Universal Terminology

Chapter 14: Definitions

This chapter is about definitions of entities of the domain of anatomy. TA98 was published without definitions of entities, speculating that all users share a common knowledge of anatomy and are able to define by themselves the entity they are manipulating. This is quite a common situation: most terminologies are published without definitions. The common reason for this absence of definitions is the lack of sufficient manpower. But we have a different opinion: the authors of past terminologies are not convinced about the need of quality definitions and they prefer to allocate their resources to other tasks.
We will try in this chapter to demonstrate the major role of good definitions in a terminology. Then we will develop a strategy for developing definitions. Finally we will open a window on the future where a formal model of definitions could automatically generate the expected definitions in several languages.
This document is the chapter 14 of the book Universal Terminology which presents a global documentation on the $\mathbf{T}_{logy}$.

Contents

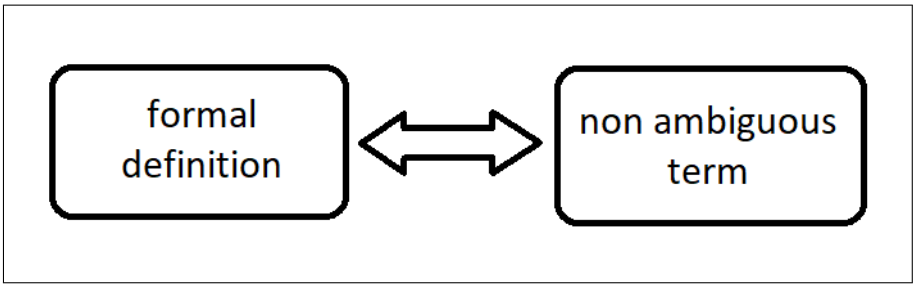

Figure 14.1: The duality of terms and definitions. Any weakness on one side is rapidely propagated to the other side. Formal definition means machine-readable definition.

14.1 The role of definitions

Let first consider a simplistic approach of the problem of definitions. One could say that it is not necessary to define what is the heart because everybody knows about this organ. The same is true for certain body parts that are known in the general population. By health practitionners one can imagine that a concensus definition does exist, possibly for 75 percent of all anatomical entities. Even if this number would be augmented to 90 percent, what about the rest of entities?

The role of the terminology is precisely to worry about those entities which are problematic because they are not well-known or ambiguous or coming with different interpretations, all this in a single population. And as soon as these criteria are examined relatively to different populations using different languages, the problem is increased.

Indeed there is a perfect duality between the term denoting an entity and a definition of this entity, see figure 14.1. What would be the use of a precise term if we do not know precisely about what entity in reality we are speaking of? What would be the benefit of an exact definition if we do not have a good term allowing to communicate on this entity? The final precision is simultaneously proportional to the quality of the term and to its precise definition. The ultimate goal of the $\mathbf{T}_{logy}$is to satisfy the needs for clarity for the problematic entities, because the more common entities can be sufficiently controlled without a terminology!

Several authors have pointed the need for definitions.

[**Cimino, 1998**]
The list of desiderata contains as its sixth part the mention of formal definitions. This article shortly considers the possibility to make formal the definitions through the development of some model and it mention the need of sufficient manpower resources for any development of definitions.
The value of this paper is that it was published early and that it already mentioned the need of definitions among its basic desiderata.

[**Michael et al., 2001**]
This article is similar and complements the article of Rosse 2003 below. In addition, it presents a set of relevant desiderata for writing definitions.

[**Rosse and Mejino, 2003**]
Citations from this article:
1) The disciplined modeling approach employed for the development of the FMA relies on a set of declared principles ... the Aristotelian definitions.
2) The purpose of definitions is to align all concepts in the domain in a coherent inheritance type hierarchy or taxonomy.
3) Paraphrasing Aristotle, the essence of an entity is constituted by two sets of defining attributes; one set, the genus, necessary to assign an entity to a class and the other set, the differentiae, necessary to distinguish the entity from other entities also assigned to the class.
This article supports the principal arguments that we have adopted for the $\boldsymbol{T}_{logy}$.

The form of definitions is as large as there are authors of definitions in any domain. The most common definitions, to which any of us is accustomed, are the so call encyclopedic definitions, made exclusively of free text. In reality, it is more than a definition: it is a set of properties relevant to the object to be defined. Dictionaries and encyclopedia usually do not distinguish the definition from the properties: saying that *the kidney is an organ of 120 to 160 grams filtrating the blood and producing urine* is correct, but the weight of the kidney is a property not a definition, and the enumerated functions are not exhaustive. Indeed, the role of a definition is to distinguish an entity from another, in other words to differentiate the entity.

When building an ontology, our task must be delimited to the strict needs of this discipline. Because the manpower resources are limited (during creation, but also during maintenance), we must be scarce of any unnecessary effort: we do not want to rewrite another encyclopedia, not even a part of it. This immediately leads us to contingent the corpus of definitions by strong guiding principles. Such a constraining context is in particular obtained with the taxonomic definitions. In addition, it is based on the core of the ontology, the taxonomy of the domain.

14.2 Taxonomic definitions

As said in [Rosse and Mejino, 2003], one can capture the essence of an anatomical entity under the form of two attribute: the genus and the differentia according to Aristotle principle.

The genus is by definition the taxonomic father entity. But the father entity itself has a genus and so on, in such a way that the full genus is the set of taxonomic ancestors. In practice we limit the genus to the taxonomic father,

A kidney is a corticomedullary organ [organum corticomedullare] which has as its part renal pelvis [pelvis renalis] shared with and connected to ureter [ureter]. (Foundational Model of Anatomy)

Un rein est un organe corticomédullaire [organum corticomedullare] qui a pour partie le bassin rénal [pelvis renalis] partagé avec et connecté à l'uretère [ureter].

Uno reno es uno órgano corticomedular [organum corticomedullare] que tiene como parte la pelvis renal [pelvis renalis] compartida y conectada al uréter [ureter].

почка - это корково-медуллярный орган [organum corticomedullare] который имеет в своей части почечную лоханку [pelvis renalis], общую и связанную с мочеточником [ureter].

Figure 14.2: The definition of kidney is available in 4 languages. The semi-automatic generation tool guarantee that the texts are equivalent in all languages: it is very important to provide precisely the same definition to all users of the $\mathbf{T}_{logy}$.

but the essence of the definition may be to be searched for on other ancestors. See the examples below about this aspect of the taxonomic definition.

This means that the genus is totally constrained and can be computer generated at will. For example we have as first pat of a taxonomic definition: *the kidney is a corticomedullary organ which ....* This text is easily computer generated. If we look at the upper ancestors, we get the following information: parenchymatous organ and solid organ.

The $\mathbf{T}_{logy}$has implemented the generation of the genus part of definitions. Because our implementation is prepared in 4 modern languages, the generated text is multilingual.

Some general rules are applicable for creating new definitions in the present context of taxonomic definitions. One rule is about avoidance of functional arguments, knowing that it is not always possible or at least desirable. We are in the domain of anatomy and the functional arguments are borrowed from the domain of physiology. The arguments issued from the morphology, histology or even embryology are to preferred.

Another guiding principle is to keep the definition simple and as easy to understand. Each definition, as much as possible, must be fully understood at the first reading by any casual user. But of course if a conflict exists between

the precision of the definition and this above requirement, the precision has the priority.

Some definitions are trivial and may seem stupid. For example: *a gyrus orbitalis anterior is a gyrus orbitalis which is in anterior position.* There is no need to add anything more, this definition is good, precise, not ambiguous. What else? In fact we have a situation where the term itself contains the definition. This is far from being true in 90 percent of all entities. But it does exist.

14.3 Examples of definitions

The idea of this section is to illustrate to guiding rules when creating new definitions by significant examples from the domain of anatomy. Each example is presented as a subsection and is coming with comments.

It should be noted that the corpus of definitions of the $\mathbf{T}_{logy}$is currently in a evaluation process and that a formal validation by experts of the domain would be organized in due time.

14.3.1 Cervical vertebra

Cervical vertebra
`A cervical vertebra is a vertebra [vertebra] which forms the upper part of the vertebral column [columna vertebralis] and supports the head [caput].`

This is classical definition based on the location. The second assertion concerning the head is not necessarily present and this is the choice of its author.

14.3.2 Vertebra

Vertebra
`A vertebra is a bone of vertebral column [os columnae vertebralis] which is the unit of construction of its articulated part above the sacrum [os sacrum].`

Here the definition is derived from the fact that the defined entity is a constituent parts of the whole. When going one step higher in the taxonomy, one learns that the vertebra is an irregular bone.

14.3.3 Decussatio pyramidalis

Decussatio pyramidalis
`A decussation of pyramids is a decussation of neuraxis [decussatio neuraxis] which is found in the caudal rhombencephalon [rhombencephalon caudale] where the fibers of the lateral corticospinal tract [tractus corticospinalis lateralis] cross from the ipsilateral to the contralateral side of their origin.`

This is a definition with two assertions: first the entity is localized in the caudal rhombencephalon, second the tract involved in the decussation is determined.

14.3.4 Thalamus

Thalamus
`A thalamus is a component of organ of neuraxis [componens organi neuraxis] which acts predominantly as a relay station for afferent sensory fibers and efferent motor fibers between the cerebral cortex [cortex cerebri] and the other segments of the neuraxis [neuraxis].`

The role of the taxonomy is important here: the thalamus is not an organ, but a component of neuraxis that is itself an organ. The FMA model is clear on this aspect. The definition is oriented on the white matter connections and insist on the main role of thalamus acting as a relay station between the cerebral cortex and the other component of the central nervous system.

A complement on the location of the thalamus could be added to this definition, something like *below the telencephalon.*This is not strictly speaking necessary, because the cerebral cortex is mentioned and further indication is optional. This is open to discussion.

This example shows the large liberty of the authors to select one aspect of this entity and to ignore other properties. Other authors insists on the location between telencephalon and midbrain or the proximity of the third ventricle.

14.3.5 Arteria basilaris

Arteria basilaris
`The basilar artery is a systemic artery [arteria systemica] which is formed by the confluence of the left vertebral artery [arteria vertebralis sinistra] and the right vertebral artery [arteria vertebralis dextra].`

This is quite a particular artery, being formed by an anastomosis of two branches of the subclavian artery. Indeed, it is not a branch of another artery. The definition is explicit on that situation.

14.4 Semi-formal definition

The differentia is more complicated to automatically generate and remains today dominated by free text. It starts with a verb at the third person and can be of any length. However, we try to restrict it to the task of differentiation of the father entity related to all its children. In order to to be too formal and to facilitate the reading of the resulting definitions, we may accept some additional text based on properties or functions, but this must be an exception. On this basis we get for the above example: *Corticomedullary organ which has as its part renal pelvis shared with and connected to ureter* (source is FMA).

But, we observe that the differentia has two links to other anatomical entities: the EN:*renal pelvis* and the EN:*ureter*. It is relatively easy to locate these two entities in the free text and to replace them by the actual link to the entities, using their identifier. In addition, because the links gives access to the whole entity, we can automatically insert the Latin term. The result in 4 languages is visible on figure 14.2.

This approach is semi-formal, because a part of the differentia is automatized and the rest remains as free text. This is the current status of envelopment. We will present the future plans for creation of fully formalized definitions in a section below.

We have seen than the generation of the genus is automatized and that the reference to other entities in the differentia of the definition is also automatized. That's important steps, but the remaining tasks are difficult. When examining the form of the differentia in more than 1000 examples, we discover that it is made of a set of assertions in the form Relation + Entity, with a maximum of 3 assertions.

The next step of the automatization process would be the modelization of the differentia. Our current evaluation is that the diversity of the texts is important and that a too simple model would not be adequate. The referenced objects in the differentia may be outside of the stict domain of anatomy and the number of assertions or relations to create is large, possibly one hundred or more. For all those reasons, this modelization has been started and is waiting for a new proposal in the future.

It is interesting to quote here a similar initiative, with the same conclusion: only a partial coverage of all definitions has been modeled. Full formal definitions have not been reached today.

[**Mungall, 2004**]
This article review an experiment by the author to capture the definitional part of the terms themselves and to use this information for validation purpose of the taxonomy. As expected, the success was real but partial because not all terms are directly significant. However this experiment shows that the modeling of anatomical texts is a source of knowledge to consider in the future.

Bibliography

[Cimino, 1998] Cimino, J. (1998). Desiderata for controlled medical vocabularies in the twenty-first century. *Methods Inf Med. 1998 November ; 37(4-5): 394–403.* PDF.

[Michael et al., 2001] Michael, J., Mejino, J., and Rosse, C. (2001). The role of definitions in biomedical concept representation. *In proceedings of AMIA 2001.* PDF.

[Mungall, 2004] Mungall, C. (2004). Obol: integrating language and meaning in bio-ontologies. *Comp Funct Genom 2004; 5: 509–520.* PDF.

[Rosse and Mejino, 2003] Rosse, C. and Mejino, J. (2003). A reference ontology for biomedical informatics: the foundational model of anatomy. *Journal of Biomedical Informatics 36 (2003) 478–500.* PDF.

14.5 Log of updates

04 Apr 2022 Creation of the file.

14.6 Credentials

This document is part of the book "Universal Terminology" accompanying the website on Terminologia Anatomica. It expresses the vision of the authors of the $\mathbf{T}_{logy}$about the foundations of the science of ontology, supporting the here presented terminology. Despite it is as exact as possible, close to the reality of the database of the terminology and the surrounding software, approximations, errors and ambiguities are possible and should be considered as independent of their willingness and intents.

Identified comments about the content of the website and its presentation are welcome. An appropriate answer will be given when pertinent.

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