MRI ADNI Steering committee – April 2017

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outline

- ADNI 3 protocol – description, rationale
- Changes from ADNI 2 to ADNI 3

ADNI 3 protocol

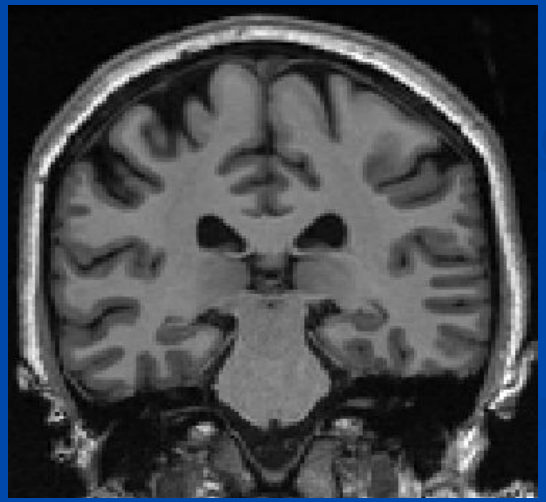
all 3T, all 8 sequences in all subjects (where possible)

- 3D T1 volume
- 3D FLAIR
- T2* GRE
- ASL – 3 possible sequences depending on model
- TF-fMRI - advanced and basic versions
- Field map
- dMRI - advanced and basic versions
- Coronal high resolution T2

ADNI 3 MRI protocol rationale

3D T1

- core for multi modality comparisons
- required for standard of care local clinical reads
- precise longitudinal measure

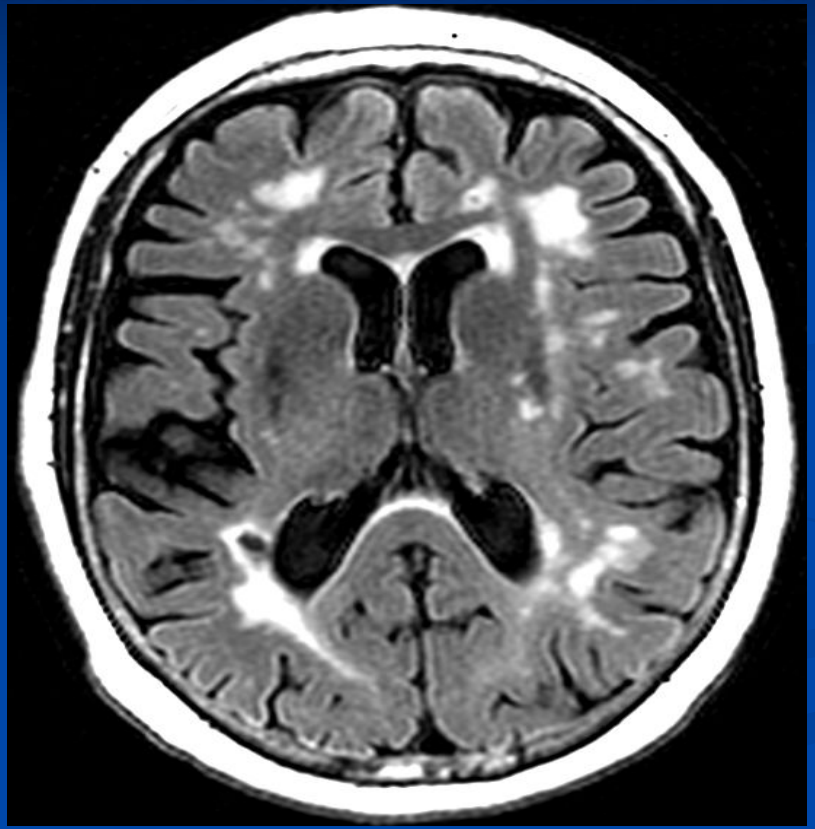


3D T1: Change from ADNI 2 to 3

- ADNI 2
  - Unaccelerated and 2x accelerated
  - all platforms
- ADNI 3
  - 2x accelerated
  - All platforms
  - Slight resolution change – 1mm cubed

ADNI 3 MRI protocol rationale

FLAIR: CV disease detection, safety standard for trials, required for standard of care local clinical reads

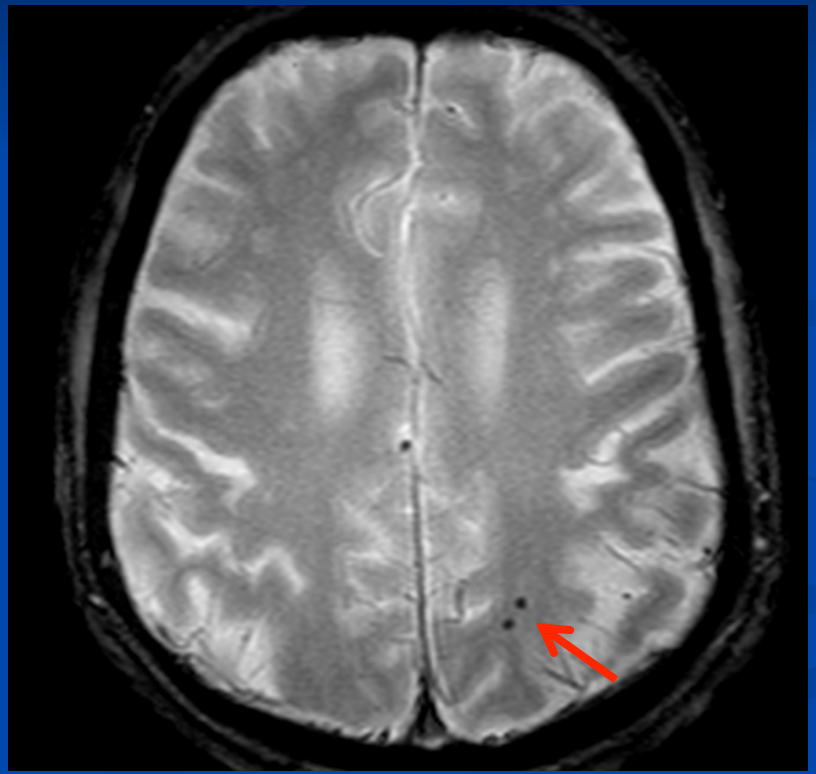


FLAIR: Change from ADNI 2 to 3

- ADNI 2
  - all platforms
  - 2D FLAIR
  - 1x1x5 mm
- ADNI 3
  - all platforms
  - 3D FLAIR
  - 1x1x2 mm

ADNI 3 MRI protocol rationale

T2*GRE: MCB detection, safety standard for trials, required for standard of care local clinical reads

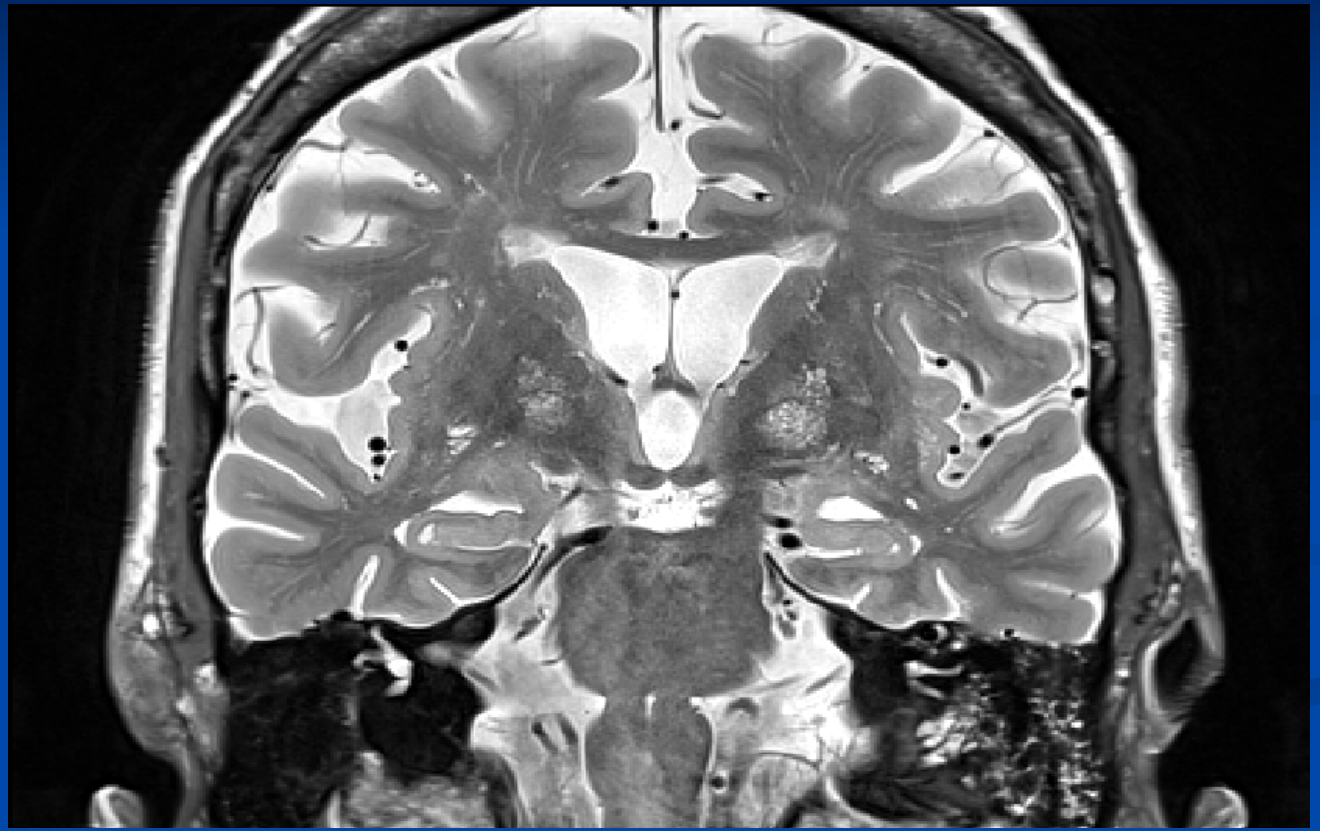


T2*GRE: Change from ADNI 2 to 3

- None
- All platforms

ADNI 3 MRI protocol rationale

Coronal hi res T2: Hippocampal subfields



Hi res coronal: Change from ADNI 2 to 3

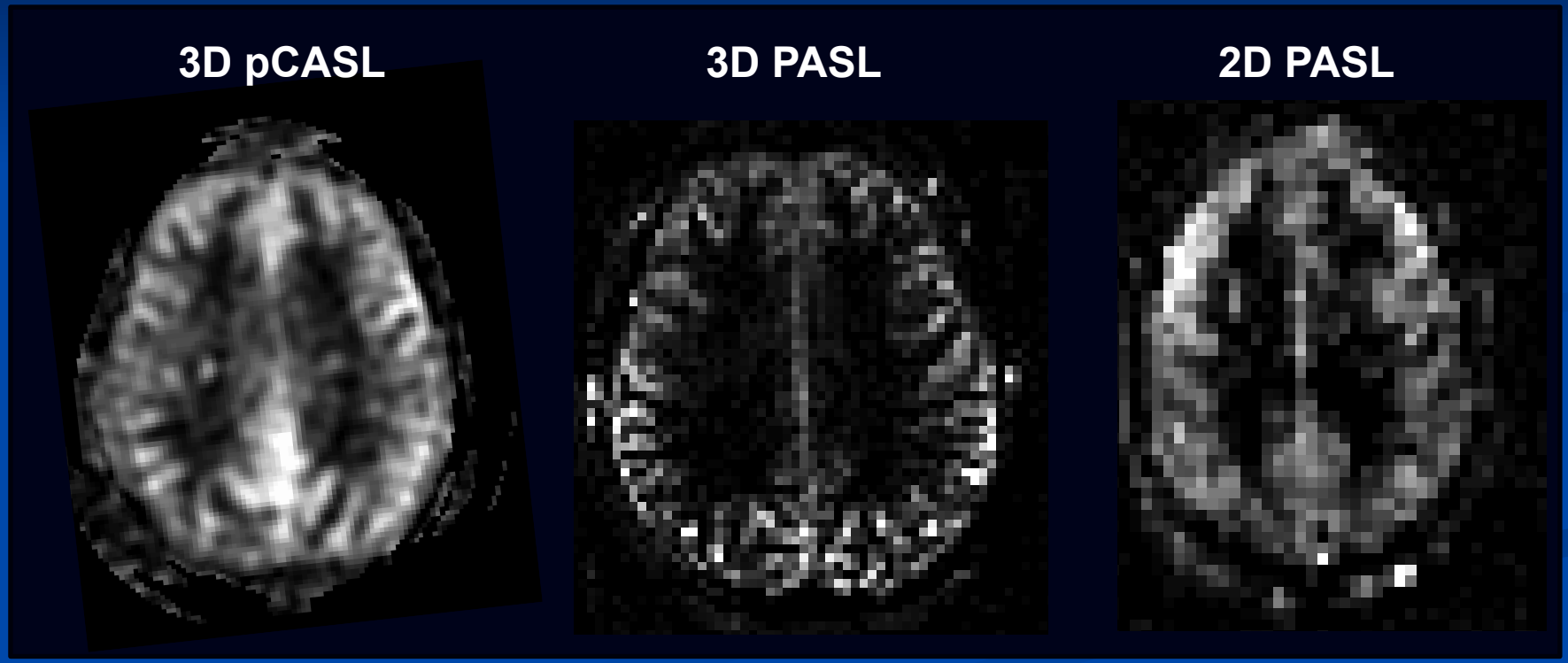
- ADNI 2
  - One vendor
- ADNI 3
  - Minor tune up to parameters
  - all platforms

ADNI 3 MRI protocol rationale

ASL, dMRI, TF-fMRI

- technical improvements since ADNI 2 – esp. SMS
- Opportunity to see if advanced methods cross the diagnostic "value" threshold in clinical trials environment
- Without change, 2009 methods (ADNI 2) would be carried to 2022
  - do not want methods to be outmoded by end of ADNI 3 grant cycle

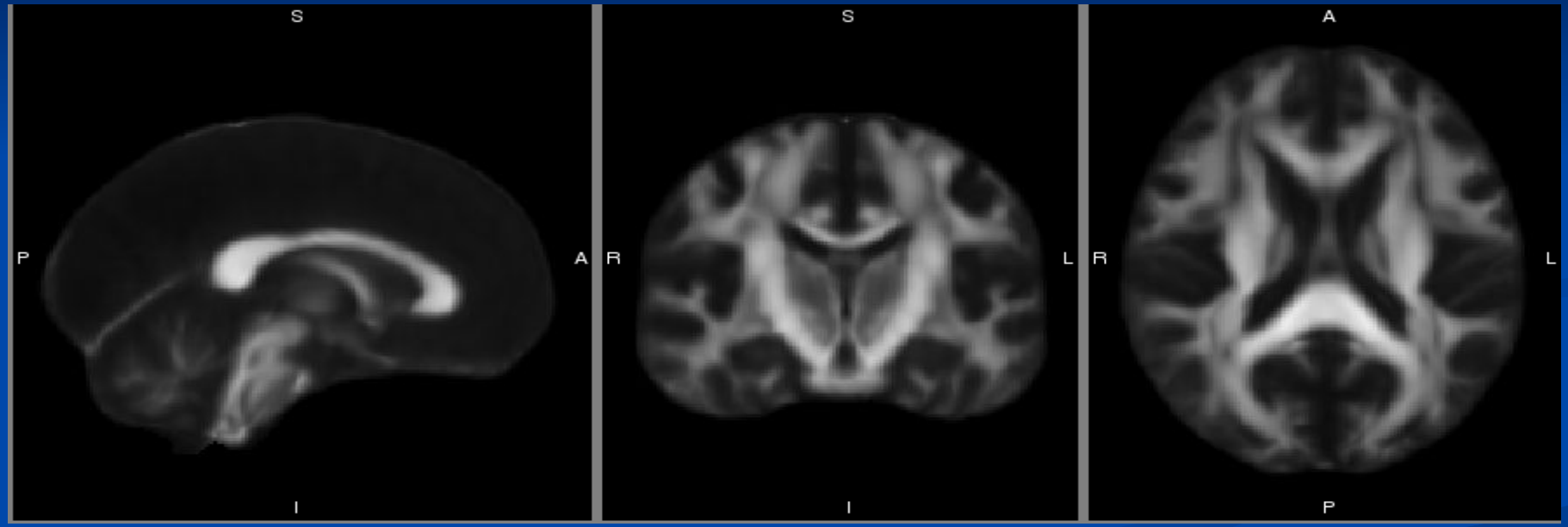
ASL



ASL: Change from ADNI 2 to 3

- ADNI 2
  - One vendor – Siemens 2D PASL
- ADNI 3
  - all platforms (but must have license)
  - 3D pCASL (11): GE >15
  - 3D PASL (18): Siemens VD & VE
  - 2D PASL (26): Siemens VB, Philips 3X and 5.1
  - Upgrade schedule
    - Philips 5.3 – 3D pCASL – initial roll out starting
    - Siemens 3D pCASL ?

dMRI – FA group map, ADNI CN and AD



dMRI : change from ADNI 2 to 3

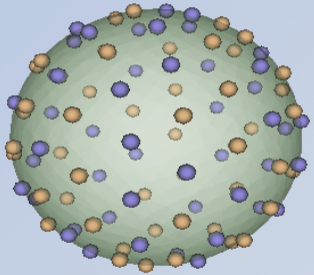
- ADNI 2 - single vendor, single b=1000 shell
- ADNI 3 – all platforms, advanced or basic
- basic – single b=1000 shell
- advanced, HCP-like: b=500, 1000, 2000; 3X SMS, 6/8 PF
  - Better FA/MD
  - Enable NODDI, tractography, cortical hub to hub connectivity , multi tissue compartments
- Custom gradient direction set - downloadable
- Compatibility – derive equivalent of basic single b=1000 shell in every subject at no time penalty

ADNI3's Diffusion Gradient Shells

Basic* (no SMS acceleration)

*GE Basic also has 48 b=1000, but in a different, still spherical, arrangement.

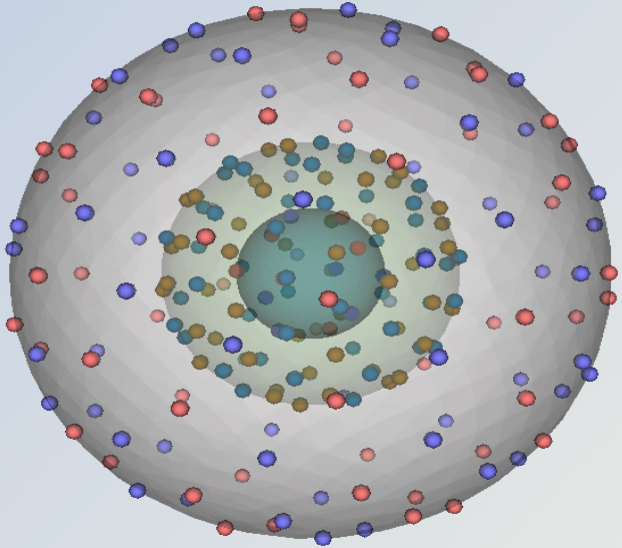
7 b = 0 + 48 b = 1000



TE = 56 ms,
TR = 8000 ms,
Scan duration = 7:05

Advanced (with SMS acceleration)

13 b = 0 + 6 b = 500 + 48 b = 1000 + 60 b = 2000

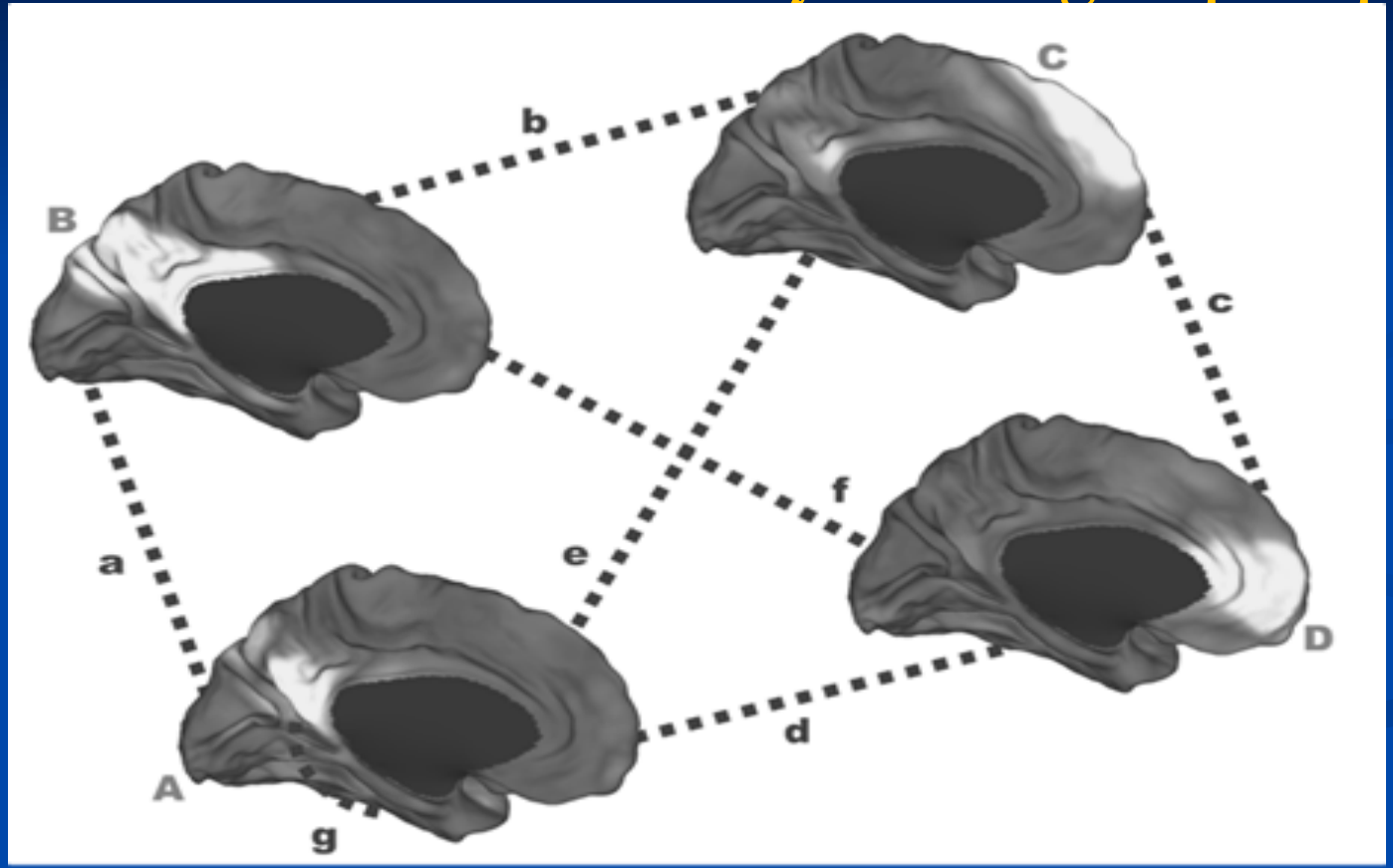


TE = 71ms,
TR = 3300 ms,
Scan duration = 7:20

The given times are for a Siemens Prisma, and will vary for different scanner models. The basic set is included in the advanced one, to facilitate comparison between basic and advanced scans.

TF-fMRI

Default Mode Network subsystems - group map



TF-fMRI: change from ADNI 2 to 3

- ADNI 2 – single vendor, ~ 3 sec TR
- ADNI 3 – all platforms, advanced or basic
  - basic – 10 minute, ~3 sec TR
  - advanced, HCP-like – 10 min, 600msTR, 8x SMS
    - More precise measure of time series (temporal resolution)
    - Less noisy node to node, ICA, graph theory measures
    - Time varying connectivity metrics
  - Compatibly advanced and basic → derived basic equivalent

dMRI and TF-fMRI – requirements for advanced

- multi band (SMS)
  - Siemens product VE11C plus SMS license
  - Philips 5.3 – initial roll out
  - GE DV 2.6 – 2017, only dMRI, fMRI SMS?
- Consequently, almost all ADNI 3 have started with basic and sites will step up to advanced as systems are upgraded

MR measures – funded investigators

- Structural MRI measures
  - BSI – UCL (Fox)
  - Freesurfer – SFVA (Tosun)
  - TBM – USC (Thompson)
  - TBM-Syn – Mayo ('Jack')
- Cerebrovascuar disease – UC Davis (DeCarli)
- AIRA H (MCB) – Mayo ('Jack')
- ASL – SFVA (Tosun)
- TF-fMRI – Mayo ('Jack')
- dMRI - USC (Thompson); DeCarli; Fox
- Hipp subfields – Penn (Paul Yushkevich)

ADNI 2 to 3 consistency: rollover subjects go to ADNI 3 protocol – i.e. no parallel ADNI 2 protocol for roll overs

- 3D T1 volume - consistent
- T2*GRE - consistent
- 3D FLAIR - break
- ASL - break
- TF-fMRI and dMRI
  - basic & derived - consistent
  - advanced break
- Coronal high res T2 - consistent

ADNI 3 MR certifications as of 4/17

- 56/57 sites sent protocol
- x have been certified
  - X basic
  - 2 advanced

Link to protocol PDFs: http://adni.loni.usc.edu/methods/documents/mri-protocols/

MRI Scanner Protocols

The MRI Core developed structural MRI protocols and an MRI phantom for calibration. MRI scanner protocols are available for GE, Philips and Siemens devices.

- MRI Analysis
- MRI Acquisition
- MRI Image Data

MRI Scanner Protocols from recent models of General Electric (GE) Healthcare, Philips Medical Systems, and Siemens Medical Solutions are supported. The tables below contain active links to PDF files of scanner protocols, click to download.

ADNI 3

General Electric (GE) Healthcare	Philips Medical Systems	Siemens Medical Solutions
• GE 24x • GE 25x • GE Widebore 25x	• Philips R3 • Philips R5	• Siemens 20VB17 • Siemens Prisma D13 • Siemens Skyra E11