Functional MRI
for neurosurgical planning

fMRI scans need special hardware and software so they are only performed in the DMP

Usually they are done on scanner 1 (Siemens 3T)
They can also be done on scanner 4 (same as DMP1)

If necessary, fMRI can be done on DMP3 (GE 1.5T)
(but this is much more complicated!)

fMRI scans will usually be assisted by Jim Voyvodic, either in person or by phone

Steps particularly important for fMRI scanning are in red
Recent changes to MRI protocol are shown in green

Special hardware for fMRI

TV screen in scanner room
  Put near scanner and centered

Power supply with on/off switch

TV control box on console desk
  Has audio and video cables from PC

(same setup on DMP1 and DMP4, not DMP3)

Training patient is <u>very</u> important

Use fMRI training tablet to show patient the tasks as part of their screening.
   (Note: If tablet doesn't work you can use Pin station
      go to: hawking.biac.duke.edu/fMRI
      and use "fMRI Links" button to find training videos online)

Make sure they can read (use MR-compatible glasses if needed)

Emphasize that the speech tasks are silent, (they say the sentence in their head, not out loud)

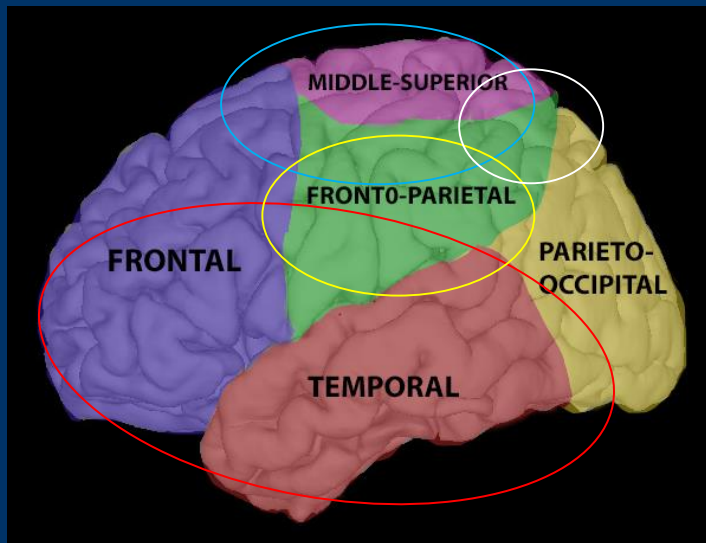Watch them move when practicing the hand, foot, or mouth movement tasks

May need to change a task if they can't do it

fMRI tasks

Patient performs simple tasks during functional scans.
Which tasks depend on:
    1) where surgery will be in the brain

Frontal or Temporal (red ellipse)
    main concern is speech

Superior or Parietal, main concern
    is usually motor (blue=hands,
    white=feet, yellow=mouth)
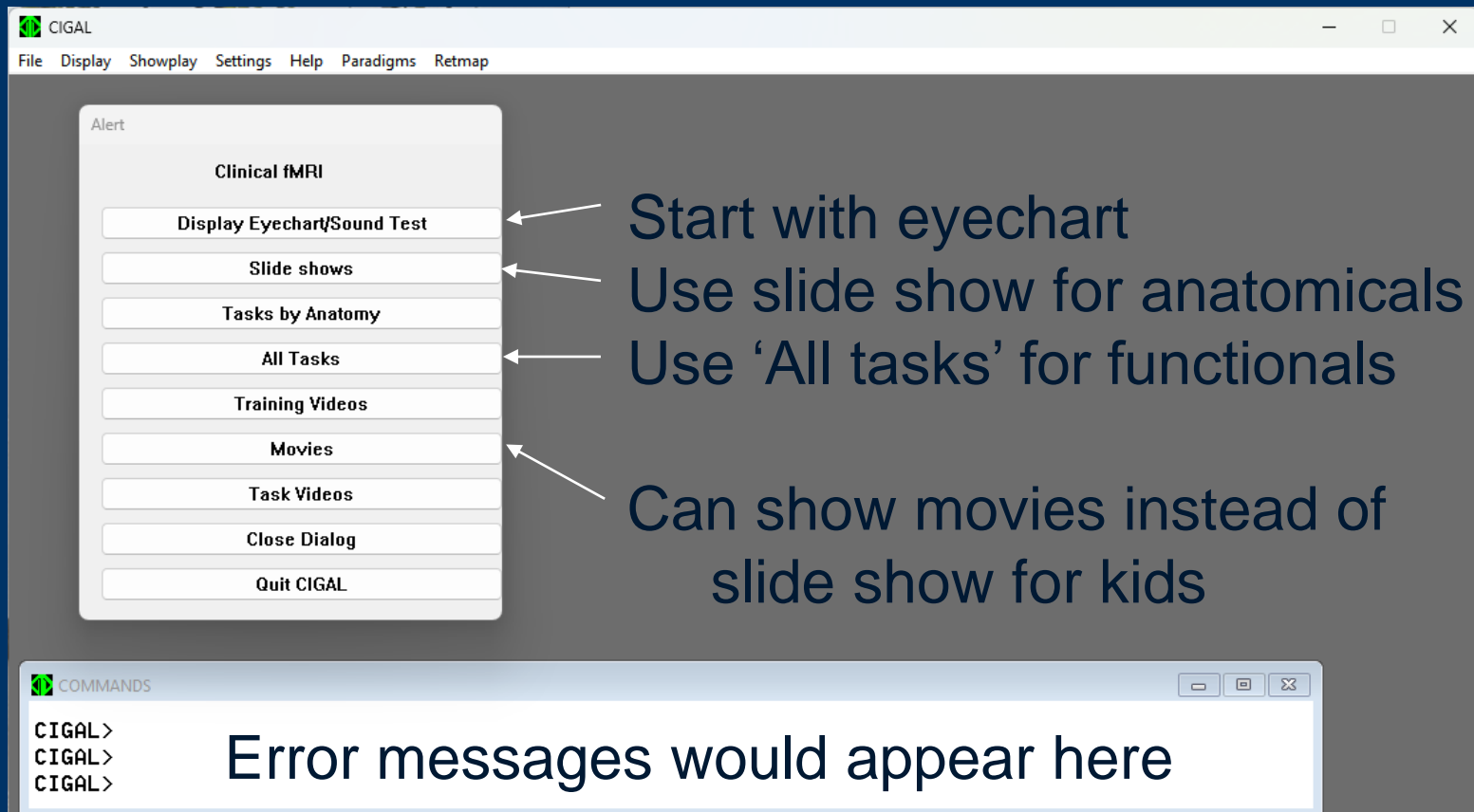
2) what the patient is able to do
    If they can't read, use audio tasks for speech
    If they can't move, someone may help move hands or feet

You will usually be told which specific tasks to run

Use "CIGAL" on PC to run tasks

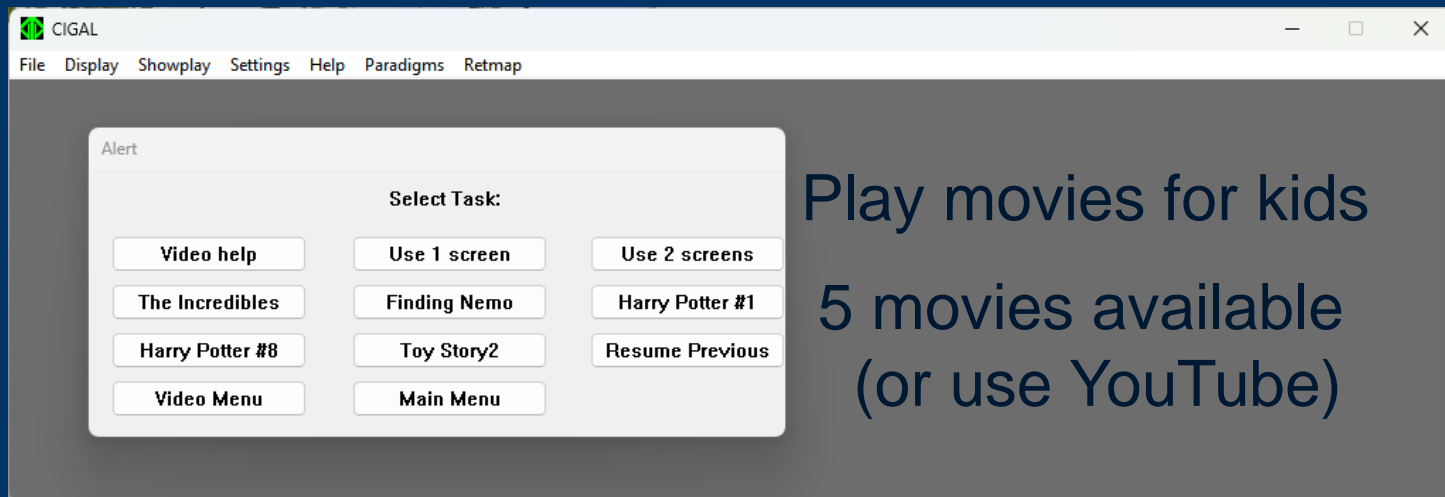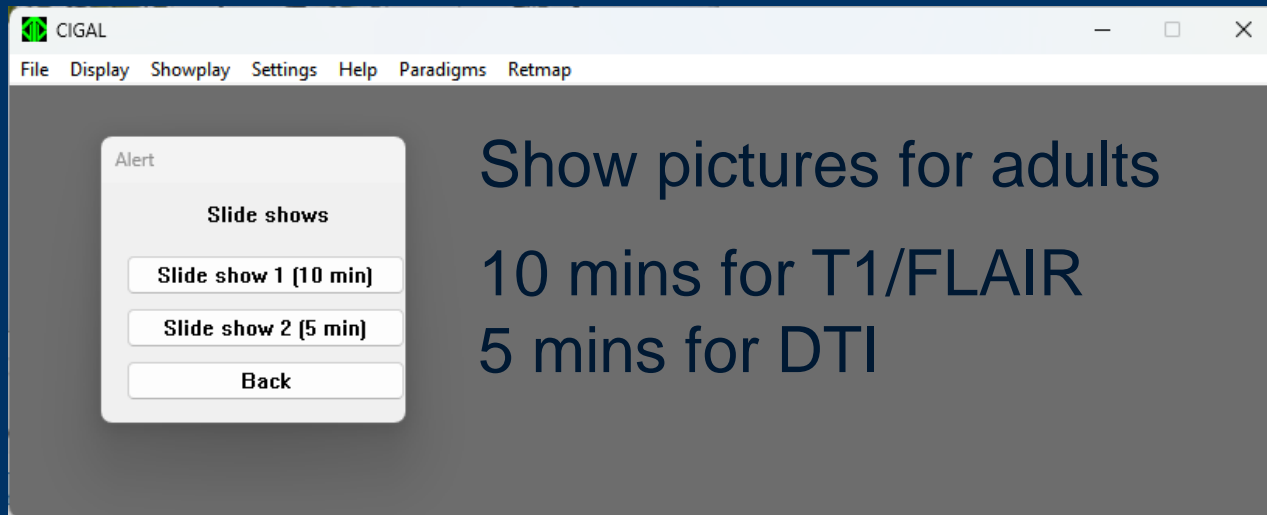Run CIGAL icon on the PC desktop ⟶

Start with eyechart
Use slide show for anatomicals
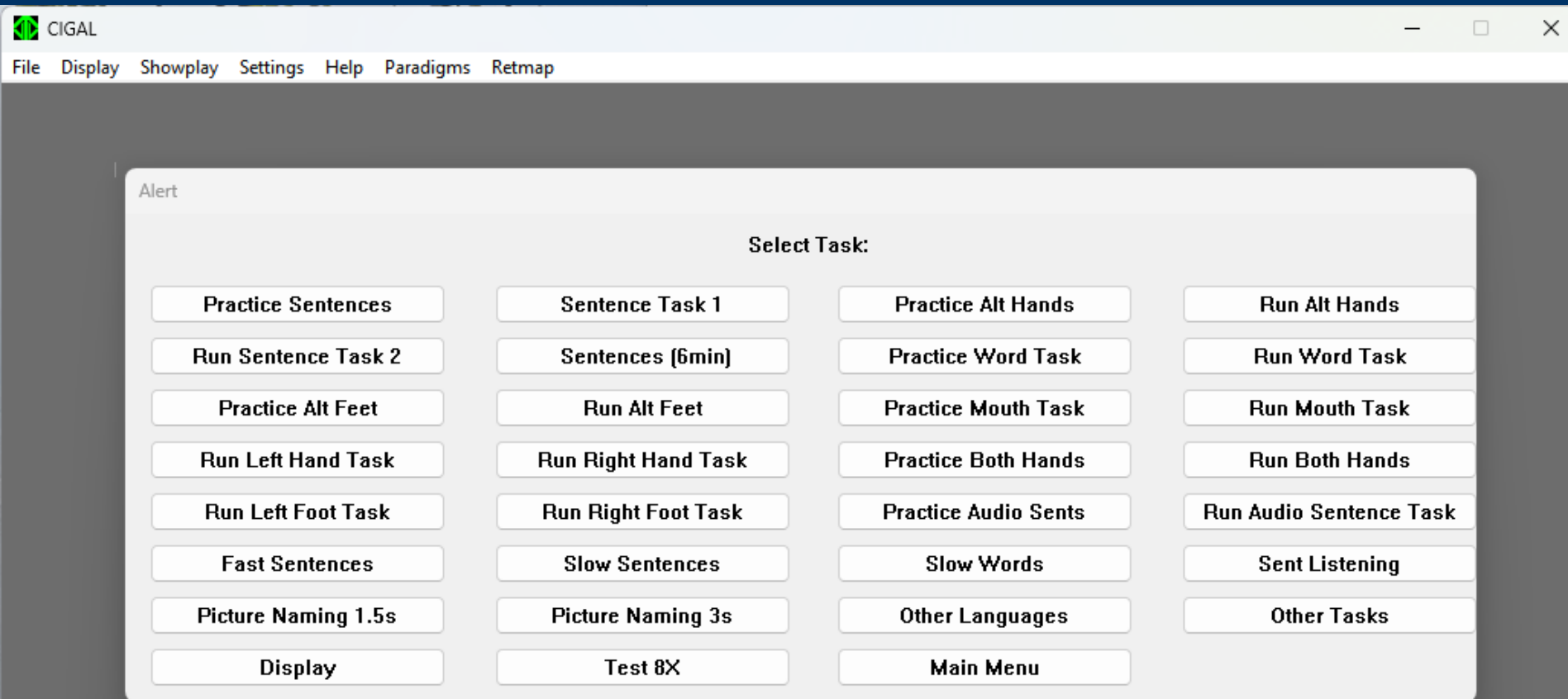Use 'All tasks' for functionals

Can show movies instead of slide show for kids

Error messages would appear here

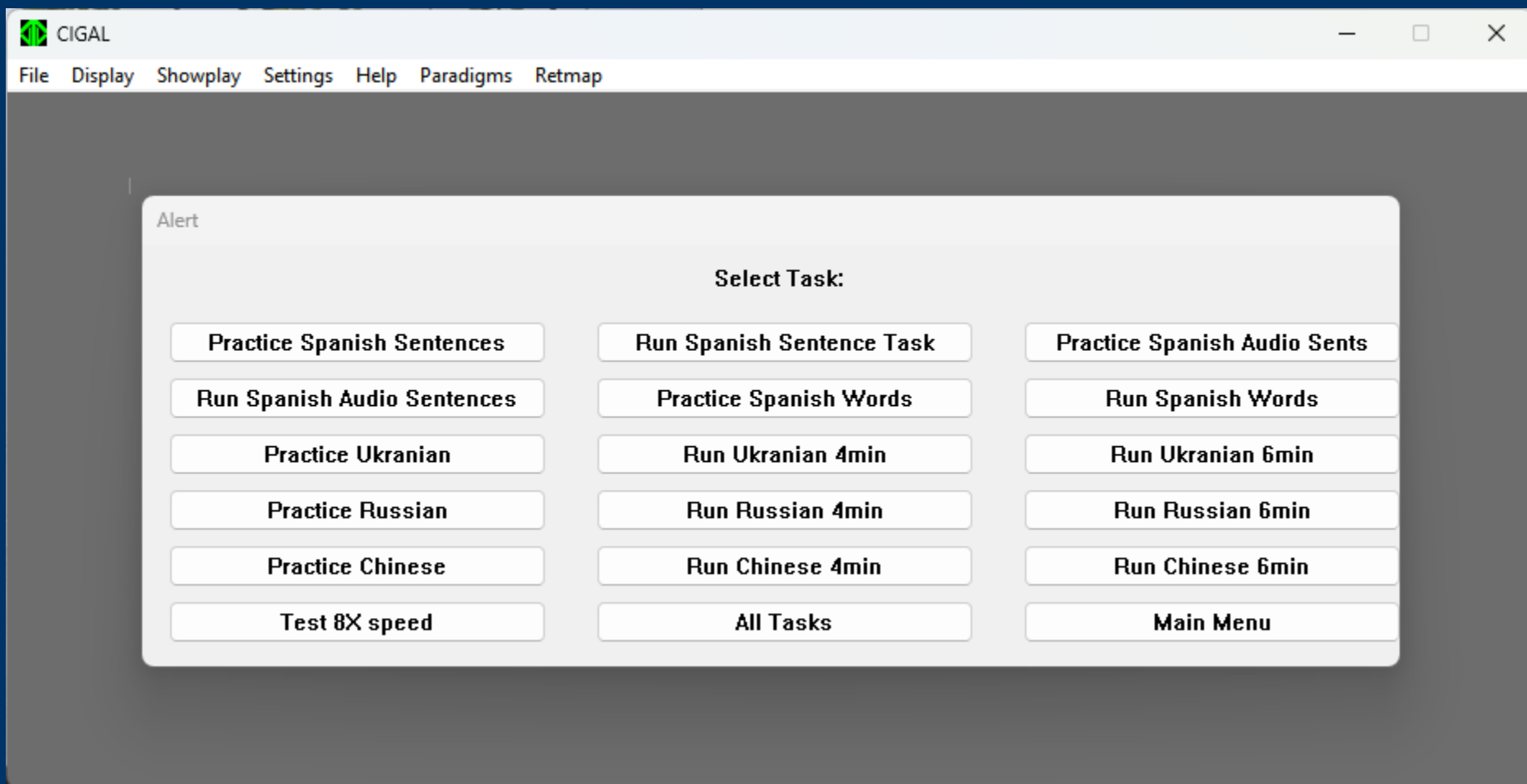# Put on entertainment when not running tasks

Show pictures for adults

10 mins for T1/FLAIR
5 mins for DTI

Play movies for kids

5 movies available
(or use YouTube)

Use "All tasks" for running standard tasks

CIGAL

File   Display   Showplay   Settings   Help   Paradigms   Retmap

Alert

Select Task:

Practice Sentences	Sentence Task 1	Practice Alt Hands	Run Alt Hands
Run Sentence Task 2	Sentences (6min)	Practice Word Task	Run Word Task
Practice Alt Feet	Run Alt Feet	Practice Mouth Task	Run Mouth Task
Run Left Hand Task	Run Right Hand Task	Practice Both Hands	Run Both Hands
Run Left Foot Task	Run Right Foot Task	Practice Audio Sents	Run Audio Sentence Task
Fast Sentences	Slow Sentences	Slow Words	Sent Listening
Picture Naming 1.5s	Picture Naming 3s	Other Languages	Other Tasks
Display	Test 8X	Main Menu	

For each new task, run 'Practice' then 'Task'

Standard tasks: Sentences, Alt Hands, Sentences 2 (for speech)
or: Sentences, Alt Hands, Alt feet   (for motor)

Use "Other Languages" tab for non-English or bilingual patients

CIGAL

File Display Showplay Settings Help Paradigms Retmap

Alert

Select Task:

Practice Spanish Sentences	Run Spanish Sentence Task	Practice Spanish Audio Sents
Run Spanish Audio Sentences	Practice Spanish Words	Run Spanish Words
Practice Ukranian	Run Ukranian 4min	Run Ukranian 6min
Practice Russian	Run Russian 4min	Run Russian 6min
Practice Chinese	Run Chinese 4min	Run Chinese 6min
Test 8X speed	All Tasks	Main Menu

New languages can be added easily now so the list may change

The "Other Tasks" tab provides some extra task options (eg kids or special needs patients)
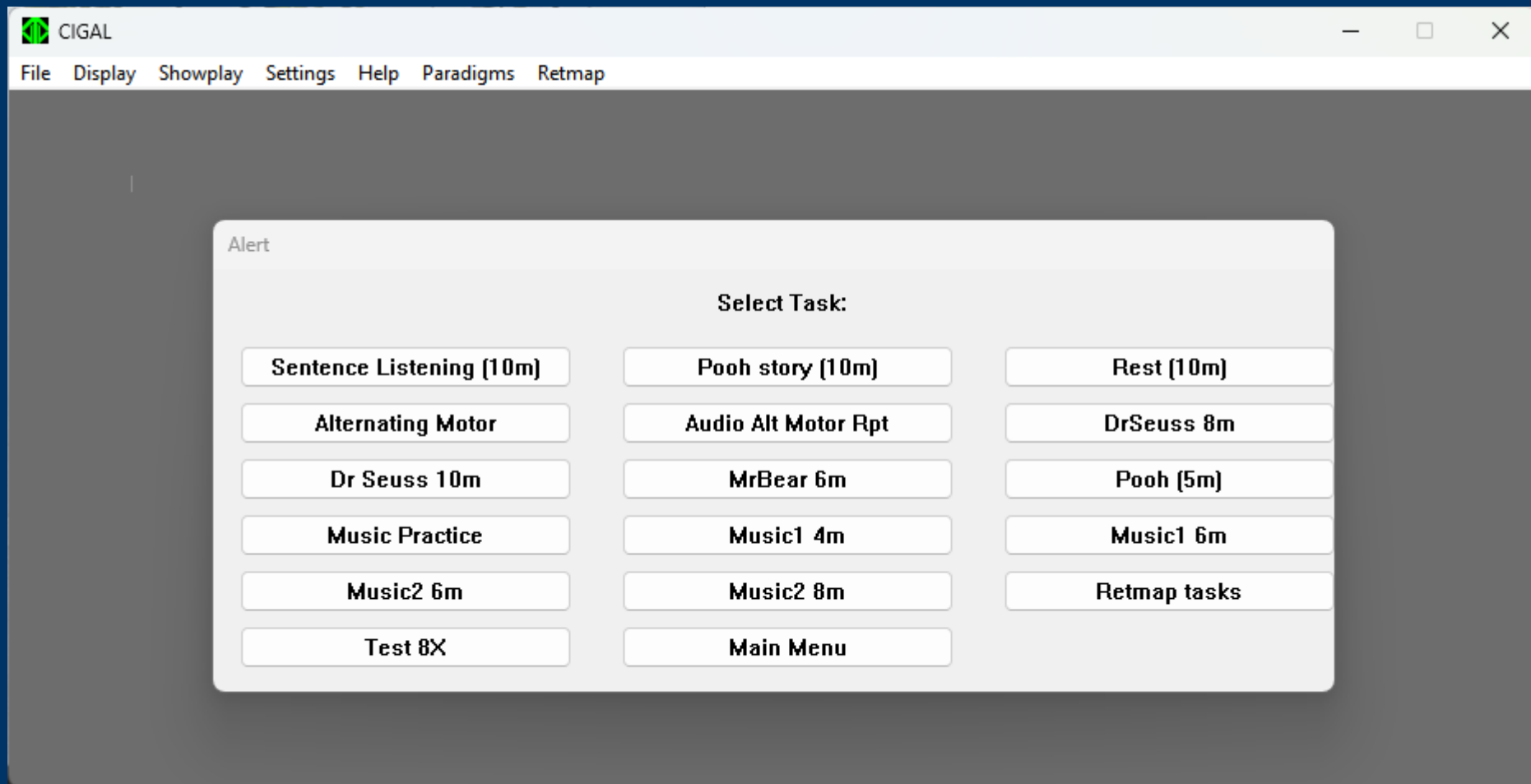
fMRI scanning protocol

Always includes:
    Whole brain T1 (3D: 1x1x1mm voxels) – do not oblique
    Whole brain FLAIR (3D: 1x1x1mm voxels)
    High-order shim scan (~5s – Do not skip!)
    3-4 fMRI task scans (usually 4min each):
        Language mapping (usually 'sentence' tasks)
        Motor mapping (hand, foot, or mouth tasks)
    Diffusion tensor imaging (~4min) – do not oblique

Optionally:
    Whole brain T2
    Post-contrast T1

Siemens protocol now starts by choosing standard or T/R coil

Scan slice prescriptions

Anatomical scans (T1, FLAIR, post-C)
   are whole brain – do not oblique

Shim scan Rx set for functional tasks
   Should cover most of the brain
      From top of cerebrum to near bottom of temporal lobe
   Does not need to include cerebellum
   Must include lesion if present

Do not add slices!
Can tilt shim in sagittal plane,
   but not in axial or coronal
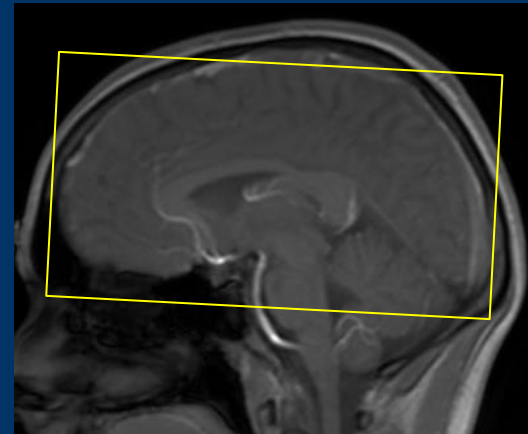
fMRI scans and tasks must be synchronized

Make sure scan description matches task
   (Names don't need to match exactly, but close)
Task series usually only differ in the names
    Most are 4 mins but some are longer
    Make sure scan duration matches task duration
      (except 6s extra on scan)

Prep the scan series
Select and start task on PC
    Task waits for scanner
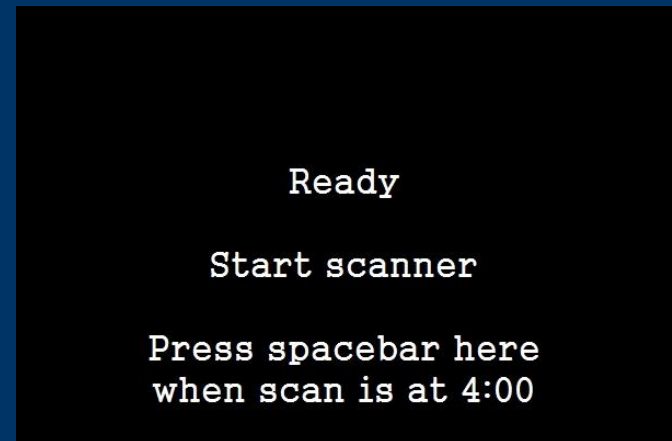
Start scan, then start task
(If more than 1sec error must stop and do again)

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Ready

Start scanner

Press spacebar here
when scan is at 4:00
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While scanning

Look at scanner to see:
Is the task on the patient's screen?
Is their screen image left-right flipped (should be)?
For motor tasks, is the patient moving?

Use scanner in-line display to see brain activity

Should see clusters of yellow
 dots indicating active areas

No dots, maybe sleeping
Too many dots, maybe head motion
These are hard to interpret
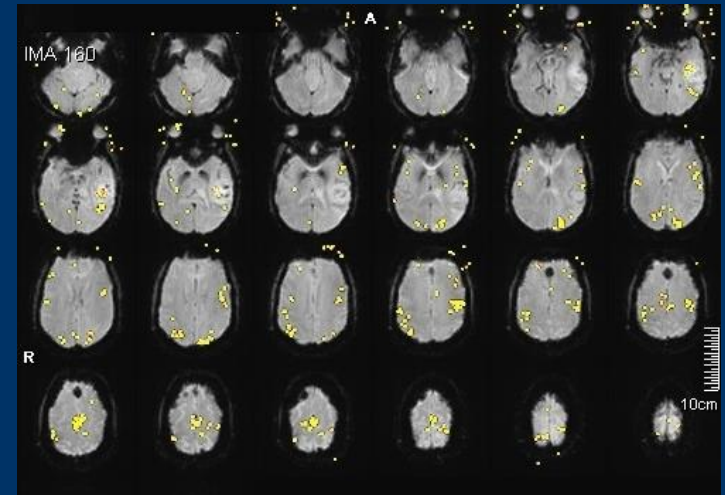
After scanning

Send images to PACS asap after each series

For anatomical scans can omit 'ND' series if present
  (ND is 'not distortion corrected')

For shim, just send the first series ('shim')

For fMRI tasks, send the task series (same name as scan)
  and the 'GLM Eva' series (the Siemens activation map)

For DTI, send all series

fMRI quality control website

Open a web browser (on pin station) and go to:

   hawking.biac.duke.edu/fmri

Click 'Status' to see if website processing is working

Click Login, then
   User: 'mrtech'
   Enter password
   Add your name

A list of exams will appear
   with most recent
   exam first.
D=day of month
M72=72yo male
Click your exam
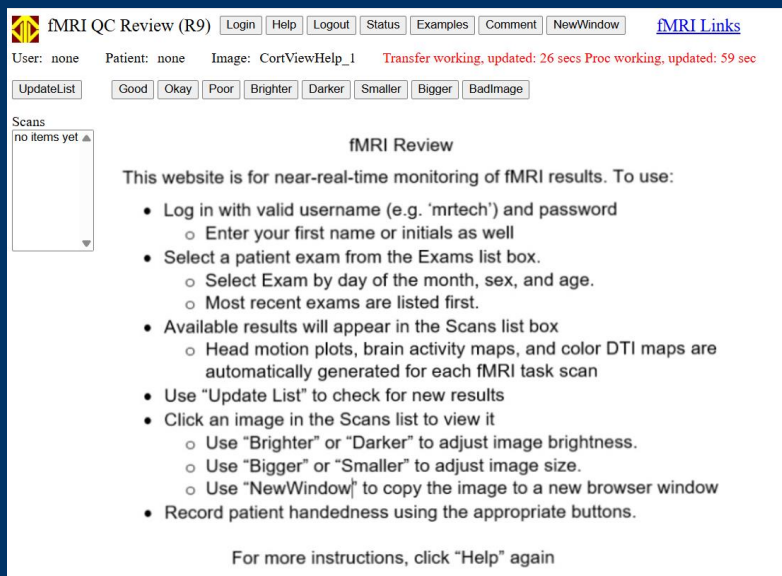
Use the 'Help' and 'Examples' buttons to learn more.
Click on "fMRI Links" for related web sites.

"MR Functional Brain" protocol images sent to PACS will be automatically post-processed and appear on this website (~3 mins after sending to PACS)

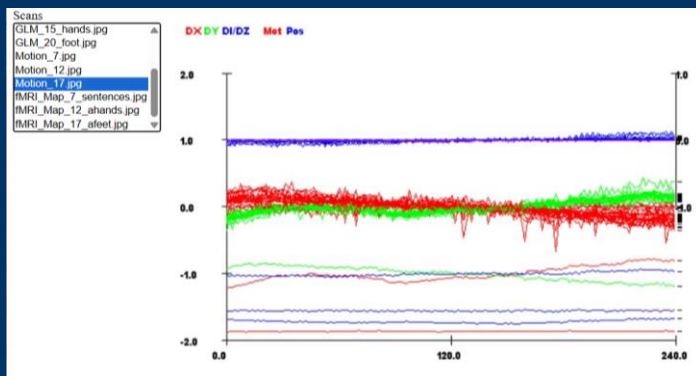# When scans appear, click the name to see the images

Example of a good sentence task map
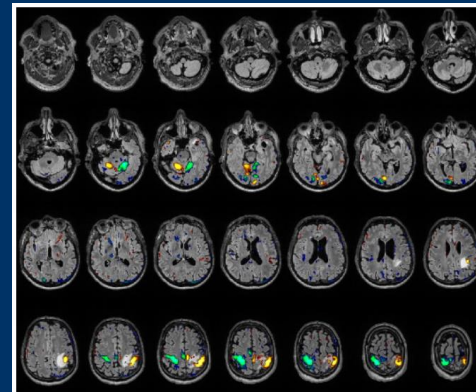

Choose image from scan list
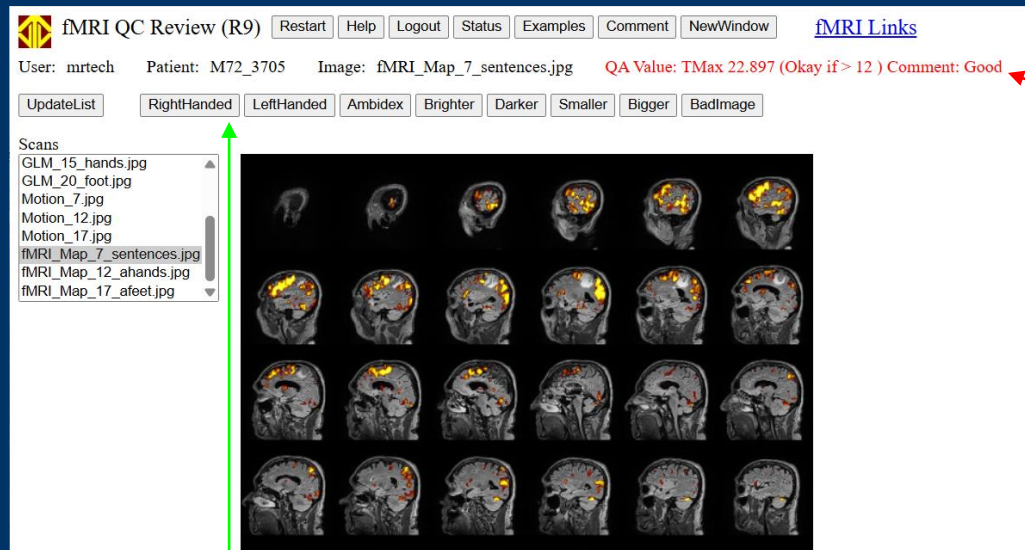
Jim Voyvodic will usually be on-line using the same website and will add QA comments (good/okay/poor) for fMRI maps

Be sure to ask patient if left or right handed and enter on the website

Sample okay head motion plot. (see 'Examples' for more info)

Example of a good hand motor map

DTI

Tell patient they are done with tasks. Just lie still for this one.
Can show slide show or video on TV to help them stay still.

After scanning, check the color FA map series image quality
on the scanner (takes too long to wait for QC web-site).

You should see red, green, and blue brain connection pathways
like this   (it should not all look like this)
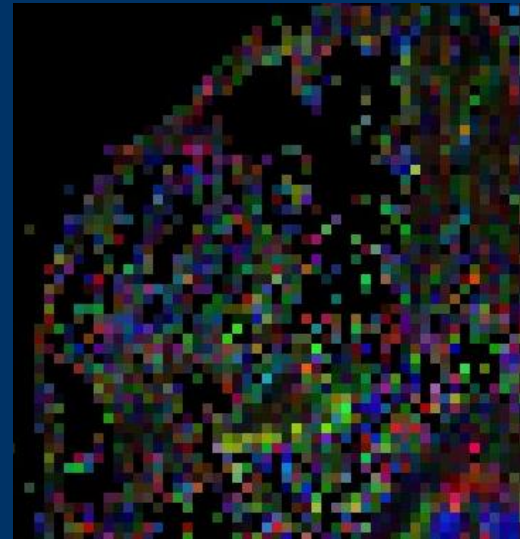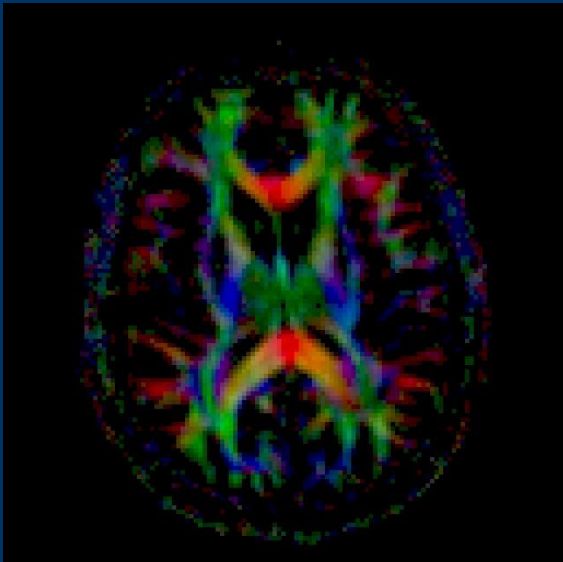
Example of fMRI results after post-processing
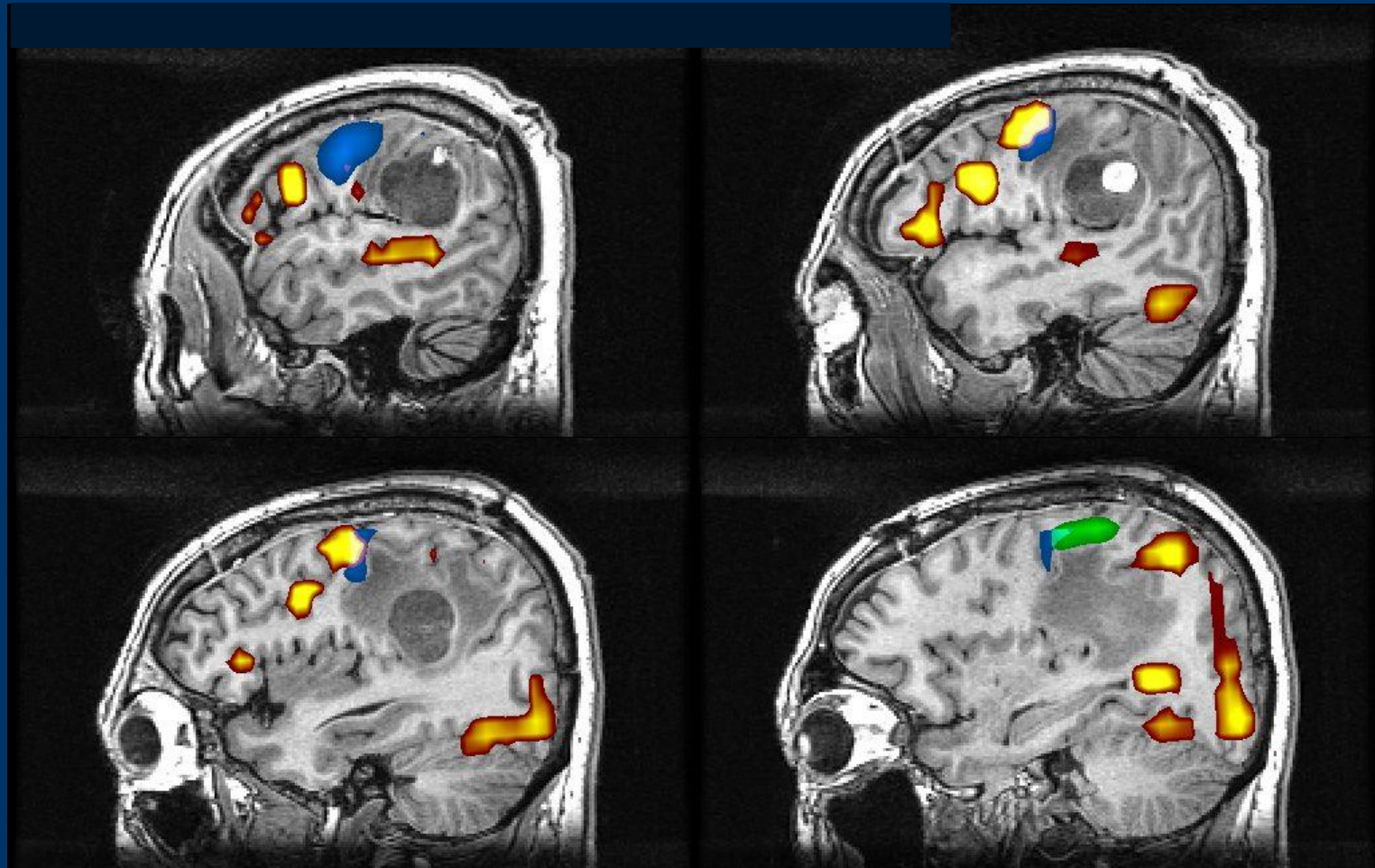
Yellow is sentence task, Green is hands task, Blue is mouth task

This is what neuroradiologists and neurosurgeons see