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A Conceptualist Construal of the Semantic View of Physical Theories

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Abstract. What is the relationship between the models of a physical theory and the systems and processes in its domain? This question arises for philosophers of science from the semantic view of such theories, which conceive a theory as a set of classes of models –where the concept of physical model plays a crucial role. The semantic view is a conception of the structure of theories, and it becomes neutral about their content, allowing it to be assumed from different philosophical stances about science. We adopt the conceptualist or conceptual relativism stance about science to try a plausible thesis on that epistemological question, which contrasts with the theses sustained by realist, instrumentalist, and empiricist philosophers. We intend to elaborate on theoretical models, considering that abstractions and idealisations are ubiquitous in physical theories, from laws to models, and reside in their conceptual frameworks. The key idea of our proposal is that models provide idealised conceptualisations of bodily processes.

Keywords: Relativism, conceptual framework, idealised conceptualisation, theoretical model.

Introduction

The objective of this paper is to elaborate a version of the semantic view of theories in physics from conceptualism (or conceptual relativism) as an alternative to stances such as Suppes' instrumentalism, van Fraassen's empiricism, and Giere's realism, where the concept of model plays a double role. Considering a model of a theory as a conceptual construct with a mathematical structure which, if it is physically interpreted, could fulfil the laws of that theory, on the one hand, and provides a *conceptualisation* of a process that a physical system undergoes when the available experimental data match well enough with what the model involves about it, on the other hand. When that is the case, we may say that such a model modelled both the states of a physical system and its evolution or transformation, which amounts to saying that that model correctly conceptualises them *relative* to the theory on consideration. Thus, we could say that one understands physical systems' processes through theoretical models.

Moreover, one may think of physical models as theoretical constructs with an abstract and idealised character which, to provide the right conceptualisations of bodily systems and processes relative to a physical theory, must fulfil the fundamental laws of that theory ─as well as some of its unique nomic statements ─, and approximately match with the available experimental data about the processes which they intend modelled.

My proposal aims to contribute to the epistemological debate about the relationship between theoretical models and processes in the physical world, a central problem of contemporary philosophy of science. I focus on the theses of prominent contemporary classical authors, which are the sources of the present state of that issue.[1] I hope that our conceptualist approach becomes enlightener because it takes into account that idealisations and abstractions permeate laws and models of physical theories, which are generally overpass, to some extent, by several philosophers of science, mainly by realist philosophers which represent the principal trend on the philosophy of science.

We begin recalling Tarski's logical concept of model and pointing out how such sort of model can be interpreted in physical terms. We then make some general remarks about the abstract and idealised character of the models of physical theories that they inherit from the fundamental laws of those theories, such as Newton's second law and Schrödinger's equation. A brief discussion of the former three philosophical stances about scientific knowledge is supplied to contrast them with the conceptualist stance to emphasise its main features. Next, we intend to explain the thesis that physically interpreted models that fulfil some laws of a theory could provide *idealised conceptualisations* of pertinent processes when they match the

[1] A critical review of recent philosophical works about our main issue is beyond the scope of this paper. An important variant of the semantic view, the partial structure approach, has been developed mainly by Octavio Bueno, Newton da Costa, Steven French, and James Ladyman, with the original intention to defend the structural realism proposed by John Worrall. However, it is too technical, and there is insufficient space here to analyze it. As a sample, see Bueno et al. (2002).

experimental data about those processes. We finish with some general remarks on conceptualism concerning the realism/antirealism debate in the philosophy of science.

Models

Logical models

Regarding formal theories, Tarski (1953, p. 11) defines: "A possible realisation in which all the valid sentences of a theory T are satisfied is called a model of T", where a possible realisation is a mathematical entity of the appropriate logical type. When a theory T is axiomatised, the valid sentences of T are the hypotheses and their logical consequence. The axioms of a formal theory delimit the class of its models as the class of possible realisations that satisfy them.

An interpretation of the axioms of a formal theory is obtained via an assignation of individuals to singular terms, sets to class terms, functions to functors, and so on, concerning a given domain specified by the theory on consideration. A formal or logical concept of truth is involved here. If a theory's axioms are satisfied under an interpretation, the logician says such hypotheses are true. For example, if we think of a set-theoretical axiomatisation of group theory with a structure <*X,* o*, e*> where *X* is a non-empty set, o is a binary operation on *X*, and *e* is a distinguished member of *X*, then the interpretation *I* = <*Z*, +, 0>, satisfies the axioms, and we can say that they are valid under *I* which is equivalent to say that <*Z*, +, 0> is a model of group theory, that <*Z*, +, 0> is a group. Thus, in formal theories, it makes sense to say that the axioms of a theory are true when they are satisfied under a given interpretation.

Physical Models

Patrick Suppes (1960, p. 12) advanced the thesis that the concept of the model in the sense of Tarski is the fundamental concept both in formal and empirical theories: "In this sense, I would assert that the meaning of the concept of the model is the same in mathematics and the empirical sciences. The difference to be found in these disciplines is to be found in their use of the concept." It is worth noting that theories and models are different kinds of entities; in brief: "A theory is a linguistic entity consisting of a set of sentences, and models are non-linguistic entities in which the theory is satisfied." (Suppes, 1960, p. 13).

Since Suppes, the logical concept of the model was adopted by several philosophers of science, such as Joseph D. Sneed (1971), Wolfgang Stegmüller (1976), and the structuralist philosophers Balzer et al. (1987). One may call the approach to theories of those philosophers the model-theoretical view of theories. Other philosophers of science like van Fraassen (1980), Giere (1988), and Suppe (1989), members of the group of semanticist philosophers, share with them the thesis that models are central in scientific knowledge or even the conception of scientific theories as sets of classes of models; however, they do not maintain the logical concept of model. Regarding physical models as mathematical structures, Bas van Fraassen (1980, p. 67, p. 196) adopts the phase-space approach from physics, which allows for the description of the behaviour of a physical system in terms of a state-space expressing the system trajectory in that space (see 1980, pp. 67 and 196). Ronald Giere adopts physicists' general use of the term 'model'; for example, Bohr's model of the hydrogen atom and the standard model of elementary particles. He regards models as abstract entities with the properties attributed to them by the physicists in the standard texts (Giere, 1988, p. 78). Furthermore, Giere (1988, p. 79) wrote:

> *"I suggest calling the idealised systems discussed in mechanics texts 'theoretical models' or, if the context is clear, simply 'models'. This suggestion fits well with how scientists use this (perhaps overused) term."*

Frederick Suppe (1989, p. 167) proposes a realist concept of physical model: "Here we are using 'model' to mean iconic model —an entity which is structurally similar to the entities in some class." The structures of such kind of models have to be expressed as relational systems which admit physical interpretations consisting of "mapping relations between theory structure and phenomena." (1989, p. 422).

In the case of physical theories, axiomatised or not, their fundamental laws take the place of axioms. According to the former intended twofold role played by models, from the model-theoretical approach to theories of physics, one can say that a possible realisation or possible model of the laws of such a theory can be obtained by assigning individual objects to the singular terms, sets of physical entities to the class (or kind) terms, and magnitudes to the quantitative (or metric) terms which occurs in them. In addition, to provide physical content to a possible realisation of a physical theory, it is required to describe the initial state of a physical system and its evolution in time, in the usual way that physicists do it, in terms of the concepts of that theory, which entails a specification of the terms of the laws of the theory by linking them with the terms of such description. In very rough terms, an interpretation of the laws of a physical theory to obtain a possible model of it consists of the two former steps, where the domain is formed by physical systems and processes described in terms of the concepts of the theory on consideration (generally, physicists dispense the former first step which is implicit in the labour of describe physical systems and its processes). However, this simple answer overlooks the abstractions and idealisations that permeate physical theories and their models, an issue we will see below.

If we wish, we can say that the laws of a physical theory are true under a given interpretation, as the logician does for the hypotheses of formal theories. It makes sense because a set-theoretical axiomatisation of a theory offers a general structure into which the structure of a possible model can be embedded via a morphism, which allows us to determine if the nomic statements of that theory are satisfied. However, that does not allow us to claim that such a model is true of the physical process that intents models because it is feasible to construct possible realisations that fulfil the laws of a theory but without any physical processes as its counterparts. Nevertheless, the main reason is that a model is abstract, whereas the physical process is concrete. Thus, it is senseless to think there could be a formal relation between them, as Suppe (1989, p. 4) claims:

> *"On the Semantic Conception, the heart of a theory is an extralinguistic theory structure. [...] When one propounds a theory, one specifies the theory structure and asserts a theoretical hypothesis claiming that real-world phenomena (or a particular real-world*

phenomenon) stand(s) in some mapping relationship to the theory structure whereby that structure models the dynamic behaviour of the phenomena or phenomenon."[2]

Such theoretical hypotheses, to which Suppe appeals as candidates for truth values, rest on inconceivable mappings, as mathematical functions, between concrete entities, the phenomena, and abstract entities, the theory structures.

Moreover, it is not feasible to maintain that theoretical models represent or are similar to phenomena or physical processes, as some philosophers have maintained, as we will see below. Our thesis is that physical models are our vehicles to conceptualise the systems and processes they model, allowing us to understand them relative to and depend on a theory.

Abstraction and Idealisation

The logical model concept concerning formal theories about abstract entities is clear and precise. However, some issues arise when it is extrapolated to physical theories, such as: What is the relationship between theoretical models, granted that they are abstract and idealised in character and bodily systems?

Answers to this question are controversial because they depend, in part, on the philosophical stance about scientific knowledge involved. For realist philosophers:

"[…] scientific models attempt at providing an approximately true description of some aspect of the world. Deidealized models should be understood as truer than more idealised models, or at least as less unrealistic representations" (Cassini & Redmond, 2021, p. 33).

In contrast, from an instrumentalist stance:

"Highly idealised models are just useful devices designed to solve some well-defined problems […] idealised models are not necessarily better representations or descriptions of the phenomena. They can be regarded as more refined instruments used to solve more specific problems." (Ibidem).

From the point of view of conceptual relativism, we could say that models provide *idealised conceptualisations* of the systems within the intended domain of application of a physical theory, which amounts to saying that the models *present* them as systems of certain kinds characterised by the theory itself. There are models for frictionless pendulums, inertial bodies free of acceleration, rigid bodies, perfectly elastic spheres, potential wells, harmonic oscillators, systems of material bodies as masses concentrated at extensionless points, and subsystems of two bodies as the Sun and Mars. Such models present their intended *instances* as systems of certain kinds, conceptualising them in specific modes relative to the theory on consideration.

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[2] Theory structures can be characterized via set-theoretical predicates *á la* Suppes (Suppes, 1957).

The candidates to models that one could attain by the former procedure of interpretation are, however, abstract and idealised structures that, on the one hand, select some quantitative properties of the physical systems that are intended to model, at once omit or neglect other such properties and, on the other hand, simplify and distort such systems. In other words, to construct a possible model of a kind of process, physicists *abstracted* some magnitudes and at once subtracted other magnitudes from the systems, on the one side, and made some unrealistic suppositions that *idealise* the systems of that kind, simplifying and deforming them, on the other side. The process of abstraction includes counter-actual conditions, which in principle can be eliminated, while the process of idealisation could introduce counterfactual conditions that might never happen. To approximatively apply an idealised model to a physical system and its evolution, it becomes necessary that the physicists perform the inverse procedures to abstraction, including some missed magnitudes of the system, steps of *concretisation* (Nowakowa & Nowak, 2000), and to idealisation, removing some unrealistic suppositions, steps of *de-idealization* (McMullin, 1985).

The former distinction can be illustrated with simple physical laws: Galileo's law of free fall is a counter-actual statement subtracting the medium, whereas the inertia law is a counterfactual statement because nobody is free of external forces. Moreover, fundamental laws such as Newton's second law and Schrödinger's equation seem to be more of a law scheme than a law statement, in which the main functional symbols ─F and H, respectively─ stand for families of functions instead of just functions, which show their high abstract and idealised character.[3] Because of this, it becomes implausible to claim that the physical laws are *actual* physical systems themself, even if the models associated with them match pretty well with the available experimental data, as a realist philosopher could aim. Still, it is not viable to maintain that models *represent* physical systems and their evolutions within the domain of application of the theory on consideration, as several philosophers have intended, from different philosophical views, among others, van Fraassen (1989, 2008) and Giere (1999, 2006). Instead, I think it becomes feasible to maintain that models, as theoretical constructs, allow us to conceptualise physical systems and processes based on the conceptual framework of a theory, *presenting* them as systems and methods of certain kinds characterised by that theory. In other words, theories display the processes in the physical world within their intended application domains as models that conceptualise them in specific modes relative to the theories themselves. In Fregean spirit, we could say that the *conceptual content* of a model consists of the mode of presenting the system that is its relata. If that is right, the relation between theoretical models and physical systems and their evolutions consists in that the former presents and displays the latter in terms of the concepts and laws of a theory as entities of certain kinds that are typified by the theory itself and so relative to it.

Representation

Concerning the content of scientific theories, the semantic conception is *neutral*, particularly on our main issue: the relationship between theoretical models and the physical world. Instead, it is a conception of the *structure* of scientific theories as sets of classes of models contrary to the syntactic conception of such theories. The theses that define both conceptions

[3] See Kuhn (1970, p. 188) and Cartwright (1989, p. 203), respectively.

of scientific theories are about their components and structure rather than their content. As is well known, the syntactic view sustains that the components of theories are lawlike statements provided with a deductive structure. In contrast, the semantic view maintains that the components of theories are (classes of) models with a hierarchical structure, in Suppes' (1967) version, or with a structure conformed mainly by relations of presupposition and specialisations in the structuralist philosophers of science's version (Balzer et al., 1987). In any case, both conceptions leave a place for different philosophical tenets regarding the content of theories. This allows different philosophical theses about models and their relation to the phenomena or processes of the physical world to be maintained, as we will see below.

Suppes' Instrumentalism

We find an instrumentalist view in Suppes (1967). He sustains that the structure of a theory consists of a hierarchy of classes of models from the theoretical models at the top to the models of data at the base, which are obtained by systematising the raw data of the experimental experience. A central thesis of Suppes' view is that data models can be embedded into theoretical models to search for a match between them. In addition, he and his colleagues propose proving representation theorems for the fundamental quantities of physical theories, such as mass and distance (Krantz et al., 1971). A theorem of representation consists of a statement that establishes that a qualitative structure that corresponds to a qualitative concept of a physical magnitude can be embedded into an appropriate mathematical structure that corresponds to such physical magnitude, preserving the relations among the members of the former structure into the members of the latter structure. Such representation theorems, called theorems of fundamental measurement, justify applying numerical values to magnitudes linked to measurement procedures.[4]

Suppes' instrumentalist thesis is that the laws of a theory could be considered principles of inference rather than general premises to derive predictions that could be confronted with the results of experimental experience. The laws that occur in a set-theoretical definition of a class of models are considered principles of inference, which allow predictions to be derived and tested in the laboratory. Then, there is no question about the truth values of the laws because the rules of derivation are tools rather than statements. The concern with laws is not whether they are true but, instead, whether they are sound instruments.

As is characteristic of instrumentalism, Suppes' view of theories involves a few ontological commitments, such as sets of objects that are the domains of the set-theoretical structures and those that come from the theorems of fundamental measurement (and derived measurement). He attributes to theories scarce conceptual content since the derivation of predictions using laws as principles of inference is a formal task that, to some extent, does not involve their conceptual content.

Van Fraassen's empiricism

In the first instance, Bas van Fraassen (1980) sustains that the phenomena or appearances (terms that he used indistinguishably there) are embedded indirectly into theoretical models.

[4]Moulines and Sneed (1979) call Suppes' proposal to prove theorems of representation for physical magnitudes sophisticated operationalism.

Realising that this thesis assumes the conceptual mistake that the phenomena or appearances are structures instead of physical processes, he changes it since any morphism can be defined only as a relation between structures. Van Fraassen (2008, p. 386), recognising such a mistake, wrote:

> *"Mea culpa: in The Scientific Image constructive empiricism was presented in the framework of the semantic view of theories [...] where I define empirical adequacy using unquestioningly the idea that concrete, observable entities (the appearances or phenomena) can be isomorphic to abstract ones (substructures of models)."*

Then, he introduces a surface model, refined model data that extrapolates probabilities in an abstract and idealised mode from a homogeneous class of data models to sustain the idea that this model is embedded into theoretical models. The issue of the relation between models and phenomena seems to remain. To confront this, van Fraassen (2008, p. 258) proposes a pragmatic notion of representation as a ternary relation among a surface model, a phenomenon, and a scientist. A given representation consists of somebody using something *x* to represent something else *y* as thus or so.. Briefly, his thesis is that surface models represent the appearances of somebody. Ask what the relation between data models and the related phenomena is amounts to asking a metaphysical question that presupposes a relation between them on its own (van Fraassen 2008, p. 252).

I agree that there is no representation relation between model data and phenomenon that could be independent of someone who establishes it. However, van Fraassen's general thesis about representations as ternary relations seems to allow for arbitrariness or, at least, conventionalism because it looks to permit anything to represent something if somebody decides to do so. Van Fraassen appeals to the context in which users of surface models propose representations of phenomena, which attenuates the possible arbitrariness. Nevertheless, the alleged morphisms between surface models and theoretical models suggest that the possible representations somehow depend on the theory involved, and this is not a pragmatic issue but rather an epistemological one. In any case, it is the conceptual framework of an approach that allows us to conceptualise a phenomenon as thus or so ─that is, as a phenomenon or physical process of a certain kind─ to propose a possible representation of it. Without the contribution of a conceptualisation of the phenomenon to be represented, as could be the case in some nonscientific contexts, a proposal of representation of it becomes arbitrary.

Giere's Realism

Ronald Giere (1988) proposes constructive realism as an alternative to van Fraassen's constructive empiricism, where he confronts the issue of the relationship between theoretical models and the processes that happen in the physical world. He held that theoretical models are similar in some respects and certain degrees to actual systems, so the former are partial and approximative representations of the latter. According to Giere (1988), the scientist makes particular hypotheses that claim that a given model is similar in the former sense to a real system. Such hypotheses are valid if real systems fulfil the assertions about the aspects and degrees claimed.

Later, Giere (1999, p. 150) develops his realist thesis in a way that is relevant here. There, he advances a perspectival realism: "[…] our theories do not ever capture the totality of reality, but provide us only with perspectives on limited aspects of reality. Scientific knowledge is not absolute, but perspectival." Moreover, he improves his thesis by introducing the concept of the data model and maintaining that the similitude involved between models and fundamental aspects is structural: "When, through observations and experimentation, these particular models are judged to be well-fitting, we are justifiably confident that the world itself exhibits a structure similar to that of our models" (Giere, 1999, p. 241). We must note that this thesis attributes structures to real systems based on their presumed similitude with theoretical models.

Giere (2006, p. 15) adjusts the semantic conception of theories with his new perspectival realism. He holds that

> *"On this account, general principles by themselves make no claims about the world, but more specific models constructed under the principles can be used to make claims about specific aspects of the world."*

Thus, Giere's perspectival realism (2006) is not at the level of fundamental principles of theories but rather at the level of their models; we think in a double sense: firstly, the specific models provide perspectives of aspects of the objects under study, and secondly, these sort of models are the scientific constructs that physicists link with real objects to make claims about these objects.

Nevertheless, no model could represent a single aspect of the world such as it is, as classical realists would claim; instead, the representation of an element of the world that one could obtain via any model is from the *perspective* of the model adopted or constructed. In general, "[…] scientists create perspectives within which conceive of aspects of the world" (Giere, 2006, p. 59).

Several of his theses confirm the relativist vein of Giere's perspectivism ─which moves away from scientific realism. For example, where he holds that "For a perspectivist, truth claims are always relative to a perspective" and, better, "That scientific observational or theoretical claims should, in general, be relativised to a perspective is, if anything, easier to accept" (Giere, 2006, pp. 81-82). Thus, from Giere's (2006) conception of theoretical models, we can say that the statements that scientists can claim have the form: 'Model M represents the actual system S, relative to the perspective that M provides of S.' Eliminating the last clausula implies an absolutist claim, which, for Giere, is unsupported. It is clear, then, that Giere holds a sort of relativism: the theoretical claims about aspects of the world are relative to the perspectives that models provide of such elements.

We have seen that Suppes' instrumentalism lacks a substantial thesis about the relationship between theoretical models and the processes that occur in the physical world; his related dissertation is about the connection between models of data and experimental experience via measurements of magnitudes that share data and theoretical models. In general, instrumentalists, as antirealistic philosophers, consider theories as devices of predictive calculus and conceive them, to some extent, empty of conceptual content. Van Fraassen, avoiding the assumption that one can attribute a non-conceptualized structure to phenomena, proposes a pragmatic notion of representation that fails to provide connections between surface models and phenomena that are not conventional or even arbitrary. Realist philosophers like Suppe and Giere fail to avoid the former assumption and attempt to sustain the thesis that assigning structures to physical processes is possible. Suppe implicitly appeals to that assumption to claim that there are mapping relations between actual processes and theoretical models. At the same time, Giere tacitly calls it to argue that there are structural similitudes between actual features of the world and the models of a physical theory.

Conceptualism's Epistemological Theses

We find Giere's (2006, p. 92) perspectivism cognate with our conceptualist view of physical theories. He says, "The knowledge we get comes from one perspective or another, not from no perspective at all." However, we deem that his relativist epistemological theses are hardly compatible with any concept of truth that aims to link theoretical models with what happens in the physical world in such a way that one would be allowed to claim the truth of empirical statements because it involves a model-world comparison, which is unviable since as Chang (2020, p. 404) rightly asserts: "All we can talk about are conceptualised objects, not things-in themselves". So, we cannot compare our perspective of a real system provided by a model with its non-conceptualized counterpart in the world.[5]

Our central thesis is about the role that conceptual frameworks ─webs of interconnected concepts linked by types of relationship like connotation, subsumption and entailment─ of physical theories play, which make possible and limit at once our conceptualisation of how the world is, as well as our cognitive access to what happens in it. Every physical theory has its characteristic concepts, both kind (or class) concepts and metric (or quantitative) concepts, which configurated their conceptual vocabularies, using Kuhn's (2000) expression appropriate to describe physical systems and the processes that they undergo.

We add the thesis that models, as conceptual constructs, are mediators between a theory T and the physical systems and its evolutions within the intended domain of application of T in such a way that they bring the means to conceptualise the processes that physical systems undergo relative to the concepts and laws of T. For a possible realisation, as a candidate to model a physical process, to supply a conceptualisation of it, it becomes necessary that such possible realisation fulfil the pertinent laws of a physical theory. If, besides, it approximately matches the experimental data about such a process, we may say that the conceptualisation provided by that possible model is proper, which amounts to saying that it modelled the process in question relative to a given physical theory.

As an epistemological view, conceptual relativism maintains that our knowledge of the world, the way of thinking and understanding the domains of diverse physical theories, is *relative* to and depends on the theories that we assume or construct: scientific knowledge is especially relative to the conceptual frameworks comprised in such type of theories. Theoretical models are the means to conceptualise the physical world in a specific mode and to understand in some way what happens in it relative to a physical theory. From an ontological

[5] For a detailed account of Giere´s scientific perspectivism, see Rolleri (2022).

point of view, conceptual relativism does not maintain any existential claims or any thesis about how the physical world is. The theories suitable for sustaining allegations about how the world is are precisely the physical theories. Epistemological relativism is consistent with the thesis on the independent existence of the physical world, the world that is the subject matter of the diverse theories of physics. Such theories neither contribute to constituting what there is and what happens in the physical world nor describe the physical entities and processes such as they are really, nor provide models that represent phenomena or physical processes. The conceptual contribution of these theories to the mode in which we think the world does not entail any dependence on its existence on such theories.

Conceptualising a physical process via a theoretical model involves the physicist's intentionality in understanding that process based on the relevant theory. He projects the model to a space-time region of the physical world where the process occurs as an intellectual procedure to capture it in the conceptual web of a theory. Eventually, the model projected allows the physicist to conceptualise the target process in terms of the concepts of the relevant theory and understand it relative to that theory.

As we said, from the semantic conception of theories, the models could bring a mode for conceptualising physical process if, on the one hand, it satisfied the nomic statements involved and, on the other hand, what the model entails about such process fits well enough with the data model associated with the theoretical model. The former supposes that a surface model can be embedded into a possible realisation, which satisfies some nomic statements of a physical theory, and such a surface model involves an admissible approximation to the target process. The last clause can be elucidated as follows: At a pre-theoretical level, it is required to obtain a systematisation of some empirical data from the (kind of) target process, a surface model. In addition, finding a possible realisation that fulfils some relevant laws of a theory is required. Eventually, the surface model could be embedded into such possible realisation, entailing that the related theoretical model is approximatively applicable to the pertinent physical process up to a permissible degree of inaccuracy.

In line with the former order of ideas, if we conceive a theory as a set of classes of models, we can think that every class of models it includes provides us with idealised conceptualisations of the kinds of processes within its intended application domain. If so, although physical theories allow predictive calculus, they are not merely predictive instruments. This is contained in the idea that the physicist projects the theoretical models to the processes that happen in the world. Neither empirical adequacy is sufficient to think about how the theoretical models contribute to understanding the processes that occur in the world. However, holding a model that an appropriate surface model could be embedded into it becomes necessary. The predictive power and the empirical adequacy are ingredients of our conception of scientific knowledge in physics. Nevertheless, such ingredients do not exhaust what physical theories provide us to think about how the world could be because they miss the conceptual webs of such theories.

In contrast, the realist thesis on the relationship between theoretical models and physical processes has no place in our conception of physical knowledge because, as we tried to show, it is unsustainable: the thesis of the realist philosophers rests on the untenable assumption that the bodily systems and processes have structures by themselves or, in any case, that it is possible to attribute structures to them which allows defining mappings with theoretical models. If we wish, we can attribute structures to physical entities, such as hydrogen and helium atoms, as well as quantum processes of fission and fusion, and represent them with figures, diagrams, or something else. This could have a heuristic value; however, we do not have to think that such entities and processes have themselves such structures. To do that is an unjustified idea.

Conclusions

Perhaps the main epistemological conceptualist's thesis, that our scientific knowledge of the physical world is relative to and depends on the theory that one adopts or constructs, would be accepted by some philosophers of science as a worth uncontroversial thesis, while others would consider it, however, as a trivial truism, even some others would find that it implies a silly relativism which asserts that, drawing Giere (2006, p. 39) expression: "Every perspective is regarded as good as any other." For me, conceptual relativism is a worthy, coherent, and plausible alternative, in some respect, to philosophical stance as instrumentalism, empiricism, and pragmatism, though incompatible with scientific realism.

Some realist philosophers may deem acceptable the claim that all scientific knowledge about facts comes from the perspective of some theory, as Popper (1970) does; however, those philosophers sustain the concept of knowledge that entails truth, and thus, for them, such a theory must be the true theory about those facts, in the sense that it corresponds with them. The conceptualist construal briefly exposed here contrasts with that epistemological realist thesis in that we cannot claim how the world is but how we conceptualise it relative to our theory. So, knowing something connotes conceptualising it in a specific mode relative to a theory. From the semantic view, this is achieved through the models of physical theories.

The central concept in the classical debate realism/antirealism about science is the concept of truth as correspondence with the facts, which philosophers understand on both sides of the debate in an absolutist sense. For example, Popper (1972) explicitly adopts what he calls the objective or absolute concept of truth, sustaining the thesis that science aims to reach for the unattainable true theory, while when Kuhn (1970) rejects assertions about true theories, he refers to that absolute sense of truth. Besides, many philosophers write about proper laws and theories without explicitly specifying what they understand by truth but assuming that everybody knows what a true lawlike statement is. An exemplary case of this is Hempel's model of deductive nomological explanations since he stipulates that as a condition for explanations, the statements that form the *explanans* must be factual, implying that the scientific laws are valid. Otherwise, for logical reasons, one cannot assert that the *explanandum* statement is accurate and, thus, does not explain anything (Hempel, 1965). As far as I know, nowadays, no philosopher of science holds the classical, absolute concept of truth.

The surrogate concepts of the Aristotelian concept of truth have failed. Popper's (1976) concept of authenticity has been found to have insuperable technical problems.[6] Niiniluoto's (1987) proposal of a truthlikenes concept that tries to improve Popper's approach also has

[6] See Harris (1974), Miller (1974), and Tichý (1974).

formal difficulties. The idea of approximation to the truth is senseless; it involves the naïve assumption that a false statement or theory we know approximates a true statement or theory we do not know (see Balzer et al., 1987, p. 328).

The absolute concept of truth permeates the dispute between realists and antirealists to a large extent, which precludes anyone from attempting to hold a concept of truth in a relativist sense. Therefore, I decline the idea of true theories in their traditional absolute sense in the philosophy of science. Conceptualism requires a concept of scientific knowledge that does not entail that physical theories aim to be accurate, or could be true, or even that they are approximations to the actual theory. Conceptual relativism only entails that a physical theory contains *idealised conceptualisations* of the processes in the physical world, which reside on theoretical models. Via such models, physicists understand the physical processes relative to one theory or another. That may be all that is reasonable to demand to the scientific knowledge.

Several philosophers think that to the extent that theoretical models could be less abstract, idealised, and inaccurate, they can better approximate their target actual processes. "We can easily image a sequence of less and less idealised models obtained by the successive deidealization of a basic model. […] Deidealized models are often called more "realistic" models, that is, models that provide a better and more complete representation of some complex phenomena" (Cassini & Redmond, 2021, p. 35). Indeed, theoretical models could be improved by procedures such as concretisation, des-idealization, innovative equations, and more precise measurements. However, the former does not entail getting approximations of the target processes such as they are. What is possible to achieve by the prior procedures for improving theoretical models consists in a more comprehensive, fuller understanding of such processes from the perspective of the conceptual framework of a theory. Even under the supposition that it would be a systematic procedure to get better and better conceptual approximations of physical processes, that does not mean we are gaining knowledge of them as they are. Except in simple cases, some unrealistic, idealised assumptions will remain without the possibility of being removed in favour of realistic ones. Idealisations are ubiquitous in our theoretical conceptualisations of the physical world, embracing laws and theoretical and surface models.

Prospect. The conceptualist framework displayed here could be developed to address the philosophical problem of scientific explanation, elaborating a concept of an explanatory model under the semantic view of physical theories.

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Conflict of Interest

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