QIBA fMRI Biomarker Committee (BC) Call

Wednesday, November 18, 2020 at 11 a.m. (CT)

Call Summary

In attendance			**RSNA staff**
Jay Pillai, MD (Co-chair)	Cathy Elsinger, PhD	Ho-Ling (Anthony) Liu, PhD	Joe Koudelik
David Soltysik, PhD (Co-chair)	Ping Hou, PhD	Nancy Obuchowski, PhD	Susan Stanfa
Shruti Agarwal, PhD	Ichiro Ikuta, MD, MMSc	James Voyvodic, PhD	

Moderator: Dr. Soltysik

Review of Previous Call Summary

- The 11.04.2020 call summary was approved as presented

Progress Report on Language Reproducibility Study (Dr. Voyvodic)

[Some information taken from Dr. Voyvodic's slide presentation]

- Dr. Voyvodic has been working with Nicolás Sánchez Domínguez, MD from the Universidad del Desarrollo, Santiago, Chile, who is a Visiting Research Scholar in the Department of Radiology at Duke University, specializing in language fMRI
- A language reproducibility database was developed and includes:
    - 628 MRI sessions for 581 different subjects with at least two language task scans each; 544 subjects had only one scan session and 37 were scanned in more than one session
    - 1362 language task scan series: 1088 sentence completion, 192 opposite word generation, 77 passive video and 5 other tasks
- Subject health status: 60 healthy volunteers, 460 cancer patients, 41 epilepsy patients, 14 AVM patients and 6 other patients
- The fMRI task scan acquisition process took 20+ years to develop and involved the use of four clinical-grade MRI scanners (1.5T to 4T) and multiple scan parameters (mostly linear EPI used)
- The fMRI analysis process included the following steps:
    - Identify task "subtype" (stimulus timing info) for each task scan
    - Check alignment of each task scan to anatomical scan
    - Affine register each scan session anatomical to MNI brain
    - Use FSL "FEAT" GLM analysis to create t-value maps: rigid-body motion correction, smoothing and task and motion regressors for GLM
    - Customize automated cluster analysis
    - Generate AMPLE-normalized (half-max > 50%) maps
    - Calculate weighted Laterality Index using AMPLE maps
    - Calculate map activation statistics for anatomical ROIs
- The methodology for the reproducibility analysis was as follows:
    - Only subjects with more than one language fMRI task were included
    - Only one task scan for each subject was designated for use as "reference"
        - Although an arbitrary designation, typically a subjectively "good" map was chosen
        - Other task scans were designated as "comparison"
    - For cluster analyses, corresponding clusters in scan pairs were identified
        - All cluster locations in MNI coordinates for comparison between sessions
        - Clusters were sorted by size in a comparison map
        - Reference clusters were sorted by closeness of centers to comparison clusters

    - Overlap between task pairs for anatomical ROIs and clusters was calculated
    - There was a discussion regarding how magnitude of activation was considered

- Anatomical ROIs
    - Began with using large MNI lobe ROIs based on the brain atlas map (frontal, temporal, parietal)
    - An average language map (mean of all language task maps) was produced
    - New clinical fMRI ROIs were generated (average map >= 1.0, dilated ~3 mm, and masked by left lobe ROIs)
    - Left ROIs were duplicated to right side (focus on four major language areas, two on each side, left/right symmetric)

- Average activation maps were generated for: all language tasks, sentence completion task and opposite word generation task, left/right/non-dominant receptive language, left/right/non-dominant expressive language
- An overview was provided on the creation of the language reproducibility database
    - Start with 380 parameters for each individual map
        - Scan and task parameters (e.g., mag field, scanner, vox dims)
        - QA parameters (e.g., head motion, subjective quality, peak activation)
        - Activation parameters (e.g., location, volume, amplitude in ROIs or clusters)
    - For each "comparison" scan, parameters were added for "reference scan", including 380 scan parameters plus comparison values (e.g., time between scans, ROI, and cluster overlaps)
    - The table was refined to 810 columns (for each of 1365 scan rows)
        - Duplicate (i.e., highly correlated) columns were removed
        - More comparison values (e.g., distance between activations) were added
    - The table was randomly divided in two parts (by subject and age) for testing, using Part A to identify trends and Part B to test consistency of trends
    - Database table included links to original images and activation maps

- Due to detection of many bad scans during the first round of analysis (e.g., activation below a minimal cut off value), minimal quality criteria were developed and used in the second round
- Now that all of the results are available, outliers found during the analysis will be investigated to help develop a quality threshold
- Discussion on this topic will be continued during the December 16 fMRI BC call since this work will likely result in development of claim language for Profile v2.0

Next call: Wednesday, December 16, 2020 at 11 a.m. CT (1st & 3rd weeks of each month)
