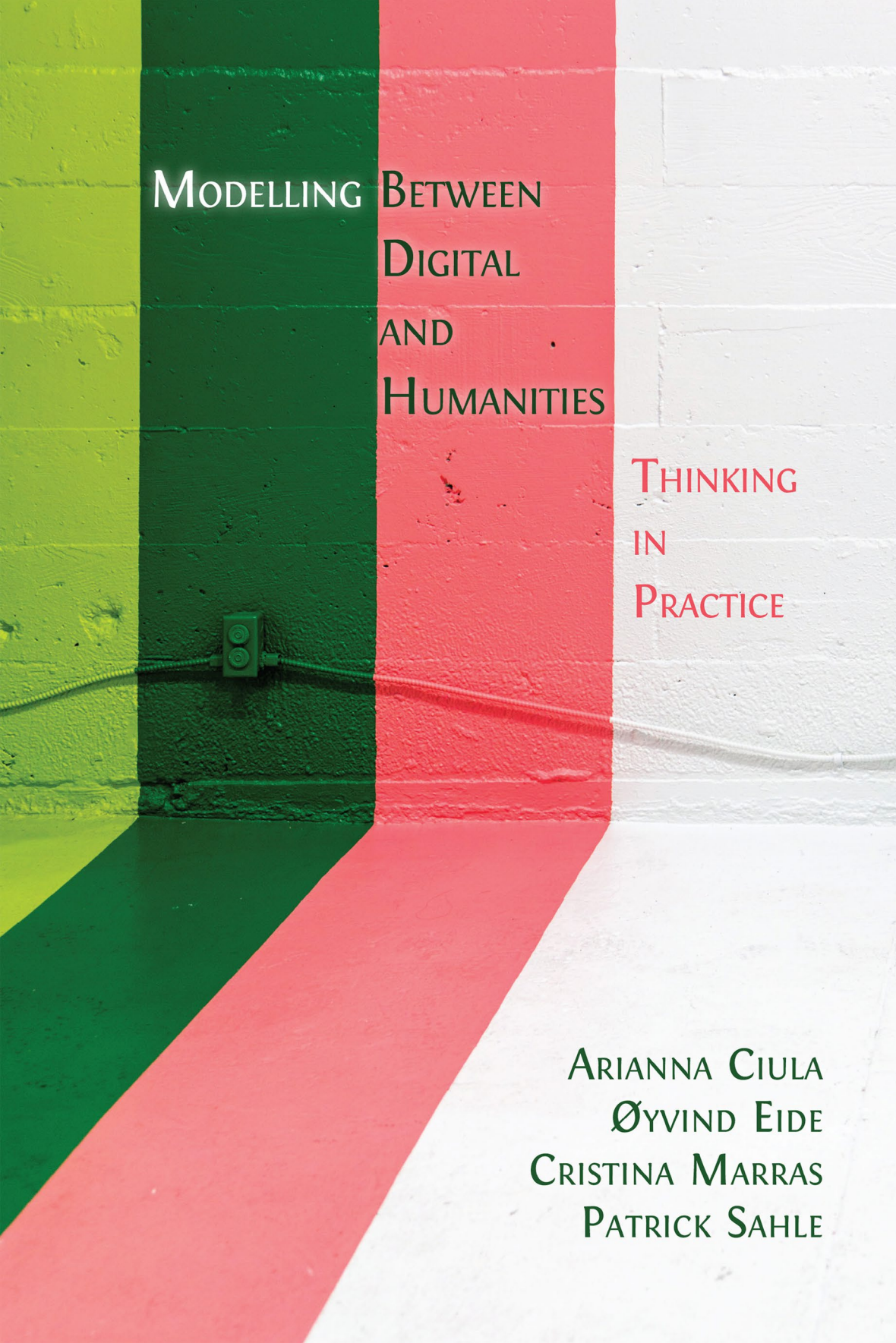
Modelling Between Digital and Humanities

Thinking in Practice



Arianna Ciula
Øyvind Eide
Cristina Marras
Patrick Sahle

https://www.openbookpublishers.com

ISBN Paperback: 978-1-80511-098-9

ISBN Hardback: 978-1-80064-811-1

ISBN Digital (PDF): 978-1-80064-846-3

ISBN Digital ebook (EPUB): 978-1-80064-895-1

ISBN XML: 978-1-80064-949-1

ISBN HTML: 978-1-80064-970-5

DOI: 10.11647/OBP.0369

Cover photo by Jason Leung, 'White, pink, green and yellow pained wall, https://unsplash.com/photos/xnFOY9SfcgI

Cover design by Jeevanjot Kaur Nagpal

1. Model and Modelling in Digital Humanities: Towards a Renewed Language[9]

1.1 Model, Modelling and Modeller: An Overview of the Metalanguage

In this chapter we turn our attention to the history and the polysemy characterising the terms *model* and *modelling* in order to be able (a) to reflect on their current use, and (b) to bring out the pragmatic elements implied by the concept of model in the modelling practices through language (metalanguage). The underlying assumption is that by analysing the metalanguage, we can acquire a deeper understanding of the practices of modelling and the related processes of conceptualisation, representation, visualisation and communication. The complex scenario we outline is not only in debt to decades of theory about and practices of modelling but it is actually embedded, as we will try to explain, in the roots and history of the terms.

(A) *model* and *modelling* belong to the same lexical family and are polysemic. *Model* is used to identify both formal modes of reasoning and representation, pertaining to *deductive* scientific methods, and less formal ones, mostly attributable to *analytical* research approaches.[10] The first is well explored and theorised by scholars and represents the overall approach adopted in empirical sciences, including some

9 This chapter was written in collaboration with Michela Tardella.

10 On the denotative dimension of terms in scientific language vis à vis the presence of pre-theoretical forms, see the examples of "Text: Thought, spoken and written", "Thinking of text", "Text as megaphone" in chapter 5.

 https://doi.org/10.11647/OBP.0369.01

branches of Digital Humanities (DH), while the second has not yet been fully recognised as a form of modelling adequate to DH, nor investigated as such. The analytical approach has been recognised by some epistemologists as *the model of* doing science in which inductive, analogical and metaphorical forms of reasoning acquire a pivotal heuristic function, whereas the deductive one is considered as strictly logical.[11]

Tracing the history of the term *model* back to its etymological roots, it seems to us useful to expand the directions of the research, as we will attempt to explain further below. In fact, despite the tradition of studies,[12] the two approaches mentioned above are complementary rather than separate. This complementarity is implicit in the different meanings of the term, as noted elsewhere:

> Traditionally, prediction and reproduction of results, as well as explanations of observations, have been the main phases of the scientific method in which models in the sciences have been created and evaluated. More recently the creation and use of models to explore rather than measure, predict, or explain have also gained recognition in the philosophy of science. All these functions are associated with what is considered the purpose of models, which is to support analysis and discovery as well as to enhance learning and understanding. Models are indeed considered to be better suited to learn something new about the target systems or objects for several reasons. Their creation and manipulation support surrogative reasoning, where aspects of the system under study are sharpened up in the model and hence made more "observable" than by studying the target systems or objects directly. The novel concept of model-based reasoning captures exactly this. (Ciula, Eide, Marras, Sahle 2018, pp. 8-9).

11 See Carlo Cellucci (1988) and Mary Hesse (1966). These categorisations are directly related to an animated debate that took place in the 1990s, in particular in the epistemological domain. The core of the discussion was the dialectic relation between 'real objects' and 'objects of knowledge', where real objects are those objects existing outside of thought, in the real world, which are targets for research, observation, analysis, etc., and objects of knowledge are those objects resulting from the research process; this distinction is well discussed in Silvano Tagliagambe (1995). On the construction of objects in science, see Bruno Latour (1996).

12 For a multidisciplinary approach to the analysis of the term model, see the proceedings of the conference organised at the Accademia dei Lincei in Rome in 1998 entitled *The role of model in science and knowledge; Il ruolo del modello nella scienza e nel sapere* (1999).

The use of models and the process of modelling have a long tradition in the humanities. Going back to early modern Europe, the use of models in what could be called scholarship in 'the Humanities' included modelling in natural philosophy, which later developed into the natural sciences.[13] The long history of modelling is complex due to the only partial overlap between contemporary and current concepts of model and modelling and because often (and in particular in the humanities) models and modelling processes are used implicitly rather than expressed as explicit formal statements. The relationship between models and the objects or systems being modelled (what we call the *targets* of the models) is also complex and hard to define. It varies across research traditions and has developed significantly over time. In the twentieth century, models have been described as representations of their targets; the specific nature of those representations did not attract much attention until the latter part of the century. In the philosophy of science, a pragmatic view on modelling has emerged over the last few decades, such that the relation between a model and its target, traditionally expressed as some kind of representation in the form of formal, structuralist or syntactic morphism (such as isomorphism), is gradually being replaced by an emphasis on a pragmatic relationship, often simply described as a situation where somebody creates a model of something with some purpose (Gelfert 2016, p. 113).

In this chapter, we focus on the use of language in the context in which the object and subject/observer (the researcher who creates and uses models, also called the *modeller* in this book) operate while models are made. This interplay between *model*, *target*, and *modeller* includes an interpretative aspect and can be considered therefore as a process of 'translation'. In this perspective theory and the object being modelled are seen as complementary rather than mechanically related. The relationship between models and their targets is certainly complex and hard to define (Chapter 3 dwells further on this, discussing it in terms of *sign-relation*), as is the nature of the object or target system itself (Gelfert 2016, p. 93; Ciula, Eide, Marras, Sahle 2018). We argued elsewhere that models take a "middle position" (Ciula and Marras 2016) and imply an inductive (bottom-up) method complementary to a deductive (top-down) method (see Key term Model/s 2); epistemologically, they occupy an n-dimensional space defined by multiple axes, they are contingent on

13 See Bod (2018).

social practice and on language in use (pragmatics; see Key term Model/s 5).

What follows is firstly an overview of the terminological and etymological references of the terms *model* and *modelling*, which provides some evidence based on a series of occurrences extracted from selected dictionaries, encyclopaedias, etymological vocabularies and philosophical texts. All theoretical issues are deeply connected to their relevant terminology (and the etymology of a term), so that reflecting upon terms and their relationships can help us to piece together the "ontological puzzle" around models (Frigg 2006). In order to show what the roots of the term imply, and to follow its articulated semantic development, we start by mapping the related terms and some of the interlinguistic relations across different terms in a selected set of languages, namely Latin, Greek, English, Italian, French, and German (see Section 1.2).

We are aware of the fact that the semantic dimension of a term is not determined solely by its etymological roots but above all by the users and the contexts in which they are used; however, we cannot but point to a certain evident continuity between the original semantic traces of the terms and the different meanings established over time. It is important to stress that from this terminological overview it emerges that *model* denotes different forms of representation (i.e. notes, diagrams, images, tridimensional objects) that play a key role in the reasoning processes and knowledge development (see Chapter 3).

Beyond it, there is a dynamic process (the act of modelling) that is context-dependent and object-oriented (Section 1.3). Any model is therefore primarily pragmatic because it favours the specificity of the modellers, the objects, and the contexts of use, but also because its pivot lies in their manipulability, in pragmatics terms, their negotiability and flexibility (Verschueren 2012). On the basis of the terminological and etymological evidence we have at hand, we focus on the properties and the elements that make a process of modelling 'pragmatic'. This is to develop a richer and more contextually aware understanding of how representation works in model-based research. We will discuss the concept of pragmatic modelling emerging from the terminological analysis both as it stems from the polysemy of the term and as it has evolved during our research project in a DH context. We will thus highlight the need to adopt a language and a terminology adequate

to support, articulate, and capture the complex iterative process of integration and exploration with the repeated loops of testing, feedback, and adjustment that characterise the process of modelling (Section 1.4).

1.2 A Terminological and Lexicographical Discussion

The term *model* derives from Vulgar Latin *modellus*, obtained with the suffix alteration from Classical Latin *modulus*, diminutive of *modus*.[14] Modus mostly refers to "a measured amount", "quantity", "size, extent, length, circumference", "a proper measure, due measure", "the measure of tones, measure, rhythm, melody, harmony, time" and, in poetry, "measure, metre, mode". However, the most revealing meanings are those generated by figurative transfers, like "a measure which is not to be exceeded, a bound, limit, end, restriction", "moderation", "restraint", or "a way, manner, mode, method", namely a criterion, something that controls or regulates an action.[15] In Table 1.1 we sketch an example of these literal and figurative meanings:

MODUS	
General meanings	Figurative meanings
a measured amount	a measure which is not to be exceeded, a bound, limit, end, restriction
size, length, circumference, quantity	a way, manner, mode, method
the measure of tones, measure, rhythm, melody, harmony, time (Music)	a proper measure, due measure
measure, metre, mode (Poetry)	

Table 1.1 General and figurative meanings of Latin *modus*.

14 We based our study on the *Oxford English Dictionary, 21989; Portail lexical, Etymologie, Centre National de Ressources Textuelles et Lexicales* (*CNRTL*) http://www.cnrtl.fr/etymologie/; and on the *Dizionario etimologico italiano*, Alessio & Battisti, 1965; *A Latin Dictionary*, Charlton T. Lewis & Charles Short, 1879, online at https://www.perseus.tufts.edu/hopper/text?doc=Perseus%3atext%3a1999.04.0059

15 *A Latin Dictionary*, *ad vocem*.

Modulus in classical Latin generally means "a small measure, a measure", but was used to express specific technical and diversified accepted uses according to the context; for example, in architecture it was used as "module" (the fifteenth part of a Doric column); in music, "rhythmical measure, rhythm, music, time, metre, mode, melody"; in hydraulic engineering, "a watermeter".[16]

Moreover, the metaphorical uses of *modulus* are particularly insightful; indeed, in some philosophical and literary works, the term acquires the meaning of "prototype" but also of the "measure of intellect" or "measure of ingenium".[17] In these latter cases, the abstract concepts of reasoning, thinking and reflecting are expressed by means of a concrete reference, namely to the measurement of quantifiable substances (columns, sound, water, and so on): some of the features and functionalities (Gensini 2010) of the concrete object and actions implied in its measurement are transferred (*metapherein* means "to transfer" in Greek) to the operations of mind, making them more understandable.

The two terms *modus* and *modulus* therefore do not only convey the general meaning of "measuring" but also that of "method", namely the manner of intellectual measuring (see Table 1.2).

MODULUS		
General meanings	Technical meanings	**Metaphorical meanings**
A small measure	*Module* (Architecture, 15th part of a Doric column)	*Prototype*
A measure	*rhythmical measure, rhythm, music, time, metre, mode, melody* (Music)	*Measure of reason*
	a watermeter (Hydraulics)	

Table 1.2 General, technical and metaphorical meanings of Latin *modulus*.

16 *A Latin Dictionary*, *ad vocem*.

17 In Horace we find a clear example of the latter use: "cur non ponderibus modulisque suis ratio utitur?" [Why does the ratio not use its own weights and measures?] (*Satyrae*, 1, 3, 78).

This semantic nuance, in our opinion, is still present in the transition from Latin to vernacular languages and it is not only related to the substantive *modus*,[18] but also to (its derivative) *modulus*/*modellus*. The interlinguistic equivalents of this latter term, namely *modelle* (Old French), *modèle* (Modern French), *Model*/*Modell* (German), *modello* (Italian),[19] bear a wide range of meanings, most of them indicating the result of an activity in which the observer and the object (*observatum*) are integrated.

If we turn from these translational issues to the analysis of the first attested occurrences of the term in the vernacular languages, further complexity emerges. Indeed, the term *model* and its interlinguistic equivalents show a semantic cloud resulting from usage both in ordinary language and in the technical lexicon of different disciplines.

As we learn from the *Oxford English Dictionary*, the term *model* is present in the English language from the second half of the sixteenth century, with the meaning of "an architect's set of designs for a projected building", that is, a *model for* (McCarty 2004), a "representational object" which must be imitated in order to build something else. Other accepted uses, such as "an object of imitation" (i.e. something that is imitated rather than imitates), can be attributed to the same representational concept. In these cases, *model* denotes "an object or figure made in clay, wax, or the like, and intended to be reproduced in a more durable material" (1686); "a mould" (1593); "a person, or a work, that is proposed or adopted for imitation, an exemplar" (1639).

In the same lexicographical sources, we find an alternative meaning, that is, a "set of drawings made to scale and representing the proportions

18 One of the most common translations of *modus* is the Italian *modo*, the English *mode*, the German *Mode* and the French *mode*. Notable for example is the use of the German *Mode*, which nowadays is one of the most used German derivatives of the Latin *modus*. However, J. & W. Grimm challenged this notion as early as the seventeenth century; they even doubt a direct relation to (Lat.) *modus*: "dessen unmittelbare ableitung vom lat. masc. modus nicht ohne zweifel steht (man müste denn die geschlechtsänderung durch den einflusz des älteren fem. manière erklären wollen)." See *Deutsches Wörterbuch von Jacob Grimm und Wilhelm Grimm, Mode*, *ad vo* http://www.woerterbuchnetz.de/DWB/mode.

19 See *Dizionario di filosofia, ad vocem; Oxford English Dictionary, ad vocem; Centre National de Ressources Textuelles et Lexicales, Etymologie, Liste des formes* (CNRTL, http://www.cnrtl.fr/etymologie) *ad vocem*; *Dizionario etimologico italiano, ad vocem*; Deutsches Wörterbuch von Jacob Grimm und Wilhelm Grimm, digital version 01/23, http://www.woerterbuchnetz.de/DWB/modell and http://www.woerterbuchnetz.de/DWB/model, *ad vocem*.

and arrangement of an existing building". In this sense, *model* denotes a representational object resulting from an imitative practice or activity, namely a *model of*:

> And I shall well my sillie selfe content, To come alone unto my lovely Lorde And unto him... To tel some... reasonable worde of Hollandes state, the which I will present, In Cartes, In Mappes, and eke in Models made.

These verses belong to *Posies* (1575), a book by George Gascoigne, one of the most important poets of the early Elizabethan era.[20] The passage is particularly relevant to our study, because *model* co-occurs with *map* and *chart*,[21] two pivotal concepts in the current discussion of *modelling*. Maps, charts and models are conceived as objects aiming at generating knowledge of something else (a country for example) by means of different forms of representation.

The *Oxford English Dictionary* also attests a "cognitive" role of models (1581):

> The same man, as soone as hee might see those beasts wel painted, or the house wel in moddel, should straight waies grow without need of any description, to a iudicial comprehending of them. (Philip Sidney)

Model as the result of an imitative process is also related to a *working model*, i.e., a tridimensional object built in order to imitate the structure and the movements of the machine that it represents. This representative (imitative) function can also be identified in some figurative meanings, such as "a small portrait" (1622), or "something that accurately represents something else; a person or a thing that is the likeness or 'image' of another", the latter attested in *Richard II* (1593) and *Hamlet* (1602).[22]

Among the most inspiring occurrences of the term, there are some philosophical and technical works, both in Latin and in vernacular languages, dating back to the Renaissance and the early modern period.

20 See Hamrick (2005) and Austen (2008).

21 The etymologies of 'map' and 'chart' are outlined in Eide (2012, pp. 29–30).

22 *Model* is also used as a synonym of *modillion*, "an ornate bracket, or a corbel, underneath a cornice and supporting it" (1663) and of *module* (1598) from which it derives, as already said.

A relevant passage, taken from the treatise *Della imitazione* (1560) by the humanist and teacher of rhetoric Giulio Camillo, reads:

> Ricordomi già in Bologna, che uno eccellente anatomista chiuse un corpo umano in una cassa tutta pertugiata, e poi la espose ad un corrente d'un fiume, il qual per que' pertugi nello spazio di pochi giorni consumò e portò via tutta la carne di quel corpo, che poi di sé mostrava meravigliosi secreti della natura negli ossi soli, e nei nervi rimasti. Così fatto corpo dalle ossa sostenuto io assomiglio al modello della eloquenzia dalla materia e dal disegno solo sostenuto. E così come quel corpo potrebbe essere stato ripieno di carne d'un giovane o d'un vecchio, così il modello della eloquenzia può essere vestito di parole che nel buon secolo fiorirono o che già nel caduto languide erano (Camillo, 1544, pp. 46-47).
>
> I remember at the time in Bologna an excellent anatomist closed a human body in an all over perforated box to then expose it to a river current, which through those holes consumed and took away all the flesh of that body in the space of a few days. That body showed of itself wonderful secrets of nature, in its only bones and leftover nerves. Similarly, like that body supported by its bones, I look alike the model of the eloquence of matter, sustained only by its design. And just as that body could have been filled with the flesh of a young or an old man, so the model of the eloquence can be filled with words that flourished in the good century or that already were languid in the past one.

Noteworthy here is the comparison between two really different disciplines, Anatomy and Rhetoric, a comparison that implies a *transdisciplinary* understanding of the notion of model. The author argues that these two knowledge domains can be put in relation and compared on the basis of an analogy between their methodologies and practices. Camillo, while trying to develop a good rhetorical method, notices an impressive similarity between the two disciplines. This method implies a retrogradation from the concrete, sensible and compound exemplar (i.e. a particular body/a particular text or discourse) to a set of constitutive elements which can be combined in different ways. In this paradigm, a *model* is conceived as a complex and steady schema, on the basis of which infinite possible contents (textual or anatomical, but the method also fits architectural elements) can be organised (Carlino 2013, p. 85) through a combinatory process. A highly relevant theoretical context, philosophical and epistemological, is the work of the German philosopher G. W. Leibniz. In his *Quid sit idea* (1678) the concept of model (*modulus*) is defined through that of *expressio*:

Exprimere aliquam rem dicitur illud, in quo habentur habitudines, quae habitudinibus rei exprimendae respondent. Sed eae expressiones variae sunt; exempli causa, modulus Machinae exprimít machinam ipsam, scenographica rei in plano delineatio exprimit solidum, oratio exprímit cogitationes et veritates, characteres exprimunt numeros, aequatio Algebraica exprimit circulum aliamve figuram: et quod expressionibus istis commune est, ex sola contemplatione habitudinem exprimentis possumus venire in cognitionem proprietatum respondentium rei exprimendae. Unde patet non esse necessarium, ut id quod exprimit simile sit rei expressae, modo habitudinum quaedam analogia servetur (Leibniz 1678).	That is said to express a thing in which there are relations [habitudines] which correspond to the relations of the thing expressed. But there are various kinds of expression; for example, the model of a machine expresses the machine itself, the projective delineation on a plane expresses a solid, speech expresses thoughts and truths, characters express numbers, and an algebraic equation expresses a circle or some other figure. What is common to all these expressions is that we can pass from a consideration of the relations in the expression to a knowledge of the corresponding properties of the thing expressed. Hence it is clearly not necessary for that which expresses to be similar to the thing expressed, if only a certain analogy is maintained between the relations.[23]

The concept of *expressio* was elaborated by Leibniz in relation to a gnoseological issue: the role of representation in knowledge development and reasoning processes. According to Leibniz it can be defined as a representational connection between two heterogeneous sets of elements, governed by a law of correspondence (Kulstad 1977; Lamarra 1991). As we can understand from the quoted passage, the expressive/representational connection can be established between extremely different domains:

discourses	and	thoughts,
scale models	and	machines,
characters	and	numbers,
algebraic equations	and	geometric figures,
perspective projections	and	solids.

The first set of these pairs belong to the category of *model* as it is understood in the current era, i.e. mathematical models, scale models, notational symbols, and verbal language. The notion of relational

23 Loemker 1989, p. 207.

correspondences should be stressed here: something expresses (represents, is a *model of*) something else, when the relations (*habitudines*) between the elements belonging to the first domain match/correspond to the relations between the elements belonging to the second domain. That is one of the most important characteristics of *expressio*: what can be discovered in and said about the *exprimens* (the model), can also be discovered in and said about the *exprimendum* (the target). The heuristic value of the expressive connection lies exactly in a constant and regulated relationship.[24] Furthermore, the representational relation is not rooted in the immediate resemblance between the model and the object, but can be based upon a structural and relational analogy.

If we turn our attention to the complex practice of translation, we can note that the English *model*, the Italian *modello* and the French *modéle* have been chosen by translators to vehiculate some of the meanings of the Greek terms *idea* (Ἰδέα), *paradeigma* (Παράδειγμα), *typos* (Τύπος)[25] (see Table 1.3) and the Latin *exemplar*.[26]

***IDEA* (*eido*/*orao*)**	***PARADEIGMA***	***TYPOS***
Form - shape (external aspect of an object)	*Copy* (of an existing thing)	*The print or impress of a seal* (associated with "blow" and with "the effect of a blow")
Semblance (appearance vs reality)	*Pattern* (of the thing to be executed)	
Ideal forms – archetypes (Plato' works)	*An architect's plan* (of a building)	

24 Namely a constant and regulated relationship between what can be said about one and the other: "un rapport constant et reglé entre ce qui se peut dire de l'une et de l'autre" as Leibniz wrote to Arnauld in 1687 (Leibniz 1978, vol. II, p. 112).

25 The definitions are from Liddell-Scott, 1940. See also the entries in philosophical multilingual dictionaries such as Maso 2010, and also http://www.perseus.tufts.edu/hopper/definitionlookup?q=model.

26 See *A Latin Dictionary, ad vocem*.

Class - kind - principle of classification (Logic)	*Example*	
	Lesson	

Table 1.3 Meanings of Greek *idea*, *paradeigma*, *typos*.

Let us briefly discuss them in turn. *Idea* derives from the verb *eido*/*orao*, "to see", both as "perceive with the eyes", or "experience", but also, in a metaphorical sense, "see with mind's eyes" or to know something. In its accepted usage, indicating appearances in opposition to the reality of things, an *idea* is connected to the concept of seeing, and not necessarily in conformity to reality. In Platonic philosophy, on the contrary, the "ideal forms, archetypes" are intended as an "intelligible form of things", while tangible reality is just a provisional image.[27] Beside these, there are at least two other meanings of *idea*: one related to Rhetoric ("literary form", "style", "a quality of style"), and another specific to Logic: "class, kind" and thus "principle of classification".

Paradeigma contains among its meanings "the model or copy of an existing thing", "a pattern or model of the thing to be executed",[28] but also "an architect's model (or perhaps plan) of a building", "a sculptor's or painter's model", "example" and "lesson".[29] These uses are clearly related to the more recent categories of *model of,* and *model for*, both of which imply an act of manipulation and representation of certain features of the object/phenomenon under consideration. *Paradeigma* has also been used as "a precedent, an example" and "an argument, a proof from example". These meanings show the *integrative function*[30] of a model, intended as a set of elements and characters unified in an event, a person, a fact, considered as a whole, complete.

Typos, "the print or impress of a seal" (associated with "blowing" and with "the effect of a blow"),[31] introduces an additional semantic

27 See Maso 2010, *ad vocem.*

28 *An Intermediate Greek-English Lexicon, ad vocem.*

29 *A Greek-English Lexicon, ad vocem.*

30 This is an interesting suggestion made by the physicist Giorgio Careri (1999, p. 185) in his contribution to the interesting and multidisciplinary discussion on the role of models in the history of thought and knowledge.

31 Here are some other entries taken from *A Greek-English Lexicon*: pl. "marks, letters"; "anything wrought of metal or stone", in pl. "figures worked in relief", then, simply,

element to the present excursus: the relation of similarity. What can be deduced from this term is the mirroring or, more precisely, indexical relation between an amorphous thingness and an object, the seal, that gives a specific form to that thingness defined by its own qualities (a letter, an image, a number, a sketch, etc.).

The complexity pertaining to the theory and practices in modelling, as embedded in the history of the key terms, are summarised and visualised in Figures 1.1 and 1.2.[32] Figure 1.1 illustrates the synchronic and diachronic relations between *model* and the terms belonging to its semantic field via the images of the wheel and its spokes; while Figure 1.2 stresses the historical-diachronic dimension through the metaphor of the tree.[33]

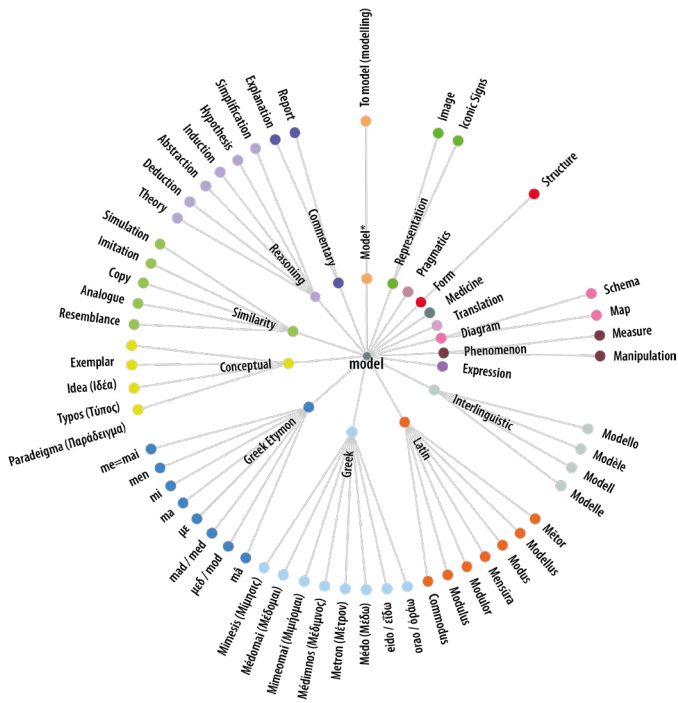


Fig. 1.1 Radial synoptic view of the analysis of the term *model*.

"a figure, image, statue"; "general form or character", "the type or model of a thing"; "an outline, sketch, draught".

32 A first attempt to build a dynamic network graph of terminological connections is the one developed using D3.js by Pak (2018), and slightly reworked by Geißler (2018).

33 For a discussion on visual metaphors and for the use of conceptual metaphors like the tree or wheel, see Chapter 2.

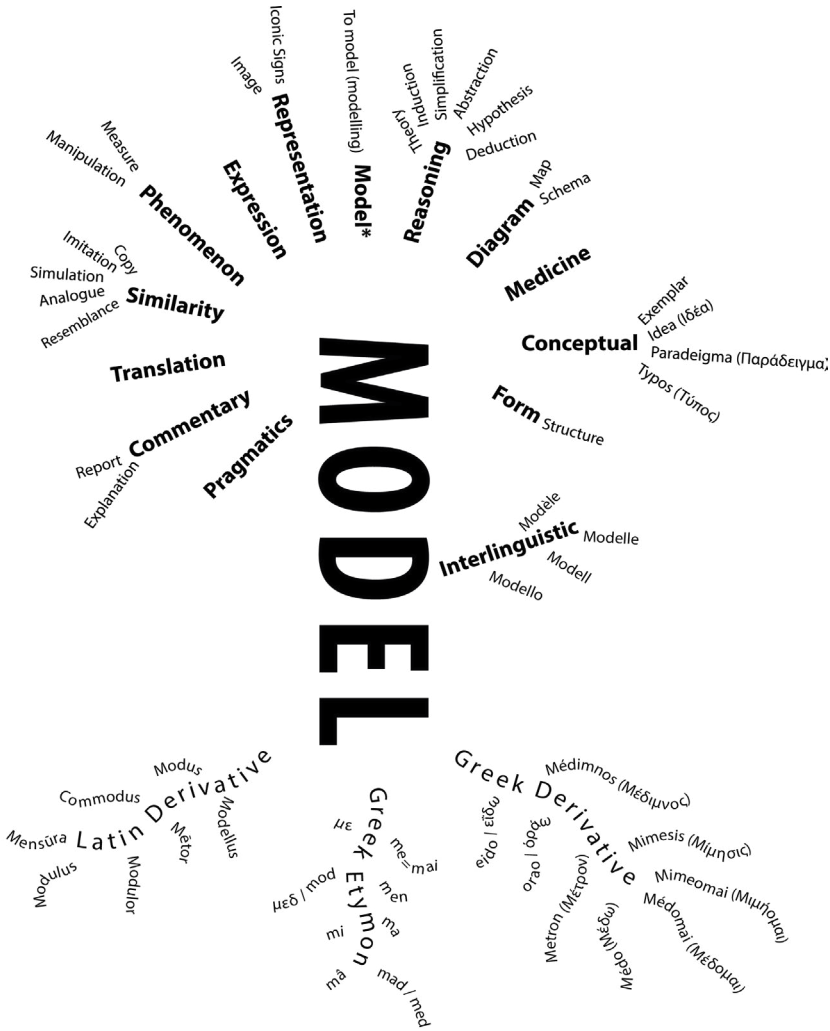


Fig. 1.2 Tree-like synoptic depiction of the analysis of the term *model*. Drawing by Julia Sorouri.

The consequences of polysemy are manifold. The meanings of models and modelling are negotiated within the different disciplines and areas of application. In this respect it is useful to frame DH modelling activities within recent works on model building (i.e. Kralemann and Lattmann 2013; Ciula, Eide, Marras, Sahle 2018). As aforementioned,

the complexity pertaining to theory and practices in modelling is embedded in the history of the terms *model* and *modelling*: on the basis of the terminological and etymological evidence we have at hand, we will attempt to develop a richer and more contextually aware understanding of how models operate in reasoning processes. We thus focus on the properties and the elements that make a process of modelling 'pragmatic', namely a process of thinking in practice based on the language in use.

1.3 Toward a Pragmatic Modelling in DH

We want to highlight thus that the current metalanguage used by scholars when reasoning on models and modelling entails both technical and formal languages on the one hand, and metaphorical and analogical ones on the other, but more fundamentally, a complementary use of them. The work done during the project *Modelling between Digital and Humanities: Thinking in Practice*, especially the discussion which took place at the interdisciplinary Workshop "Thinking in Practice" held in Cologne on 19-20 January 2017,[34] are useful to substantiate this interplay between linguistic (and epistemic) variations. Figure 1.2 is a diagram of the words used by the workshop's participants to encircle the concepts of *model* and *modelling*. The terms were gathered not just from the explicit definitions provided by each speaker, but also from the discourse(s) around those concepts with which the participants engaged, both in their own talks and in the discussion that followed. We attempted to represent and freeze the metalinguistic activity around these two terms, by means of which the participants delimited their meanings in their own field of research (Geißler and Tardella 2018, p. 213).

34 See http://modellingdh.eu/index.php/events/our-workshop-2017/. On language analysis see, in particular, Geißler and Tardella (2018) and Sahle (2018).

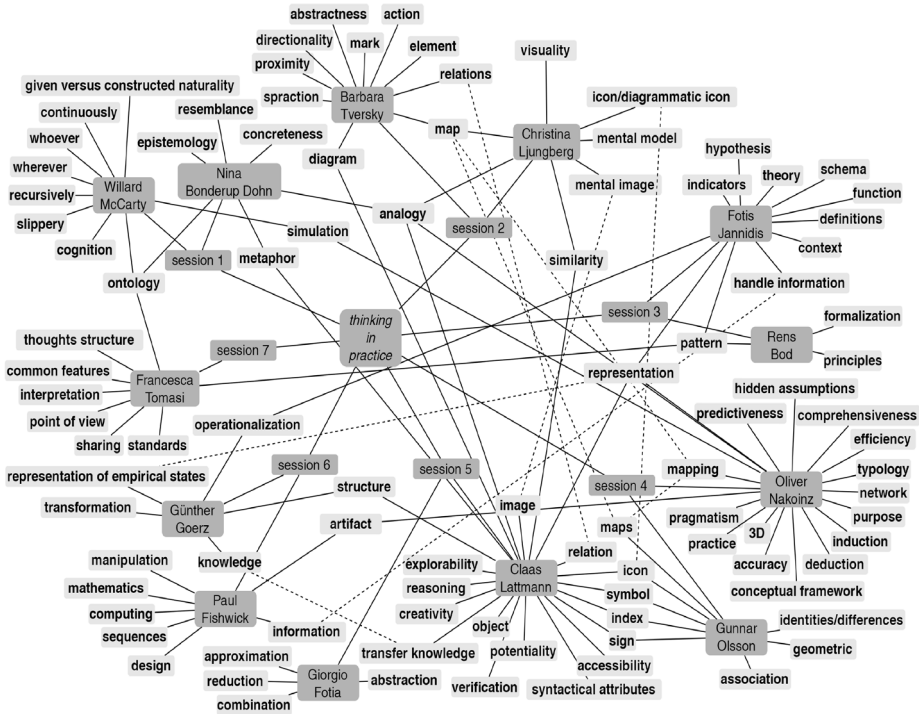


Fig. 1.3 Network Diagram for the terms used in the Workshop "Thinking in Practice" to encircle *model* and *modelling*. Dashed lines indicate similar or related terms (by Nils Geißler).

If we analyse the lexicon used by the participants, we note that they use pragmatic concepts and terms, such as *context*, *action*, *directionality*, *analogy*, *interpretation*, *purposes*, *communicable* (identities/differences), together with some Peircean semiotic categories, such as *metaphor*, *diagram*, and *icon* (Nina Bonderup Dohn, Claas Lattmann, Christina Ljungberg and Gunnar Olsson). In their metalanguage – that is, the language employed to explicitly define, describe and formalise their statements on modelling – this lexicon coexists with key concepts of formal deductive reasoning in the usage of terms such as *formalisation*, *deduction*, and *mathematics*.

It is also interesting to note that along with this terminology, instances of some 'frozen metaphors' occur, such as *slippery* (concept), *handle information*, *explorability*, *manipulation*, and *transfer knowledge*. These metaphorical expressions are unavoidable even in a technical lexicon;

they are in fact frozen metaphors (based on the conceptual metaphor IDEAS ARE OBJECTS, cf. Chapter 2) in the sense that they belong to ordinary language and by being used extensively, have become an integrated part of the technical metalanguage. It also emerged that the most frequent metaphor employed to explain how the concept of model and the practice of modelling are conceived is the cognitive TO KNOW IS TO SEE. According to this metaphor, modelling is a practice that allows us to look at (to think upon, interpret, represent) an object of knowledge. A model is, at the same time, both a heuristic tool (*lens*) by means of which an object is re-described and a result of a process (Geißler and Tardella 2018, p. 6). In Chapter 2 we will discuss the heuristic and cognitive role undertaken/assumed in structuring knowledge by some selected conceptual metaphorical models belonging to the traditions of Western thought. We concentrate on the creative process of thinking in modelling practices; in particular, we focus on the manipulation of model interfaces with other acts of signification and reasoning when they are facilitated by the use of metaphors.

In analysing the language of the workshop, we also focused our attention on the explicit definition of model and modelling. *Genera*[35] extracted from the definitions can be correlated with some general concepts. Concerning model(s), we found the following *genera*:

- *cognitive instrument* (instrument, thinking tool)
- *icon* (iconic sign, iconic and visual abstraction)
- *representation* (representation, mapping, artefact)
- *method* (ways, guidelines, question, matter, conceptual framework).

With respect to modelling, we can group these dynamic concepts:

- *form* (formalising, form)
- *action* (act, production, actualisation, activity)
- *selection* (choice, identifying, extracting).

35 The *genus* is, according to the approach of the "intensional definition", the category the *definiendum* belongs to.

This partial result confirms that the workshop's speakers link the two concepts, model and modelling, both to practical and theoretical dimensions, with an important caveat: modelling is defined by the majority of the participants as an activity, an actualisation, a production, an act; the concept is positioned on the practical side of the theory-praxis axis. In contrast, 'model', although conceived of as an artefact or even a concrete (visual, perceptible) representation, is mainly positioned on the side of theory, for example as an abstraction, a framework, or a sign, even if it is grounded in reality.

Models are contingent on the contexts of their production and use, and contingency is one of the primary aspects of modelling. Therefore, an epistemology of modelling in DH must depart from the specificity of its objects of study.[36] This means that in pragmatic modelling the analytical perspectives of study applied to objects must be made explicit both in interpretative and technical terms (cf. Chapter 3). The pragmatic aspects of modelling should receive in fact further attention in a DH context.[37] A pragmatic approach (Ciula and Eide 2017; Ciula and Marras 2018) allows us to offer a new interdisciplinary perspective on how DH modelling works both in the sense of construction (how models as signs are made, cf. Chapter 3) as well as with respect to its epistemic value, i.e. how something new can be discovered in the process of using models as signs (see Ciula, Eide, Marras, Sahle 2018). Texts, for example, are primary objects in human sciences, and for instance, unpacking a theory of texts as a way of making explicit modelling practices is as important as algorithmic criticism of the use of computers in analysing large corpora of texts.[38] Hence, we can say that somehow all modelling processes,

36 The understanding around the nature of objects of experience in science and in the humanities has evolved substantially in the Western tradition from Galileo onward (see Floridi 2011; Bod 2013; Marras 2013). Partially due to this evolution, it can be stated that in DH "[...] the objects that take part in an act of modelling [...] feature both an element of *factuality* (an experienced substance) and one of *fictionality* (they presuppose some rules of artifice). This implies that in a DH modelling activity a process of making explicit both components and their interaction is paramount" (Ciula and Marras 2018).

37 The pragmatics of modelling is also linked to the situatedness of the speaker (Ciula and Marras 2016).

38 "Algorithmic criticism would have to retain the commitment to methodological rigour demanded by its tools, but the emphasis would be less on maintaining a correspondence or a fitness between method and goal, and more on the need to present methods in a fully transparent manner" (Ramsay 2008). See also Smithies (2017, pp. 165-171).

by nature, are pragmatic, but more importantly here is the fact that by using the term *pragmatic modelling* in DH we intend to emphasise an understanding of the act of modelling as anchored not only to theory but also to practice and language.

1.3.1 Why Pragmatics?

The word *pragmatics* (from the Greek *praxis,* action), was first introduced by the ideal language philosophers under the distinction between syntax (the study of relations among symbols of a language), semantics (the study of the relations between symbols and their *designata*), and pragmatics, defined as the study of the relations between symbols and their users (cf. Morris 1938; Carnap 1942). Ideal language philosophers were interested in formal languages, structured and designed to capture and express mathematical truths. Therefore, the syntactic structure of any well-formed sentence of a formal language was believed to be defined by strict rules of formation. Semantic values "are assigned to the symbols of the language by stipulation and the truth-conditions of a sentence can be mechanically determined from the semantic values of its constituents by the syntactic rules of composition" (Jacob 2011, p. 8 ff). Within this perspective, some features of natural languages, such as their context-sensitivity, the metaphorical and metonymic transfers of word meanings, and their flexibility, were conceived as imperfections. On the other hand, philosophers of ordinary language have been interested in exactly those features which distinguish natural languages from formal ones, among which the most important are how the context-dependency of the content is expressed ("the circumstances" in which the utterances take place) and the fact that languages are not used only for describing objects or states of affairs (what Austin called the "descriptive fallacy"): by using natural languages, speakers do not simply describe something, but perform actions (Austin's *speech acts*). Therefore, in this theoretical framework, an important role in human use of language was given, first by Grice and then by Sperber and Wilson, to the concept of intentionality. This was intended as a pivotal element both in defining what a meaning is and in explaining communication and comprehension processes.[39]

39 See the discussion in AI and Computational linguistics, for example Gillis, Daelemans & DeSmedt (2009, p. 20). See the examples of "Text as Megaphone" and "Textual Atmosphere" in Chapter 5.

Although focused mostly on the elaboration of a model of human communication, this approach can also be fruitful for our discussion around modelling in DH due to the key role attributed to the *subjects* involved in what is called *speech acts*. Our assumption is that an act of modelling can be compared to a speech act: as we have already seen, one important element is the involvement of the subject and the context-dependency, but to these we should add the role of intentionality, the role of interpretation and the role of language. These categories, belonging to linguistic pragmatics, are useful for clarifying core notions of modelling without reducing it to a verbal act.

In a DH context (Ciula and Marras 2016) models have their grammars, and semantics within a processual consideration of the use of language that is not purely functional or descriptive, but also metaphorical (see Chapter 2), i.e., models are at least capable of adaptability and negotiability. Moreover, pragmatics and modelling share some key concepts such as context, intentionality and interpretation.[40]

Context. It is a core notion. We are not adopting here a cognitive and internalist conception of context, or a situational and externalistic one. The notion of context[41] covers quite a broad territory; it means different things for different research paradigms and disciplines.[42] We refer here to a dynamic and interactive notion of context as 'event'; recalling the Latin root of the term meaning "joining together", we assume an articulate notion that helps us to identify the phenomenon/object being contextualised, to look and take into consideration all the 'other' elements that are embedded or that feature in that 'event' (physical, linguistic, social and epistemic contextual aspects). The context is a frame (not a container) surrounding or underpinning the event in which the *observer* and the *observatum*, the modeller and the object or phenomenon being modelled, dynamically interact.[43] The context is not just an isolated object constructed by the modeller, but rather a mode of praxis, as discussed in Chapter 3.

40 See Allan & Jaszczolt (2012). On the pragmatic aspects of research (and their epistemic value) in the field of DH, see also Malazita et al. 2020.

41 It is worth noting that an insightful (frequently forgotten) contribution to the reflection on the role of *context* originated in the first half of the twentieth century in the fortunate convergence of several disciplinary fields, such as anthropology (Malinowski 1923), philology (Gardiner 1932) and psychology (Bühler 1934).

42 For a discussion on the notion of 'spurious context' in natural language and in knowledge representation, see Hirst (2000).

43 See Sperber and Wilson (1986).

Intentionality. Models are intentional in that they offer a representation of some features considered relevant *vis à vis* specific purposes. Modelling is not a mere act of describing an "object/phenomenon" (*observatum*) but a process of goal-oriented selection of features, motivated by the aims and the purposes of the modeller. Any model can only establish a partial mapping between the model and the object being modelled, otherwise modelling would merely result in a duplication of the objects/phenomena under study (the map is not the territory). Modellers aim for their models not only to be understandable and useful, but also meaningful. Some of the key aspects defining pragmatics which strictly correlate with intentionality as it is intended here, are:

- Variability – the range of choices in the use of language cannot be seen as static in any respect;
- Negotiability – such choices are not made mechanically or according to strict rules or fixed form-function relationships, but on the basis of highly flexible principles and strategies, thus also implying the indeterminacy and unexclusiveness of the choices being made;
- Adaptability - such negotiable choices can be adapted based on specific needs and contexts according to a variable range of possibilities.

These aspects (of language use) are relevant especially in the selection or identification of features, properties, and elements of the object being modelled. They are related to each other, and they direct the choices of the modeller and contribute to it. Therefore, a model incorporates both semantic aspects and the intended implicated 'messages'. Although we are not implying here that intentionality is a pure *act of communication*, specifically related to the speaker's intention, we can say that modelling is also a communicative act, as further discussed in Chapter 4.[44]

44 Paul Grice (1957) argued that word and sentence meanings are based on the speaker's meanings, and these in turn are based on speakers' intentions (*M-intentions*). "What he conceived as a study of the ontology of semantic notions has been received, however, as a characterization of communicative intentions, the mental causes of communicative acts, and those that the hearer has to understand for the communicative act to be successful" (Korta & Perry 2020). Communicative intentions have three fundamental properties: they are always oriented towards

Interpretation. Within the perspective explained above, modelling can be defined as a process of translation (see Chapters 2 and 4) and in particular of interpretation in the sense that it makes understandable facts and data correlated by the model. In this way interpretation is inherently integrative. The pivotal components of the act of modelling selected above (the context, the language, the actors, in essence: its pragmatic nature) in the field of DH operate dynamically and therefore the structural polarities of object *versus* model can be overcome. Therefore, adopting an interdisciplinary perspective, we can talk of models as 'mediated objects', mediated by the conditions and constraints under which perceptions, as well as the language that expresses them, are derived.

In Figure 1.4 we summarise the interplay between all the discussed categories, and how it unfolds in the modelling act.

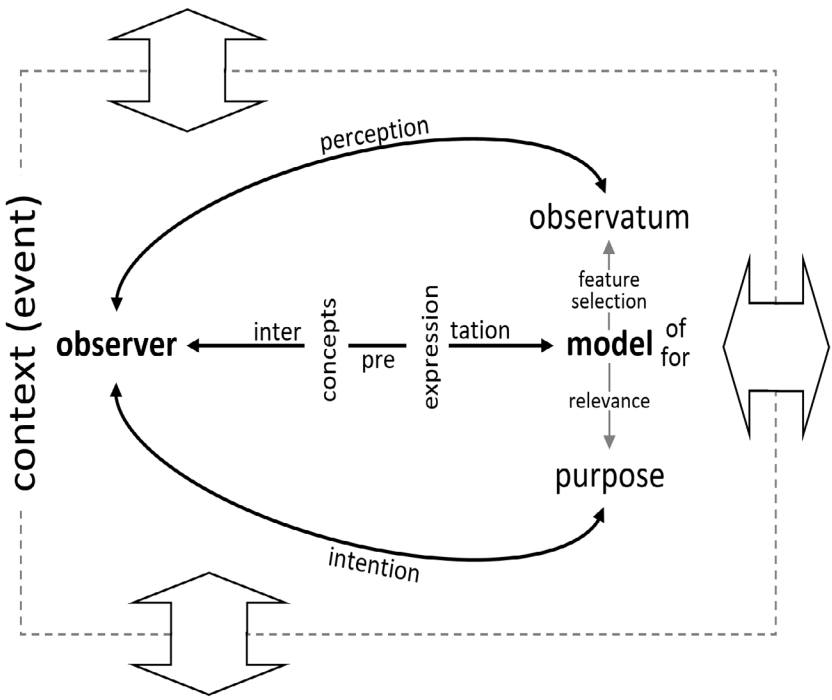


Fig. 1.4 Pragmatic modelling act.

some other agent — the addressee; they are overt, that is, they are intended to be recognised by the addressee; their satisfaction consists precisely in being recognised by the addressee (cf. Pacherie 2006).

1.4 The Language around Modelling in DH

In this chapter, we have sought to turn our attention to the multifaceted and polysemic range of the terms belonging to the semantic field of *model* and *modelling*. We have drawn a complex scenario (based on dictionaries, vocabularies, lexicons and encyclopaedias) resulting both from decades of theory and practice in modelling and the history of these terms. Such a terminological discussion and analysis allows us to reflect on the current metalanguage on models and modelling and to acquire a deeper understanding of the practices of modelling and the related processes of conceptualisation, representation, and visualisation.

A pragmatic understanding of modelling, as we adopt it in this volume, can facilitate the recognition that modelling operates within relational and dynamic cycles which are elicited via negotiations over the use of modelling languages (e.g., by narrowing and broadening categories of analysis, or borrowing categories from other disciplines).

Three dynamic aspects of modelling in DH make it pragmatic:

1. the dependency on the contexts within which modelling practices occur – e.g., research project, teaching module
2. the dependency on how the modelling workflows are used – e.g., to conceptualise a data model, to deliver a course assessment
3. the reliance on forms of expression of modelling – e.g., the constraints of a programming language, the capability of a Virtual Reality kit, and the diagrammatic expressiveness of models, as will be seen in Chapter 4.

Pragmatic modelling is a conceptual device which enables us to position the study of modelling in critical scholarship,[45] away from a mechanical and positivistic application of technical methods. A pragmatic vision of modelling implies awareness of the complexity of the objects being studied; of the multiple perspectives of analysis under which they are studied; and of the recurring conceptual schemes in structuring knowledge (metaphorical language, see Chapter 2). It also clarifies how a pragmatic understanding of modelling enables the manipulability

45 See for example some of the approaches emerging in Critical Infrastructures Studies: https://criticalinfrastructure.hcommons.org/session-description/.

of models via heuristic processes of formalisation (models are made computable) and translation (models take the form of media products). Indeed, pragmatic modelling combines formal and experimental modelling techniques with a constructive use of verbal and visual languages.

The interplay between the object of analysis (for instance texts) and the model, as well as across different levels of the interpretative process (e.g., close and distant reading, symbolic/paradigmatic and semantic/syntagmatic levels of text analysis), exemplify some of these dynamic aspects. Knowledge about the domain provides the means for inferring connections between objects and events that are often left implicit in natural discourse. It also creates the basis for inferring new knowledge from known facts. The problem is therefore to further develop the language (and a metalanguage) adequate for this approach to modelling in DH. A discussion and an analysis on metaphorical language and conceptual metaphors used in modelling in DH can certainly help in the definition of a renewed language for modelling.