EVENT ABSTRACT

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# Standardizing Metadata in Brain Imaging

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Introduction: In neuroimaging open data sharing is not a common practice [1]. While publishing a paper in many disciplines requires that data be made public, in human brain imaging there is no general agreement that data should be shared, and there is a lack of community standard for data sharing. However, the neuroimaging community increasingly recognizes that sharing raw and processed data is critical for reproducible research, enabling meta-analyses and allowing for serendipitous discoveries.
In light of this challenge, the Neuroimaging and Data Sharing Task Force (NIDASH-TF) formed by the International Neuroinformatics Coordinating Facility's (INCF) Program on Standards for Data Sharing [10] supports the development of standards and tools that will have a community-wide impact on the prevalence of neuroimaging data sharing. In this abstract we report on work to facilitate the sharing of neuroimaging metadata and analysis results.

Methods: The Neuroimaging Data Model Working Group (NIDM WG), a sub-group formed to design a metadata model for neuroimaging, holds weekly calls with participating members from the international community and organizes INCF-hosted yearly meetings. The NIDASH-TF wiki [10] is the primary resource for disseminating information and contains weekly minutes, publications, and links to products. NIDASH code is available in the GitHub repository (github.com/incf-nidash). The Google Group incf-datasharing [11] hosts an email list on data sharing issues, reaching out to a wider community. The NIDASH-TF meets several times a year to review progress on projects (eg [16]) that will make data sharing easier and fruitful for the scientific community.

Results & Discussion: The NIDM WG has developed DICOM [6,7] and neuroimaging [2,7] terminologies, and the Neuroimaging Data Model (NIDM) [2,5]. NIDM is a neuroimaging-specific extension of the PROV Data Model (PROV-DM; [18]) to facilitate sharing of semantically meaningful neuroimaging provenance and derived data. Using these tools, we have developed novel applications to demonstrate federating data across relational databases and spreadsheets [4], visualizing FreeSurfer segmentations [12] across a large

cohort [3], and modeling SPM and FSL statistical results [8], and have started to model results from AFNI. Further, we have developed detailed specifications of the core NIDM standard and "object models", specifying the recommended minimal set of entities, agents, and activities to describe datasets, workflows, and derived data. The SPM and FSL statistical analysis object model specifications [14] and examples are available online [15]. Under the auspices of NIDASH, C. Gorgolewski and colleagues have also developed a website for sharing raw statistical maps (NeuroVault.org) which uses NIDM [9].
The INCF task force meetings have encouraged adoption of these resources in various outside projects. We are linking this work with projects that are providing and hosting data, developing lexicons, and generating derived data for different purposes (e.g. data mining). The group includes developers and is in close contact with projects that plan to use these resources, or may do so in the future (e.g., Neurosynth, Neurovault, Brainspell), as well as with developers of integration platforms (e.g. NeuroDebian). Recently, we have worked with R. Poldrack and colleagues on the new version of the OpenfMRI specifications and will be describing this standard in the NIDM-experiment model [17].

Conclusions: The immediate goals of the NIDASH NIDM working group are to 1) refine existing terminologies and object models, 2) continue working with software developers to incorporate NIDM into their software, 3) create similar models for related tools such as multivariate models so that common aspects across software packages can be identified, and 4) facilitate broad and expanded use of the NIDM standard for data querying and data exchange, fostering applications such as meta-analyses.

Standardization within communities are always challenging. The task force has adopted cultural practices of open source software development to carry out the specification of standards for brain imaging data sharing.

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