

# TOP-NT NEUROIMAGING WORKGROUP

*Marcelo Febo, PhD*

*Associate Professor, Depts. Psychiatry and Neuroscience*

*Director of Preclinical Imaging, McKnight Brain Institute*

*Advanced Magnetic Resonance Imaging & Spectroscopy (AMRIS) Facility*

*College of Medicine, University of Florida*

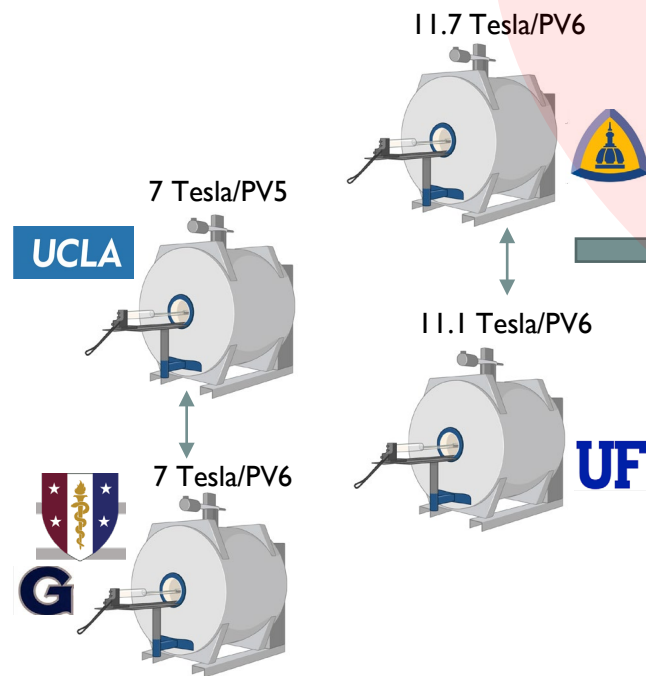
# PRECLINICAL NEUROIMAGING HARMONIZATION SUBGROUP

- Highly collaborative, multi-site team-based effort to harmonize acquisition protocols at different field strengths (7 and 11.7 Tesla), image processing, and assemble common data elements (CDE) to facilitate the reporting of imaging data:
  - The Neuroimaging team: Neil G. Harris (UCLA), Jinyuan Zhou (JHU), Alexandru Korotcov (USUHS), Christopher Albanese, Mark Burns and Xiong Jiang (Georgetown), Marcelo Febo (UF)
- Guided (and mandated) by NIH/NINDS at every step of the way
- Standardizing protocols for **image acquisition**
- Standardizing image **post-processing**, **data extraction** from images, and **statistical analyses**
  - **Statistical parametric mapping** – TBI scans thresholded by **z normalized sham group**
- **Reporting with CDEs** – working with odc-tbi.org team (*Adam Ferguson et al.* UCSF)

# MR IMAGING DATA HARMONIZATION: *EASIER SAID THAN DONE*

## Image acquisition

- MR Hardware (e.g., RF coils, field strength, gradients, setup, engineering support, etc.)
- MR acquisition software and available pulse sequence packages (3D DTI-EPI, GEEPI, APTw)

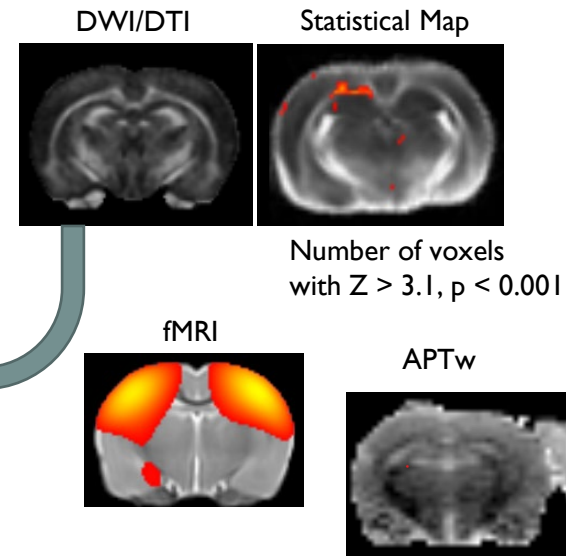


## Harmonization

## CDE Reporting/Data Sharing

## Image Processing

- Image processing pipelines (In-house, AFNI, FSL, ANTs, etc)
- Availability of high-performance computer facilities or high-end computational resources
- Staff with programming skills
- Availability of brain atlases/parcellations and
- Decisions regarding statistics (e.g., whole brain vs. ROI analyses for DWI, ICA, Seed, vs Hcorr for fMRI)



# COMMON DATA ELEMENTS FOR PRECLINICAL IMAGING MARKERS

- Differences odc-tbi tabulation vs Bruker parameter file information (will also vary from any sites using other MRI vendor platforms like MR solutions or Varian)
  - ImgDiffusionFirstBVal = ##\$PVM\_DwBvalEach=( 1 )
  - ImgDiffusionGrdtDur = ##\$PVM\_DwGradDur=( 1 )
- MRI CDEs from human TBI neuroimaging vs preclinical TOP-NT CDE may in some cases be similar but in others not available from MRI parameter files (will need manual entry)
  - ImgFMRITaskTyp = Tasks performed during a functional magnetic resonance imaging (fMRI) scan
  - ImgFatSignalSuppressedInd = ##\$PVM\_FatSupOnOff=On
- Translation of MRI software parameter files to data entry sheets will be key (can be automated via programming)

```
##$TITLE=Parameter List, ParaVision 6.0.1
##$JCAMPDX=4.24
##$DATATYPE=Parameter Values
##$ORIGIN=Bruker BioSpin MRI GmbH
##$OWNER=LPerez
##$ 2022-03-03 15:30:20.848 -0500 LPerez@CZC606B607
##$ /opt/PV6.0.1/data/LPerez/20220303_152958_TBI_417_D3_R7_1_1/14/method
##$ process /opt/PV6.0.1/prog/bin/parxserver
##$Method=<Bruker:POSITION>
##$GradientDirection=X_dir
##$GradientCurrent=1.32326529579558
##$PVM_RepetitionTime=500
##$PVM_NAverages=1
##$ @vis= Method GradientDirection GradientCurrent PVM_RepetitionTime
##$NDummyScans=0
##$PVM_ScanTimeStr=( 16 )
```

Translate MRI parameter files to CDE dictionary definitions



	A	B	C	E	F	H	I	J	K	L	M	N	O	P
	Anim al ID	GUID	Animal AgeVal	Animal SexTyp	Animal WgtMe asrVal	AnimalInju ryGroupAs signTyp	Img2DGap BetwnSlice sMeasr	Img2DSlice EncondeDirct Txt	Img2DSlice OverSamp Val	Img2DSlice ThicknessV al	ImgAbortR sn	ImgAcqAcc Factor	ImgAcqEnti reBrnCover ageInd	ImgAcquisi tionDur
1														
2	1	r2694	4	F	313	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
3	1	r2694	4	F	313	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
4	2	r2695	2	M	258	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
5	2	r2695	2	M	258	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
6	3	r2696	4	F	291	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
7	3	r2696	4	F	291	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
8	4	r2697	4	F	288	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
9	4	r2697	4	F	288	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
10	5	r2698	4	F	294	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
11	5	r2698	4	F	294	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
12	6	r2699	2	M	294	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
13	6	r2699	2	M	294	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
14	7	r2700	5	F	289	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
15	7	r2700	5	F	289	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
16	8	r2701	3	M	443	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
17	8	r2701	3	M	443	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
18	9	r2702	5	F	314	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
19	9	r2702	5	F	314	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
20	10	r2703	3	M	352	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
21	10	r2703	3	M	352	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
22	11	r2704	5	F	297	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
23	11	r2704	5	F	297	CCI	0	coronal	null	0.25	null	EPI	Yes	7187
24	12	r2705	3	M	420	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
25	12	r2705	3	M	420	Sham	0	coronal	null	0.25	null	EPI	Yes	7187
26	13	r2706	5	F	283	CCI	0	coronal	null	0.25	null	EPI	Yes	7187

# Magnetic Resonance Imaging 175: 151+24 on data

## FITBIR MRI organization

**119+7** TOP-NT CDEs placed into Form structures

Subject **46**  
22 subject +24 on data = 46

Equipment **16**

Pulse Sequence **61**

Diffusion weighted imaging DWI **16**

Functional, fMRI **5**

Analysis **24**

## TOP-NT new MRI Form structure

Amide Proton Transfer, APT-MRI **7**

## CDEs

**56:** 49 adopted, 7 modified

**4+7** Elapsed time; Brain ROI  
Anesthesia; Study  
Notes (7 modified)

**4** Scanner, software

**17** Acquisition & echo  
spec.'s, orientation

**2** Diffusion values

**5** Software, analysis,  
task, exp. notes

**17** QC, abort, software  
Artefact removal

## New TOP-NT CDEs

**94+24=119**

**35** Monitoring vitals  
Subject identifiers  
24 MRI data variables

**12** Gradient, coil spec.'s & manufacturer  
Scanner strength

**44** Slice spec.'s, Bregma dimensions  
Field of view, measurement method  
Phase encoding (resolution), repetition

**14** DWI analysis indices  
Method gradient spec.'s  
Phase and reverse ph. direction and number

**7** Method, measure,  
unit, blinding

**7** Method, correction method,  
saturation pulse spec.'s

# GENERAL POINTS ON A PERSONAL VIEWPOINT OF TOP-NT EXPERIENCE

- Very enjoyable experience, with deep and at times heated conversations regarding how to best collect, processing, analyze, report, represent data/results for imaging.
  - Take a hard look at your methods
  - Communicate with colleagues at other sites
  - Share! And ask others for their assistance
  - Be willing to critique other methods and also have your approach critiqued (in person!)
- CDEs include imaging measures of tissue microstructure, functionality, and mobile amide protein concentrations
- CDEs include widely applied imaging methods (most novel modalities not included)
- Well characterized quantitative imaging methods not included in CDEs (e.g., T2, T2\*, T1 known to reflect hemorrhage and edema)
- Use of a z-score normalization method may be highly effective in comparisons across sites.
- Coordination across sites may be subject to institutional administrative differences (e.g., IACUC approvals, etc) and personnel fluctuations