

## Intelligent Queries over BIRN Data using the Foundational Model of Anatomy and a Distributed Query-Based Data Integration System

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### Abstract

*We demonstrate the usefulness of the Foundational Model of Anatomy (FMA) ontology in reconciling different neuroanatomical parcellation schemes in order to facilitate automatic annotation and “intelligent” querying and visualization over a large multisite fMRI study of schizophrenic versus normal controls.*

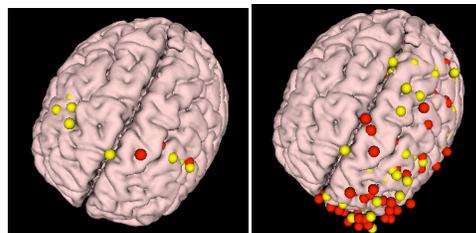
The Biomedical Informatics Research Network (BIRN) is a multisite consortium that is developing federated approaches to data integration and sharing. As part of this project the function BIRN (fBIRN) component conducted a multisite study across 10 institutions looking for differences in fMRI activations of schizophrenics (sz) versus healthy controls<sup>1</sup>. The same fMRI tasks and protocols were used across all sites, and the federated system was used to allow access to the data across sites. In an earlier study we demonstrated the potential of the FMA for reconciling different approaches to querying over these data, but manual annotation with FMA IDs was required<sup>2</sup>. In the current study we remove the need for manual annotation.

The image data were first downloaded from the participating sites, processed using the fBIRN pipeline, and analyzed looking for significant clusters of fMRI activation in normalized space. The centroids of these clusters were submitted to the Talairach demon<sup>3</sup> (TD) to automatically obtain anatomical labels. The resulting summary data were made available on the web as an XML data source.

The TD contains no relationships among terms to permit intelligent queries. Thus, we augmented the FMA (subsequently transferred to RadLex), adding TD labels as synonyms of corresponding FMA classes, thereby providing a richer network of relationships between TD terms. We then made the modified FMA available as an ontology web service accessible via

our vSPARQL extensions to the SPARQL semantic web query language<sup>4</sup>.

Using our distributed XQuery data integration system called DXBrain<sup>5</sup>, we wrote several “intelligent” queries over the BIRN data that included subqueries to the vSPARQL service. An example query finds all fMRI cluster centroids annotated with any part of the dorsolateral prefrontal cortex (DLPFC)<sup>6</sup>. Since the only information provided by the TD is detailed TD labels, the vSPARQL query first finds all FMA parts of the DLPFC, then for each such entity looks up the corresponding TD label. This list of TD labels is then used in an outer XQuery to retain only clusters annotated with the parts of the DLPFC. The resulting clusters are then automatically displayed as red (healthy) or yellow (sz) dots on a 3D brain (left). Small changes to the vSPARQL query allow other brain regions to be compared as well, such as the left frontal lobe (right). Further development of this tool will lead to an automatic pipeline for annotating and querying this and similar studies.



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