International Conference

MODELLING AND REPRESENTATION. HOW TO MAKE WORLD(S) WITH SYMBOLS

10-12 December 2015

Donostia International Physics Center (DIPC)

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Project "Configuraciones de la validación del conocimiento: prácticas epistémicos y decisiones políticas" (FFI2012V33550)

PROGRAM

Thursday, 10th December

9:00– 9:30 :: *Registration, Welcome and Introduction*

9:30– 10:30 :: Catherine Elgin (Harvard University)
Chekhov's Gun

10:30– 11:15 :: Stefano Canali (University College London)
Models and Data Curation

11:15– 11:45 :: *coffee break*

11:45– 12:45 :: Jay Odenbaugh (Lewis & Clark University)
Models, Models, Models: A Deflationary Approach

12:45– 15:00 :: *lunch*

15:00– 15:45 :: ***Cancelled! –*** Maria Serban (CPNSS, London School of Economics)
From representations to interventions: understanding the empirical success of mathematical models

15:45– 16:30 :: Koray Karaca (University of Twente)
Modeling Data Acquisition at the Large Hadron Collider: Against the Hierarchy of Models in High Energy Physics

16:30– 17:00 :: *coffee break*

17:00– 18:00 :: Tarja Knuuttila (Helsinki Collegium / U. of South Carolina)
Small Worlds Variously Embodied: The Material Dimensions of Modelling

Friday, 11th December

9:30– 10:30 :: Hans-Jörg Rheinberger (Max Planck Institute for the History of Science)
Models as a Form of Scientific Objects

10:30– 11:15 :: James Nguyen & Roman Frigg (London School of Economics)
Scientific Representation and Representation-as

11:15– 11:45 :: *coffee break*

11:45– 12:45 :: Thomas Mormann (University of the Basque Country)
Structural Representation, Constitution, and the Relative A priori

12:45– 15:00 :: *lunch*

15:00– 16:00 :: Christopher Pincock (Ohio State University)
Scientific Representation without Representationalism

16:00– 16:45 :: Andrew Wayne (University of Guelph)
Explanation without (traditional) Representation

16:45– 17:15 :: *coffee break*

17:15– 18:15 :: Eric Winsberg (University of South Florida)
Confirmation in Computer and Analog Simulations
(Videoconference)

20:30 :: *Conference Dinner*

SATURDAY, 12TH DECEMBER

9:00– 10:00 :: Andoni Ibarra & Iñaki San Pedro (University of the Basque Country)
Performative Representing with Computer Simulations

10:00– 10:45 :: Gabriel Giovannetti (Aix–Marseille University)
Empirical Meaning of Metrological Concepts in Physics: A Failure of Representation?

10:45– 11:15 :: *coffee break*

11:15– 12:00 Julia Sánchez Dorado (University College London)
Judgments of Similarity, Understanding and Scientific Practice

12:00– 13:00 :: James Griesemer (UC Davis)
Representations of Theoretical and Evidential Landscapes in Ecological Science

13:00 :: *end*

ABSTRACTS

Stefano Canali (University College London)

"Models and Data Curation"

In this paper I study representation in scientific models from the new perspective of data curation. In particular, I argue that representation in models, as it has been considered in the recent literature, and representation in data curation, as it has been described in the empirical work on database curators, have significant similarities. As a consequence of such similarities, I argue that studying curation activities such as data selection, annotation, tagging, etc. can help us better understand models' representation as well as other issues like validation; at the same time, I suggest that data curation can be considered a way of modelling data, specifically the first level where modelling takes place and which we can think as the basis of different kinds of modelling. In order to practically ground my argument, I focus on *The Arabidopsis Information Resource* database and scientists' curation practices regarding data annotation and labelling.

Catherine Elgin (Harvard University)

"Chekhov's Gun"

Models exemplify some of their own features and impute those features to their targets. Sometimes this requires no more than highlighting aspects of the target whose importance had not previously been appreciated. In such cases a model makes those aspects and their significance salient. In other cases, however, the model also reconfigures the domain, drawing new boundaries to mark out significant kinds, thereby enabling us to recognise significant similarities and differences that cut across traditional divides. As Chang's discussion of temperature shows, this can amount to reconstituting the phenomena a model bears on.

Gabriel Giovannetti (Aix–Marseille University)

"Empirical Meaning of Metrological Concepts in Physics: A Failure of Representation?"

Modelling has become an important part of the physicist's work in order to ensure the applicability of theoretical Physics to empirical phenomena. In this context, the relation of representation plays a central part in understanding the link between theory and experiment. Yet this "representation" cannot be carried out without measuring operations and instruments designed to assign numbers to physical properties. Relations thus obtained among objects or properties ("greater than", "heavier than", "equal", etc.) can be rightly translated into mathematical language by the use of suitable mathematical structures.

We would like to give some reasons to believe that the mathematical structures used in representing empirical observations do not always translate appropriately the peculiarities of the magnitude concepts such as "length", "mass" or "temperature". As the physicist P. W. Bridgman puts it in *The Logic of Modern Physics*, (New York, Macmillan, 1958): "mathematics does not recognise that as the physical range increases, the fundamental concepts become hazy, and eventually cease entirely to have physical meaning, and therefore must be replaced by other concepts which are operationally quite different" (p. 63).

However, from the empirical side of measurement, they are only defined on small scales of limited range, a fact that the recent historical researches on the concepts of temperature by Hasok Chang has contributed to highlight, see H. Chang, *Inventing temperature: measurement and scientific progress* (New York, 2004). Hence the empirical meaning of metrological concepts is not rightly captured by their mathematical representation. As a consequence it seems necessary to emphasise that mathematical structures may be useful in representing *some* "relational" features of the empirical world, but that they are unable to represent fully the empirical meaning of magnitude concepts. This conclusion will lead us to an assessment of the limits of the representation relation in understanding the ties between theory and experience.

James Griesemer (University of California Davis)

"Representations of Theoretical and Evidential Landscapes in Ecological Science"

Richard Levins' well-known argument for theoretical pluralism, that there is no single, best all-purpose model in ecology, was bolstered by his equally famous conjecture that useful models could not simultaneously maximise theoretical virtues of generality, realism and precision (Levins 1966, 1968). A virtue trade-off must be faced if models are to be manageable, and thus useful, for understanding, explanation, prediction, and control. It has been argued that Levins' pluralism about models is a pragmatic response to idealistic research programs which sought to represent all ecological complexity in a single unified or overarching comprehensive ecosystem model which might be conceivable but which, Levins argued, would be unmanageable, uninterpretable, and largely untestable (e.g. see Odenbaugh 2006). Recently, large-scale data synthesis projects have aimed to collect data from many empirical studies interpreted as bearing on a single major hypothesis or several related hypotheses.

These include quantitative meta-analyses organised by statistical measures of effect sizes and qualitative systematic literature reviews bearing on major hypotheses. Recently, a specific version of systematic review called the "hierarchies of hypotheses" approach has been proposed (Jeschke et al. 2012; Heger and Jeschke 2014, in prep). The organisation of ecological complexity in a patchwork of models according to a theoretical "virtue space" and discovery of "robust theorems" across a theoretical landscape, I argue, is complemented by recent efforts to manage evidential complexity in a patchwork of empirical studies according to a dataset virtue space organising a hierarchy of empirical hypotheses. In this paper I begin to explore conceptual connections between representations of theoretical tradeoff landscapes, as implied by Levins' pluralism, and evidential tradeoff landscapes, as implied by the hierarchy of hypotheses approach to dataset synthesis. I argue that hypotheses which successfully organise systematic data synthesis must be framed in terms that respect theoretical virtue-tradeoffs for the models that generate the hypotheses. The relevant respects and degrees in which a dataset may be interpreted as standing in an evidential support relation to a hypothesis, and thus its position in an evidential landscape delimited by a dataset virtue space, depends on the corresponding model's position in a theoretical landscape delimited by a model virtue space. Using Heger and Jeschke's hierarchy of "enemy release" hypotheses for biological invasions as a case study, I explore an approach to visual representation of theoretical and evidential landscapes in order to articulate the conceptual connection between the patchwork of theoretical models implied by hypotheses and the patchwork of empirical data discovered by systematic reviews.

Iñaki San Pedro & Andoni Ibarra (University of the Basque Country, UPV/EHU)

"Performative Representing with Computer Simulations"

The paper starts by looking at three notions of "computer simulation". Namely, a 'narrow' sense in which computer simulations are understood exclusively in terms of the computer routine used in simulating a specific system; a 'broad' sense which includes, besides the computer routine, the whole process of choosing a specific model, implementing the model's algorithms, as well as analysing and visualising the simulation output; and an 'alternative' conception that defines simulations independently to the use of computers or numerical methods.

We argue that the above three notions of computer simulations each correspond to a different type of representational activity (or of representation). Thus, computer simulations in the narrow sense can be identified with scientific representations based on the idea of mirroring or homomorphism. On the other hand, computer simulations understood in the broad sense are associated to less strict notions of representation such as deflationary approaches. Finally, under the 'alternative' reading, computer simulations can be associated with so-called performative representations. We contend that climate change models are better understood from this latter perspective and thus constitute a good example of performative scientific representation.

Koray Karaca (University of Twente)

"Modeling Data Acquisition at the Large Hadron Collider: Against the Hierarchy of Models in High Energy Physics"

According to the hierarchy of models (HoM) account of scientific experimentation developed by Patrick Suppes and elaborated by Deborah Mayo, theoretical considerations about the phenomena of interest are involved in experiment through theoretical models that in turn relate to experimental data through data-models, via the linkage of experimental models. In this paper, I argue that the HoM account fails to account for the involvement of theoretical models in the process of data-acquisition. I examine the ATLAS experiment currently running at CERN's Large Hadron Collider as a case-study to illustrate that in order to acquire data from the detector outputs, what I call a model of data-acquisition is used in present day high-energy physics experiments. I point out that the main function of a data-acquisition model is to ensure that data-selection is performed in such a way as to yield data that are appropriate for the intended objectives of the ATLAS experiment. In view of the consideration that the theoretical models that are aimed to be tested at the ATLAS experiment are directly involved in the data-acquisition model through the chosen data-selection criteria, I argue that, contrary to the HoM account, the relation between theoretical models and procedures of data-acquisition is a direct one that does not involve any intermediary of models.

Tarja Knuuttila (Helsinki Collegium / University of South Carolina)

"Small Worlds Variously Embodied: The Material Dimensions of Modelling"

This paper presents an artifactual approach to fiction in science that addresses the shared features of models and fictions. It approaches both models and fictions as purposefully created entities, artifacts, which are constructed by making use of culturally established representational tools in their various modes and media. As intersubjectively available artifacts models and fictions have both abstract and concrete dimensions. Three further features that models and fictions share are discussed: constructedness, self-containment, and constrained constitution. The

account proposed gives a unified account of different model types and circumvents some problems of those approaches that consider models in terms of the imaginings of scientists.

Thomas Mormann (University of the Basque Country, UPV/EHU)
"Structural Representation, Constitution, and the Relative A priori"

The aim of this paper is to show that for a comprehensive theory of representation it may be useful to reconsider some neglected theses of classical philosophy of science put forward already in the first decades of the last century. More precisely, I'd like to argue that Hans Reichenbach's theory of a relativized constitutive but non-apodictic a priori component of scientific knowledge, put forward in *The Theory of Relativity and A Priori Knowledge* (1920) can be usefully combined with a representational account of empirical theories that conceives them as partially structure-preserving representations in a new way. Moreover, this re-interpretation help overcome an often criticised fundamental weakness of the "received view" on representation, namely, a too simplistic distinction between the level of the "represented" and the "representing". This shortcoming may be surmounted by relying on a non-standard concept of representation that Reichenbach's mentor Ernst Cassirer put forward already in Substance and Function (1910).

James Nguyen & Roman Frigg (London School of Economics)
"Scientific Representation and Representation-as"

In virtue of what do scientific models represent their target systems? We provide a novel account of scientific representation that takes inspiration from Nelson Goodman and Catherine Z. Elgin's account of pictorial representation. The result is a complex kind of representation that involves a mixture of interpretation, denotation, exemplification, property translating, and imputation. We call the result the DEKI account of scientific representation and illustrate how it works using the Phillips-Newlyn model of an economy as a case study. The account makes room for scientific models that are not models of any particular target system, but also explains how models with targets represent them as thus or so in a way that is immune to objections levelled at the existing accounts of scientific representation available in the literature.

Jay Odenbaugh (Lewis & Clark University)
"Models, Models, Models: A Deflationary Approach"

Work on models and modelling is pervasive in the philosophy of science. Models are supposedly distinctive as representational vehicles, and modelling is supposedly distinctive as a theoretical activity. For example, they indirectly represent and they are similar to their targets in certain respects and to certain degrees. In this essay, I first articulate this view as found in a variety of authors. Second, I argue that viewing model and modelling this way incurs significant ontological philosophical costs regarding mathematics and modality. Third, I provide a deflationary approach to idealisation and abstraction that avoids these costs, which also depicts modelling as of a piece with ordinary forms of representation.

Christopher Pincock (Ohio State University)
"Scientific Representation without Representationalism"

One use of scientific models is to formulate and justify claims about the world. This paper considers this activity using an important case from the history of science: Kelvin's 1863 model of the age of the Earth. I argue that Kelvin arrived at a justified (though false) claim about the age of the Earth using this model and that Kelvin's claim should ultimately be justified by a special form of inference to the best explanation. This reconstruction seems to be incompatible with several influential accounts of representation, including those recently offered by van Fraassen and Price. I conclude by considering the tensions between my account of Kelvin's model and these theories of scientific representation. Where there is a conflict, I argue that my account is preferable.

Hans-Jörg Rheinberger (Max Planck Institute for the History of Science)
"Models as a Form of Scientific Objects"

At the beginning, I will explain my interest in the curious existence of epistemic things as hybrids of materiality and conceptuality. Then, I propose an outline for a typology of the different forms that scientific objects can take in the life sciences. First, I discuss preparations, a form of scientific objects that accompanied the development of modern biology in different guises from the seventeenth century to the present: as anatomical-morphological specimens, as microscopic cuts, and as biochemical preparations. Second, I discuss the characteristics of models in biology. A few remarks

on the role of simulations —characterising the life sciences at the turn from the twentieth to the twenty-first century— will conclude my reflections.

Julia Sánchez Dorado (University College London)

"Judgments of Similarity, Understanding and Scientific Practice"

In this paper, I will argue that, despite some well-known arguments against the role of similarity in representation (Goodman 1972; Suárez 2003; Frigg 2006), the concept of similarity is an epistemically fruitful notion that should be preserved in the explanation of the success of scientific models. Nonetheless, I will move away from certain contemporary proposals in philosophy of science that discuss similarity in terms of necessary or sufficient conditions for representation (or for accurate representation) (French 2003; Contessa 2009). The account of similarity I would like to develop has a more limited scope and a more pragmatic character: the search for relevant similarities plays a central role in the practices of representing that produce genuine understanding of the world.

The location of the value of similarity in scientific practice puts the emphasis on the agents doing the representing and on their decisions about the resemblance relations that are worth highlighting. The idea of judgments of similarity will be advanced with the help of particular cases of modelling practices (Brown 2000, Weisberg 2013). In addition, I will point out how a broader account of scientific understanding –less strongly committed to truth-values than traditional accounts of scientific knowledge- can help us reinforce this account of similarity and, at the same time, take into account the presence of idealisations, distortions and other forms of felicitous falsehoods (Elgin 2007) in modelling practices.

Andrew Wayne (University of Guelph)

"Explanation without (traditional) Representation"

Idealised models in science contain components that do not represent, in any traditional sense, elements of their target physical systems. Some recent work in philosophy of science focuses on how non-representational components are sometimes used successfully to explain phenomena or regularities, despite the fact that these explanatory practices do not fit traditional accounts of scientific explanation. This talk begins with an account of the explanatory value of idealised models, and it illustrates this account with a brief case study of explanations of gravitational waves, in general relativity. The talk shows that scientists' use of idealised models fits well with Goodman's account of making worlds and "right versions" of worlds, and with his idea that standards of rightness or correctness go beyond truth. It focuses on one such standard, the advancement of understanding. The talk distinguishes Goodman's sense of understanding, which is phenomenological, from a distinct sort of understanding produced by scientific explanation, which is the outcome of a learning process. The talk argues that understanding cannot do the work Goodman wants it to do as a standard of rightness, at least in science. Rather, scientific explanation can (and, in fact, does) function as a standard of rightness, and a very important one, in the practice of science.

Eric Winsberg (University of South Florida)

"Confirmation in Computer and Analog Simulations"

(*Videoconference*)

It is a widely held view that computer simulation is merely a tool of inference and cannot provide genuine confirmation. I examine this question by looking at computer simulations from the angle of their analog cousins--using the example of acoustic analogs of Hawking black hole radiation. I argue that analog simulation can be genuinely confirming when they are supported by "Model External Empirically Grounded Arguments" (MEEGA). I then look at what, if anything, plays the role of MEEGA in computer simulations.