Application for QIBA Project Funding

Title of Proposal: Quantitative Measures of fMRI Reproducibility for Pre-Surgical Planning – Long Term and Functional Reproducibility		
QIBA Committee/Subgroup: fMRI		
NIBIB Task Number(s) which this project addresses: 1,3,5,6,7,9		
Project Coordinator or Lead Investigator Information		
Last Name: DeYoe	First Name: Edgar	Degree(s): PhD
Institution/Company: Medical College of Wisconsin		

Please check the primary category for this proposal from among the following:

- [x] 1. Identification of Technical Characteristics and Standards
  - [ ] a. Creation and refinement of protocols for image acquisition, analysis, quality control, etc., for specific clinical utility
  - [ ] b. Phantom development and testing
  - [ ] c. Identification and assessment of intra-reader bias (1) and variance across scanners and centers
  - [ ] d. Identification and assessment of inter-reader bias and variance across scanners and centers
  - [ ] e. Other
- [x] 2. Clinical Performance Groundwork
  - [ ] a. Assessment of intra-reader sensitivity and specificity
  - [ ] b. Assessment of inter-reader sensitivity and specificity
  - [ ] c. Other
- [ ] 3. Clinical Efficacy Groundwork
  - [ ] a. Assessment of correlation between new biomarker and 'accepted-as-standard' method
  - [ ] b. Characterization of value in clinical trials
  - [ ] c. Characterization of value in clinical practice
  - [x] d. Development/merger of databases from trials in support of qualification
  - [ ] e. Other
- [x] 4. Resources (money and/or people) committeed from other sources.

Ongoing or completed funded studies will provide datasets that can be used to address issues of reproducibility. Existing personnel are available for study design, data processing/analysis and report generation but will have to be partially re-tasked to support this project.

Long term and Functional Reproducibility (PI: Edgar DeYoe, PhD)

Project Description: This subproject will provide quantitative measures of reproducibility for a unique set of vision- and motor-related fMRI brain maps using a set of data manipulations, computations, and the AMPLE normalization algorithm that will be standardized in coordination with subproject 1. In addition, this subproject will provide a unique analysis of the reproducibility of fMRI functional specificity and will compare reproducibility measures over different time durations both within and across subjects. The results of this study will help address NIBIB Tasks 1, 3, 6, 7, and 9 in the context of fMRI as a biomarker of brain function/dysfunction.

Primary goals and objectives: In this subproject, existing or soon-to-be-acquired data from an ongoing study at the Medical College of Wisconsin will be used in the project proposed here to determine the reproducibility of the location, volume, amplitude and functional specificity (retinotopy) of vision-evoked cortical activation. Reproducibility will be tested using repeated fMRI scans of the same subject both within scan session (3-5 reps) and across scan sessions (3-12 reps) at intervals as short as 24 hours and as long as 1 year. Such data from 8 healthy volunteers will be used to compare differences in reproducibility across subjects and to derive an initial estimate of "normative" reproducibility measures representative of healthy individuals. In addition, the analysis will be repeated for a range of "threshold settings" and also after applying the AMPLE normalization procedure (Voyvodic et al. 2009) in order to verify its efficacy in improving reproducibility across multiple functional systems. Data analyzed in this subproject will also permit detailed measurements of the reproducibility of function-specificity (retinotopy) that is difficult to perform precisely with other datasets. Ongoing data acquisition in the parallel funded project will also yield repeated scans of 6 healthy volunteers on conventional motor mapping paradigms (finger tapping, toe tapping, lip pursing) that can be subjected to the same reproducibility analyses thus yielding matched data from two distinct functional subsystems. These results will be combined with analyses performed in parallel within the ongoing study to yield quantitative estimates of both the reproducibility of the aforementioned measures and the predictive validity of fMRI as an indicator of cortical function/dysfunction. When completed, the datasets used in this subproject will be submitted for inclusion in a communal data repository to be developed and exploited further in year 2.

Deliverables: This project will provide estimates of the mean (and variance) of the location (centroid in Atlas-based coordinates and relative to fiducial sulcal/gyral landmarks), volume, intensity (as % signal change and as T and F statistics), temporal correlation (with the task timing) and functional specificity of visual (preferred stimulus eccentricity and angle) and motor activation (preferred limb). These measures will be provided for both within-session and across-session measures for data sets obtained up to 1 year apart, with and without the use of the AMPLE normalization procedure. Estimates of the variability of those same measures across the sample population as a whole will also be computed.

Timeline:

Months 1-2: Select, test and install standardized computational sequences including the AMPLE algorithm. Data compilation – Many of the existing datasets are archived and will need to be retrieved and reprocessed using up-to-date methods including atlas-based standardization.

Months 3-4: Set up analysis scripts and perform AMPLE normalization and generate temporal stability and other automated QA metrics for all data sets. Develop/test unique repeatability measurements to be performed on the data from this site: repeatability of functional specificity.

Months 5-6: Calculate reproducibility metrics for all repeated scans. Compare reproducibility.

Months 7-8: Analyze variability in functional specificity.

Months 9-10: Final reproducibility analyses and meta-analyses with Voyvodic subproject.

Months 11-12: Prepare reports/papers and integrate results into QIBA profile. Share data sets.