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Realizability and the varieties of explanation

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ABSTRACT

What realization is has been convincingly presented in relation to the way we determine what counts as the realizers of realized properties. The way we explain a fact of realization includes a reference to what realization should be; therefore it informs in turn our understanding of the nature of realization. Conceptions of explanation are thereby included in the views of realization as a metaphysical property.

Recently, several major views of realization such as Polger and Shapiro's or Gillett and Aizawa's, however competing, have relied on the neo-mechanicist theory of explanations (e.g,. Darden and Caver 2013), currently popular among philosophers of science. However, it has also been increasingly argued that some explanations are not mechanistic (e.g., Batterman 2009).

Using an account given in Huneman (2017), I argue that within those explanations the fact that some mathematical properties are instantiated is explanatory, and that this defines a specific explanatory type called "structural explanation", whose subtypes could be: optimality explanations (usually found in economics), topological explanations, etc. This paper thereby argues that all subtypes of structural explanation define several kinds of realizability, which are not equivalent to the usual notion of realization tied to mechanistic explanations, onto which many of the philosophical investigations are focused. Then it draws some consequences concerning the notion of multiple realizability.

1. Introduction

For many years philosophers of science have been interested in multiple realizability. Because of mind-body issues in the philosophy of mind they first emphasized the fact that mental states seemed to be realized by many physical states (e.g., Putnam 1975), which led to a discussion about the role and extent of multiple realizability in the sciences, an issue overlapping of course with that of reductionism in general (Fodor 1974; Gillett, 2003, 2007; Endicott, 2005). Recently, some philosophers tried to make sense of what the realization relation is in itself (Shapiro, 2000; Polger, 2003; Gillett, 2003, 2007; Shoemaker 2007; Endicott, 2010; Polger and Shapiro, 2016) and elaborated several competing views of realization.

In all these views realization is a metaphysical relation, and identifying the specific realizers of a realized entity, property or law, as well as deciding whether one or several realizers can realize it, is a scientific endeavor. Many of those conceptions therefore took into account how explanations in the sciences actually work (e.g., Gillett, 2003, 2007, 2010, 2013; Polger and Shapiro, 2016; Aizawa & Gillett, 2009, 2011) – with a focus on psychology and cognitive neuroscience, but often with a general concern with developing a view of scientific method that is accurate for all special sciences. Explanatory mechanisms have been an important aspect of the discussion: the realizers, according to Gillett and Aizawa, are microlevel entities that contribute to realize the realized property as a result of a proper mechanism, whereas according to Polger and Shapiro, who hold a competing view of realization, the realized entity plays a causal role that is fulfilled on the basis of a mechanism explaining how it's fulfilled. Many realization cases are therefore decided by scientific explanations: we can state that various types of corkscrews each realize the property of being a corkscrew because one can explain the fulfilling of the corkscrewing function of this object by investigating each variety of corkscrew and its physical properties (Shapiro, 2000). However, this explanation, as well as many explanations underpinning realization relations, e.g., in the case of neurosciences of memory (Craver, 2007; Bechtel & Abrahamsen, 2005), is of the mechanical kind – in the sense of "mechanism" put forth by the so-called neomechanicist philosophers of science (Craver & Darden, 2013; Glennan, 1996, 2017).

Granted, what the realization relation is, a metaphysical issue, and may not necessarily have a single answer; but in any case what the realizer of a given X is, is an empirical question, to which an answer is given a posteriori. And the ontology of a specific domain

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prescribes what sort of things are likely to be found by the empirical enquiry as realizers – for instance, the ontology of physics tells us that only some things may realize hardness, which excludes things of a gaseous or liquid nature. Thus, the metaphysical concept of the realization relation, as it should be related to available scientific explanations, relates to the notion of a genuine scientific explanation. Therefore, it is not obvious how to make sense of realization independently of a theory of scientific explanation, at least when one wants to account for the way realizers are discovered in the world, and design a metaphysical concept of realization that matches such account. In the present paper, I will explore the consequences of the acknowledgement of a plurality of explanation types for the theory of metaphysical realization.

In the first part, I review some recent views of realization, and argue that many of them are tied to a model of explanation that has been successful in philosophy of science during the last decade, namely the neomechanicist view of explanation. I describe some aspects of this view, and isolate a common core that, notwithstanding the divergences between alternative metaphysical conceptions, supports a general take on realization. In the second part, I consider other explanatory kinds, which are not mechanistic. I call them "structural explanations", and analyze some of their commonalities. In the third section I argue that those structural explanations support different concepts of realization from the mechanistic ones, and explain how the consideratin of structural explanation accounts for a specific realization relation. The last section draws some consequences of explanatory pluralism regarding the multiple nature of multiple realizability.

2. Metaphysical views of realization and mechanistic conceptions of scientific explanation

2.1. Metaphysical realization and scientific explanation

The phenomenon of multiple realizability arguably supports philosophers' interest in making sense of realizability. There is no logical *caveat* against the idea of a property that is realized by one and only one realizer, by metaphysical, conceptual or physical necessity, but since Fodor (1974), the issue of realizability has mostly been raised by the fact that some properties seem to be realized in multiple ways, thus providing an argument for the discontents of reductionism. Many of the examples discussed initially were from psychology, and students of the mind-body problem, as well as philosophers of mind in general, frequently appealed to the multiple realizability of mental states as a premise of their arguments (see Polger and Shapiro, 2016 for examples). However, all the special sciences may involve multiple realizability, as was already clear in Fodor's paper. Fodor's argument is that the legitimacy of special sciences rests on the fact of the multiple realizability of their typical properties. If a property typically studied by a science is multiply realized, then, Fodor argues, the study of the realizers is not the proper science to address this property and the counterfactual regularities or nomothetical regularities it supports.

To this extent, we can start by commenting on a simple example of multiple realizability, which involves simple physical devices – the example of the mousetrap, often given as a case of multiple realizability (e.g., Polger and Shapiro, 2016). Mousetraps catch mice and kill them. The catching and the killing can be done by several means: poisoning the mouse, crushing it, electrifying it – following the display of some food, or some smell, that the mouse searches for. Hence several mousetraps are sold, and those types of mousetraps rely on very different physical properties: mechanical ones, using springs and iron sticks; chemical ones, using poisons; or electric ones, using an electric current.

The intuitive idea of the connection between multiple realizability and the autonomy of the special sciences is illustrated by the fact that focusing on the laws of electricity may not capture what a mousetrap is. Shapiro (2000) sharply stated the problem of realizability in these terms: what are the differences between distinct instances of P (here, mousetraps) that count as differently realizing P? Here, the color of the mousetrap doesn't count, but the difference between chemistry and electricity counts. Even though the electric mousetrap could not *work* as a mousetrap, and even *be* a mousetrap, without the laws of electricity obtaining, yet it is not those laws that make it the mousetrap it is. It is a mousetrap in virtue of some facts, to the obtaining of which the laws of electricity contribute – but which could be contributed by other laws, were the mousetrap another kind of mousetrap. Relying on electrical laws rather than biochemical laws and processes makes the electric mousetrap a realization of the mousetrap different from the chemical mousetrap.

However, in all cases of mousetraps, one can explain the effect of catching mice by appealing to the mechanisms through which the mouse trap performs its mouse-catching function; those can be electric, mechanical or chemical mechanisms, yet they underlie the same relationship between an input (a mouse-occupied space) and an output (a dead mouse in the mousetrap). The property of being a mousetrap is realized through those *mechanisms*, and because they are distinct mechanisms, one will say that the mousetrap is multiply realized. The fact that different mechanistic explanations are given of the input-output relation, in each case, supports the claim of multiple realizability. Therefore, if one wants to account for multiple realizability, one should point to the difference in explanations pertaining to the multiple realizers. The difference between realizers can be read off the differences between explanations of why the realizers realize the realized property. In our example, those explanations appeal to various mechanisms underlying the same input-output relation.

But the major lesson of this example is that explanations and realization are correlated, which implies that any account of realization should assume an account of explanation. Granted, realization is a relation of *metaphysical* dependence between two relata, be they property instances (as Gillett insists), or entities or states (as Shapiro and Polger maintain); yet there should be a *scientific* explanation of the fact that it's A that realizes B, and possibly of how and why this is the case. Realizing B means making B real as Polger and Shapiro (2016) say, which means make B something actual, detectable, occurring and likely to be witnessed and stated; and this making calls for explanations, which should be scientific. Without these explanations, it's not clear how we could reliably see realization in the world. The form of the explanation therefore says something about how realization can be detected, which in turn is not orthogonal to the metaphysical nature of realization itself, since any concept of realization must be such that instances of the concept should be likely to be recognized using an explanation of the supposedly correct form of scientific explanation. Therefore, "the question of multiple realization is a question about actual sciences, and it is always specific and contrastive" (Polger and Shapiro, 2016, 79). More precisely: the question about *whether* some Xs are *multiply* realized, as Polger and Shapiro, argue here, concerns science; but what about the question of what realization *is*, metaphysically speaking? It seems that, whatever science is and however it is done, realization is a particular metaphysical relation. Yet our access to realization relations relies on us using correct explanations, and therefore, explanations are the only way we have to recognize realization. This means that the metaphysical nature of realization is tied to the nature of our explanations of realized properties, even though the nature of realization is a metaphysical

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