published in *Principia* (Brazil) 11 (2007): 151-169

The Value(s) of a Story:
Theories, Models and Cognitive Values

Isabelle Peschard
University of Twente/San Francisco State University

Abstract

This paper aims 1) to introduce the notion of theoretical story as a resource and source of constraint for the construction and assessment of models of phenomena; 2) to show the relevance of this notion for a better understanding of the role and nature of values in scientific activity. The reflection on the role of values and value judgments in scientific activity should be attentive, I will argue, to the distinction between models and the theoretical story that guides and constrains their construction. The aim of scientific activity is to develop understanding of phenomena, and something that serves this aim and contributes to the development of understanding has a cognitive value. Cognitive values are the features that something that plays a role in scientific activity should have so that it can serve its aim. I will focus my attention on the features of the theoretical story and of the models.

Introduction

This paper aims 1) to introduce the notion of theoretical story as a resource and source of constraint for the construction and assessment of models of phenomena; 2) to show the relevance of this notion for a better understanding of the role and nature of values and value judgment in scientific activity.

It may be that certain important things about the world can only, as Cora Diamond (1995) seems to think, be said and learnt through stories. That is indeed the value of a story, a cognitive value, as I will argue. I believe that the stories "we wish to tell and believe suggest what we value most in this world" (Shannon 1995). In that sense, we can also speak of the values of a story; the values that are promoted by the story. I will argue that they can be cognitive values, even though they do not belong to the 'traditional' set of cognitive values.

Contrary to most writings on the role of values in scientific activity, I will insist on the distinction between theories and models, largely indebted to the development of semantic approaches to scientific theories. I will demonstrate the relevance and fruitfulness of this distinction, for a better grasp of how cognitive values contribute to our understanding of the world, by addressing two of the

Principia, **11**(2) (2007), pp. 151–69. Published by NEL — Epistemology and Logic Research Group, Federal University of Santa Catarina (UFSC), Brazil.

most elaborate and insightful reflections on 'values in science', namely (Longino 1990, 1996) and (Lacey 1999). I will show how, by not observing this distinction, these conceptions nevertheless misconceive the role of cognitive values as well as the distinction between cognitive and other sorts of values, and miss an important distinction among cognitive values themselves, a distinction which casts a new light on the difference between the traditional and feminist characterizations of the values and value judgments involved in scientific activity.

The story I will tell aims to articulate a functional, and thereby non-dichotomist, conception of values identification as cognitive, social, ethical. I take these values to be respectively things, or features of things, that contribute to the realization of understanding of the world, or of a Good Society, or of a Good Life. That is the functional part. But this is not an exclusive disjunction and things or features can be values of different sorts, just as a virtue can be both an intellectual and a moral virtue (Zagzebski 1996). This is the non-dichotomist part. The cognitive value of this story will be that it enables a distinction between two kinds of cognitive values, contributing to a better understanding of this part of the world that the development of our scientific understanding of the world constitutes.

A recurrent character of my story, beside theoretical stories, models, and values, will be a particular theory, a theory of cognitive activity, namely the theory of enaction (Varela 1991; Noe 2004), that is to say, the enactive story about cognitive activity, by contrast with the symbolic-computationalist story about it. Even though it is a character that, as we say, really exists, the most important is the drama it enables me to explore. The drama turns around values and how, just like a secret can pervade and shape human relationships, they pervade and shape in different ways the construction and assessment of scientific models.

1. Theo(stor)ies and models

1.

In its contribution to *Models as Mediators*, Stephan Hartman (1998) argues that "telling a plausible story is often used as a strategy to legitimate a proposed model ... [E]mpirical adequacy and logical consistency are not the only criteria of assessment of models acceptance. A model may also be provisionally entertained ... when the story that goes with it is a good one" (p. 326). Hartman is absolutely right on the importance of stories, but I will even go further. First, I will emphasize that what makes a story a good story is not necessarily what makes a model a good model. Second, the two competitive stories that he considers take

place in a particular theoretical framework and legitimate two different models that both pertain to this theoretical framework. The theoretical framework is that of quantum chromodynamics. This theory, says Hartman, has three characteristic features, which are three properties of the quarks and their behavior. The two stories that he considers are those that go with two different models of this theory which have been entertained by many physicists even though each could only account for one of these three properties. The story going with each of them is crucial in that "this story must provide an argument as to why the chosen feature is relevant and why the other features are insignificant" (p. 343). These stories are, so to speak, intra-theoretical.

Stories, however, are not only important with respect to the legitimacy of models, they are crucial to the legitimacy of a *kind* of model and to the identification and construction of models of that kind. In that case, as will become clearer, what I will call the theoretical story cannot be considered as a criterion of assessment of a model, at least not in the same sense as, for example, empirical adequacy (I will use this term in the sense of predictive accuracy) or logical consistency can be. That the theoretical story is not a criterion for the assessment of models does not preclude that the formulation and acceptance of a story which goes with a kind of model involves values and value judgments. It does involve values and values judgments, and these play an essential role in the construction of the models and the application of the criteria with which they are assessed. But for now, let's focus on this idea of theoretical story.

As is well known, the semantic view of theories argued that a more realistic and less philosophically and logically problematic account of scientific theories should conceive of it as identified by a set of models rather than a set of sentences. Does that mean that a theory is nothing else than a set of models? In a recent paper, Margaret Morrison accuses the semantic view of claiming the reduction of theories to sets of models. But is it possible to refer to such a set of models without referring to a theory? We could identify the models as structures satisfying a particular structural constraints — think for example of Newton's laws as general structural constraints that all Newtonian models satisfy. But if models were mere structures, how could they have a physical meaning, how could they be models of phenomena of a certain class? An answer may be that these structures acquire a physical meaning, that they become connected to the world, through an interpretation. For instance, Ronald Giere (1984) added that a theory involves both a particular set of structures and a 'theoretical hypothesis' which asserts a relation of these structures to a domain of phenomena. Then a theory is not *just* a set of models and a reduction is clearly precluded. Nevertheless, we need still ask: does

this conception of the way in which models relate to the world provide a realistic account of what scientist are doing?

Because of its silence on how models are obtained, in practice, the semantic view seems to suggest the following scenario: models are derived from a structural constraint; a physical meaning is bestowed on them through an interpretation that relates them to a class of phenomena; they are assessed by confrontation to the phenomena in the class that the scientist aims to model.

According to this scenario, all that is crucial for the philosopher of science in the production of scientific knowledge, is the assessment of models, just as for the syntactic view it was the assessment of theories. The role of values and value judgments, in this account, is well circumscribed and restricted to the assessment of models. This restriction however is only possible because the theoretical framework is taken for granted as the one to which the models in question pertain, and the structure of the phenomena that the models in question are meant to model, is also taken for granted as what has to be modeled. Let's see why this account is unrealistic and how it has to be modified.

The neglect of the practice of modeling has triggered a critical reaction insisting, on the basis of particular case studies, on the difficulty and creativity of the process of production of models with its contextual dependence on particular assumptions and approximations, as well as on the diversity of their functions. An alternative scenario can then be sketched. Models are not derived from first principles, axiomatic or structural they are constructed; and theories, to spin out the metaphor, are tools for this construction, among many others (Cartwright et al. 1995). Moreover, the relation between models and the phenomena they are models of is not an external relation, it is an intrinsic relation. The physical meaning of the model is 'built-in' the model in the course of the process of its construction rather than a sort of additional property bestowed on it (Suarez 1999). I am very sympathetic to the conception of theories as tools for the construction of models, and a convinced proponent of the 'built-in' conception of the physical meaning of models (Peschard 2007). However, a proper understanding of the way in which it is 'built-in' requires a strong qualification of the notion of tool applied to theories. And it is here that the notion of a story will be put to work.

If we think of a tool as an object submitted to the goodwill of the user, theories are definitely more than tools. Even though we should keep in mind that a tool dictates a large part of the domain of its use, the image of a tool suggests too much passivity on the part of the tool and freedom on the part of the user to do justice to the practice of modeling. As to the latter, the practice of modeling is always already situated, embedded in a theoretical framework. As to the former,

this theoretical framework guides and structures the process of modeling, and it exerts a constraint on the kind of model that this process can produce. It is for that reason that, despite the important development which the emphasis on and elucidation of the role of model constitutes, "the notion of a theory is necessary", as Morrison contends, 'for capturing the structure of scientific knowledge" (Morrison 2007). The question, now, is how it is necessary.

2.

When Morrison writes that "it is the identification of a theoretical core rather than all the features contained in the models that enables us to claim that a set of models belongs to Newtonian mechanics" (2007, p. 205), she is pointing out an essential aspect of the relation between models and theories. According to the semantic view, as we saw, this theoretical core is to be conceived in terms of structural constraints that all the models must satisfy. It may seem that this is what Morrison means when she adds: "[t]he core features not only are common to the models but constrain the kind of behavior described by those models and provide (along with other information) the basis for the model's construction" (p. 204). But it would be wrong to think that the constraint on the kind of behavior is nothing more than a structural constraint on the models.

First, the constraint on a kind of behavior is a constraint on the kind of phenomena that the models of the theories will have to be models of. It is one way in which the physical meaning of the models is built-in. The model is born interpreted, because the theory is first of all a constraint on the phenomena that the models of the theory are to model. For example, a computational theoretical framework is a framework in which cognitive activity is a computational process, whereas in the framework constituted by the theory of enaction, it is a dynamical process. This is how I understand Morrison when she writes: "The essence of Newtonian mechanics is that the motion of an object is analyzed in terms of the forces exerted on it which are described in terms of the laws of motion." (p. 204)

But there is an additional reason why the constraint on the kind of behavior is a not a mere structural constraint, so fundamental that it becomes invisible. The laws of motion are not a mere structural constraint. Morrison, in the previous quotation, speaks of the 'motion of an object' as an example of a kind of behavior theoretically constrained. But she seems to forget that 'motion' and 'object' are also part of the Newtonian theoretical framework. The theoretical framework is not only a constraint on the kind of behavior but on the kinds of things that manifest this behavior and the kinds of properties these things have. To continue

the other example: in the enactive story, which takes neuronal activity as essential, we have neither symbol nor rule of combination but populations of neural oscillators, phases, frequencies, and the behavior of the system takes the form of a temporary local or long-range synchronization resulting from a locking in phase of different oscillation cycles.

Furthermore, contrary to what Morrison seems to suggest, when she speaks of "the theoretical coherence provided by core laws," core laws are not necessary to the theoretical coherence that characterizes models of a certain kind, nor to the construction of these models. There are no such laws to identify computationalist theory or enactive theory of cognitive activity, there are only symbolic-computational models and non-linear dynamical models.

We need then a conception of theories that enables us to account for

- the theoretical coherence that characterizes the models of a theory, but without depending on the existence of mathematical principles;
- the way in which a theoretical framework guides and constrains the construction of models, but indirectly, through a constraint on the phenomena.

This is what conceiving of theories as stories will enable us to do. The main function of a theoretical framework is to guide and constrain the construction of a certain kind of models and does so not by providing laws but first of all by dramatizing the world. The theory shows, not as a demonstration but as a story does, what to look at and how to look at it, what are the relevant features of things and processes, which are fundamental, which are apparent, what sorts of relations there are, and what form of development they have. It is in that sense that the theoretical framework constrains the kind of behavior that can, and has to, be modeled and exerts a constraint on the kind of model that is adequate.

2. Theories, models and cognitive values

1.

Most, if not all, works on the role and nature of values and value judgments in science fail to clearly distinguish models and theoretical frameworks, and suffer from these three shortcomings:

- taking 'theories or models' as the object of empirical assessment. Models, not theories are what are empirically assessed, unless the theory in question is so simple that it reduces to a single model or a sentence. In

scientifically interesting cases, the theory cannot be directly empirically assessed for it doesn't describe any particular phenomenon. Models, on the other hand, are directly empirically assessed, because they are models of particular phenomena — but they are not descriptions of these phenomena. They are more like instruments of anticipation and exploration.

- being unable to make the appropriate distinction between the values and value judgments involved in the formulation or selection of a theoretical framework and those involved the assessment of models.
- taking for granted the theoretical framework in which models are embedded and being oblivious to the values and value judgments that are involved in the formulation or selection of a theoretical framework. These values and values judgment are not criteria for the assessment of models. But they are intrinsic to the process of construction and to the significance of models, and they condition the selection and specification of the criteria for the assessment of models

I will illustrate the way in which these shortcoming can obstruct the analysis of the role of values and value judgments, and their proper characterization, by considering the reflection developed on the subject by Helen Longino (1990, 1996). Her analyses are extremely perceptive and her demonstration of the role of what she calls 'contextual values' and 'background assumptions' constitutes an important advance by uncovering an essential component of the process of construction and assessment of models. But her analysis of the cognitive function of these values remains unclear and ambiguous because it suffers from the first two of the above shortcomings. In spite of the advance that this analysis represents, she cannot draw its full implication with respect to the identification of cognitive values and value judgment.

What are traditionally recognized as cognitive values varies a little from one author to the other; this slight variation is not relevant to my concern. They form a set that comprises such items as predictive accuracy or empirical adequacy, internal and external consistency, explanatory power, breadth of scope, simplicity. What is important for my purpose is that these items, that I will call 'traditional' cognitive values, are meant to be features of the same thing, of what the authors of these lists call 'theory' while what they have in mind is something that can be directly empirically assessed. That *S* is directly empirically assessable means that it make sense to ask about *S* how well it predicts or how well it fits with some empirical information about a particular phenomenon. Empirical assessment is not the only, and sometimes not the most, important form of assessment. The

features that are listed as cognitive values are values in the sense that they are criteria of assessment. They are features that the best product of our cognitive activity, scientific conceptions of phenomena, should have. We have to keep in mind that the assessment is a value judgment at two levels: the selection and the ranking of the relevant criteria, and the determination of their conditions of application (Kuhn 1977).

As long as philosophers of science were only interested in rational reconstruction, these 'traditional' values and value judgments seemed to be the only ones relevant to philosophy of science. Feminist epistemologies, however, have pointed to the role played by other value judgments in the production of scientific conceptions of phenomena. As we will see, the values that are in play in these judgments are obviously very different from those traditionally recognized as cognitive values. But whether and how the function ascribed to these value judgments is distinct from that of traditionally recognized cognitive value judgments is not equally clear. It may consequently seem then that these values and values judgments, without being themselves cognitive because of their obvious difference with respect to the items of a traditional set, sometimes function as illegitimate substitute for the traditional ones. These values, I will show, cannot be substitutes for the traditional ones. In effect, the distinction between the models that are objects of direct empirical assessment and the theoretical story constituting the framework in which they are constructed will reveal that they are simply not features of the same thing. I will consider some specific examples of these values pointed to by feminist epistemology and show that they are, in fact, characteristics of the theoretical story. But not being part of the traditional set doesn't make them necessarily illegitimate. As characteristics of the theoretical story, they have no less epistemological right to count as cognitive values; but here I am anticipating on the last part of the paper.

2.

Let's focus for now on the role played by what Longino (1996) calls the "alternative set" of 'desiderata' promoted by feminist epistemologies. "[T]hey function", she says, "*like* the more traditional candidates for cognitive or scientific values, as virtues; that is, as qualities of a theory, hypothesis or model that are regarded as desirable and hence guide judgment about them" (p. 45, my italics) But what does that mean that they "function like" cognitive values or "as qualities of theory, hypothesis or model"? Are they the 'same sort' of qualities as the traditional cognitive values, and do theories and models have the same 'qualities'?

To say that these values function 'like' cognitive values strongly suggests that they are not cognitive values. And it is not difficult, when we look closer at these feminist 'desiderata' discussed by Longino — novelty, mutuality of interaction, ontological heterogeneity — to find the reason for this qualification. It is that they are socio-political values: they are features that are values as features of sociopolitical phenomena which destabilize or prevent the existence of certain power relations. Ontological heterogeneity is respectful of differences in forms of being, by treating them as differences in resources, rather than eliciting a standard form of being and treating the others as failures and therefore inferior. Mutuality of interaction promotes the recognition of a plurality of forms of contribution to the realization of a process or an object rather than opposing active and passive forms of involvement. But even if it is important for our understanding of the significance of these features to investigate the different forms of argumentation and characterization in which they may be involved, it is important in order to understand each of these forms not to conflate them. It is not as sociopolitical features that they can be 'qualities of a theory, hypothesis or model". How then? Longino noted herself earlier in the paper, the values promoted by feminist epistemologies, are not incompatible at all with traditional cognitive values: "Endorsing novelty is not claiming to depart from the standard of empirical adequacy" (1996, p. 52), nor is it to depart from that of simplicity or consistency or fruitfulness, and the same holds for ontological heterogeneity or mutuality of interaction. However, at another moment, she speaks of "comparing [traditional values] *with contrary* theoretical virtues [feminist desiderata]" and showing thereby, "that in specific research contexts the traditional virtues have a demonstrably political valence" (1996, p. 54, my italics). Are these feminist desiderata contrary values or are they not incompatible with traditional values?

Longino speaks of assessment of "scientific theories, models or hypotheses" but doesn't make explicit the distinction between theories and models, which remains epistemologically idle. The distinction between theoretical framework and models pertaining to this framework becomes crucial here. In fact, there is a simple reason why these values are not incompatible with the values of the traditional set and do not constitute, contrary to what she writes, "an alternative list". It is that they are not features of the 'same thing'. The items of the traditional set are formal features of what is empirically assessed, that is of models. Whereas mutuality of interaction or ontological heterogeneity are general features of the phenomenon, which characterization is provided by the theoretical story that guides and constrains the construction of models of the phenomena. There are some values with respect to which ontological heterogeneity and mutuality of

interaction are contrary values, like 'ontological homogeneity' or 'unidirectional causality'. But these are not the items of the traditional set of cognitive values; they are general features of the phenomena promoted by the theoretical stories that feminists called into question.

3.

Scientific inquiry, as Longino aptly emphasizes, cannot develop without a "preliminary characterization of the inquiry's subject matter, [which] can be called the specification, constitution of the object of inquiry" (1990, p. 99). The characterization of the object of the inquiry, she says, "provides assumptions that highlight certain kinds of observations and experiments" (p. 100), "prescribes the character of hypotheses and determine the character of reasoning" (p. 99). But the way in which this characterization relates to theories, how it prescribes hypotheses or provides assumptions, remains unclear. This characterization is rightly perceived as a condition of possibility of the investigation of a particular object, but without a clear distinction between the theoretical stories and the models to which they pertain, it cannot even be seen as an integral part of scientific activity. It is regarded as the expression of contextual values, which are social values or ideology, and scientific objectivity can only be preserved by appealing to their 'transformation', through the social organization of the inquiry, into cognitive values.

That simplicity can be an aesthetic value doesn't prevent it from being a cognitive value in other contexts of argumentation, characterization, and evaluation. Novelty, ontological heterogeneity and mutuality of interaction are values that can be promoted, not only in a sociopolitical but also in a scientific context of argumentation, characterization, and evaluation. The same characteristic can be a characteristic of different kinds of objects and consequently be different kinds of value. As it happens, the theory of enaction promotes the three feminist desiderata that have been mentioned. This theory promotes novelty in that it attends to features of cognition that are dismissed or considered as secondary, accidental, or only epiphenomenal in other frameworks, such as for example experience, neuronal embedment, and sensorimotor activity, and it rejects some claims about cognition that other stories promote (that cognition is computation and that it is representation). (Varela 1991; Noe 2004) It promotes ontological heterogeneity in that it takes experience to be an active component of cognition and promotes a science of cognition able to articulate phenomenological descriptions and neuronal descriptions rather than to reduce the former to the

latter (Varela 1996; Lutz 2002). It promotes mutuality of interaction, in that it takes neuronal activity to be the activity of a system of coupled oscillators with the emergence of global patterns of oscillatory activity interacting with the local behavior of the individual oscillators; and also in that it takes cognitive patterns to result from an interaction between the cognitive system and its environment, rather than a passive reception (Thompson and Varela 2001).

The phenomenon of cognition is presented there as having these features in the normative story that forms the theoretical framework in which models of a certain domain of phenomena are constructed and assessed. The theoretical story partly constitutes the normative space in which any judgment of causality will take place: "Causality must be understood as always already normative. Causality must enter the space of reasons (and vice-versa)." (Rouse 2002, p. 183.) The features presented in the theoretical story are what should be accounted for and what should be taken into account. Since these features characterize a certain theoretical framework, we could speak of theoretical values. But we could speak as well of phenomenal values, since they are features of the phenomena. These values, as features of the phenomena that are the target of the process of modeling, will constrain the construction of models through the constraint exerted by the theoretical story on the kind of parameters and variables that are relevant, as well as on the kind of behavior that the phenomenon exhibits. By exerting these constraints, these values will give flesh to the formal criteria of assessment of models mentioned in the traditional set of cognitive values.

So obviously these values play a crucial role in our understanding of the phenomena. It is clear, accordingly, that when Varela defends the theory of enaction against computationalism, he thinks that computational models do not and cannot account for cognition, at least not as we 'know' it, as we experience it when we are perceiving and dealing with the world: "When it is cognition or mind that is being examined, the dismissal of experience becomes untenable. To deny the truth of our own experience in the scientific study is not only unsatisfactory; it is to render the scientific study of ourselves without a subject matter." (Varela 1992, p. 13) According to the enactive story, if computational models are said to be models of cognition, it must be that the concept of cognition has been reconstructed such that, whatever virtue these models may have, it will not be that of furthering our understanding of what it is to be the cognitive beings that we are.

So now the question is: What sort of values are the theoretical values? They are not part of the traditional set. But can there be other sorts of cognitive values? What makes a value a *cognitive* value?

3. Cognitive values: questioning the tradition

1.

Whether cognitive values are, as McMullin (1983) thinks, or are not, as Laudan (2004) argues, truth-conducive, makes no difference to how they can be recognized as cognitive values. In fact, McMullin and Laudan display a similar reliance on history of science and on the analysis of particular cases of theory choice: "this is their primary justification" says McMullin, "and it is an adequate one." But we need to make some distinctions that this reliance on history of science does not enable us to make. Some values that played a role in scientific judgment of acceptance or rejection were later on regarded as illegitimate. We need the identification of a feature as a cognitive value to serve, not only as a retrospective explanation, but as an instrument of elucidation of scientific judgment and understanding of scientific activity. That we speak of cognitive values rather than simply scientific values should be taken as an indication that something more may be at stake in cognitive value judgment than science for its own sake.

An interesting attempt in this direction is made by Hugh Lacey. Even though Lacey distinguishes a cognitive value with respect to "whether or not it serves the objectives of science" (1999, p. 93), the objective is not, for him, "simply to gain theories that manifest highly the cognitive values that are currently adopted in scientific practice" (1999, n5, p. 93). It is to gain an empirically grounded and well confirmed understanding of phenomena (1999, p. 94; 2004, p. 30–1).

Now, if understanding of phenomena is, as I think it is, the objective of science, and no less for engineering science than for fundamental sciences (Boon, forthcoming), and if whether a value is a cognitive value depends on whether it serves this objective, one would expect to find a set of cognitive values that is, if not completely different from the traditional one, certainly much larger. Just as anything can have a social value or an ethical value in virtue of its contributing or even being part of the realization of a Good society or a Good Life, we can say that something has a cognitive value when it contributes to the realization of an empirically grounded understanding of phenomena. Now, it is not the society itself that is, for instance, just, it is a form of distribution of rights or of wealth; it is not the Good Life that is respectful of diversity, it is an attitude. In the same way, we should say that cognitive values are features that enable something to contribute to, or even be part of, the realization of understanding. For instance, one may say that a methodology has a cognitive value, or that certain

objects or a certain theoretical framework, what Lacey calls in fact a 'strategy of research',[1] may have a cognitive value, or a greater cognitive value than others. And Lacey does say these things may have a cognitive value (2004, p. 27, 40). But nevertheless, what he identifies as cognitive values is only another version of a traditional set of cognitive values with empirical adequacy, explanatory power, internal consistency, simplicity, etc. If the theoretical framework may have a cognitive value, how can it be that for Lacey no other features than the traditional ones count as cognitive values, how can it be that the phenomenal features that it may promote, such as ontological heterogeneity or mutuality of interaction, will be necessarily precluded?

This is possible thanks to a subtle conceptual distinction that Lacey introduces, which, even though its conceptual analysis of the role and nature of value and value judgment is remarkably meticulous and clarifying, will turn out to be untenable. The distinction is between having and manifesting a cognitive value. *Manifesting* a value is having a particular characteristic, one that is intrinsically valuable. A theory is here said to manifest a cognitive value when the particular characteristic is a cognitive value, for instance empirical adequacy or explanatory power. *Having* a cognitive value, on the other hand, is contributing to the manifestation of a cognitive value, or of an object manifesting a cognitive value. Having a cognitive value is then having a certain function, and that is possible without manifesting these characteristics, like empirical adequacy or explanatory power, that count as cognitive value in virtue of their being intrinsically valuable. But if the aim of science is understanding phenomena, why should any characteristic be considered as intrinsically valuable? The only thing that is intrinsically valuable is understanding, even though it may have also a cognitive value when understanding something contributes to the understanding of something else. The reason why, for Lacey, traditional cognitive values are intrinsically valuable seems to be the following: to gain 'theories' that manifest them is *ipso facto* to gain understanding of phenomena in that it is "to gain theories that express empirically grounded and well-confirmed understanding of phenomena" (2004, p. 31) And this is what goes wrong.

2.

We say of a person that she expresses understanding, or more precisely, we say this of her behavior; that is, what expresses understanding is the way she reacts, how she goes on, answers a question, solves a problem, or deals with a difficulty. What could it mean, that a theory expresses understanding? Understanding things

"involves", says Lacey, "an account of what they are: of the kind of thing they are; of their properties, behavior, relations and their variations with time. An account of why they are the way they are… An account of the possibilities that they allow in virtue of their own powers to develop" (1999, p. 95) If the something that expresses understanding is something that can be empirically adequate and explanatory, then it must be the model of a particular phenomenon. It would express understanding in the sense that it enables to formulate those sorts of accounts.

But first, it is the role of the theoretical story to specify what kind of things there are and what kind of behavior they can have, even though it is the model that enables one to answer specific questions. It is the theoretical framework to which the model pertains, the theoretical story that constrains its construction, that makes it possible for a model that is empirically adequate and explanatory to further our understanding. A model could be empirically adequate or explanatory without furthering our understanding of the phenomenon it models, if it doesn't explain what has to be explained, does not take into account what has to be taken into account. It doesn't further our understanding of cognition, for example, if we have a model that explains cognitive activity in terms, for instance computational, by denying the relevance of features of cognition that we take as essential, for instance the neuronal implementation or the function of consciousness. We would have to say that it is explaining something else. Of course, retrospectively, we know what had to be accounted for and what features were really significant, and we can see that as an external constraint on the different stories; but it is only because we have then already endorsed one of the stories that were proposed. This description of the phenomenon was not given prior to the story that was finally endorsed. So empirical adequacy or explanatory power is not intrinsically valuable; whether they further our understanding depends on the theoretical framework and the phenomenal features it promotes.

One may object that the theoretical story only furthers the aim by making it possible to construct a model that is relevantly empirically adequate and explanatory, whereas the model furthers this aim just by or in itself in that it expresses understanding rather than simply making it possible. Here we have to attend more closely to this idea of expressing understanding and to the idea of understanding itself.

When we speak of understanding we have to ask whose understanding. Nothing expresses understanding by itself, but only as an achievement; it is what one does, what one has achieved, that expresses understanding. It is not the model of a phenomenon itself that expresses understanding of the phenomenon, but what

one does with a model, what one is able to achieve. But there is no such thing as *the* understanding of the phenomenon. There is only some understanding, more understanding, or better understanding. Understanding is not reducible to giving answers to a finite closed set of questions. Understanding of a phenomenon is a process, it is progressive and open-ended; it starts well before the formulation of a model and develops well beyond any particular use of the model. It develops well beyond that, because a model is an instrument of exploration of a phenomenon. A model is, as Giere says, like a map that can guide us in the investigation of the capacities of the elements that are involved in the production of the phenomenon. The model furthers understanding in that this exploration is a source of understanding. It starts well before, because the construction of a model is itself a process of exploration which generates understanding, through the identification of the relevant features that are significant, the parameters that are relevant, the construction of an experimental system in which they are exemplified, measured and controlled. And here it is the theoretical story that guides the investigation.

The point that I want to make is that no feature of anything is intrinsically cognitively valuable. The only thing that could be intrinsically cognitively valuable is understanding of the phenomenon, in so far, I would like to add, as it would not prevent us to say that some understandings are more valuable than others. Different things can contribute to one's understanding; in particular, theoretical stories and models. Of something that has this capacity we say that it has a cognitive value. In each case, we can identify certain characteristics of these things that enable them to have this function. Cognitive values are these characteristics: it may be the simplicity of a model or even of a theoretical story, the empirical adequacy of a model, or the ontological heterogeneity promoted by a theoretical story. In fact, instead of distinguishing between manifesting a cognitive value and having a cognitive value, we should better look at the different characteristics of all the different things that in different ways contribute to our understanding of the world. "[T]he constitutive standards of the sciences", writes Rouse, "are themselves rich and complex, focused by what makes the practice and its outcomes *significant*" (Rouse 2002, p. 246) There are no general rules to recognize what makes the practice and its outcome significant; it depends, primarily, on what is at stake in the investigation of a particular phenomenon. But what is at stake is never entirely visible, it is revealed in the course of the investigation. It might be that what had been taken to be a cognitive value was not a cognitive value after all, and it might be that a certain characteristic is a cognitive value only at a certain point of the investigation.

Conclusion

The reflection on the role of values and value judgments in scientific activity should be attentive, I have argued, to the distinction between models and the theoretical story that guides and constrains their construction. The aim of scientific activity is to develop understanding of phenomena, and something that serves this aim and contributes to the development of understanding has a cognitive value. Cognitive values are the features that something that plays a role in scientific activity should have so that it can serve its aim. I focused my attention on the features of the theoretical story and of the models.

Among the features that have traditionally been recognized as cognitive values, some are features of the theoretical story, like internal and external consistency, some are features of the model, like empirical adequacy, that I take in the sense of predictive accuracy, and explanatory power. Only models can be empirically adequate to or explain a particular phenomenon. Simplicity can be a feature of a theoretical story and also of a model.

Traditional cognitive values were features considered independently of a particular theoretical framework and can therefore only be formal features or *formal cognitive values*. It is only in the context of a particular theoretical framework that empirical adequacy, explanatory power, simplicity can be used as criteria for the assessment of models.

The theoretical story guides and constrains the construction of models by prescribing what should be accounted for, what should be taken into account, what are the things that are relevant to the understanding of a domain of phenomena, what features they have, what kind of behavior these things can have or kind of relations there can be between the features of the different things that are involved. The theoretical story constitutes a normative framework which is characterized by certain *phenomenal cognitive values*. These values are *constitutive* of the phenomena that have to be modeled and thereby of the kind of models that is cognitively valuable. Moreover the theoretical story specifies the material content of the formal cognitive values, what counts as empirical adequate or as explanation or as simple, and guides the assessment of their comparative relevance.

Certain features that are phenomenal cognitive values may also be social values, as we saw in the case of mutuality of interaction or ontological heterogeneity, because they are features that certain objects or phenomena which play a role in the development of a Good society should have. The same features can then be values of different sorts. And very different sorts of features can be cogni-

tive values. The two groups that I have considered, formal cognitive values and phenomenal cognitive values, are only two among others.

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Keywords

Cognitive values, theoretical story, understanding, models, Lacey, Longino.

Isabelle Peschard
Philosophy Department
University of Twente (NL)
Philosophy Department
San Francisco State University, CA (USA)
i.peschard@utwente.nl

Resumo

Este artigo objetiva 1) introduzir a noção de história teórica como um recurso e uma fonte de restrições para a construção e avaliação de modelos de fenômenos; 2) mostrar a relevância dessa noção para uma melhor compreensão do papel e natureza dos valores na atividade científica. Argumentarei que a reflexão sobre o papel dos valores e juízos de valor na atividade científica deveria estar atenta à distinção entre modelos e a história teórica que guia e restringe sua construção. O objetivo da atividade científica é desenvolver uma compreensão dos fenômenos, e algo que serve a esse objetivo e contribui para o desenvolvimento da compreensão tem valor cognitivo. Os valores cognitivos são as características que algo que desempenha um papel na atividade científica deveria ter de modo a que possa servir a seu objetivo. Concentrarei minha atenção nas características da história teórica e dos modelos.

Palavras-chave
Valores cognitivos, história teórica, compreensão, modelos, Lacey, Longino.

Notes

[1] The roles of the adoption of a strategy are "to constrain the kinds of theories (hypotheses) that may be entertained in a given domain of inquiry (so as to enable investigation) and the categories they may deploy — and thus to specify the kinds of possibilities that may be explored in the course of the inquiry — and to select the relevant kinds of empirical data to procure and the appropriate descriptive categories to use for making observational reports" (2004, p. 36).