Modelling Between Digital and Humanities

Thinking in Practice

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2. Metaphoric Reasoning and Pragmatic Modelling

2.1 Metaphoric Reasoning

In this book we assume a definition and a practice of modelling that take into account the integration of interpretative[46] and computational approaches. In a Digital Humanities (DH) context, models have practical implications for how data is designed, generated, stored and processed and for the ways in which data is presented and interfaces are built (cf. Ciula and Marras 2018). Therefore, we propose to consider modelling as a creative and highly pragmatic process in which metaphors assume a central role and where meaning is negotiated through the creation and manipulation of external representations combined with an imaginative use of languages with different levels of formalisation and modes of expression (Ciula et al. 2023).

Thus, metaphorical expressiveness constitutes an irreplaceable part of the lexicon of modelling. Metaphors themselves are models of knowledge and they define the field within which knowledge and specific concepts operate (Marras 2017). In the history of ideas, metaphors evolved at the intersection of a reflection between language and thought on the one hand, and a reflection on the relation between rhetoric, poetry and ordinary language on the other; metaphors have been recognised as essential not only in ordinary discourse but also in scientific language;[47] they are a pervasive aspect of every genre of text and

46 See for example the use of interpretative conceptual networks for the history of ideas as explicit "framework models" (cf. Betti and van den Berg 2014).

47 See Skouen and Stark (2014, p. 148); Burkhardt and Nerlich (2010); a negative approach to metaphors in the early modern philosophical tradition is that of John

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every register of speech. Metaphors, given their cognitive and creative resonance, are much more than an episodic linguistic phenomenon; they are also a cognitive tool which helps its users and creators understand and express their world and knowledge.[48] Although there is a broad consensus regarding the fact that metaphors lead to changes in and enrichment of knowledge, the mechanism of how these changes occur is still under discussion (Gentner and Wolff 2000[49]); investigating the role of metaphors in modelling (not only) in DH is also a contribution to this debate. In particular, the concept of pragmatic modelling discussed in Chapter 1 is connected to how metaphorical language operates in DH as well as other (mainly interdisciplinary) modelling contexts. Furthermore, it exemplifies how metaphors themselves are models of knowledge, as they define the schemes within which specific concepts operate and knowledge is established and expressed.

Given its regulative function in fixing and creating boundaries around the knowledge domain of reference, natural language plays a crucial mediating role in designing, expressing and contextualising models. By observing the use of language in modelling activities, the understanding emerges that the act of modelling, and in particular its representative and descriptive functions, make use also of metaphorical language.[50]

In our work we refer in particular to metaphors as conceptual (conceptual metaphors), because we want to specifically address how metaphors shape and model the way we think, speak, and act. When attempting to make sense of abstract, intangible phenomena, we draw from embodied experiences and look to concrete entities to serve as cognitive representatives. Conceptual metaphors have been discussed, especially in the late '90s in the field of cognitive linguistics, starting with the seminal work of Lakoff and Johnson, *Metaphors We Live By* (1980). This approach considers metaphors as a 'mapping' of a source domain onto a target domain. It challenges more traditional positions that see metaphors

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Locke "all the artificial and figurative application of words eloquence hath invented, are for nothing else but to insinuate wrong ideas, move the passions, and thereby mislead the judgement" (Locke 1690, Book III, Chapter X, Of the Abuse of Words).

48 See Nerlich and Clarke (2001); Leary (1990); Thibodeau and Boroditsky (2013).

49 See Gentner (1983) and Gentner and Stevens (1983).

50 An interesting example is the analysis of the observational data carried on by Michela Tardella and Niels Geissler on the language and metaphors used to encircle the concepts of model and modelling in the international workshop Thinking in Practice (see Geissler and Tardella 2018, pp. 213-214). For metaphors in scientific modelling see Wolynes (2001).

as transportations or projections of similarities from one object to another or as a language component separate and distinct from the literal one, and rather highlight that they belong to the aesthetic and rhetorical aspects of language. Metaphors are conceived as a conceptual integrating activity.

Metaphors do not just adapt to the contextual language; they also transform it. However rich they may be, the lexical resources of a language cannot always satisfactorily capture the totality of the speaker's expressive needs. Some common linguistic phenomena, such as the proliferation of lexemes (neologisms) or the fact that they increase their range of meanings (neosemy), barely enhance the linguistic ability to satisfy these needs. Metaphors and other figures of speech become, in this respect, indispensable means to nurture the 'creative' direction of the use of language without expanding its system in a strict sense. For centuries, scholars relied on metaphorical conceptual models to 'visualise' science, worlds, and processes.[51] From the Porphyrian tree, to Darwin's corals, to Peirce's diagrammatic reasoning, to mention just a few well-known examples, metaphorical models via visual representations have been employed and developed along with the more accredited discursive forms or mathematical equations, and have recently been developed further thanks to computer graphics.[52]

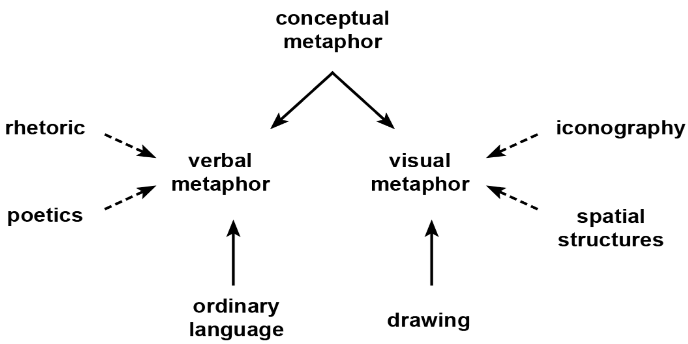

Fig. 2.1 Verbal and visual metaphor schema.

51 See Rothbart (2007). There is a large number of visual images available on the web trying to reflect on the complexity of the visualisation of spatial metaphors to represent knowledge across disciplines and domains. See for example the figurative system of human knowledge, i.e. the tree developed by Diderot and d'Alembert (http://www.visualcomplexity.com).

52 See Averbukh (2015 and 2019); the aesthetic dimension of scientific illustration is not discussed here, but see Baigrie (1996).

Metaphors play a fundamental and structural role in organising and modelling our conceptual systems. Conceptual metaphors condense complex ideas in simple terms and, as we saw in the previous paragraphs, are frequently used to understand how scholarly theories, models, objects, and knowledge emerge as a result of embodied physical and social experiences. According to Lakoff and Johnson, when attempting to make sense of abstract, intangible phenomena, we draw from embodied experiences and look to concrete entities to serve as cognitive representatives.[53] Conceptual metaphors map a target domain (i.e., the conceptual domain that we seek to understand) by the source domain (i.e., the conceptual domain from which we draw metaphorical expressions); in other words, metaphors map meaning from one knowledge domain on to another. This mapping process organises and conceptualises information and properties in domains and 'models' used in reasoning and acting as 'image-schemas'.[54] An example of an image-schema is 'IDEAS ARE OBJECTS', where the source frame is OBJECT and the target frame is IDEA. In mapping these two domains, the conceptual metaphor gives rise to a series of entailed metaphors, such as 'THINKING IS MANIPULATING OBJECTS' or 'UNDERSTANDING IS GRASPING' and so on. In this way, the image-schema, emerging from utterances, enables us to comprehend and express intangible matters.

The risk and the limits of this approach are the potential for confusing the content of a metaphor with the intended effect of a metaphor, and in a top-down approach which radicalises the focus on thought/abstraction/image-schemas (Zoltán 2008), neglecting the linguistic dimension/words/objects and cultural experience:

> Metaphor is centrally a matter of thought, not just words. Metaphorical language is a reflection/expression/translation/transmediation/mediation of metaphorical thought. Metaphorical thought, in the form of

53 Lakoff and Johnson's theory of conceptual metaphor posits that the nature of human cognition is metaphorical, and that all knowledge emerges as a result of embodied physical and social experiences (Lakoff and Johnson 1980). Similar findings have been documented in other disciplines: see Levinson (2003) for language and cognition and for clinical psychology, an overview is in Tversky (2019).

54 This idea paves the way for recent discussion on computational models. See for example: Veale and Keane (1992a); Veale, Shutova and Beigman Klebanov (2016); Way (1991); Weiner (1984). A comparable concept "map schemata" is used in cartography, see MacEachren (2004).

> cross-domain mappings is primary; metaphorical language is secondary. (Lakoff and Johnson 1999, p. 123)

At this point it is important to underline that the approach to conceptual metaphors should not be reduced to the unidirectionality (namely from concrete to abstract) but should be better understood in its bidirectionality and processuality. We should note that a conceptual approach also includes another kind of mapping, and in this case, it could be better to talk about conceptual integration or blending (Fauconnier and Turner 1998; 2002). The concept of blending treats metaphors as conceptual rather than a purely linguistic phenomenon; it involves systematic projection of language, imagery and inferential structure between conceptual domains, but it includes an entrenched conceptual relationship. Conceptual metaphor theory is primarily concerned with metaphoric associations between concepts, and blending theory focuses on the ability to combine elements from conceptualisations into new and meaningful ones.[55] In these views, metaphors are not only carriers of meaning, but actually construct meaning itself.

An epistemology of modelling even in the metaphorical dimension in DH must depart from the specificity of its objects of study. The understanding of the nature of objects of experience in science and in the humanities has evolved substantially in the Western tradition from Galileo onward (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, p. 38)

To *create* models we need to *formulate,* in the sense of giving a form and of constraining by rules (Morgan 2012) and *operationalise* concepts (see Chapter 3, note 8; see also the examples of "Text Mining as Knowledge Process and Argamon: Burrows' Delta Formula" in Chapter 5), is a process of formalisation[56] (i.e. to give a form, a schema, or a

55 See Grady, Oakley, Coulson (1999).

56 For the process of formalisation see for example: Zimmermann, Ley, Budanov, Voitsekhovitch (2002).

formal deductive frame, see the example "Text Sequence Formula" in Chapter 5). Expressions, each with a certain form, are generated as part of this modelling process and hence will also constitute part of its documentation. When these formulation and operationalisation processes are based on multiple (often interdisciplinary), rather than single pre-existing conceptualisations or models, they are documented in some form via computational tools and other artefacts.

2.2 Metaphorical Models

Metaphors integrate both linguistic expressions and conceptual mappings and visualisation[57] (Marras 2017; 2013); they describe novelties and facilitate the understanding and interpretation of theories. This expansive and heuristic force has made metaphorical language particularly suitable and fruitful in modelling activities and in science generally. Recognising this force contributes also to overcoming the distinction between a rhetorical use of metaphors and a cognitive one. Moreover, metaphors function as a vehicle to understand scholarly theories. Since the mid-twentieth century, philosophers have accepted that metaphor and analogy permeate all discourses, are fundamental to human thought, and provide a basis for mental leaps (Black 1962; Goswami 1992; Johnson 1981; Lakoff and Johnson 1980; Schön 1983).[58] For example, machine metaphors are still deeply rooted in Western culture. Their (directly observable) interacting parts and causal operations are used as the most powerful model for explaining the patterns underlying natural events and they became one of the most used conceptual metaphors in the history of science and philosophy (Haken et al. 1985). The concept of machine is frequently used to interpret complex systems

57 Shiffrin and Boerne (2004); an historical overview on metaphor and conceptual mapping is found in Trim (2011), Parts I and IV.

58 Note that rhetorical treatises, as well as classical Renaissance tradition authors (e.g., Pellegrini, Pallavicino, Tesauro) advocated the complementarity of rhetoric and dialectics. Focusing on the rhetorical notion of ingegno, these authors stress its cognitive aspect, suggesting the existence of a specific intellectual role of the imagination that cannot be reduced either to pure eloquence or to pure logic, therefore the use of natural language's resources becomes fundamental. It is in this context that the intersection between the theory of language and the theory of knowledge takes place – an intersection in which the metaphorical praxis is a crucial, albeit so far neglected, component.

in nature and in society.[59] For example, in biology, living creatures have long been described through metaphors of machinery and computation: 'bioengineering', 'genes as code' or 'biological chassis' (Vaage 2020). Comparably, we see the use of fluid mechanics to explicate and describe electric energy (Harré 1995, pp. 289-308).[60]

Both metaphors and analogies are central to Western scientific thought. Analogies are more specific than metaphors and both are largely used in everyday communication and reasoning (McCarty 2015). Consequently, researchers have been and still are interested in the form and function of analogy and metaphor in learning (and teaching) science, in how they can be used to promote higher-level thinking and yield new tools for advancing science education research.[61] Analogy can be distinguished from metaphor in the sense that in a metaphor, *A is said to be B* (a meaning is created out of this comparison), while in an analogy, *A is like B* (an explicit comparison is made between two things).[62] Both have been largely used by scientists in building the foundations of experimental and theoretical sciences, in representing and describing a domain, and in promoting understanding of scientific investigations (Marras 2006).[63] Indeed, as recognised for decades now, a metaphor, given its cognitive and creative resonance, is much more than an episodic linguistic phenomenon and is not a mere linguistic embellishment. In addition, basic conceptual metaphors are never fully

59 Haken, Karlqvist, Svedin (1993), see Introduction, pp. 2-4. For the clock metaphor in science see Pulaczewska 1999, pp. 163-168. These views on metaphor are, for example, quoted in a letter published in the *Journal of Natural Philosophy, Chemistry and the Arts* in 1805, p. 8, mentioning the Scottish philosopher Dugalad Steward: "Now, it is pretty obvious, that the terms power, force, &c. when used in mechanical science are purely metaphorical; for, as Professor Dugald Steward remarks, (Elements of the Philosophy of the Human Mind [1792], p. 202) 'All the languages which have hitherto existed in the world, have derived their origin from popular use; and their application to philosophical [and that includes scientific, BN] purposes was altogether out of the view of those men who first employed them.' Language commenced amongst simple men, who had little, if any acquaintance with what is now called science....". This comment refers to a debate that had lasted for decades on the scientific status of the common language and on the heuristic potential of metaphors as they are linked to ordinary language.

60 See also Harré 1960 and 1970; Bailer-Jones 2000, pp. 181-198; Gentner and Gentner 1983; Gentner 1983.

61 See for example Bonderup Dohn 2018.

62 See Chapter 5; McGann 2014; Gentner 1982.

63 Taylor and Dewsbury 2018.

cashed out in a non-metaphorical language; in other words, it is rare that basic conceptual metaphors shaping our scientific language and rooted in the tradition of thought are 'retranslated' into their literary meaning. For example, consider the case of the concept of genes as "blueprints" in molecular biology. This metaphor was not deemed adequate for conceptualising and guiding the recent research and advances in scientific understanding by some biologists who rejected the blueprint metaphor for the nature of genes; as Barbara Katz Rothman suggests, "recipes" are more accurate for conceptualising gene-environment interactions.[64]

The predominant tendency of seeing precise definitions of all terms as *a sine qua non* for rigorous scientific and philosophical discourse strives to minimise the use of tropes to a role as mere ornamental or 'eloquence' devices.[65] Unlike formal languages, natural languages evolve and tropes play a central role in semantic evolution, their productive role, in turn, is the essential background against which rigorous formal definitions can be engendered. In this way, rather than being strictly separated, formal languages and natural languages (including tropes) complement each other in their epistemic functions.

DH is not exempt from metaphorical language, even in the overarching discourse about its definition (i.e., McCarty 2005; Marras 2010). Metaphorical expressiveness constitutes in our view an irreplaceable part of the linguistic lexicon of modelling. As we will see below, metaphors pervade both Computer Science and DH discourse, where technical terminology and metaphors are intertwined, as they do also in the discourse about computing in a wide sense and in other areas of society. In DH, metaphors are also used for structuring

64 See Condit, Bates, Galloway, Givens, Haynie, Jordan, Stables, West 2002; Taylor and Dewsbury 2001.

65 In the twentieth century the point of departure from the discussion of scientific models as metaphors can be traced back to Max Black's interaction view of metaphor (1962) and Mary Hesse's seminal work *Models and Analogies in Science* (1966). For a discussion on metaphor and thought, see the contributions collected in Ortony (1993). "To draw attention to a philosopher's metaphors is to belittle him – like praising a logician for his beautiful handwriting. Addiction to metaphor is held to be illicit, on the principle that whereof one can speak only metaphorically, thereof one ought not to speak at all. ...do not accept the commandment, "Thou shalt not commit metaphor" or assume that metaphor is incompatible with serious thought". (Black 1962, p. 25).

concepts at a macro-level, as for example in the use of "infrastructure" and "ecosystem" or the cartography and landscape metaphors used to organise contents and visualise knowledge. Nevertheless, there is something specific related to the modelling of processes and language in DH that we would like to stress here. Indeed, a metaphorical language is not only present in the DH discourse, but it also has a heuristic function. In the analysis, acquisition, and storage of data, DH applies established techniques also used in other domains where digital tools are used, along with more refined presentation and visualisation methods (i.e. charts, graphs, interactive maps, network analysis, timelines).[66] In both cases the natural language describing and conceptualising the process of modelling should take into account and grasp the interpretative activities at stake (What are the data? How are they created and understood? What is the relationship between sources and data?) as well as the dynamics of the relations between data/objects being analysed/mapped and the model/conceptualisation based on it (see Chapter 3). The interpretative dimension embedded in the modelling process as intended here is also related to some aspects of what is nowadays defined as digital hermeneutics, namely the computer-mediated interpretation and understanding of texts or corpora of texts, or about a text's reading-inspired attitude towards digital elements such as the code (see Chapter 5). The point here is not to attribute to digital technologies an autonomous interpretational agency,[67] but to foreground the heuristic nature of the process of modelling as well as its contingency, away from a mechanical and positivistic application of technical methods and to preserve the pragmatic aspects of modelling, in research and teaching as well as in community-based activities.

The key point is that metaphors assume a complex role and function and are themselves models of knowledge (or of a specific conceptual space under study). They define what knowledge is, what the approaches to and visions of knowledge being adopted are, and

66 See Thompson 2010, pp. 18-24.

67 See Romele, Severo, Furia (2020): "Would it be possible to pave the same path for hermeneutics, inverting an anthropocentric attitude that has characterised most of its history? Is there any room for what might be called a non-anthropocentric or posthuman hermeneutics?" See also Capurro (2010). Machine-learning algorithms have already been considered as (responsible) moral agents; see for example the discussion in Floridi and Sanders (2004).

the schemes within which knowledge or a specific concept operates. In short, metaphors generate the cognitive and operational reasoning path. For example, we can identify metaphors that conceptualise a broader disciplinary approach and guide data collection or acquisition (upload, data silos, etc.).

There are many conceptual metaphors used in the domain of knowledge organisation, to model classification and acquisition in DH (as well as science in general): for example, architectural metaphors are used to conceptualise and model information and knowledge in the organisation of libraries (Van Acker and Uyttenhove 2012) and construction of enterprise infrastructures. Improvements and changes are related to the idea of a tree, usually a growing tree, which needs care; specific content and topics are presented in terms of buildings, bricks, milestones, nodes, and nets; the process of acquiring knowledge is described in terms of walkways, paths, and roads, requiring a long journey from darkness to light that can either be straightforward or involve "detours". Or we might mention mapping, which is creating metaphors for representing information. Geography and cartography are not related to a simple enumerative and descriptive approach, but they allow for the possibility of elaborating upon models of representation in which description and discovery are strictly related. Therefore, it should be stressed that as maps are made redundant by new discoveries, mapping knowledge requires new ways of sharing maps and of identifying places by names. Mapping implies and embeds spatial-territorial metaphors in terrestrial and aquatic environments. The presence of these two conceptual domains is evident, for example, in the contemporary use of the metaphor of navigation and in the spatial terminology used to describe activities related to the web. If we look at the language used for describing these land- (or sea-) scapes, we note a large metaphorical use of marine terms such as the following: *ocean* (the vast amount of information); *navigator*, *explorer* (tools to navigate the net); *pirates* (who steal intellectual property and illegally download copyrighted materials); *navigating* (accessing sites, searching); *surfing* (moving from node to node in the net); *fishing* (finding data), *hits*, and many others. These metaphors are used in a complementary way to the use of literary terms such as *websites*, *site maps*, *IP addresses*, *visiting sites*, *following links* (terrestrial), along with the persistence of the use of book metaphors like *webpages* or *browsing*.

Metaphors are also embedded in web interfaces. They shape and orient the presentation of texts, images, access, and queries, and they contribute to the creation of new knowledge. Moreover, interfaces for online access to text may help scholars/users in the interpretation of the documents;[68] in this case, for example, the metaphor of zooming (Armaselu and van den Heuvel 2017) and more generally "optic metaphors"[69] are recurrent. The two metaphorical domains/spaces: tree/terrestrial and sea/aquatic, are the most recurrent scientific metaphors in relation to knowledge (Mazzocchi and Fedeli 2013) and they illustrate the observable change in recent decades of the classification and management of scientific knowledge. They also capture the current interdisciplinary scenario strongly influenced by the adoption of ICT technologies in the sciences, helping us to cope with and to somehow understand its complexity. The new digital means of mapping, accessing, and organising scientific knowledge are more correlated with the properties of aquatic metaphors than with terrestrial ones. Nevertheless, the aquatic and terrestrial metaphorical domains complement each other: beyond these metaphors of knowledge organisation and their related metaphorical fields lies the fundamental leading idea of fluidity, travel, movement, and journey. Independently of the specific grammar of each scientific field and sub-discipline, the complexity of this scenario requires categories and models capable of describing, interpreting, and organising the many dimensions of scientific knowledge organisation.[70]

68 See van den Chiel et al. (2011).

69 See Armaselu and van den Heuvel (2017); Armaselu and Florentina (2010). See also McCarty (2012); the reverse telescope was also the title of the AIUCD 2017 Conference (Rome, January 26-28 2017 (https://web.archive.org/web/20191230160752/http://aiucd2017.aiucd.it/).

70 The most pervasive knowledge metaphors are spatial metaphors (interesting in this regard is a 2012 issue of *Library Trends*, "Information and Space: Analogies and Metaphors", edited by Van Acker and Uyttenhove), and the most common approach used to work on knowledge is to map knowledge. Knowledge in fact is usually mapped, and a map is a metaphor and an analytical tool for writing and reading locations and relations between disciplines, concepts, issues, and terms. We map knowledge as we map the Earth. Otlet (1934) was certainly a pioneer for the use of the map in relation to new technologies and their primitive formulations. But the map, spatial instrument *par excellence*, is a metaphor largely used in the Western philosophical tradition. D'Alembert (1995, p. 157; originally published 1751), for example in the "Preliminary speech" to the *Encyclopédie* said: "and the end of our

If we start to use the aquatic metaphors along with the terrestrial ones, knowledge emerges as a progressive aggregation of many different atomic parts. In turn, each part is a complex, multilayered object, tightly interconnected to a number of other parts, without a directly identifiable *a priori* fixed structure. Wikipedia, and all the "wikis", is one example of the complex, multilayered organisation of knowledge, combined with the complexity of multidisciplinary, scholarly contributions. These aspects rendered Wikipedia an interesting case study for collaborative web-based encyclopaedias as complex networks.

The dynamic set of nets, threads, maps, and links used in digital domains articulate a vocabulary and a use of language able to capture integrated and complementary perspectives, static and structural information, and changes over time and space. This rich and blended use of metaphors invites us to rethink the taxonomy and assessment generally used to classify disciplines and subdisciplines. It is necessary to create innovative environments in which plural access to individual disciplines and topics enables individuals to create, manage, and preserve information in personalised, idiosyncratic spaces.[71] Of course, these are also related to different approaches, methods, tools and areas of application or study: for example, there are digital humanists who apply computational linguistics methods, do quantitative text analysis, and do computational semantics; we have editing scholars who engage with text markup following the Text Encoding Initiative Guidelines (TEI) and abstract model. Software has also been developed to explore and represent current knowledge configurations, i.e., the "Knowledge Atlas"[72], a network of maps, diagrams, texts, peritexts, and perimaps, combined together to describe the space of research in its multifaceted aspects in a sort of "knowledge cartography".[73] Charting, mining, analysing, sorting, enabling navigation, and displaying knowledge are tools and methods used in the mapping of knowledge domains.[74]

genealogical distribution (or if you will, our world map) of science and the arts." See van den Heuvel (2015).

71 See Borgman (2003a and 2003b).

72 See http://www.visualcomplexity.com/vc/project.cfm?id=288.

73 http://www.knowledgecartography.org/

74 See the research carried out on the community of scholars working in the "spatial humanities": http://spatial.scholarslab.org/project/. Spatial humanities is a tentative answer to the necessity of mapping the scenarios and the fields that scholars are currently experiencing. Particularly interesting are

Information technologies transform the boundaries of disciplinary research and foster new areas of investigation. This requires people to set flexible tools and services to gather information from multiple sources, and to manipulate them for their own purposes. A deep change occurred in the access to information since Schiffrin and Börner (2004, p. 5183) wrote:

> The changes that are taking place profoundly affect the way we access and use information. Scientists, academics, and librarians have historically worked hard to codify, classify, and organize knowledge, thereby making it useful and accessible. The day is fast approaching when all this knowledge will be coded electronically, but mixed in a vast and largely disorganized and often unreliable sea of mostly recent information. Fishing this sea for desired information is presently no easy task and will continue to increase in difficulty. However, the speed and power of modern computation gives hope that this daunting task can be accomplished. In addition, and perhaps even more important, the new analysis techniques that are being developed to process extremely large databases give promise of revealing implicit knowledge that is presently known only to domain experts, and then only partially.

This process of knowledge organisation, which most recently has been described metaphorically as the emergence of a new landscape,[75] requires a growing ability to access and organise complex information and this landscape metaphor designs the model for a paradigm shift that moves from the dichotomic interplay between bottom-up and top-down approaches to a middle-out model of knowledge; examples include collaborative websites, content management systems, and online reference management services.[76] In a DH context the use of metaphors can have practical outcomes for how data processing, storage, and design are structured, and for how data are presented and interfaces are built (Ciula and Marras 2018).[77] Furthermore, metaphors themselves are models of knowledge and they define the schemes within which

Minard's numerous maps from the nineteenth century where he visualises all sorts of data in his "statistical graphics": https://papress.com/products/the-minard-system-the-complete-statistical-graphics-of-charles-joseph-minard.

75 For example: Svensson (2010).

76 Cf. Colburn, Shute (2008).

77 A similar approach was used in the establishment of CIDOC-CRM (Conceptual Reference Model) in the museum world, http://cidoc-crm.org, and of LRM in the library world, https://www.ifla.org/publications/node/11412. For the CIDOC

specific concepts operate and knowledge is established and expressed (Marras 2017).[78] One example are the metaphors used to represent the relationships between data, information, and knowledge, such as the pyramid of DIKW (Data, Information, Knowledge, Wisdom) or the chain, or the graphs.

2.3 The Factoid Example

An example originally reflected upon in Pasin and Bradley (2015) and Ciula and Marras (2016) comes from DH modelling applied to prosopography, an historical methodology for the study of pre-modern societies to collect systematically and analyse information about individual persons as attested in disparate historical sources. "Factoid" is the name associated with the prosopographical model used in several DH projects based at King's College London and elsewhere since 1995.[79] The name evidently mirrors the "historian's worry" (Bradley and Short 2005, p. 8) that what they record as assertions in the historical sources under study are not the same as facts. A factoid is an assertion made by historians (in a DH context, usually a project team) that a source 'S' at location 'L' states something ('F') about person 'P'. It reflects a context-aware approach to history used in prosopographical projects spanning ca. 2000 years of history. The factoid, with appropriate extensions, has been a reusable concept successfully operationalised in DH projects. The historical narratives around which prosopographical studies are built are very nuanced (multidimensional, complex, non-linear), hence not easily translatable to the unambiguous language of databases: "[...] factoid approach can show that formal structuring if designed

CRM see https://cidoc-crm.org/ and for the International Federation of Libraries Associations (IFLA), see https://www.ifla.org/resources/?oPubId=1141.

78 Recent reflections on modelling practices are at the King's Digital Lab (KDL), see Ciula et al. (2023).

79 For a detailed discussion on the digital model and access to the associated semantic web ontology, see Bradley et al. (2020). See also the example of Records in Contexts-Conceptual Model (RiC-CM), which aims to integrate into a single conceptual model the descriptive standards developed over the last two decades by the International Council of Archives, and provide the prerequisites for an application of the semantic web technologies to the archival world. The conceptual model is accompanied by a specific ontology, RiC-O (https://www.ica.org/en/egad-ric-conceptual-model).

correctly need not impose, as Veltman implies, a single perspective on the data it models, but is capable of accommodating a range of views from the different sources." (Pasin and Bradley 2015, pp. 89–96). Via its operationalisation, the factoid concept embeds the historical approach being used but also structures the digital resources being produced. The data structure of the factoid model is operationalised as the linking of different sorts of entities (e.g. persons, places, sources, possessions etc.) and was tailored to several project cases.[80]

1. The factoid model can be considered a metaphoric model which structures the digital resources it originates at least on the following three levels (see Pasin and Bradley 2015):
2. Data acquisition, by acting as a guiding metaphor to conceptualise a broader historical approach outlined above and the corresponding data entry;
3. Data storage, by acting as a practical, flexible and sustainable schema for designing databases;
4. Data presentation, by acting as a notion around which to build user interfaces.

Pasin and Bradley (2015) suggest that rather than a systematic application of formal structures to a specific knowledge domain (in this case the prosopography of specific pre-modern societies), the factoid model can rather be considered as a process of conceptualisation and formal structuring designed to accommodate a range of views on a certain society from the perspectives of different sources.

DH scholarship requires adaptable models like the factoid model to grasp domain-specific concepts. These models stem from the specificity of DH theories and objects of analysis, as they are seen in the context of specific disciplines in the humanities (mediaeval history, historiography and prosopography in this case) with potential applications beyond those contexts (e.g. modelling historical persons across time and space). They grow more or less organically during the modelling process, in connection to, rather than just as an effect of, the observational contexts in which they are immediately applied (Ciula and Marras 2016).

80 See for example Rachel Stone (2014).

In highly computational settings, the intrinsically metaphorical component of the DH modeller's use of language – whether verbal, as in documented descriptions of the model, or visual, for example in the forms of diagrams illustrating the model – is what makes the objects generated out of the application of formal and functional languages interpretable in the first place. The act of interpretation is also an act of translation (*transferre*) implying an act of transportation from one language, domain, context, or culture to another. In the perspective we adopt here, the concept of translation is the 'engine' of the modelling process. It allows us to bridge the dichotomy between formal and informal, object and theory, physical and mental. The process of modelling in DH is a translation between domains; it suggests a reconsideration of the notions of faithfulness, adequacy, and equivalence. It contributes to a non-dualistic perspective, to a de-dichotomisation of the polarities between object and subject, *explanans* and *explanandum*, observer and *observatum*.

2.4 The Pragmatic Metaphorical Modelling

To sum up, a multilayered notion of metaphor is particularly productive in understanding acts of modelling as non-restrictive. The process of signification within which modelling activities operate implies translation, negotiation and transformation of meaning, which will be discussed further in Chapters 3 and 4 and exemplified in Chapter 5. Operationalisation formalises models into, for example, programming language source code and software components, but the process of abstraction of target historical and cultural objects or complex phenomena into rule-based procedures is contingent and cannot be reduced to strict formalisation only. It is an aim in the development of DH software that the models be formalised to a level where they can be implemented and usable, e.g., as software modules, but still respect enough of the variation, peculiarity, and context awareness of the data to make them adequate to address research questions in the humanities. This is an example of the trade-off between computability and acceptance of the complexity of modelling targets that we find in all scholarly and scientific modelling. Furthermore, the notion of metaphor and the metaphorical conceptual modelling we use does not correspond simply to the use of a metaphor in an analogy-based model, but it merges different aspects:

cognitive, conceptual, heuristic, relational, and metalinguistic; indeed, in DH modelling, as elsewhere, metaphors work transversally at the experimental, theoretical and practical levels. We can therefore list a few points to sum up the characteristics of metaphorical modelling:

- Metaphors assume a complex role and function. Metaphors themselves are models of knowledge and define what knowledge is, what the approaches to and visions of knowledge being adopted are, and the schemes within which knowledge or a specific concept operates.[81]
- Metaphors enable the grasping of the unknown via what is known, both by making implicit knowledge explicit and by drawing on unexpected connections with other semantic domains. For example, in a DH context, the process of abstraction (which is usually called 'analysis' or 'design') translates the idiosyncratic data of interest into thematic clusters and categories, which in turn can be used to make sense of, classify and eventually ingest new data.
- Metaphors define their own semantic fields, which have the potential to expand across related domains. In a DH context these have practical implications, for example with respect to how data is processed and stored, and is used when designing data models, data presentations, and interfaces; very often the labelling of entities and their relations makes use of the semantic fields opened by guiding modelling metaphors.
- Metaphors structure meaning and senses. In a DH context, this is where data-model and data-structure (also at the level of presentation of the data) are organised and expressed by a metaphor. So for example, a hierarchical object oriented model will define a specific idea of relationships between entities, including inheritance of properties. A relational model expresses the connections between entities differently

81 In the area of knowledge management, computer systems are often claimed to store and manipulate knowledge. It is central to the argument here that this is a related, yet different meaning of the word 'knowledge' from that we use when we describe metaphors as models of knowledge. Metaphors have a privileged relationship to human knowledge and meaning that knowledge management systems lack.

from a graph model, even if, at some level, the "same" system (logical model) can be represented using either type of implementation (physical model).

- Metaphors lead narratives and reshape their contexts of production and use. In a DH context, the metaphorical language used in a project influences the core data and software structures as well as the presentation of the data and the design of interfaces. Of course, it also influences the narratives in more traditional publication formats, partly directly, and partly through the implemented systems.

As noted in Chapter 1, pragmatic modelling is conceived as being anchored in theory and language, and implies at least a solid understanding of the objects being modelled as complex objects, for which both elements of *factuality* and *fictionality* must be made explicit along with an adequate language to theorise and inform the practice of modelling in DH (see Chapter 3). In contrast with the life sciences and physical sciences, objects being modelled in the humanities are usually cultural constructs (whether artefacts or concepts) made by humans. The importance of metaphors in structuring knowledge and hence in modelling processes in DH can explain the integration of practices of 'analogue' modelling with practices of modelling oriented towards a digital implementation.

Furthermore, a theorisation and a reflection on metaphorical language in modelling can explain how patterns and/or principles are formalised by accounting for the integration of practices of 'analogue' modelling with practices of modelling oriented towards a digital implementation. As discussed in Chapter 1, pragmatic modelling is also intended as a research and learning strategy that takes into account the complex intellectual, social, and cultural dimensions within which DH operates. Metaphors, in terms of their cognitive and structural power, can help us to rethink disciplinary borders and reshape the terms of a debate about the nature of scholarly research, evaluation, and publication related to new knowledge organisation. A metaphorical pragmatic vision of modelling implies awareness of the complexity of the objects being studied and is therefore needed in order to further explain how it is possible to imply the multiple perspectives of analysis under which models are studied (meta-modelling) and clarify some recurring conceptual schemes in structuring knowledge (metaphorical language). Moreover, it clarifies how the manipulability of models is achieved via heuristic processes of formalisation (models are made computable) and translation (models take the form of media products).