scientific quality of the sub-concepts is no longer opaque — B_1 B_2 B_3

1. Entities the special sciences refer to — $e_{1a}, e_{1b}, \ldots$ $e_{2a}, e_{2b} \ldots$ $e_{3a}, e_{3b} \ldots$

3. Construction of physical concepts to provide reductive explanations within physics — P_1 P_2 P_3

Note that the construction of such functional sub-concepts is first and foremost an intermediate step in order to establish bridge-principles. The important thing here is that we can show that the biological concepts have a non-opaque scientific status in that the sub-concepts are coextensive with physical concepts, even though all of them may not be of any particular biological interest. Let me thus call this their *possible* scientific status. By this means, we can bootstrap upwards to establish the scientific status of the more abstract concept *B*. To put it in other terms, since any token coming under the abstract biological functional concept *B* also comes under a functional sub-concept whose scientific quality would prima facie not be opaque, *B* cannot be opaque either in as much as the only difference between *B* and one of its sub-concepts (B_1, B_2, B_3, etc.) is the degree of abstraction *within a purely functional* theory. A sub-concept brings out the same salient similarity as does its more abstract concept (its relevance here being defined in the context of selection under normal conditions) while also adding a functional detail (side effect that is salient for selection under special conditions) that is linked to this outlined salient similarity (B_1 = "$B + B_{minor}$"). Since the matter is so crucial, let me stress here that both the abstract concept and its sub-concepts are constructed in terms of *one* single theory, such that the abstraction from side effects is a purely theory-immanent matter with a conceptual linkage. Thus, under this schema, we clarify the assumed scientificity of the abstract unifying concepts of biology (for instance, a certain gene concept that accommodates the fact that the gene tokens are physically different), as we cannot do in the other reductionist approaches. There are now bridge-principles sufficient to make the abstraction step intelligible.

This philosophical foundation will help to normalize the undoubted pragmatic advantage of biology as a special science within a unified conceptual schema that retains the completeness of physics and ontological reductionism. Biology is scientific because of the systematic link to physics, and objective because the outlined biological salient similarities are those that exist in our world as they depend on biological evolution by means of natural selection. Its abstract functional concepts, integrated within the proposed reductionist framework of constructing functional sub-concepts, counter the twin threats of epiphenomenalism and eliminativism. Abstract biological concepts can be systematically linked with physics. This does not ratify the claim of the indispensable character of biology, since that does not seem to be compatible with the completeness of physics and ontological reductionism, but it does give us pragmatic wiggle room – one can now argue that the pragmatic value of biology is scientific and objective. Biological concepts and the abstract law-like generalizations governing them bring out salient similarities among entities that are physically different. This is the epistemological power belonging to biology alone: its ability to explain biological evolution in *homogeneous* terms that can't be selected from a wholly physics-based point of view. Hence, there is no positive argument left for the eliminativist approach to biology. Which gives us what we want: biology is the more unifying theory about a certain ensemble of entities (the living beings) while physics is the more unifying theory in general but not as concerns the living beings.

To sum up and conclude: there is a strong causal argument in favour of ontological reduction. Based on this argument and the completeness of physics, the standard anti-reductionist argument of multiple realization faces the dilemma that it apparently leads to either epiphenomenalism or eliminativism with regard to biology, that is, in respective to its status as a science. In order to avoid these consequences, we show that a systematic link between biology (and other special sciences) and physics is philosophically and empirically possible by means of the construction of functional sub-concepts that are coextensive with (in the last resort) constructed physical concepts. Based on this systematic link to physics, the scientific quality of biology and its abstract concepts is no longer opaque. This should not be taken as a warrant to regard biology as indispensable, given the principles of the completeness of physics and ontological reductionism, but it does show that, within our proposed reductionist framework, biology accrues standing as a objective, pragmatic science, which conceptualizes parts of the world (living systems) with abstract unificationary concepts that have no equivalent in physics.

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