


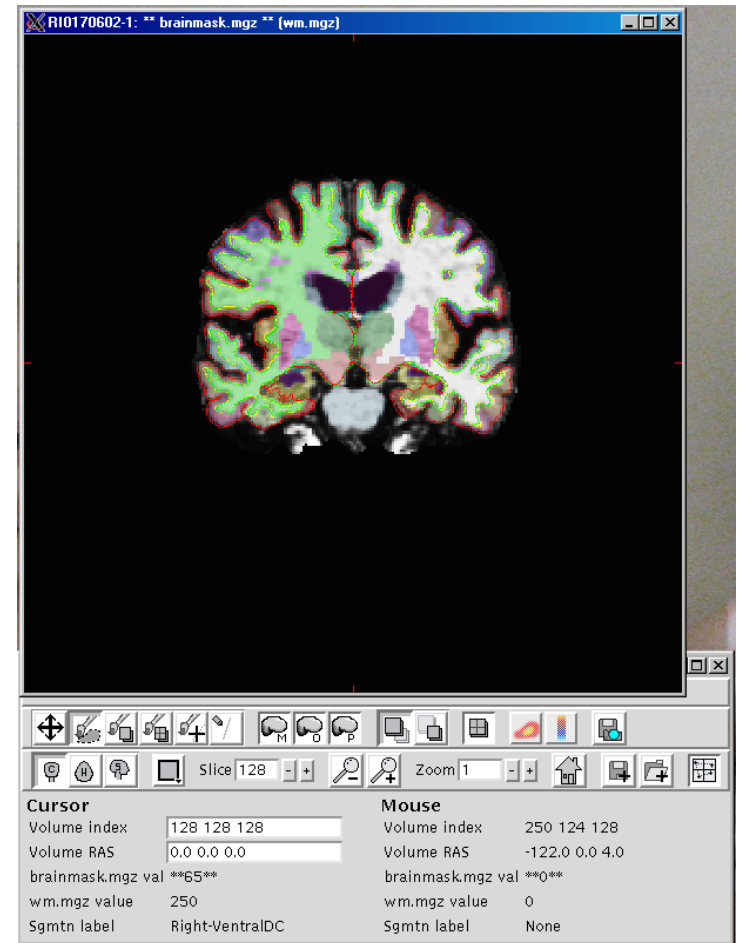
FreeSurfer Regional QC Guidelines

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Basic Image Viewing Techniques

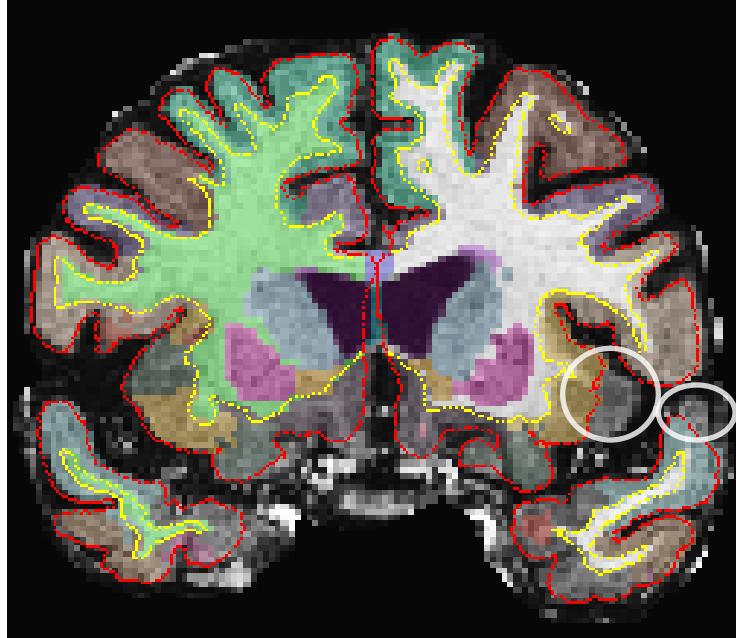
- Everyone has their own techniques to best investigate the scan/segmentation quality, though some *basic* techniques we would like everyone to utilize are as follows:
 - Adjust FOV size
 - To ensure a standard FOV size during the QC process resize your viewing window by dragging the lower-right corner down to the bottom of the first tool-bar panel and over flush with the maximize toggle button. Precisely as seen in the picture to the left.
 - Once the scan is loaded with the surface estimations (*h.white) and colored segmentation (aparc+aseg.mgz), unload the Original surface estimation (green line) by using hot-key ctrl + 'O' or clicking the  toggle switch.
 - Scroll to the anterior/posterior pole (your preference) to check for **gross** gyral/lobe CutOffs - and- mislabeling of the ventricles.
 - You may unload the color coded segmentation from the scan and scroll through the brain to better view the surface estimations and spot overestimations. However, viewing with the color coded segmentation is necessary for spotting ventricular errors and the incorrect labeling of the subcortical structures.



Gross Error Definition

(a.k.a. The Cursor Rule)

- Our basic guideline for FreeSurfer segmentation errors are defined by an overestimation/underestimation large enough to fit your desktop cursor on **three** or more consecutive slices.
 - For example, here the visual right Insula underestimation that is large enough to fit the cursor, and will be considered a Gross Error if it is consistent on three or more consecutive slices. Underestimation of the SuperiorTemporal gyrus however, is not large enough to fit the cursor and so can not be considered Gross, unless in later slices the size of underestimation increases and maintains for 3 or more consecutive slices.



Continued on next page

Gross Error Definition

(a.k.a. The Cursor Rule)

- For gross ventricular errors we are using a standard of five or more consecutive slices.

Currently ventricular errors are considered a QC rating of **HIPPO ONLY** so long as the hippocampus segmentation looks accurate.



Gross Error Definition (cont.)

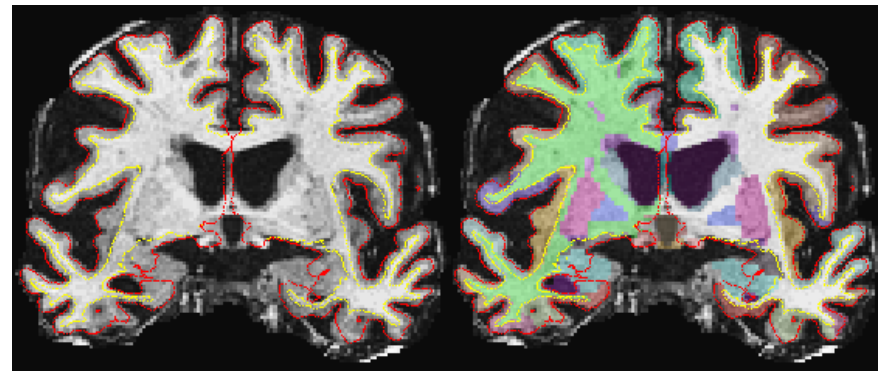
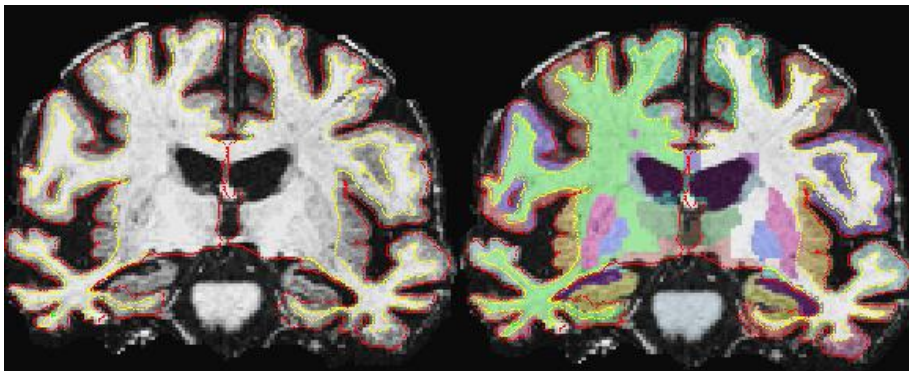
- Do's and Don'ts

Do:

- Utilize some imaginary 3D manipulation skills . Yes the cursor is fixed and cannot be rotated to fit the contour of the brain on the visual left or inferior borders, however if you imagine rotating the cursor in your mind, then you can determine if the cursor will fit inside the error.

Don't:

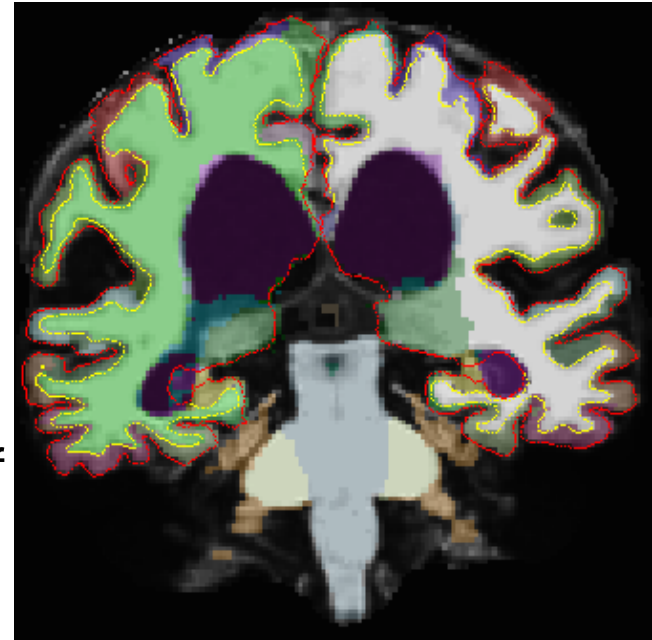
- Expect the hippocampus (bottom left) and amygdala (bottom right) to be included within the surface estimation. Despite their continuity with the cortex they are considered subcortical structures, so don't consider an error if they are not encapsulated by the pial and WM surface lines. When scrolling through with the segmentation overlaid, check to make sure they are labeled correctly before rating *Pass*.



Gross Error Definition (cont.)

Don't:

- Manipulate/smoosh the voxels to see if their summation adds up to the size of the cursor.
 - To the right is an example of a overestimation that would **not** be considered a Gross error because it would not fit the entire width of the cursor.
 - We are strictly holding to the as-is size of the error.



Autorecon3 QC

- The Autorecon3 QC has overall options of:
 - Pass
 - Fail
 - Partial
 - Hippo Only

Project: Multi-Modality-Yu
Subject: FAR150-1

Overall QC: [Dropdown]
Frontal QC: [Dropdown]
Temporal QC: [Dropdown]
Parietal QC: [Dropdown]
Insula QC: [Dropdown]
Occipital QC: [Dropdown]
Cerebral WM QC: [Dropdown]
BasalGanglia QC: [Dropdown]

Check box below to set control points for...
 Frontal Lobe
 Temporal Lobe
 Parietal Lobe
 Occipital Lobe
 Pia

Check box below to set white matter edits performed on...
 Frontal White
 Temporal White
 Parietal White
 Insula White
 Occipital White

Comments:
[Text Area]

FS Version: 4.5
Subjects Dir: /cind/00/Multi-Modality-Yu/Freesurfer/subjects

Enter Skip Cancel

Autorecon3 QC Outcomes

- Pass indicates a good overall segmentation.
- Fail indicates a global failure due to either extremely poor image quality, registration issues, or gross failure of a cortical label NOT on the A3 QC Failure List. Additionally Fail can also indicate a processing error.
- Partial indicates a “failure” in one or more of the brain regions (see QC Failure lists). These regions consist of several labels that are the most common sites of poor FreeSurfer segmentation. Aside from ADNI, a regional failure results in all labels within that region being withheld from the Volumes DB.
- Hippo-Only indicates a global failure of the segmentations but the Hippocampi are properly estimated. This A3 QC outcome only imports Hippocampi and ICV data to the Volumes DB (If Longitudinal analysis is to be performed this is the minimum requirement for the cross-sectional scans inclusion in the BaseImage)

Autorecon3 QC Failure List (as of 6/2011)

-Frontal QC:

FrontalPole
Precentral
SuperiorFrontal
CaudalMiddleFrontal
RostralMiddleFrontal
MedialOrbitalFrontal

-Temporal QC:

TemporalPole
Fusiform
SuperiorTemporal
InferiorTemporal
MiddleTemporal

-Insula QC:

Insula

-Parietal QC:

Postcentral
SuperiorParietal
SupraMarginal
Paracentral
InferiorParietal

-Occipital QC:

Lingual
LateralOccipital
Pericalcarine
Cuneus

-CerebralWM QC:

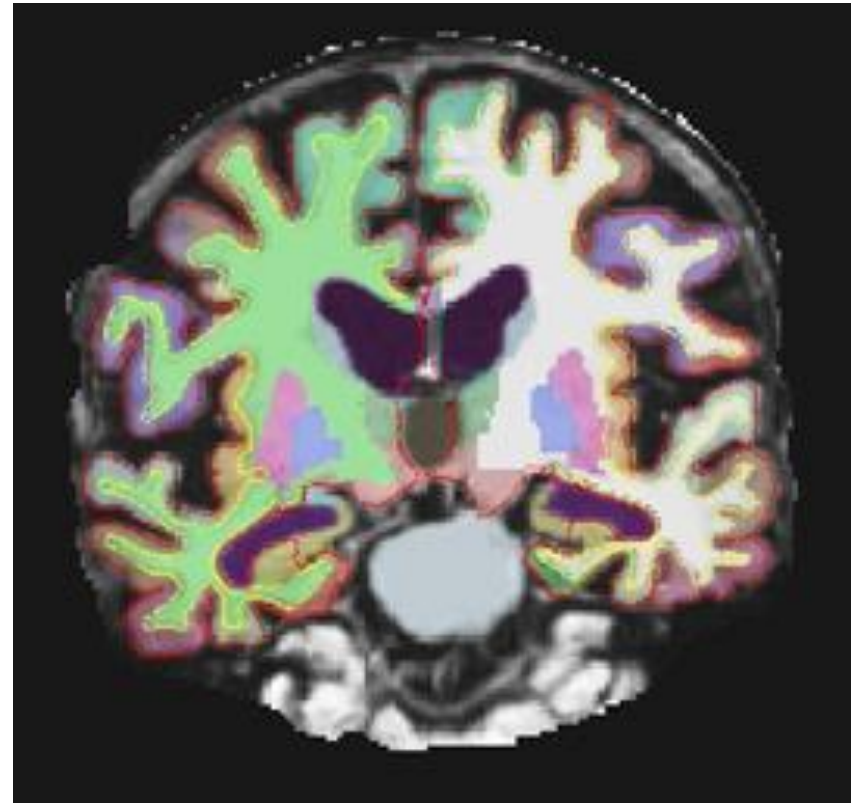
Subcortical WM

-BasalGanglia QC:

Putamen
Caudate
Pallidum

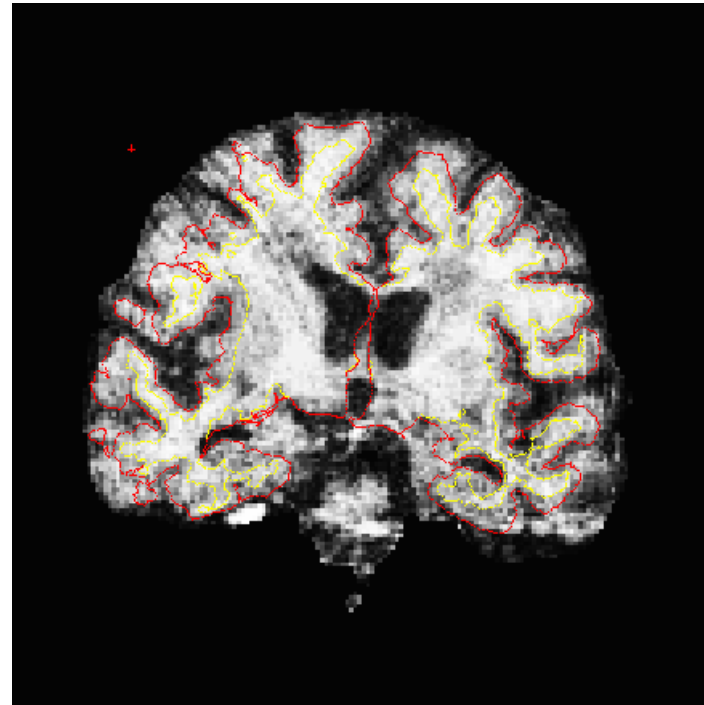
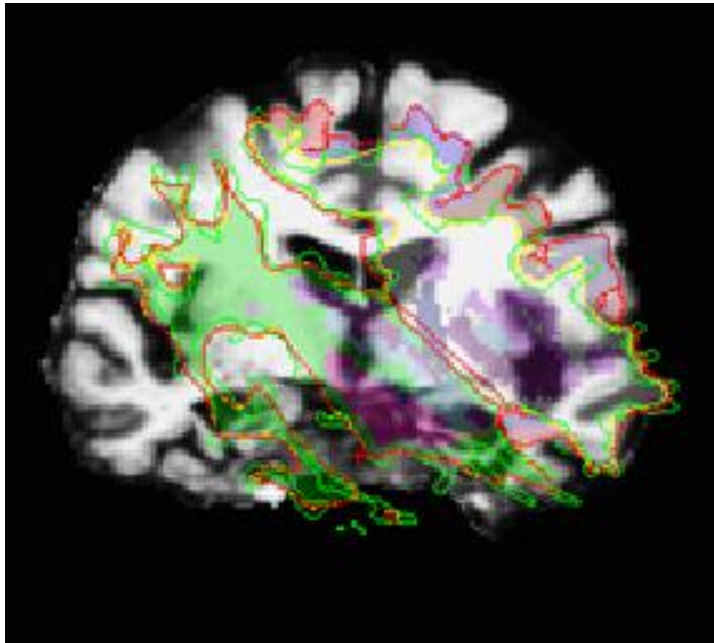
Autorecon3 QC: Pass

- A full Pass rating is given when all cortical labels within each brain region did NOT contain a gross error according to our Gross Error Definition...by no means is it 'perfect'.



Autorecon3 QC: Fail

- Sometimes the registration is off! 😊
- Or the image quality is just very poor!

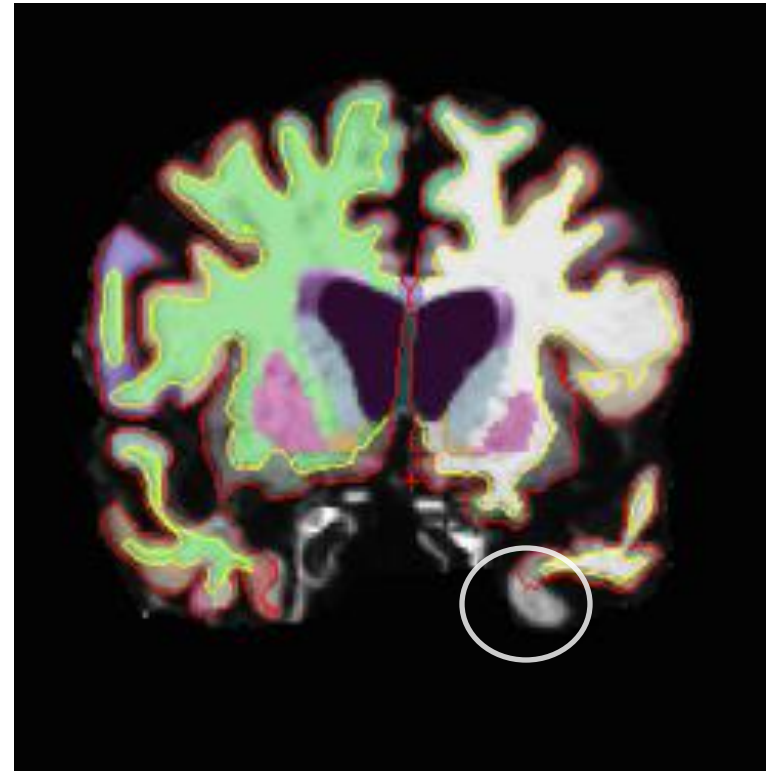
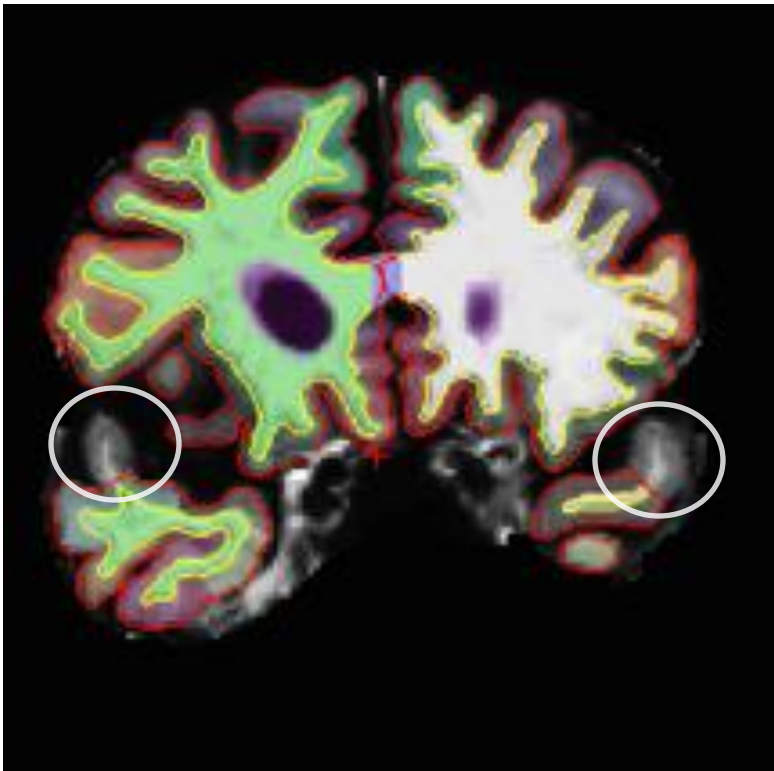


Autorecon3 QC: Partial

- Partial indicates a failure in one or more of the 6 regions- Temporal, Occipital, Frontal, Parietal, Insula, Cerebral WM, or BasalGanglia GM. A fail in any of those areas mean that one or more of the structures in that region failed to meet our QC standards (see previous slide titled: “A3 QC Failure List”).
 - Remember: gross errors are only under/overestimations that occur across three or more consecutive slices. Gross ventricular errors occur across five or more consecutive slice.
- In cases of A3 QC: Partial ratings, aside from ADNI, ALL cortical labels within that regional definition are excluded from the Volumes database (DB) regardless which specific cortical labels were affected.
 - For example, if a scan is rated as A3 QC: Partial with a Temporal ‘Fail’ due to a gross error in the SuperiorTemporal gyrus, then all the labels listed under the Temporal region (see “A3 QC Failure List”) are excluded from the Volumes DB as one or more of these sub-regions did not satisfy the cursor rule.
- With an A3 QC: Partial rating ALL brain regions could be set as regional failures, and the subcortical structures -plus- cortical labels not included in Failure List would still be imported to the Volumes DB.

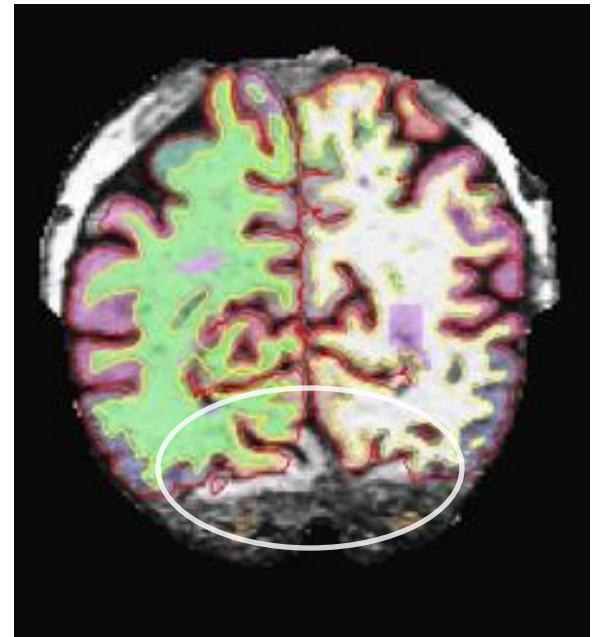
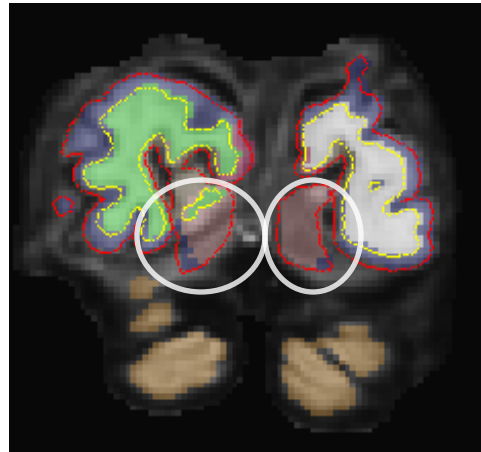
A3 QC Partial = Temporal Fail

- Below are examples of typical errors in the Temporal region. Superior Temporal and both medial and lateral Temporal Pole.



A3 QC Partial = Occipital Fail

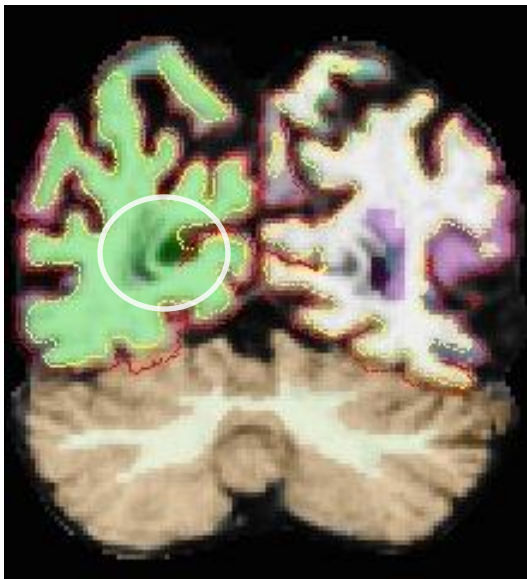
- Occipital regions are often overestimated (left) or underestimated (right, bottom) in the Lateral Occipital gyrus.



A3 QC Partial = Occipital Fail



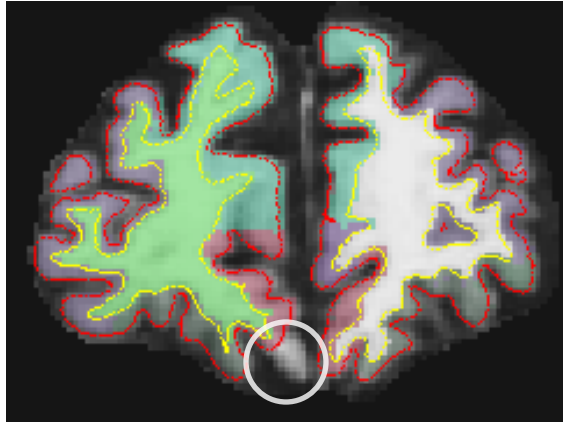
- To the left are two examples of common errors in the Pericalcarine sulcus. Often this sulcus will be labeled as LateralVentricle (top) and/or CerebralWM (bottom). Although this cortical gyrus is commonly mislabeled, it is not commonly a gross error. So be mindful and apply the Gross Error definitions carefully.



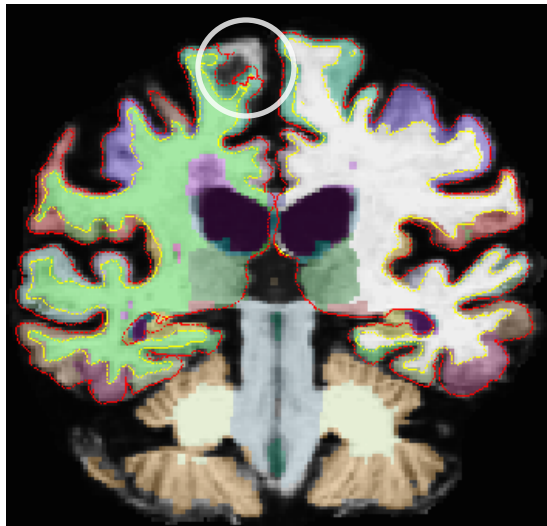
- To the right is another example of a Pericalcarine sulcus error, along with a LateralVentricle error.



A3 QC Partial = Frontal Fail

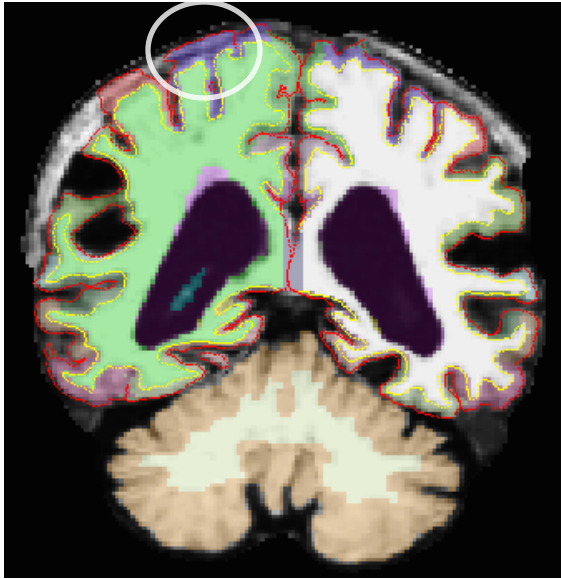


Example: MedialOrbitalFrontal CutOff

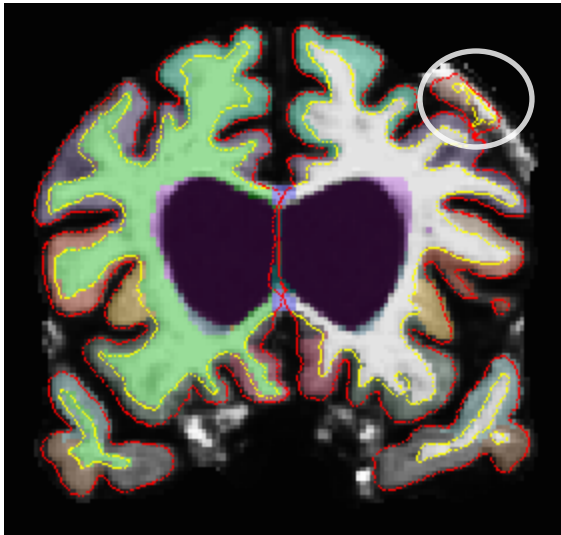


Example: SuperiorFrontal CutOff

A3 QC Partial = Frontal Fail

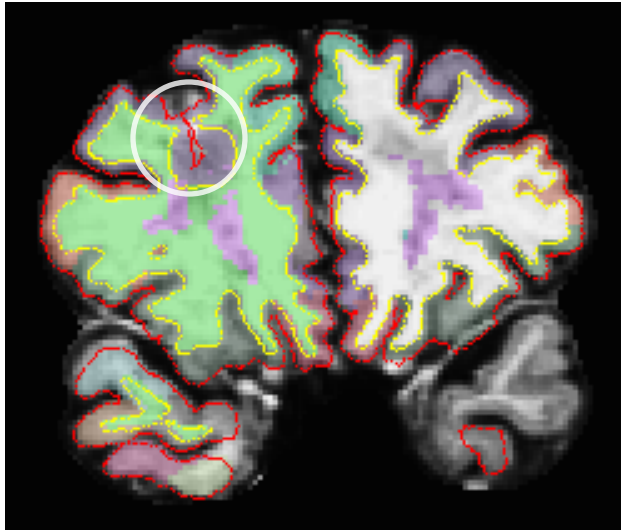


Example: Precentral Overestimation w/ some Postcentral overestimation included



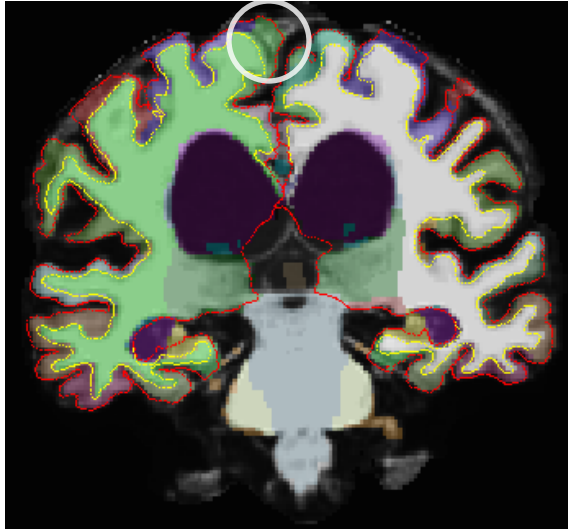
Example: CaudalMiddleFrontal Overestimation.
Note: if WM overestimation into DuraM enlarges in later slices it might be considered a CerebralWM Fail as well.

A3 QC Partial = Frontal Fail

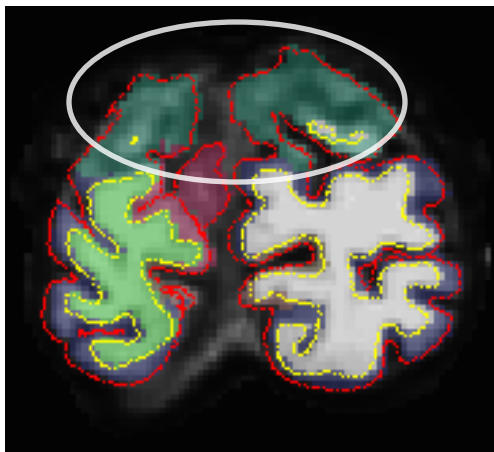


Example: RostralMiddleFrontal overestimation that miss-labels a large subcortical lesion as GM. Also large Temporal lobe Cut Off.

A3 QC Partial = Parietal Fail

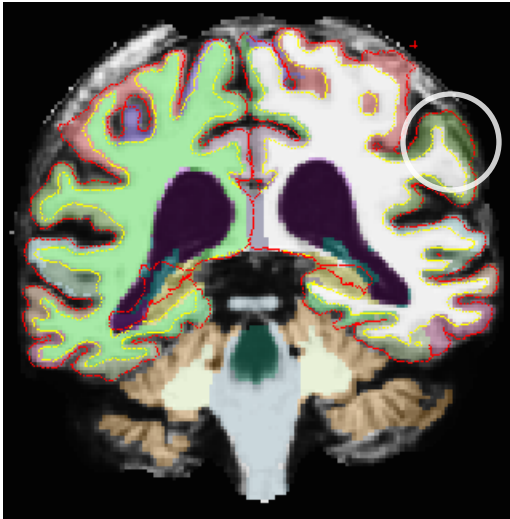


Example: Paracentral Overestimation



Example: SuperiorParietal Overestimation

A3 QC Partial = Parietal Fail



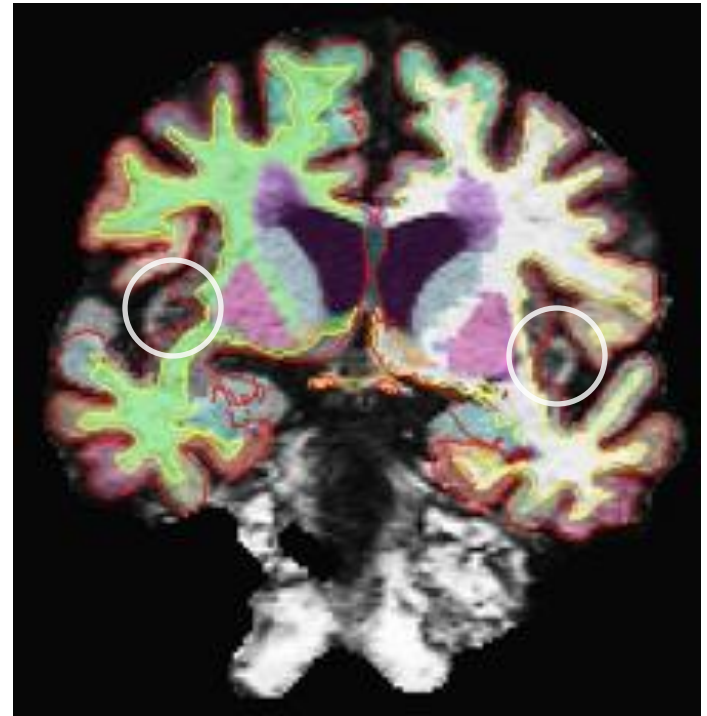
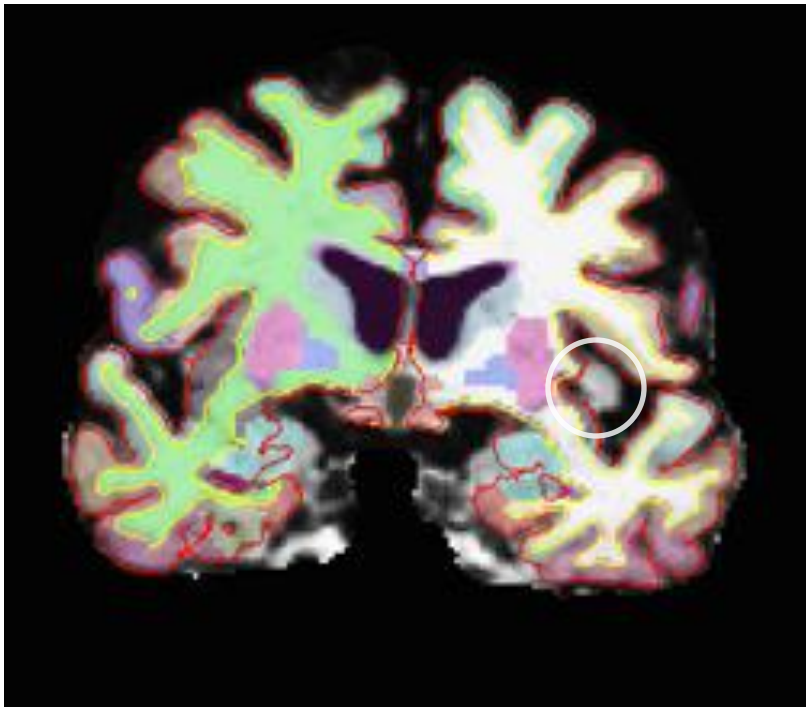
Example: Postcentral (red) and SupraMarginal (yellow) gyrus underestimation



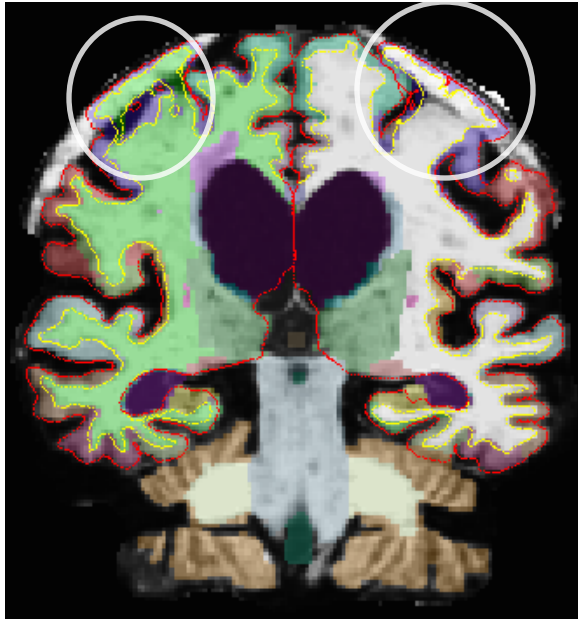
Example: InferiorParietal gyrus overestimation

A3 QC Partial = Insula Fail

- The Insula (piece of cortical GM lateral to the putamen) is commonly *underestimated*.



A3 QC Partial = CerebralWM Fail

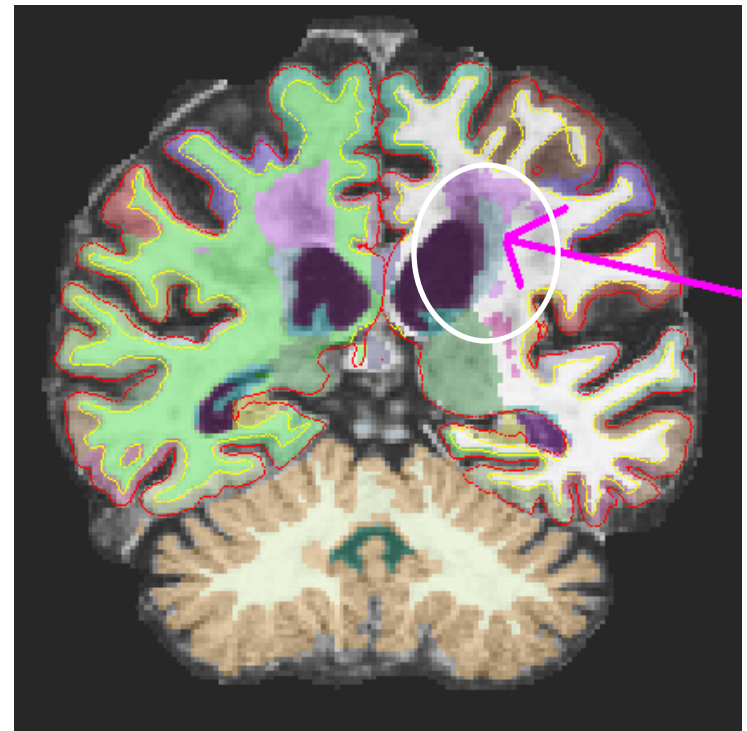
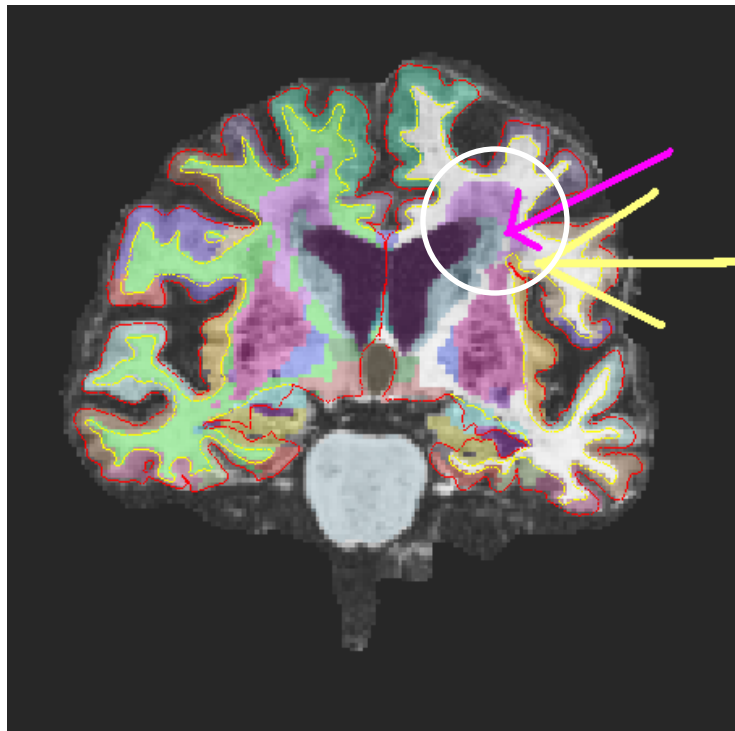


Examples: (top-left) WM overestimation of both Precentral gyri into DuraM. (top-right) WM overestimation of both Postcentral gyri. (bottom-left) WM overestimation into DuraM and Precentral gyrus.

A3 QC Partial = BasalGanglia Fail

Example: A severe WM lesion can cause an overestimation of the Caudate (left, pink arrow). The error continues throughout the brain as we see mislabeling of the caudate in a posterior slice (right).

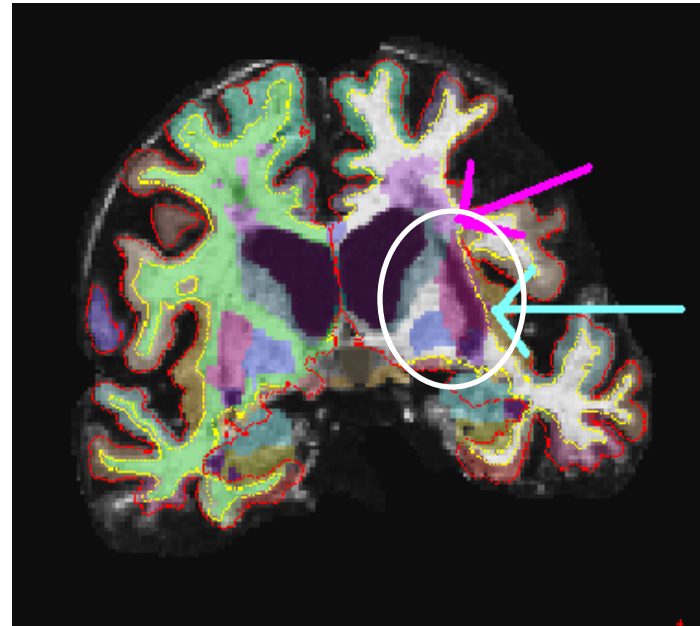
Note: In the image to the left we also see pial confusion (yellow arrow) as a result of poor segmentation.



A3 QC Partial = BasalGanglia Fail

Example: Large Perivascular (PV) spaces can cause overestimation of the Putamen.

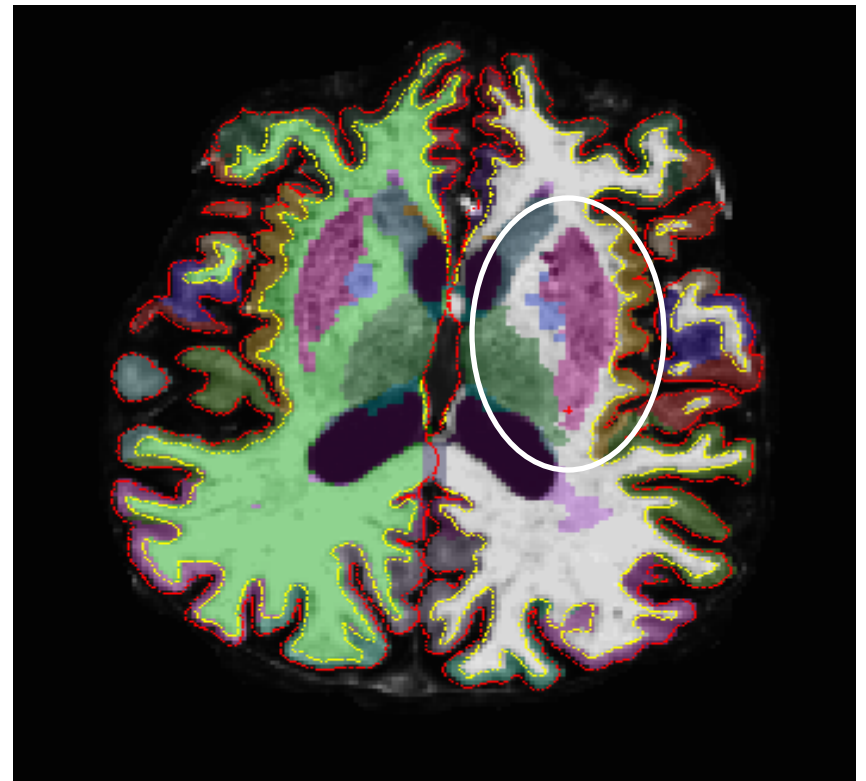
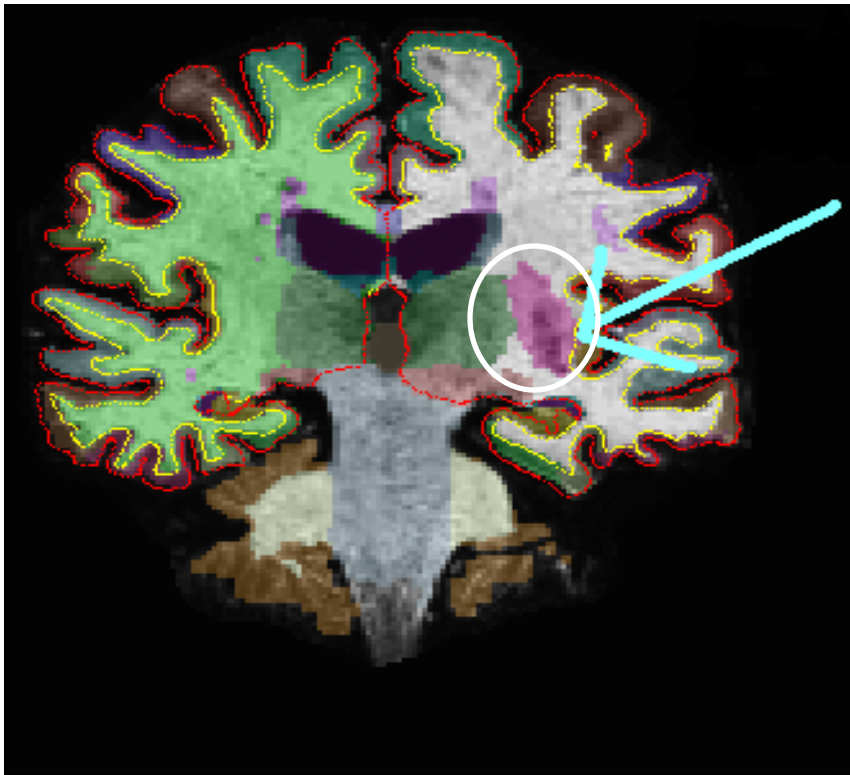
Note: In this image we also see a severe WM lesion mislabeled as caudate (pink arrow). Change orientations to axial and toggle on/off segmentation to verify. Both errors should be noted in the comments.



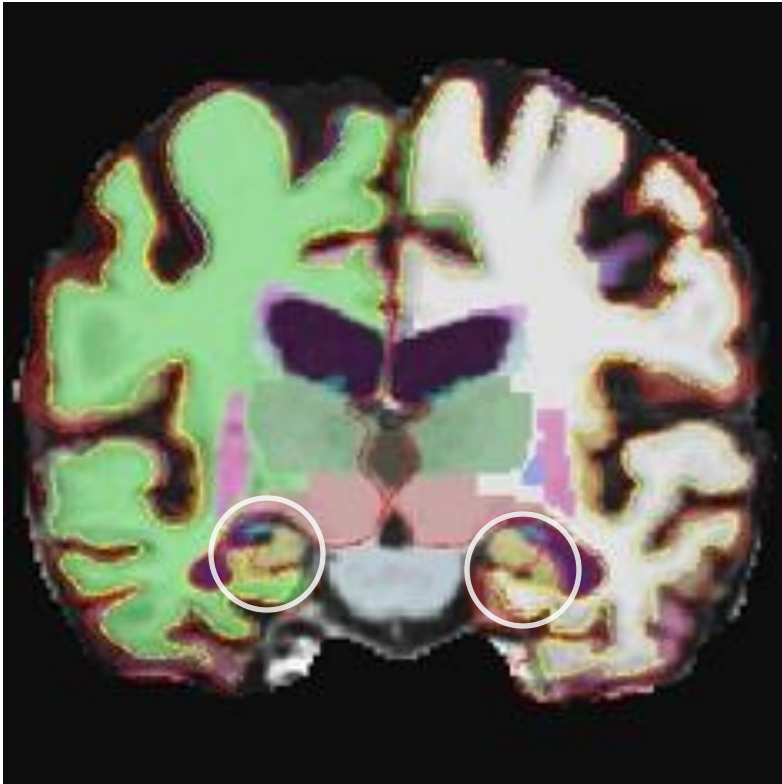
A3 QC Partial = BasalGanglia Fail

Example: Again we see overestimation of the Putamen, possibly caused by large PV spaces.

Note: In some cases the overestimation can be subtle (left, blue arrow) but become more evident in posterior slices or when viewed in the axial orientation (right).



Autorecon3 QC – Hippo Only



- The Hippo Only rating indicates a segmentation/parcellation that would otherwise be rated as Fail, though the Hippocampus estimation is accurate. In this example, a scan with severe PVE, we would rate Hippo Only to include the Hippo data in the Volumes DB. Effectively excluding bad cortical data not in our Regional Failure list.
 - Remember: Ventricular errors are rated as Hippo Only, as long as the hippocampus segmentation is accurate.