QIBA fMRI Reproducibility Subcommittee Update
January 11, 2011
11 am CST

Call Summary

In attendance:		**RSNA:**
James T. Voyvodic, PhD (Chair)	Jay J. Pillai, MD	Julie Lisiecki
Ted DeYoe, PhD	Domenico Zaca, PhD	Madeleine McCoy

Discussion of Neurovascular Uncoupling

- Dr. DeYoe discussed function field maps and using a dual mapping approach
  Test using perimetry map: overlay of visual field mapping with fMRI data on top
  - Subject-driven activity mapping
  - Independent method to determine if BOLD signal is coming through

- **CO_2 challenge:**
  - Uses whole brain map; Looks for BOLD responsiveness and areas where it is missing
  - Overall blood-flow measures mechanistic neurovascular uncoupling (NVU)
    - Monitors any disruptions to brain activity that could occur
  - Neuro-response to wherever the BOLD signal is recorded
    - Coupling nerve signal to hemodynamic signal
    - Testing vascular compliance and effects of CO_2 on vascular control/ smooth muscle systems
  - Need to use some measure to identify high-risk NVU; functional field map - more comprehensive
  - CO_2 varies from moment to moment; more sensitive to change

- **Quality-Control Cross-Check**:
- Breath-hold vs. functional field map
  - Could be used to cross-check one another/ validate other approaches
  - Any method that claims to detect NVU must be validated and proven to be reproducible

Gary Glover, Stanford University School of Medicine, Radiological Sciences Laboratory

- Dr. Glover is studying respiratory variations; regressors in fMRI analysis
- Research interests encompass the physics and mathematics of imaging with MRI
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Breath-hold Data (Dr. Pillai)

- Not much recorded respiration data; must rely on tasks (visually observe)
- Use breath-hold data; train patients *before* they go into the scanner
  - Patients are coached to breathe in and exhale at correct times
- Data does not revolve around patient compliance; Use observation of the rise and fall of the chest wall
- There is no reliable PCO_2 or CO_2 data with quantitative measurements of what is being inhaled
  - Some groups try to measure with CO_2 challenge
  - This "challenge" is not suitable for patients with brain tumors or those who had brain surgery – could pose risk
  - Danger exists in regard to patients with different inter-cranial pressure (rise in CO2) inside
    - Has to do with how long the breath hold periods are
    - Using 16 second intervals is OK; (optimal at 15-20 seconds); dangerous over 30 seconds

Pulse-Oxygen Signal

- Some patients are CO_2 retainers. Knowing how much CO_2 or O_2a patient has will not make a difference in the data
- Measuring levels of CO_2 in the blood would require a blood draw
  - This is not a trivial matter; it is very painful for this particular test and best to avoid
  - Instead – look for gaps in the map – amplitude gap response
- Colleague of Dr. Pillai is using a 'respirac' device – and has found no advantage in controlled CO_2 except for:
  1. Quantitation (bi-hemispheric changes with respect to normative data)
  2. Looking for relative changes in normal surrounding cortex and white matter
  3. For long-term study/ therapeutic intervention/ tracking changes

Optimal Display:

- Analogous to BOLD activation task

- Need to individually threshold each of the maps
    - Look for disruptions in cortical matter
    - Look for a normalization procedure that does not remove the signal
- Suggested reference for review: Thomason, et al,(HBM, 2007) – theory shared by Dr. Zaca (HBM '07 28: 59-68).
    - Signal change – rCBV vs. CVR BOLD % signal change
- Want normalization method that can be relied upon with uncoupling in the right place to cross-validate.
    - Perfusion gives good sense where there are vascular problems; however, questions remain about NVU
    - Breath hold CVR may be more sensitive than BOLD in some cases
    - Still looking for measure that is independent of variables

Closing thoughts: Any method that claims to detect NVU must be validated and proven to be reproducible. There are no obvious solutions at this time.

Next Call for fMRI Reproducibility: Tuesday, **February 1, 2011, 11 am CST**.