Enabling RadLex with the Foundational Model of Anatomy Ontology to Organize and Integrate Neuro-imaging Data.

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Abstract

In this study we focused on empowering RadLex with an ontological framework and additional content derived from the Foundational Model of Anatomy Ontology[1] thereby providing RadLex the facility to correlate the different standards used in annotating neuroradiological image data. The objective of this work is to promote data sharing, data harmonization and interoperability between disparate neuroradiological labeling systems.

Huge amounts of neuroimaging data are being produced by different groups and they are recorded based on different brain parcellation schemes that are specifically designed for particular studies. Disparate naming conventions used produce incompatible terms that make it difficult to correlate data. Current terminologies for neuro-imaging lack the semantic framework to explicitly declare the precise meanings of the terms and therefore neuro-imaging data and information represented by the terms cannot be readily associated and applied across different studies. RadLex[2] is a controlled terminology for radiology and seeks to provide the needed semantics for correlating the diverse terminologies used for annotating neuro-imaging data. In this work we leveraged the Foundational Model of Anatomy Ontology (FMA) to re-structure and reinforce the anatomical domain of RadLex so it can incorporate, accommodate and correlate the different annotation terminologies.

The approach we describe here serves two practical purposes: 1) use a reference ontology such as the FMA to provide a principled and robust framework for conferring semantics to neuro-imaging annotations and 2) leverage this underlying ontological framework to facilitate and promote integration, interoperability and reuse of knowledge among applications that use different parcellation and annotation schemes.

We examined the labels derived from several existing atlases and ontologies such as the Talairach Atlas, the Anatomical Automatic Labeling Atlas (AAL), NeuroLex and the FreeSurfer and we manually mapped them to existing neuroanatomical entities in the FMA by using direct string, synonymy or lexical mappings or through interpretation provided for the symbols used in the project (FreeSurfer). When necessary, additional classes and relationships were added to complete the mappings. The ontological structure of the FMA helped define explicitly what neuroanatomical entities are represented by the annotation terms and how they correlate to one another according to the spatio-structural properties made expressed by the FMA. As illustrated in Figure 1, the FMA provided the semantics to link the different granularity levels represented by the different terms. One can then determine or reason whether the data annotated by one system are associated or can be related to data annotated by another system.

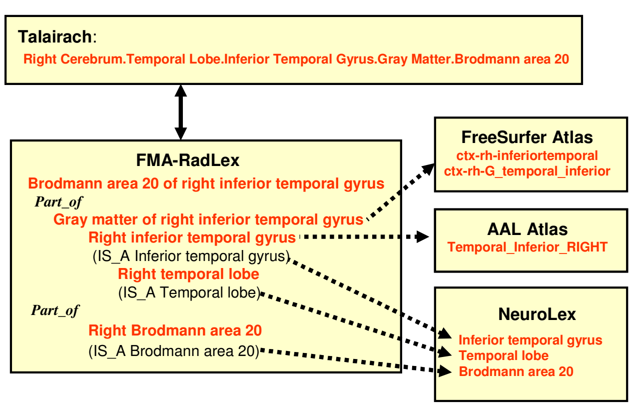

Figure 1. Correlation of neuroanatomical entities referenced by different terminologies.

Acknowledgment

Supported by NHLBI grant HL08770 and RSNA-NIBIB RadLex Project.

References

1. Rosse C, Mejino JLV. 2007. The Foundational Model of Anatomy Ontology, In: Burger A, Davidson D, Baldock R (eds). Anatomy Ontologies for Bioinformatics: Principles and Practice, London: Springer, pp59-117.
2. Langlotz CP. RadLex 2006. a new method for indexing online educational materials. Radiographics 26:1595–1597.