Modeling scientific taxonomies using frame-based representations

PATRICE SOOM
(Heinrich-Heine Universität Düsseldorf, SFB 991)

This contribution aims at highlighting the applicability and limits of frame theory in order to analyze scientific taxonomies and theories. In particular, it emphasizes that within some versions of frame theory (e.g. Petersen 2007), a frame analysis of scientific classification cannot be conducted independently of an analysis of the type-hierarchy specifying the conceptual relations between the different types of attributes and values appearing in the theory. To the extent that the type-hierarchy itself cannot be regarded as a frame, it follows that frames cannot constitute a universal and autonomous medium of representation. In order to substantiate this conclusion, this paper evaluates the applicability of frames with regards i) to individual entities described by scientific classifications, ii) to abstract types appearing in scientific theories, iii) to the classification system itself and finally iv) to the empirical content of theories. The evaluation shall be conducted against the background of the contemporary classification of mental disorders.

i) Frames consist in recursive attribute-value structures (Petersen, 2007). Given the functional character of attributes, frames are particularly suitable for describing particular individuals. Figure 1 provides an example of frame describing a particular patient with schizophrenia. The frame might be said to be maximally determinate in the sense that, given that it describes one particular individual, each attribute returns a single and maximally determinate value.

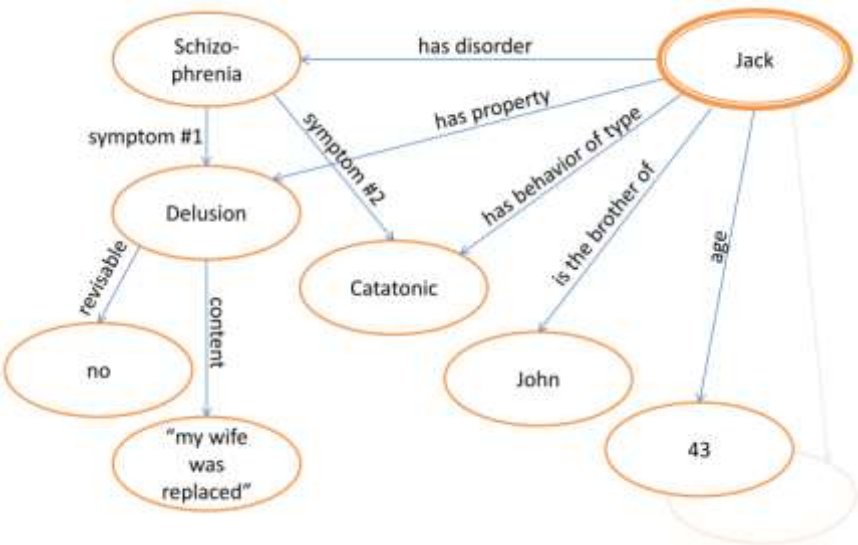

Figure 1. Simplified frame description of a patient with schizophrenia.

ii) Figure 2 provides a frame representation of the concept of delusion, which is a cardinal symptom of psychotic conditions. Accordingly, a delusion is a mental symptom of some disorder that is characterized by its content and that is immune inferential

revision. Greyed attributes items in figure 2 are non-essential attributes mentioned in the DSM-5 (APA, 2013) definition of delusions. Non-greyed represents essential attributes.

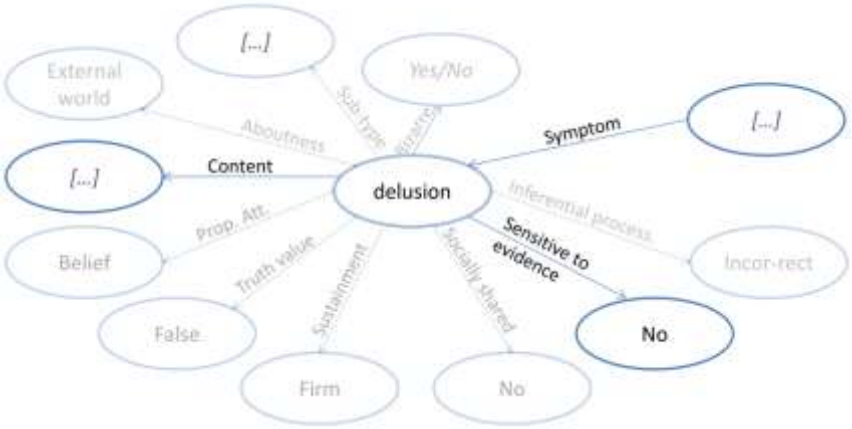

Figure 2. A frame analysis of the concept of delusion (APA, 2013).

Attributes are functional in the sense that, when the frame describes one particular entity, each attribute returns one specific value out of the list of possible values for this attribute. For instance, the attribute "content" of the frame delusion might return "the FBI is after me" when the frame describes patient *x*, while returning "I am dead" when it describes patient *y*. While alternative versions of frame theory clearly states how to represent sets of possible values within frames (Chen, 2006), Petersen's (2007) frames rely on a separate type hierarchy in order to specify which values might a given attribute receive and which attribute a given type of entities might have or not have.

iii) In psychiatry, these questions are precisely answered by classification systems. The DSM-5 specifies what are the possible symptoms of a given disorder type (which-attribute question) and what values a given attribute might receive (which-value question). We propose here to regard scientific classification systems as type-hierarchies, which specify the conceptual relations between attribute types and sets of possible values and thereby guide and constraint the construction of frames in specific domains.

iv) The empirical content of scientific theories, such as contingent nomological relations between various types of properties, might be integrated in frame representations as attribute-value constraints, which specify systematic dependencies between the values of different attributes. Figure 3 presents a case of multi-level frame, where the dependencies between attributes values located at different explanatory levels are represented.

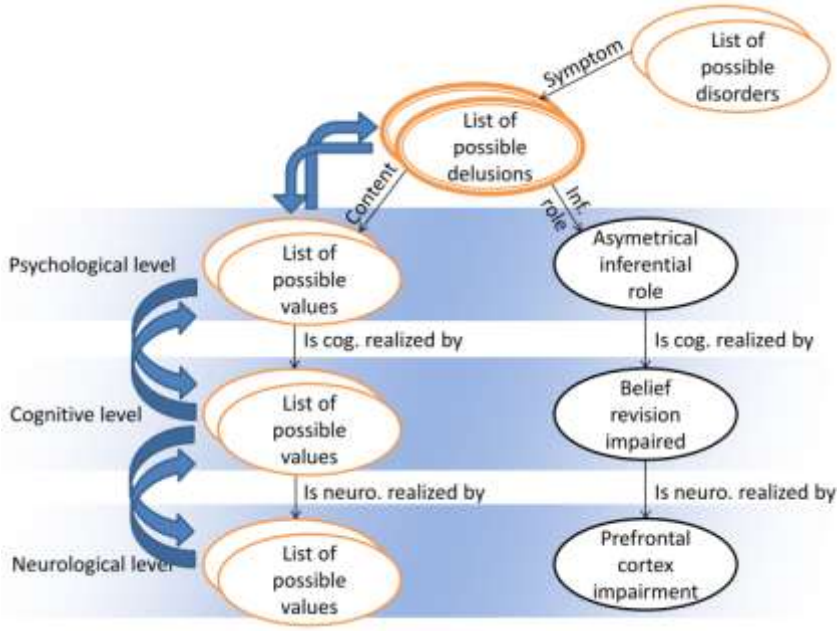

Figure 3. Multi-level frame describing the cognitive realization of the essential attributes of delusions.

Altogether, frames are recursive attribute-value structures describing particular entities, individual or abstract types on the basis of a on a type hierarchy. However, the fact that frames need to be supplemented by distinct structures such as type-hierarchies undermines the claim that the universal medium of representation of human cognition consists in frames. In a nutshell, if frames require to be supplemented by type-hierarchies, cognition cannot proceed on the basis of frames only, precisely because type-hierarchies need to be mentally represented as well.

APA (Ed.). (2013). *Diagnostic and Statistic Manual of Mental Disorders, Fifth Edition (DSM-5)*. Arlington: Amercian Psychiatric Association.

Chen, H. A. P. B. X. (2006). *The Cognitive Structure of Scientifec Revolutions.* Cambridge: Cambridge University Press.

Petersen, W. (2007). *Representation of Concepts as Frames.* The Baltic International Yearbook of Cognition, Logic and Communication., 2, 151-170.