

# Neuroanatomy Portrait

## *Dossier*

Winter Kraemer

MSC 2012 - Neuroanatomy

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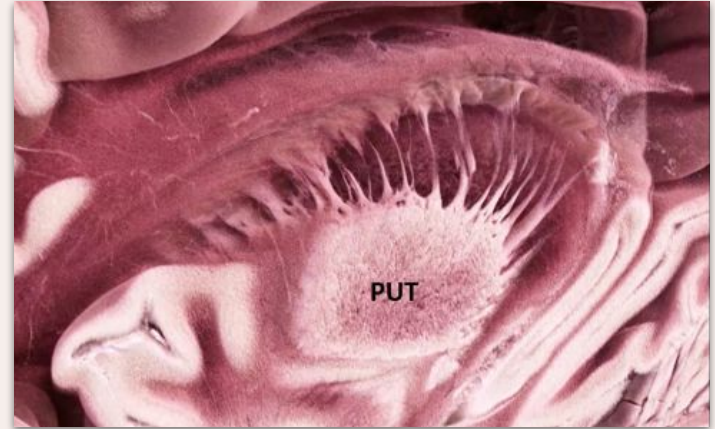
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# Goals

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- Highlight anatomy of the **caudolenticular grey bridges** (CLGBs)
- Demonstrate relationship between basal ganglia and internal capsule
- Create a functional *and* beautiful portrait

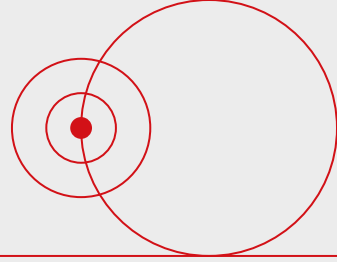


Cinematic rendering of CLGBs  
(Dang et al., 2023)

# *1. Research*



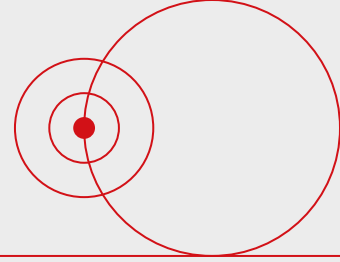
# Research - CLGBs



## Development

- During embryological development, the internal capsule (IC) courses through the dorsal striatum to divide it into putamen and caudate nucleus
- The IC does not completely split the striatum, so CLGBs are left behind as those connecting wisps of grey matter
- CLGBs are sometimes called “transcapsular bridges” as a result of their interdigitation with the IC

# Research - CLGBs

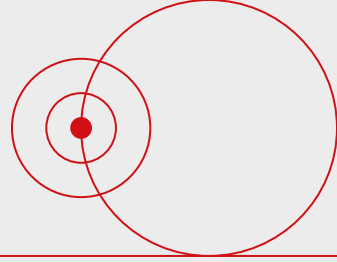


## Function

- CLGBs are the efferent gateway between the premotor and supplementary motor cortices and the dorsal striatum, via the IC
- The position of CLGBs along the rostro-caudal axis of the dorsal striatum determines their function
- More rostral CLGBs relay associative information, and more caudal ones relay sensorimotor information

Dang, B., Necker, F. N., Dhawan, S. S., Murty, T., & Massoud, T. F. (2023). Caudolenticular gray bridges of the brain: A magnetic resonance imaging study. *Clinical Anatomy*, 36(4), 669–674. <https://doi.org/10.1002/ca.24026674>

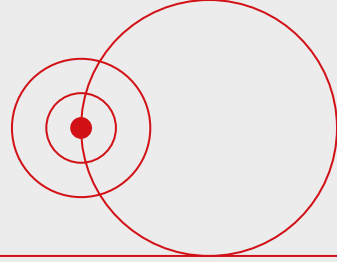
# Research - CLGBs



## Morphology

- The thickness and density of CLGBs decreases from rostral to caudal ends of the dorsal striatum (thickest CLGBs near the nucleus accumbens)
- There are roughly 20-25 bridges on either side and some are bifid or fenestrated
- The lateral edge of the caudate nucleus is serrated where the CLGBs emerge
- People assigned female at birth have thicker CLGBs than people assigned male at birth (difference not quantified in research)

# Research - CLGBs



## Note

- There is a surprising lack of primary literature on the morphology of CLGBs
- Most research focuses on function
- Most of my research was focused on 2 papers (below) describing morphology

Dang, B., Necker, F. N., Dhawan, S. S., Murty, T., & Massoud, T. F. (2023). Caudolenticular gray bridges of the brain: A magnetic resonance imaging study. *Clinical Anatomy*, 36(4), 669–674. <https://doi.org/10.1002/ca.24026674>

Little, G., Poirier, C., Bore, A., Parent, M., Petit, L., & Descoteaux. (2025). Mapping caudolenticular gray matter bridges in the human brain striatum through diffusion magnetic resonance imaging and tractography. *Human Brain Mapping*, 46(8). [10.1002/hbm.70245](https://doi.org/10.1002/hbm.70245)

## *2. Ideation*

# Ideation

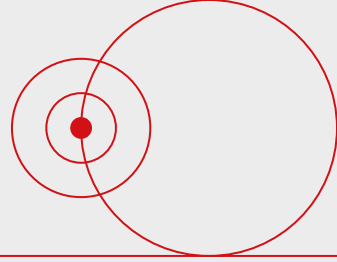
## Workflow

- Before sketching anything, I did a photoshoot from several angles (with Athena's help, thank you Athena!)
- Chose angles that could show the basal ganglia *and* IC
  - Used a plastic brain model to test out possible angles (thank you Bridget for holding it up!)
- Aimed for neutral, indirect lighting



My secret other goal: I wanted my face to look good so I could use this piece for my website

# Ideation



## Scientific Communication

- In order to communicate the relationship between the dorsal striatum, CLGBs, and internal capsule, I chose to show the following elements:
  - Entirety of dorsal striatum on one side (not cross sections)
  - Blunt dissection of the corona radiata
    - Demonstrates its arc between the caudate nucleus and putamen
  - Caudate nucleus on the other side
- I attempted different planes of section to try to resolve these requirements

# Ideation

## NEURO PORTRAIT IDEAS



- leaving only R. posterior base
- if midline, left, won't see away of BG
- St posteriorly:
  - ant. end is just behind where zygomatic arch begins
  - post. end is around front border of ear
  - should prob. be bigger than this...
  - do I want to show entirety of curve? will need to dissect lower types.

(Dang et al. 2023)

- CLGBs - connect CN + Putamen across IC
- Main receiving area for input from pre-motor + sup. motor BG
- No normative anatomy, but this study found avg. 7.4 on each side (stayed symmetrical)

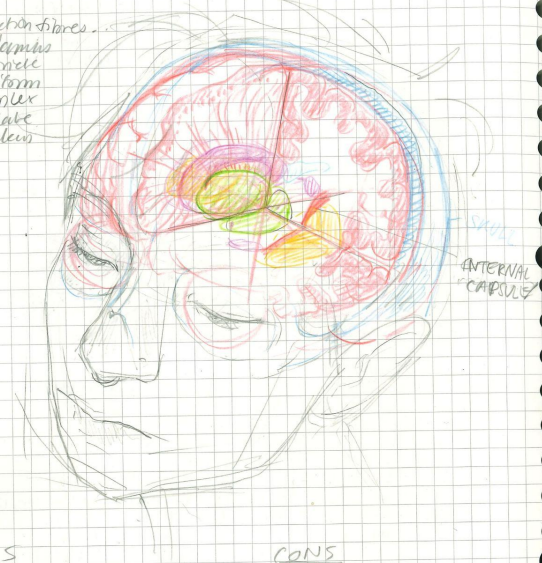
Other options:

- X-section of BG on right, full dissection on left → take away
- lower dissection to show more R. hem. and quad.
- L. hem. phre gone for show entirety?

→ No IC



- projection fibres
- thalamus
- ventricle
- lentiform complex
- caudate nucleus



## PROS

- nice angle for CR
- nice picture of med.
- good spot for x-sections

## CONS

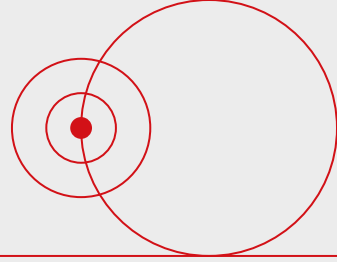
- Doesn't give good POV for CLGBs → would need to swap out x-section
- full curvature of CN not visible → section further back (to lvl of brain stem, behind ears I think)

## THOUGHTS:

- I think I want to show entirety of basal ganglia?
- → But maybe not bc then I'm just copying AML ill?
- can show x-section on one side + CR on other (like above), but w/ cut further back to show entire CN
- → guess in putamen + GP
- → still, issue w/ not CLGBs or full curve of CN
- Maybe better to show full BG on close side + highlight CLGBs.



# *Ideation*



## **Feedback**

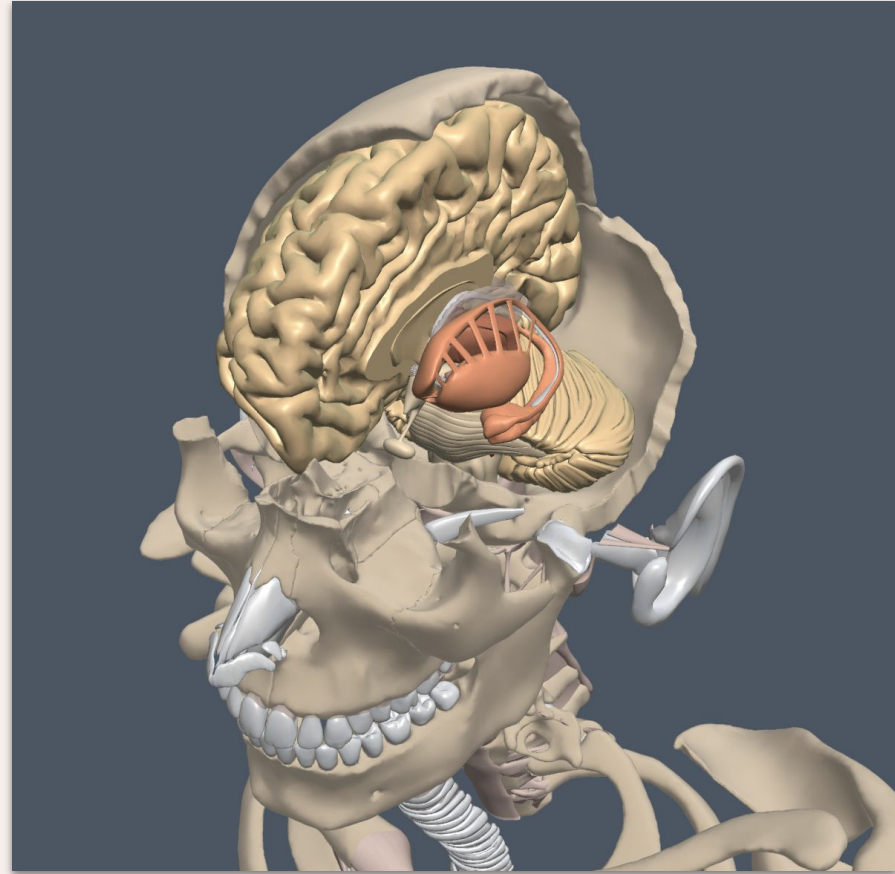
- **Blunt dissection of internal capsule is compelling and unique**
- Entire basal ganglia is preferred over a cross-sectioned one
- Learn more about CLGBs and how to accurately depict them

### *3. Maquette*

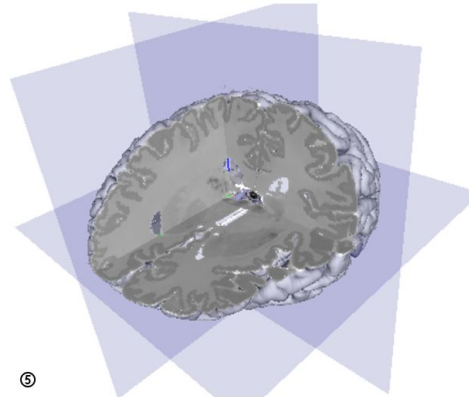
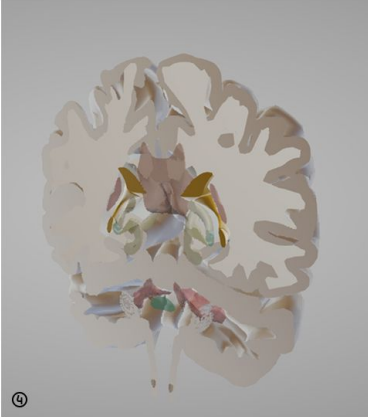
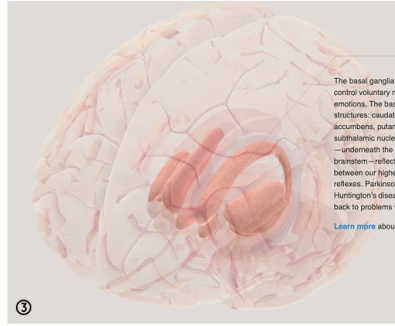
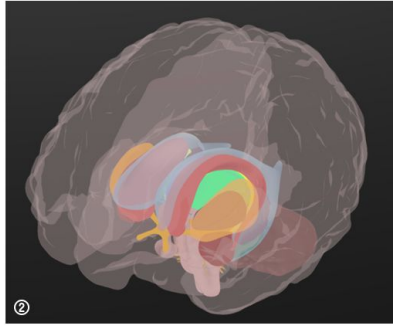
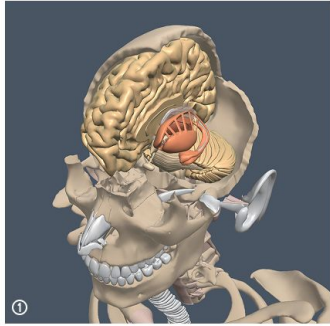
# Maquette

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- Used multiple online 3D models to generate maquette ideas
- Tried to line up framing with portraiture
- Created some custom maquettes and slices from available customizable atlases to test feasibility of my idea



(Anatomy TV, 2025)



1. Anatomy TV: [https://www-anatomy-tv.myaccess.library.utoronto.ca/unitywebgl/realtimewebgl/v5.aspx?app=Head\\_3D&version=HeadV5\\_3D&thumbURL=fromRVM%20images^homepageimages^3D\\_Head-01.png](https://www-anatomy-tv.myaccess.library.utoronto.ca/unitywebgl/realtimewebgl/v5.aspx?app=Head_3D&version=HeadV5_3D&thumbURL=fromRVM%20images^homepageimages^3D_Head-01.png)
2. Basal Ganglia model: <https://sketchfab.com/3d-models/basal-ganglia-32743a4c58134c22a1aad84919ec8ee0>
3. Wellcome trust 3D brain model: [https://www.brainfacts.org/3d-brain#intro=false&focus=Brain-basal\\_ganglia](https://www.brainfacts.org/3d-brain#intro=false&focus=Brain-basal_ganglia)
4. Neurotorium: <https://neurotorium.org/tool/brain-atlas/>
5. BigBrain: [https://atlases.ebrains.eu/viewer/#/a:juelich:iav:atlas:v1.0.0:1/t:minds:core:referencespace:v1.0.0:a1655b99-82f1-420f-a3c2-fe80fd4c8588/p:juelich:iav:atlas:v1.0.0:4/@:0.0.0.-W000...eCwg.2-FUe3\\_-s\\_W.2\\_evlu..7Lix.gIW~.10AwC.B1KK~...1LSm/vs:v2-ff011b0b](https://atlases.ebrains.eu/viewer/#/a:juelich:iav:atlas:v1.0.0:1/t:minds:core:referencespace:v1.0.0:a1655b99-82f1-420f-a3c2-fe80fd4c8588/p:juelich:iav:atlas:v1.0.0:4/@:0.0.0.-W000...eCwg.2-FUe3_-s_W.2_evlu..7Lix.gIW~.10AwC.B1KK~...1LSm/vs:v2-ff011b0b)

Maquettes used. See [Figma](#) board for active links

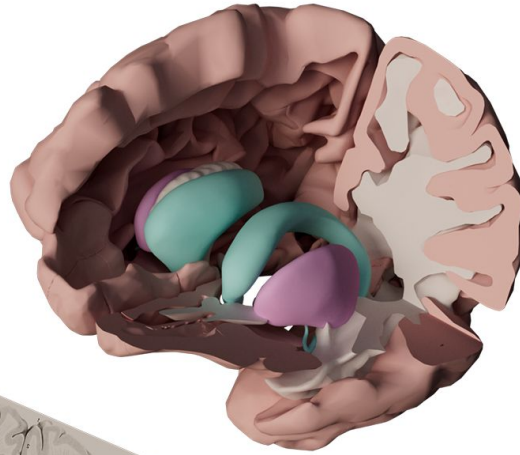
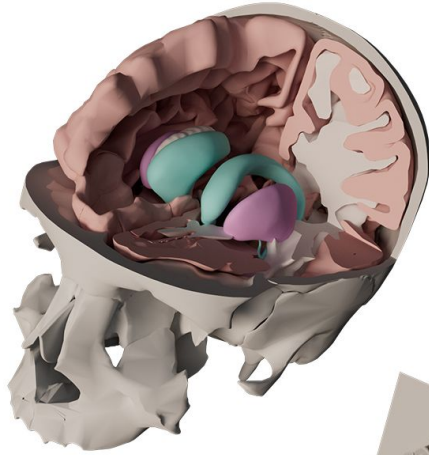
# Maquette

## Workflow

1. Import brain and basal ganglia from Japanese Body Parts into C4D
2. Boolean skull, grey matter, and white matter with cube to create  $\frac{1}{4}$  "slice" cut
3. Delete white matter tracts on the right to reveal basal ganglia
4. Create cross section planes and with Niewenhuys (2008) illustrations
5. Staging, lighting and rendering
6. Compositing with portrait in PS



Composited maquette render and portrait photo



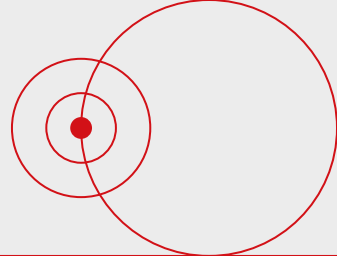
3D models sourced from Japanese  
Body Parts Database: [https://  
lifesciencedb.jp/bp3d/](https://lifesciencedb.jp/bp3d/)  
Cross sectional planes from  
Niewenhuys et al., 2008



Created multiple renderings of maquette so I could have options when  
compositing them with my portrait photo

## *4. Comprehensive Sketch*

# Comprehensive Sketch



## Considerations

- Wanted the feeling of a real dissection, not a digitally sectioned brain model
  - White matter tracts (corona radiata) also act as visual guide towards dorsal striatum, the area of focus
- Considered using transparency to show entire basal ganglia
- Did not follow through on that idea for final render → not central to the story
- Only the dorsal striatum is relevant and that is shown with the cut in the maquette

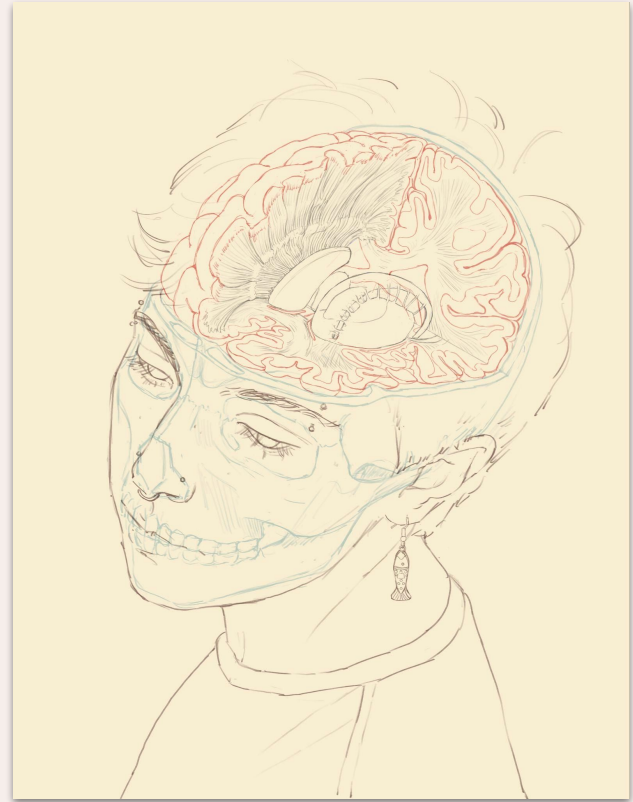


# Comp Sketch

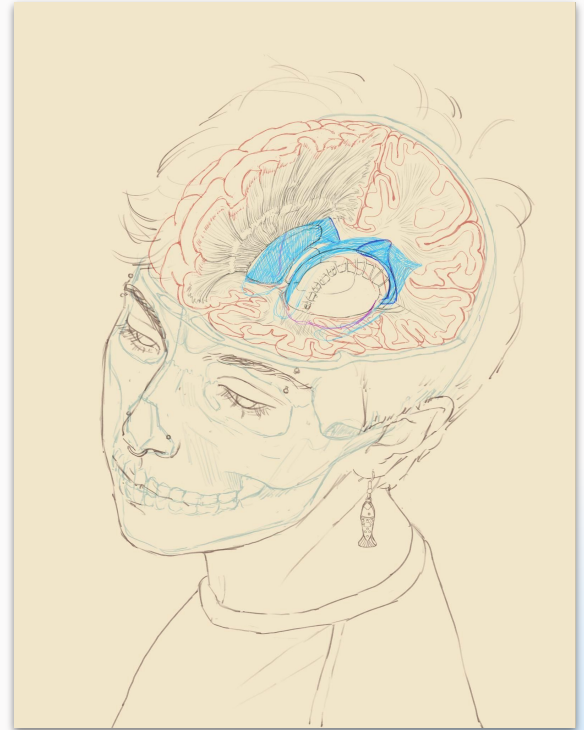
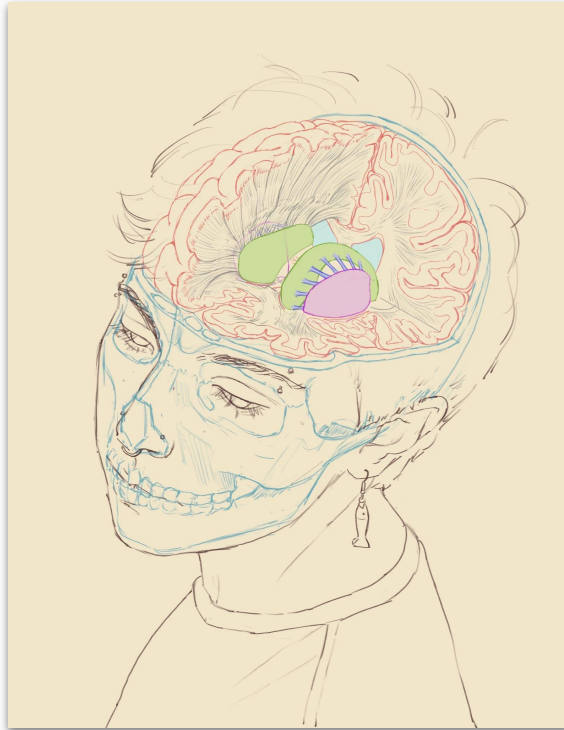
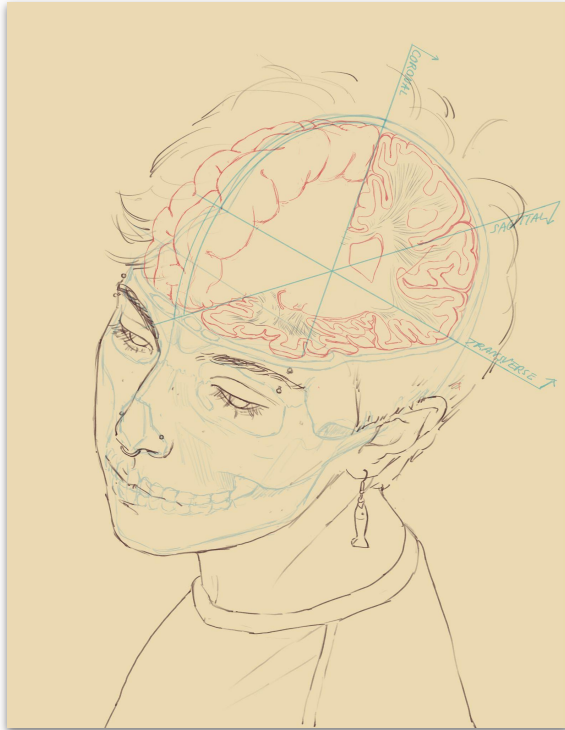
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## Workflow

1. Traced composited portrait/maquette image
2. Added bony anatomy to ensure alignment between skull and face
3. Used 3D and 2D references of corona radiata blunt dissection to replicate surface texture
4. Refined sketch based on MRI dorsal striatum references

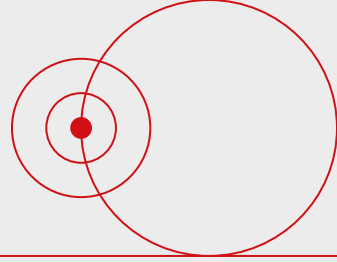


Comprehensive sketch



Multiple iterations of the comprehensive sketch. Focus on progressively refining dorsal striatum and cross section anatomy of subcortical structures

# Comprehensive Sketch

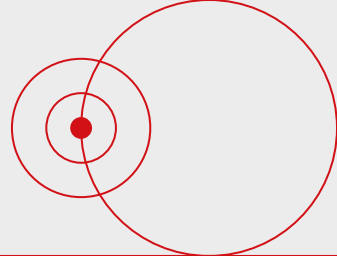


## Feedback

- Sought feedback from Kristy Cheung (TA) for anatomical accuracy
  - Extend bottom border of cut frontal lobe so it is more flush with skull
  - Where tail of left caudate nucleus meets white matter, it would be hugged by ventricles so that should be seen in cross section
  - Ensure direction of corona radiata fibres is an even arc from front to back
- Other feedback:
  - Blunt dissection should show more arcuate fibres
  - CLGB anatomy → too thick and inorganic, need more of a wispy look

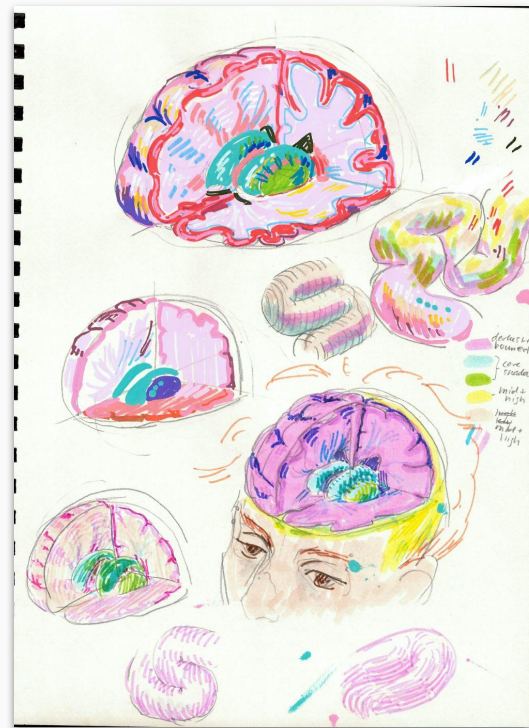
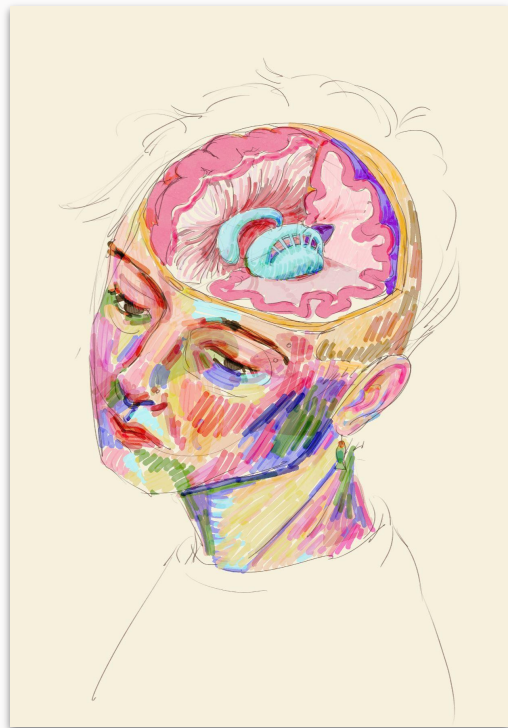
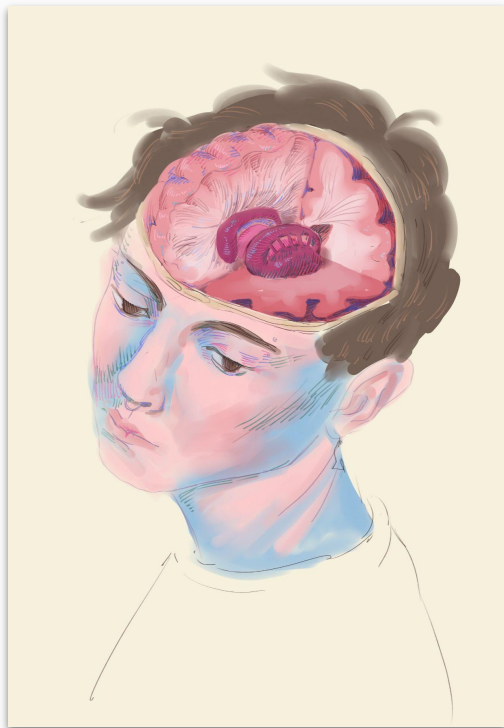
## *5. Rendering & Final Piece*

# *Rendering*



## **Considerations**

- Devoted significant consideration to how I would render this piece
- Realistic digital rendering does not interest me
- Experimented with different colouring techniques that reflect my rendering process with traditional materials
- Tried emulating watercolour, alcohol markers, and acrylic paint pens



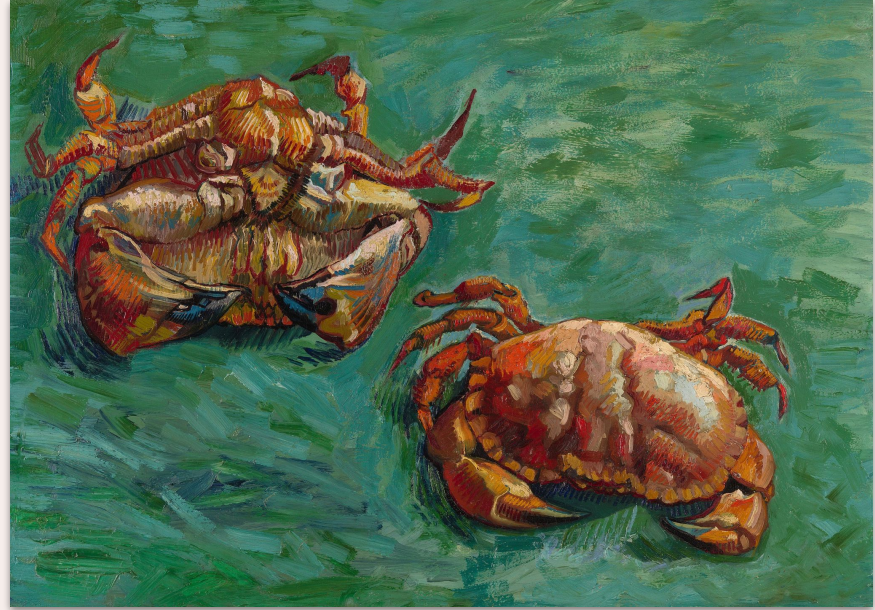
Several colour studies to see which technique would be most enjoyable to work with

# Rendering

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## Inspiration

- None of those techniques felt right for me
- Then I opened my iPad, saw my background of Van Gogh's "Two Crabs", and inspiration struck!
- **Goal:** emulate Van Gogh's loose, impressionistic style in a digital medium while retaining accuracy in neuroanatomy



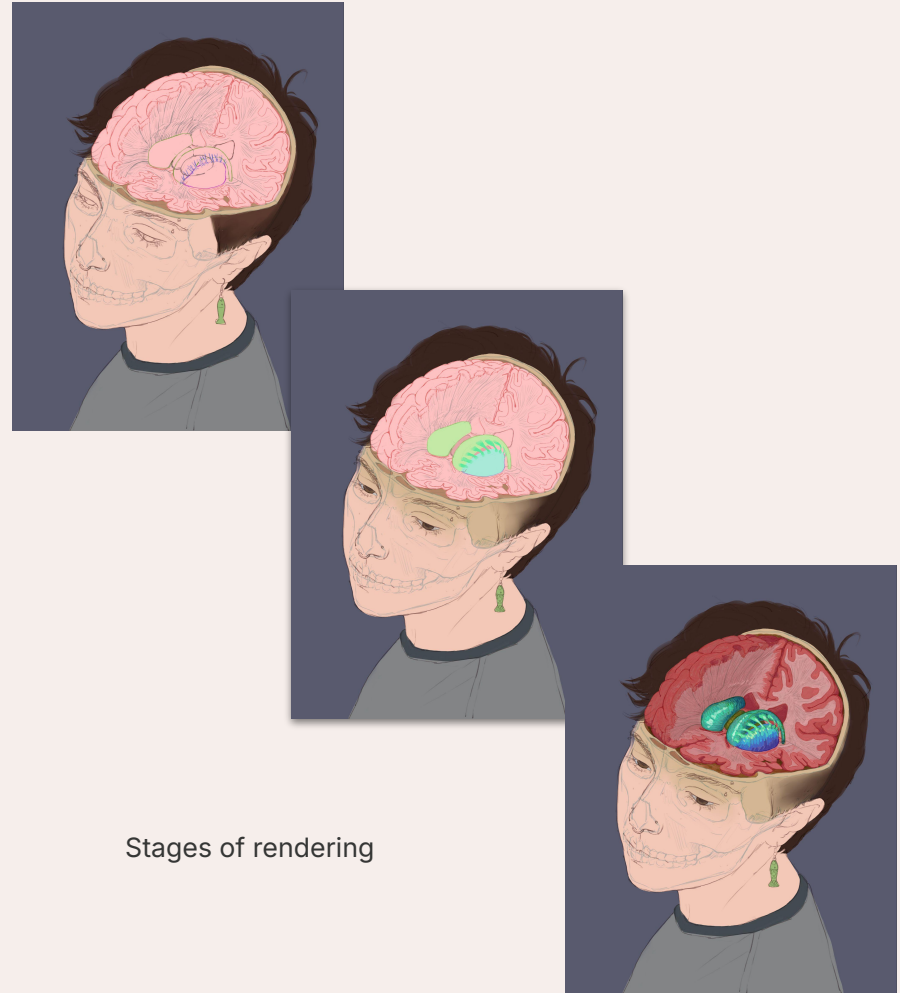
"Two Crabs"  
Van Gogh (1889)



# Rendering

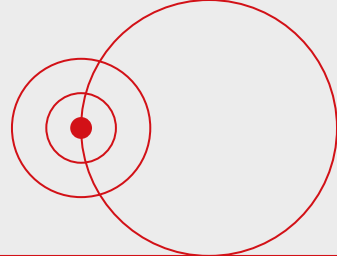
## Workflow (round one)

1. Laid down base colours for major anatomical features
2. Experimented with opacity of skull, skin and hair
3. Blocked out white and gray matter and main light and shadow in cerebrum
4. Rendered out dorsal striatum fully as a style test





# Rendering



## Feedback

- Dorsal striatum rendering looks good and should be kept
- Other parts of portrait should be painted in that style, but not to that level of detail so they do not draw attention away

## My edits

- I continuously edited the comprehensive sketch to refine the morphology
- Having difficulty understanding the lighting → needed to refine maquette

# Rendering - Maquette 2

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## Clay Maquette

- Lighting in maquette was inconsistent with portrait lighting
- Favoured the portrait lighting
- Needed to understand how light hits the planes
- Built a clay maquette and took photos in front of a window (like the portrait)

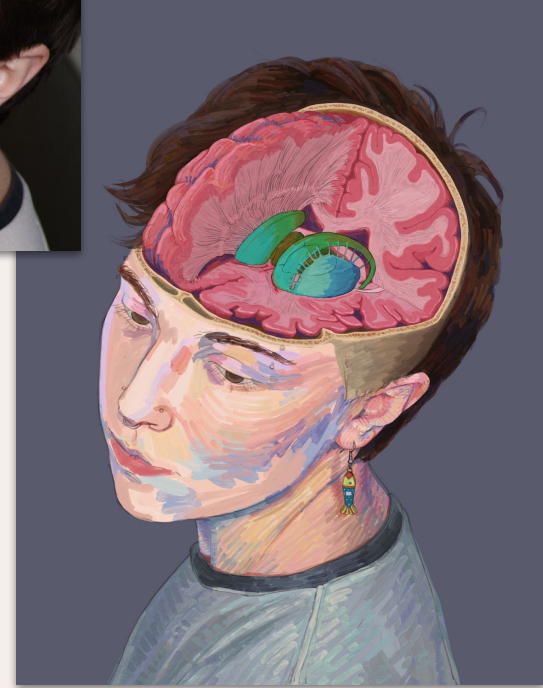
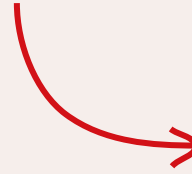
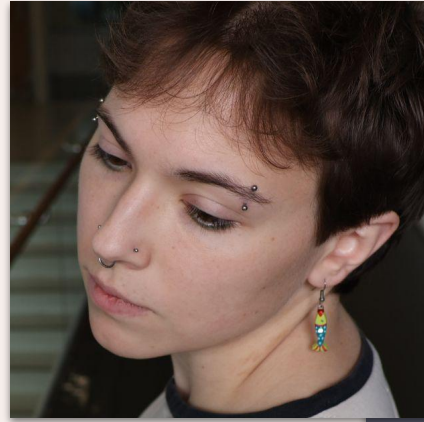


Polymer clay maquette shows parasagittal dissection is mostly shaded from this angle

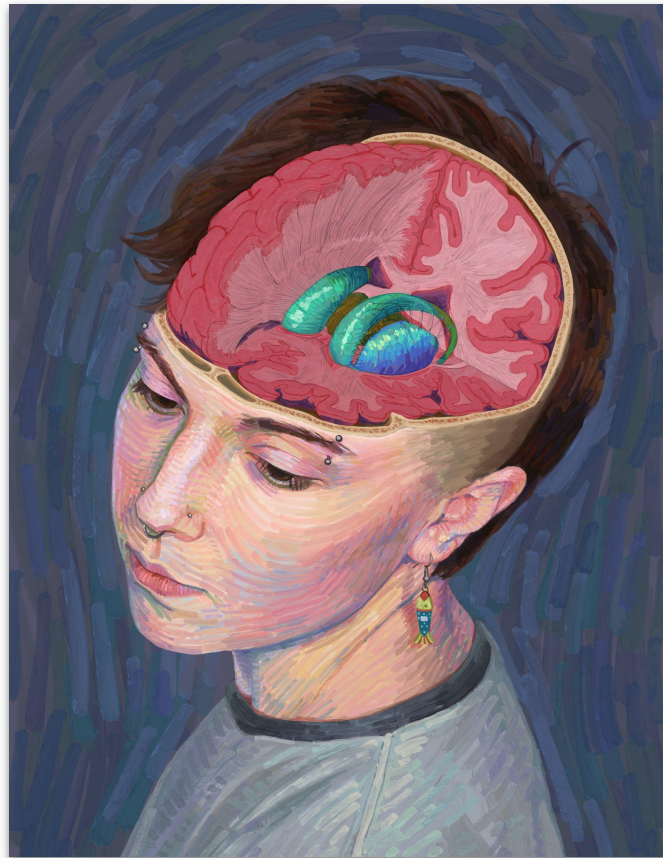
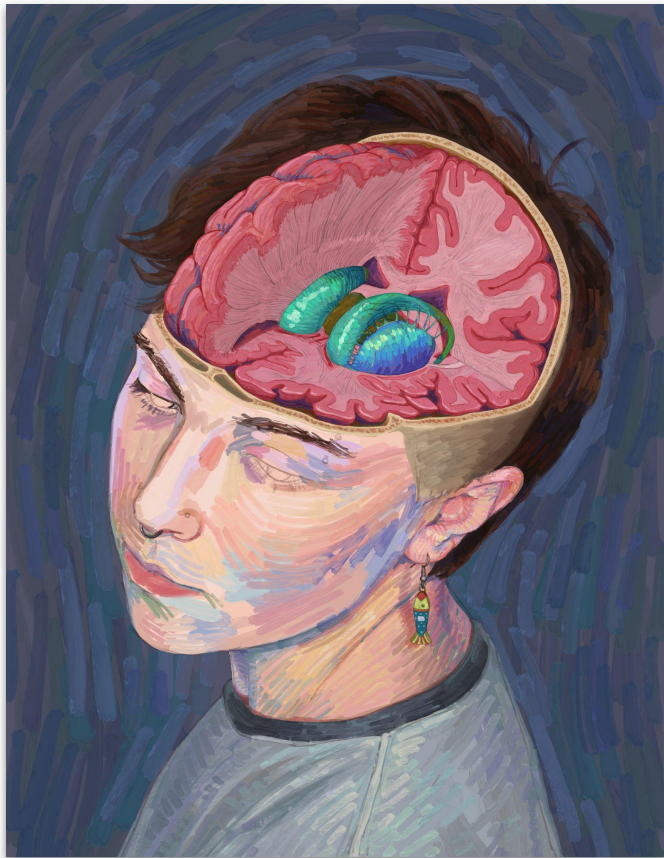
# Rendering

## Workflow (round two)

1. Got stuck in a sand trap of editing and re-editing brain sketch
2. Had to remove myself and work on painting shirt, face, and hair
3. Colour sampled from ref image
  - Pushed saturation + brightness
  - Shifted hue slightly to favour blue and pinks

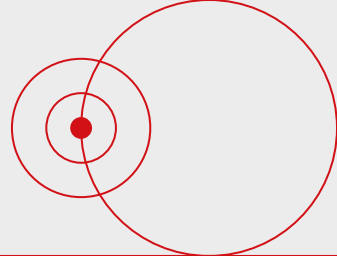


Reference image to painting workflow



Some process shots

# Rendering



## Feedback

- Asked for feedback before finishing off the brain render, got the following comments:
  - Darken the corona radiata face and lighten the gyri
  - Give the frontal sinuses a more mucosal tinge
  - Add some reflected blue/green light on the corona radiata from the basal ganglia

## My edits

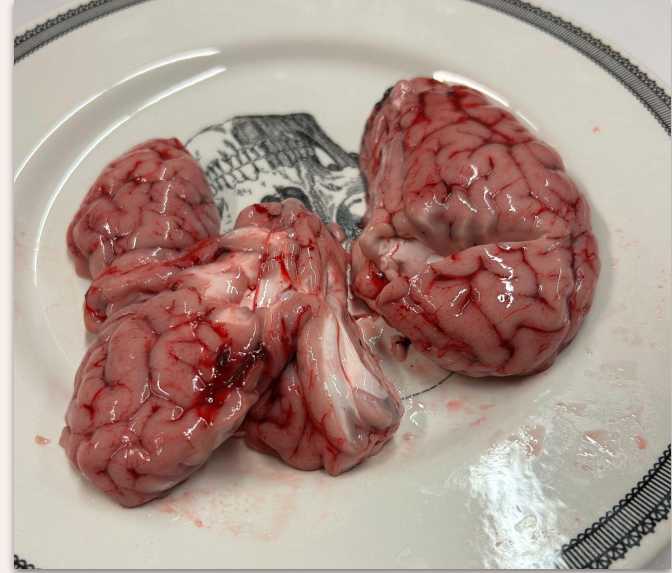
- Gyri were not accurate and I needed to resketch them

# Rendering - Gyri

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## Workflow (round 3)

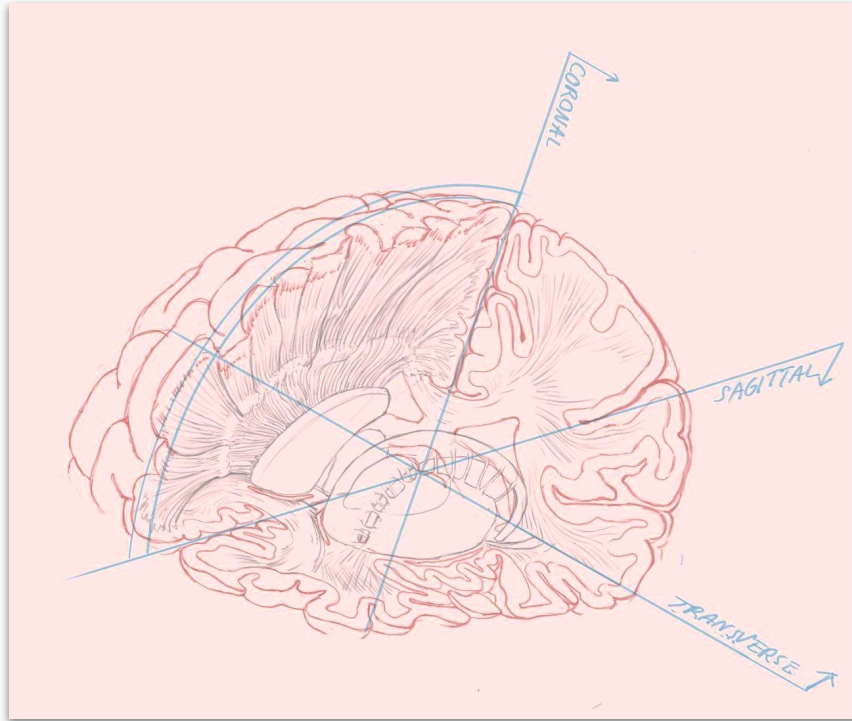
- Portraying gyri accurately was quite a challenge for me
- It is easy to recognize when the form is even slightly off, but difficult to pinpoint what about it is wrong
- This is true of many subjects but gyri have an especially low threshold
- Re-sketched right hemisphere to recreate the superior frontal gyrus more clearly with more reference images and many, many retries



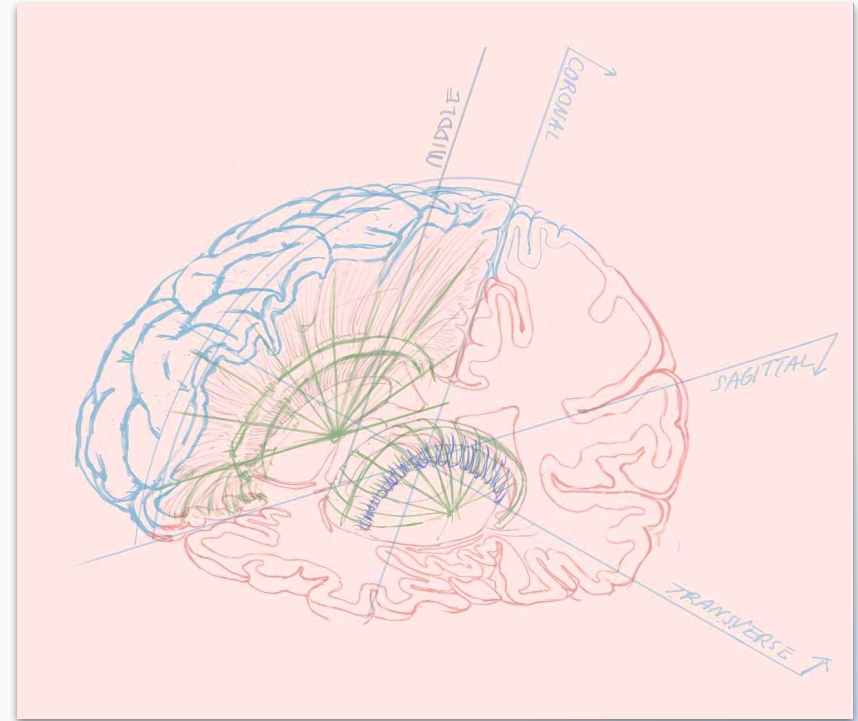
Gyri from a veal brain



**Before**



**After**

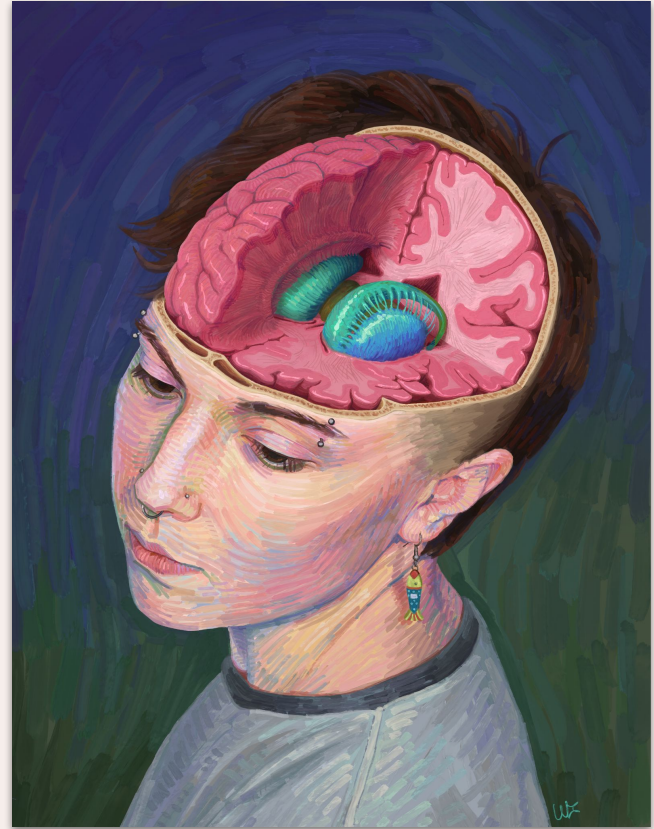


Before vs after resketching the gyri. I sketched radial perspective guides (in green) to help develop the shape of corona radiata and CLGBs

# Rendering

## Final Piece

- Rendered corona radiata with a variety of tones (which ended up getting lost in the cast shadow 😞)
- Created fine, wispy CLGBs
- Added detail to white matter of cut faces of hemispheres + specularity for “wet” effect
- Increased saturation + brightness of hemispheres to improve contrast with CLGBs



Final Piece



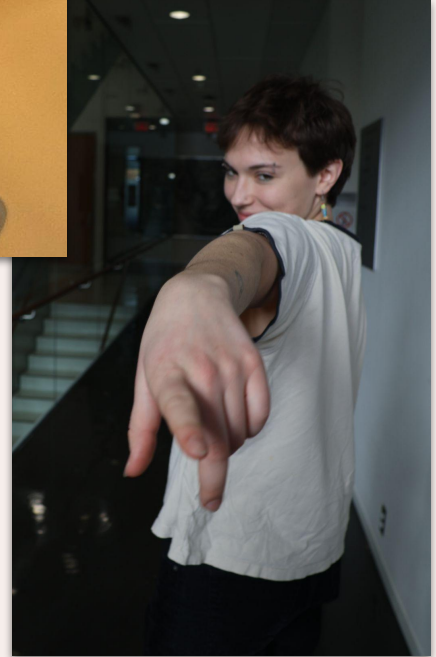


Close-ups of some details I enjoyed rendering

# Reflections

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- It was worth it to take my time finding a rendering style that I love
- The form of the corpus callosum is might be somewhat inaccurate, potential fix for the future
- Building a physical maquette is always a good idea
- Leaving a reference dossier to the last minute is not
- Nobody seems to agree on what the basal ganglia look like



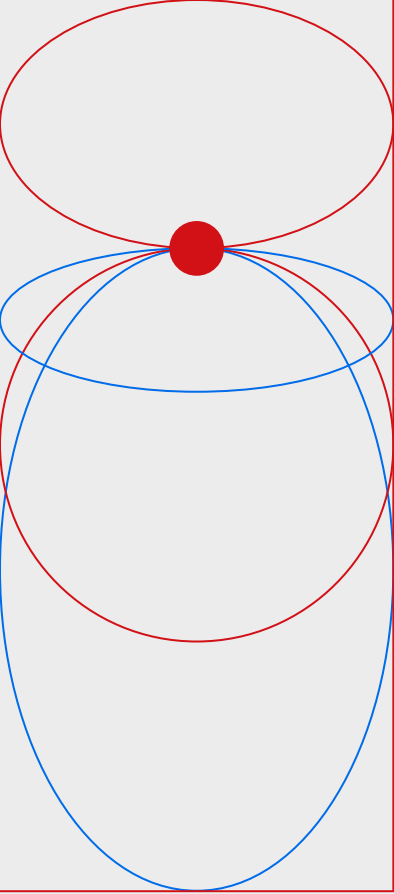
## 6. References

*All visual references can be found on my [Figma board](#)*

# References

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1. Dang, B., Necker, F. N., Dhawan, S. S., Murty, T., & Massoud, T. F. (2023). Caudolenticular gray bridges of the brain: A magnetic resonance imaging study. *Clinical Anatomy*, 36(4), 669–674. <https://doi.org/10.1002/ca.24026674>
2. Little, G., Poirier, C., Bore, A., Parent, M., Petit, L., & Descoteaux. (2025). Mapping caudolenticular gray matter bridges in the human brain striatum through diffusion magnetic resonance imaging and tractography. *Human Brain Mapping*, 46(8). [10.1002/hbm.70245](https://doi.org/10.1002/hbm.70245)
3. Nieuwenhuys, R., Voogd, J., & Huijzen, C. (2008). *The human central nervous system: A synopsis and atlas*. Steinkopff Heidelberg. (4th ed.).  
<https://doi.org/10.1007/978-3-540-34686-9>



*Thank  
you!*