Does Diet Effect the Brain?

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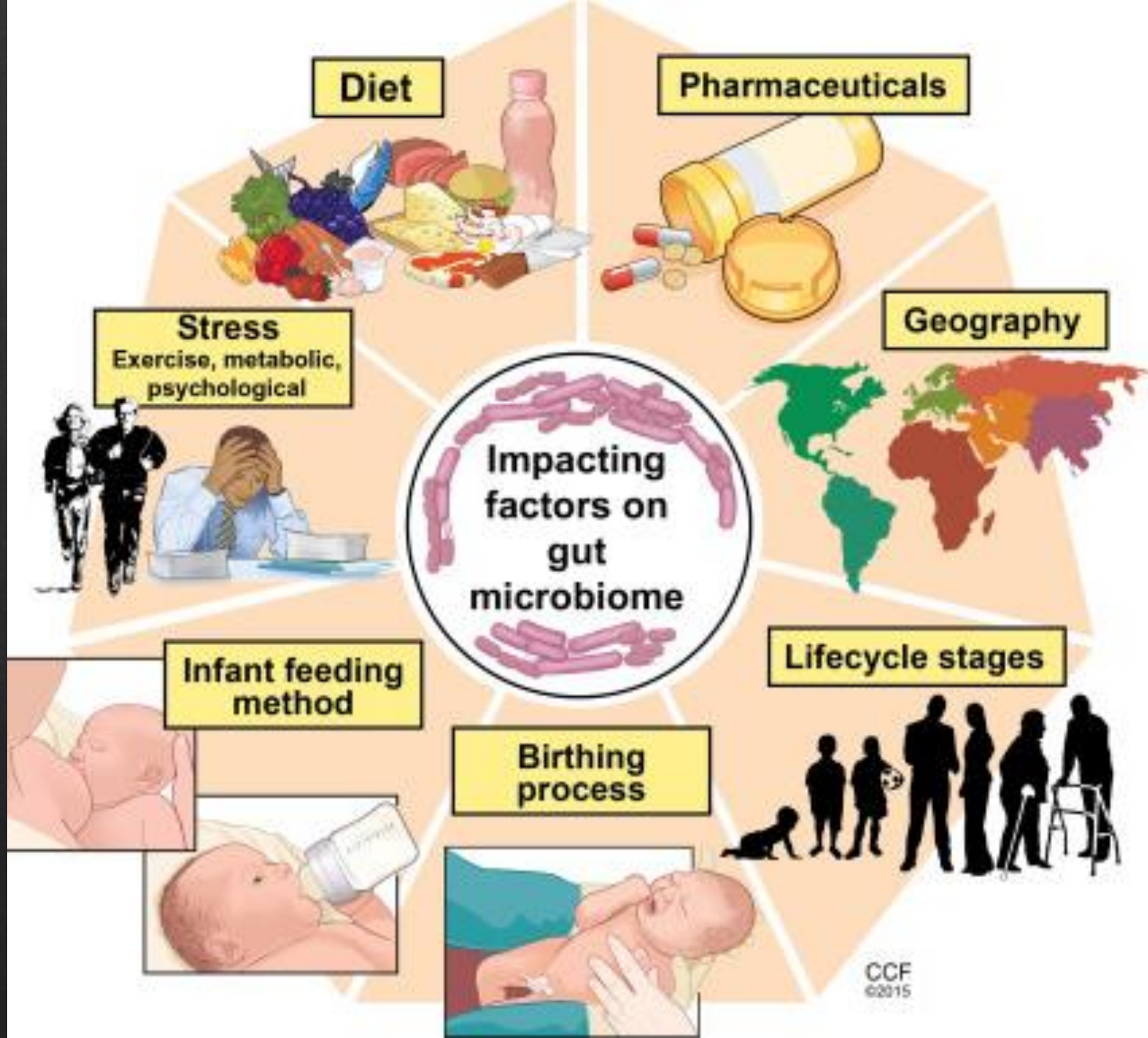
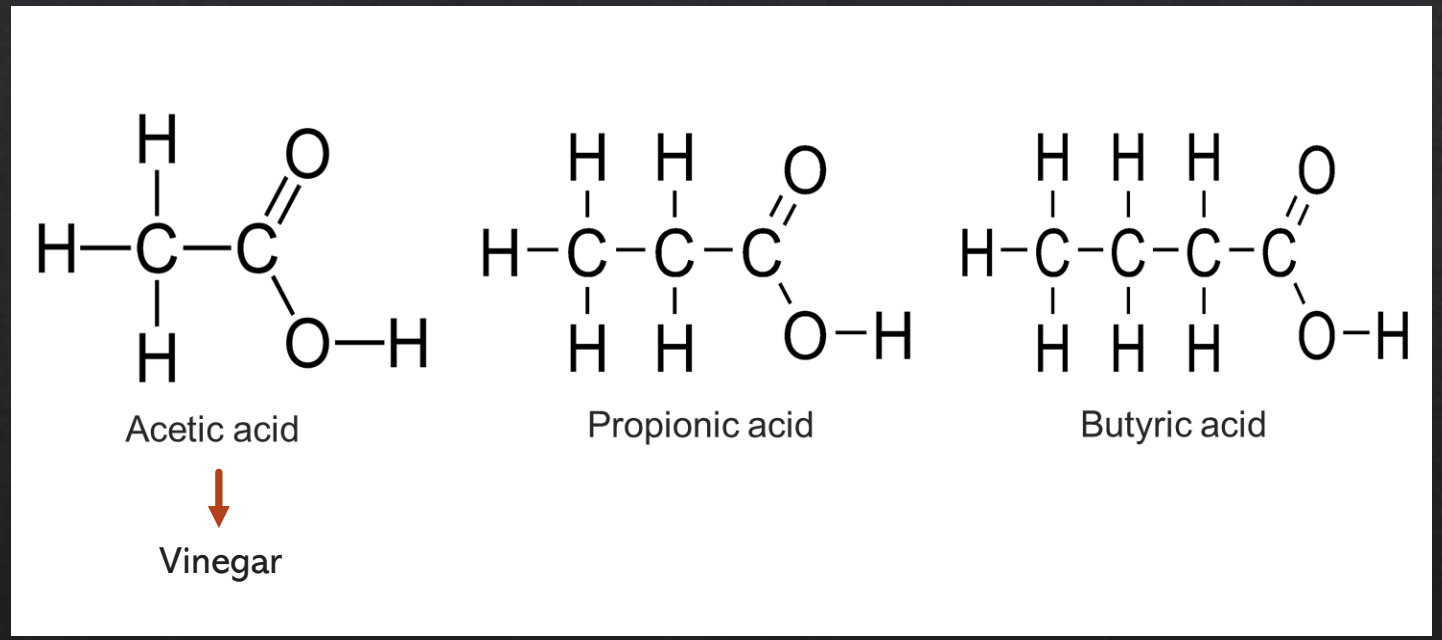
The Gut Microbiome



Gail A.M. Cresci PhD, RDN, CNSC, Kristin Izzo MS, RDN, CNSC, in Adult Short Bowel Syndrome, 2019

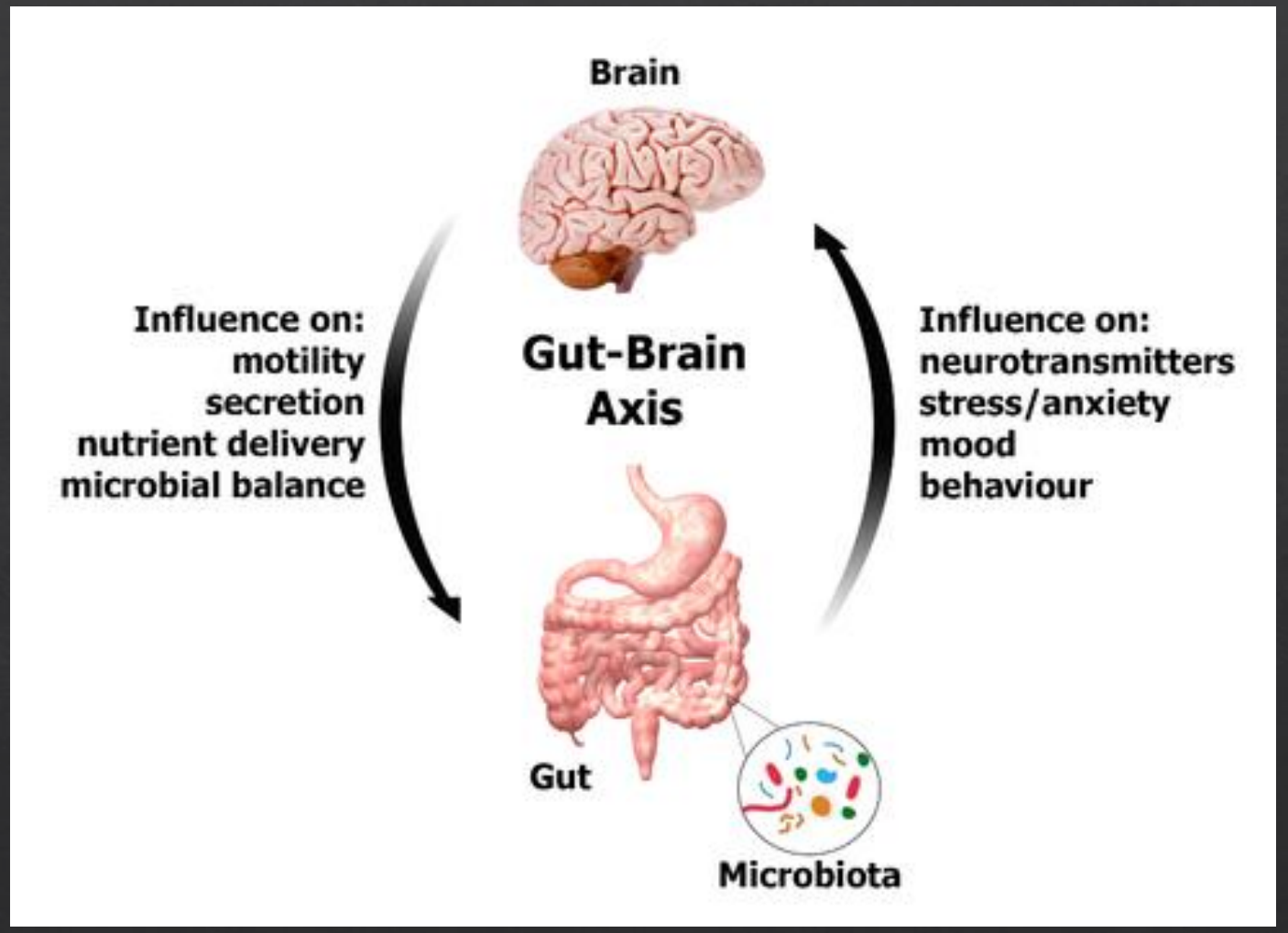
Short-Chain Fatty Acids (SCFAs) and the Gut Microbiome

- Produced via fermentation
- Amount of SCFAs are based on:
  - Dietary fiber, microbiota, gut transit time
- Preventative of Type 1/2 diabetes, liver cirrhosis, IBDs



What does this have to do with the brain?

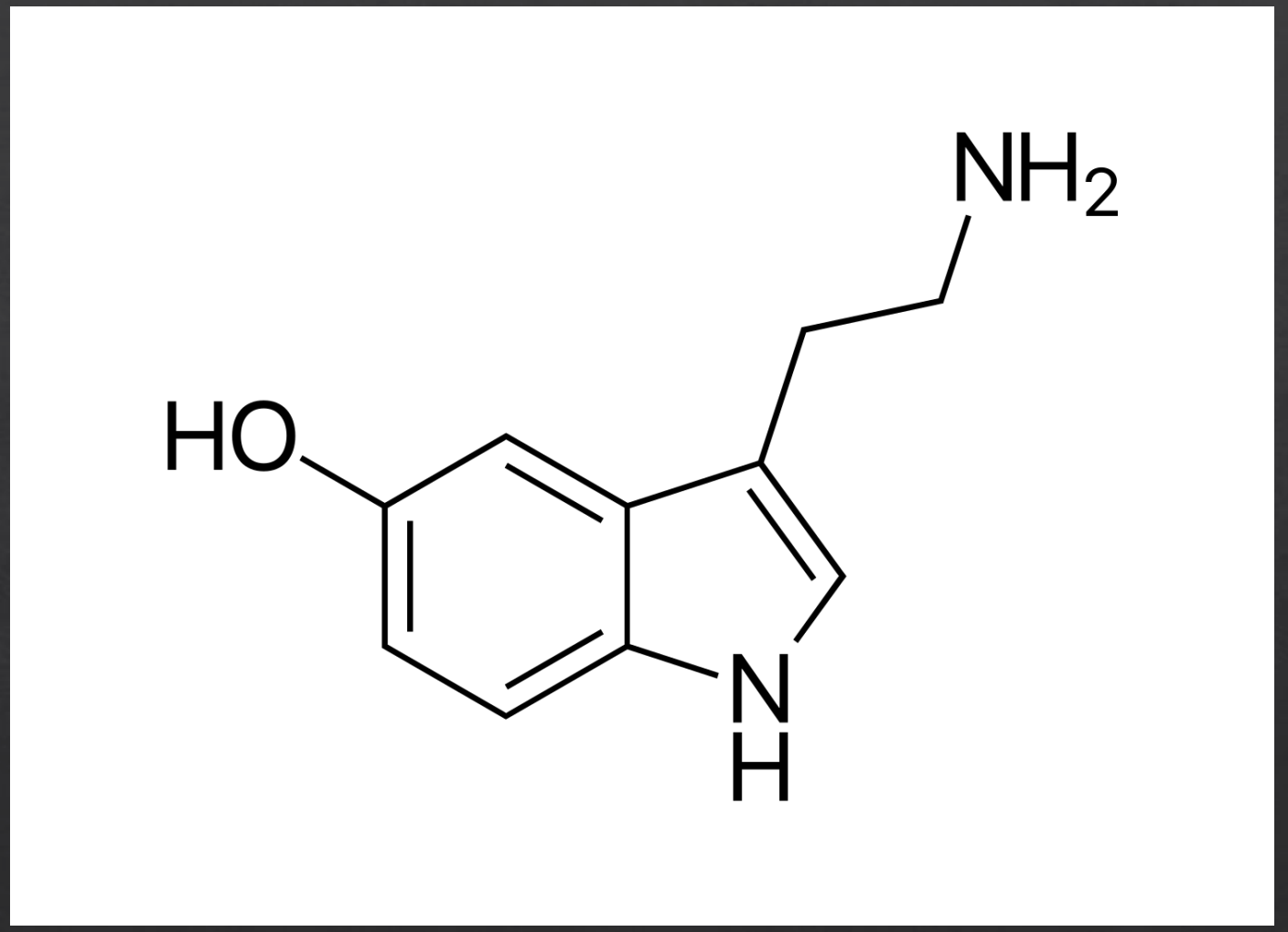
- Connected to…
  - Anxiety
  - Autism
  - Schizophrenia
  - Depression
  - ADHD
  - Alzheimer's
  - Parkinson's
  - Mood disorders



https://www.pacificnaturalmedicine.com/post/the-gut-brain-axis

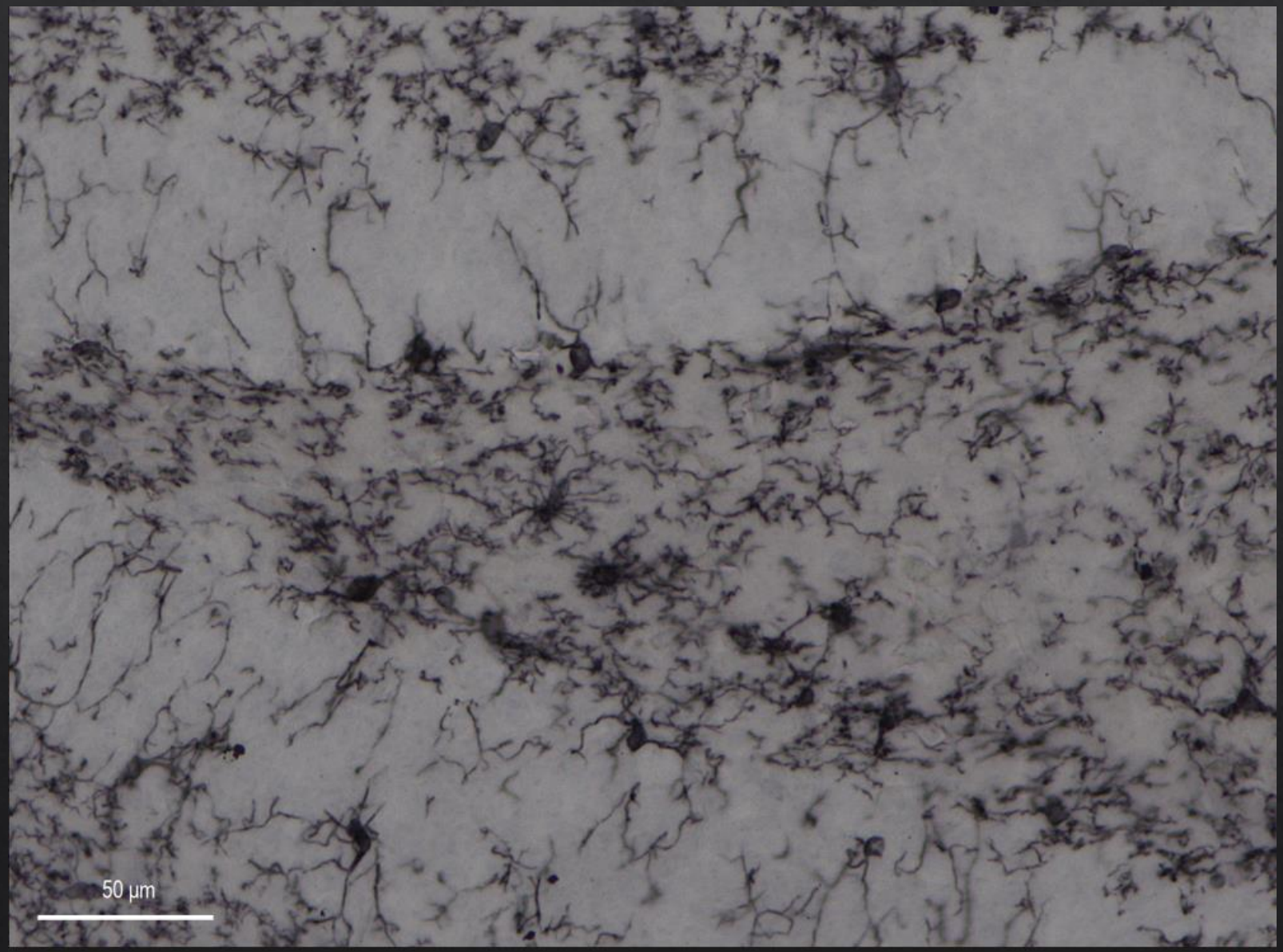
Serotonin

- Neurotransmitter important for:
  - Mood stabilization
  - Learning and memory
  - Appetite
  - Motor control
  - Sleep
- ~95% produced in the gut
  - Found in raphe nuclei in the brain



Microglia

- Immune cells of the brain
  - Help with brain development
  - Sensitive to environment
  - Dysregulation: Alzheimer's, Parkinson's, behavioral issues
- Inflammation in the gut is correlated with inflammation in the brain.



The current study

- Collaboration with Hintze and Ward Labs
- 7 groups of 12 mice were fed the diets shown here for 16 weeks
- Euthanized and brains were extracted and fixed
- Brains were sectioned at 40 um on a cryostat and mounted to slides.
- Slides were refrigerated prior to use in gene expression assays.

Diet	Fat Content	Ingredients	Description
CHOW	5%	whole food	50g /1000 kcal fiber (Negative Control)
LFC	5%	semi purified	Cellulose only (Negative Control)

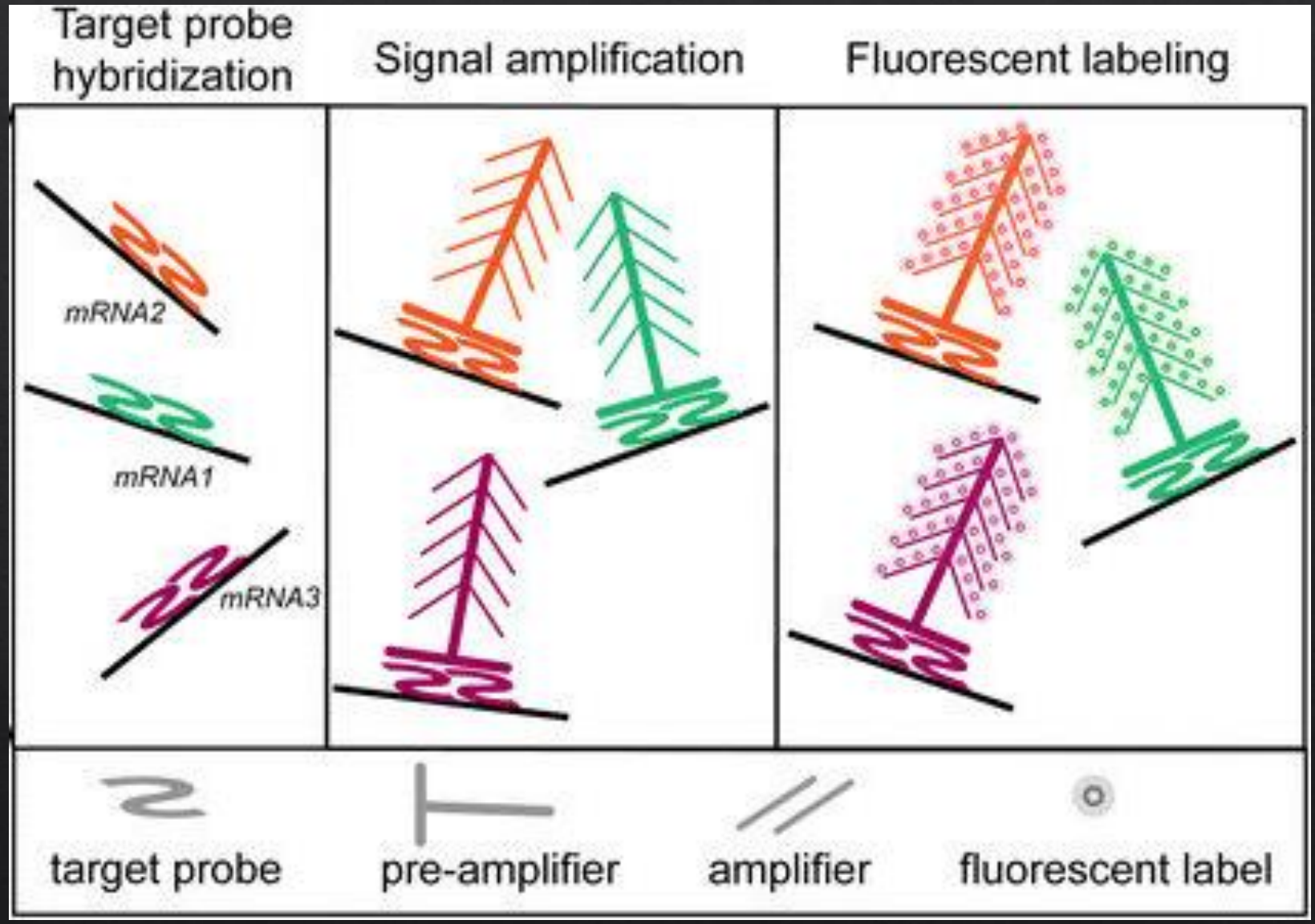
Diet	Fat Content	Ingredients	Description
DIO	45%	semi purified	58g/kg cellulose only (Positive Control)
HFI	45%	semi purified	14g/1000 kcal fiber (80:20 insoluble: soluble)
HFS	45%	semi purified	14g/1000 kcal fiber (20:80 insoluble: soluble)
LFI	45%	semi purified	8.4g/1000 kcal fiber (80:20 insoluble: soluble)
LFS	45%	semi purified	8.4g/1000 kcal fiber (20:80 insoluble: soluble)

Gene Targets

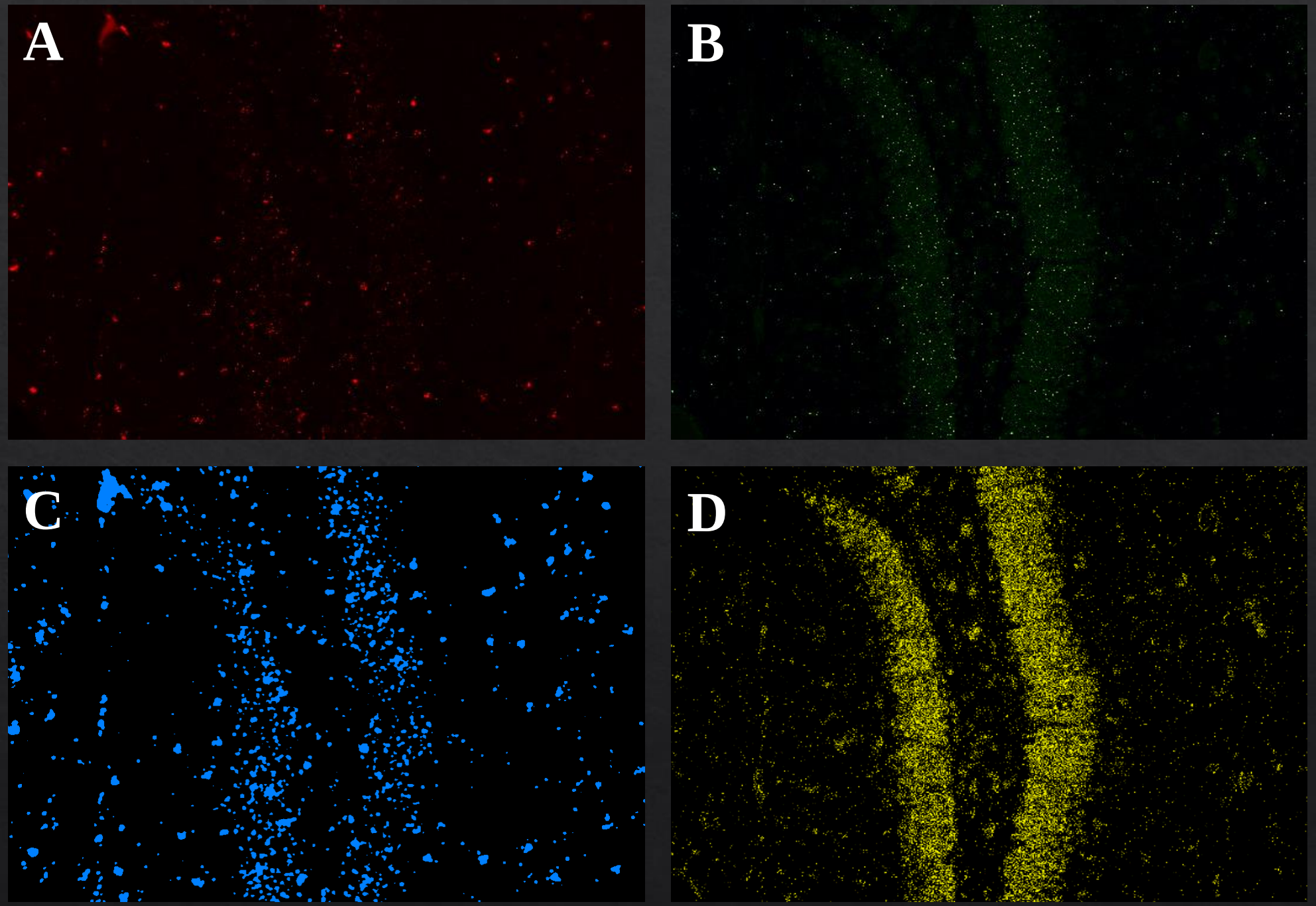
- SCFAs → FFAR3
- Serotonin → TPH-2
- Microglia → AIF-1

Methods: Fluorescent *in situ* Hybridization

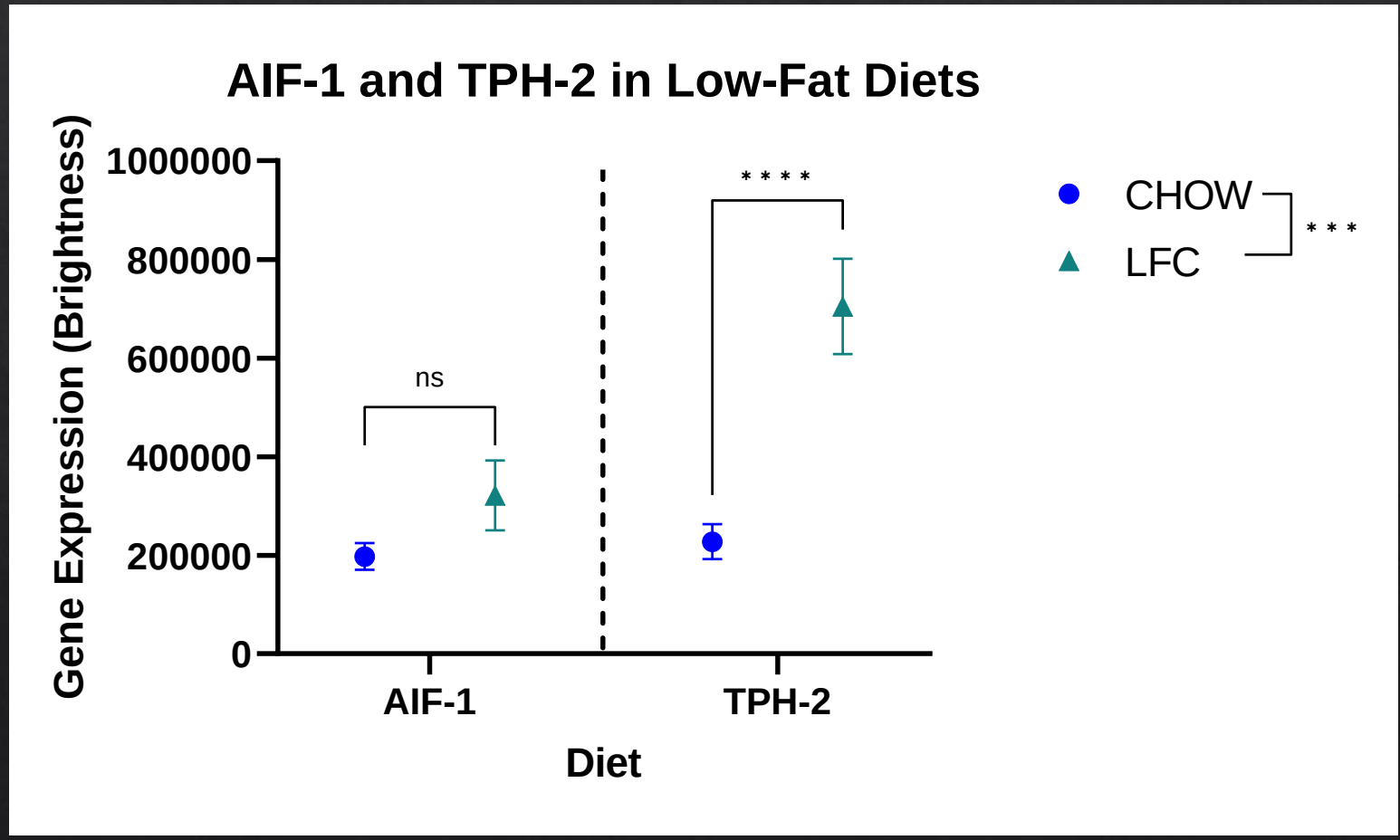
- Visualizes mRNA for genes of interest in tissue sections
- Used to measure gene expression
- Can visualize multiple targets in the same tissue
- TPH-2 (red) + FFAR3 (green)
- AIF-1 (red) +FFAR3 (green)



Simultaneous high-resolution detection of multiple transcripts combined with localization of proteins in whole-mount embryos - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/The-RNAscope-principle-Target-probe-hybridization-Sets-of-oligonucleotide-probes_fig1_264833304 [accessed 6 Apr, 2023]


A
B
C
D

What We Found



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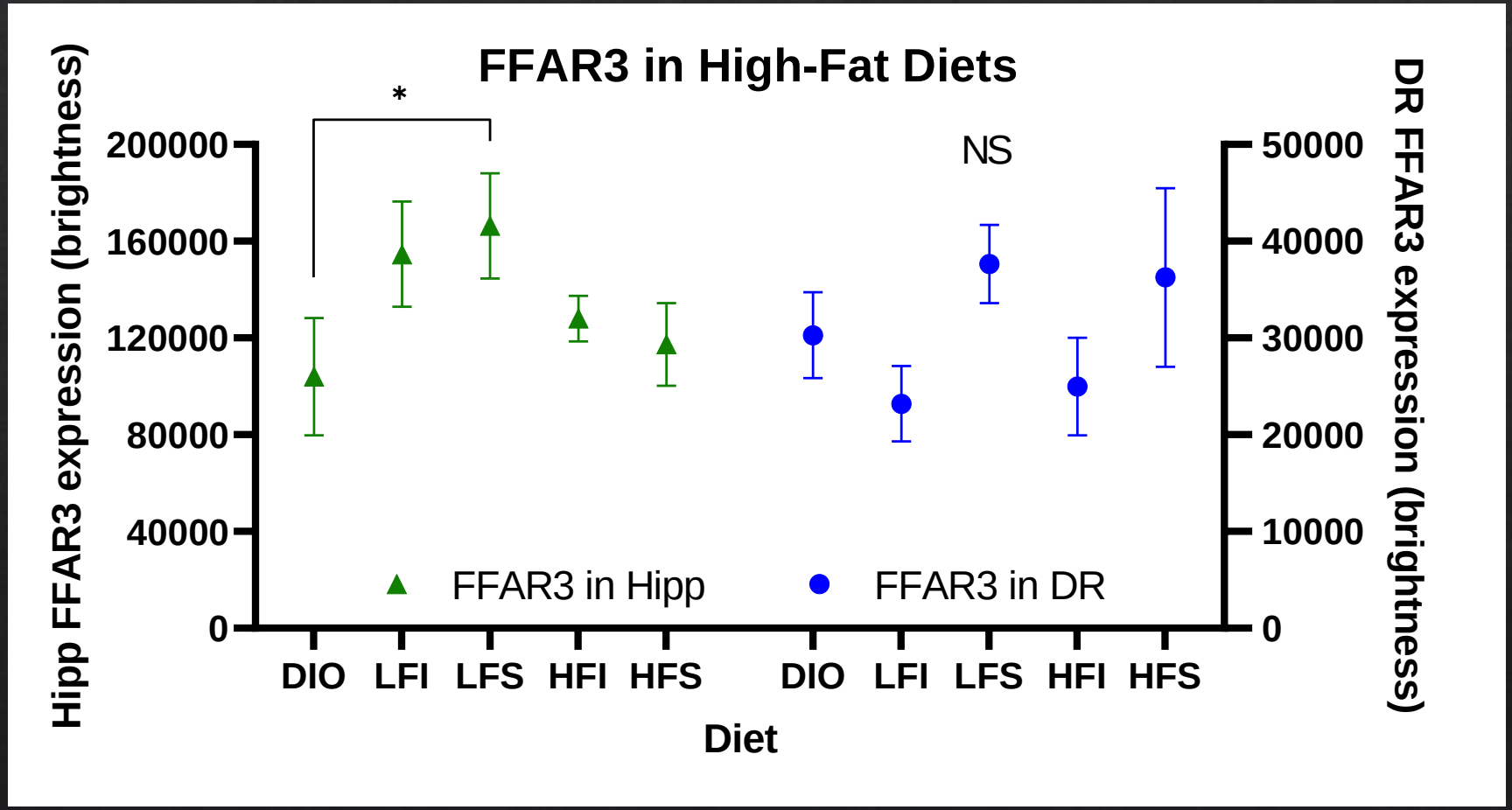

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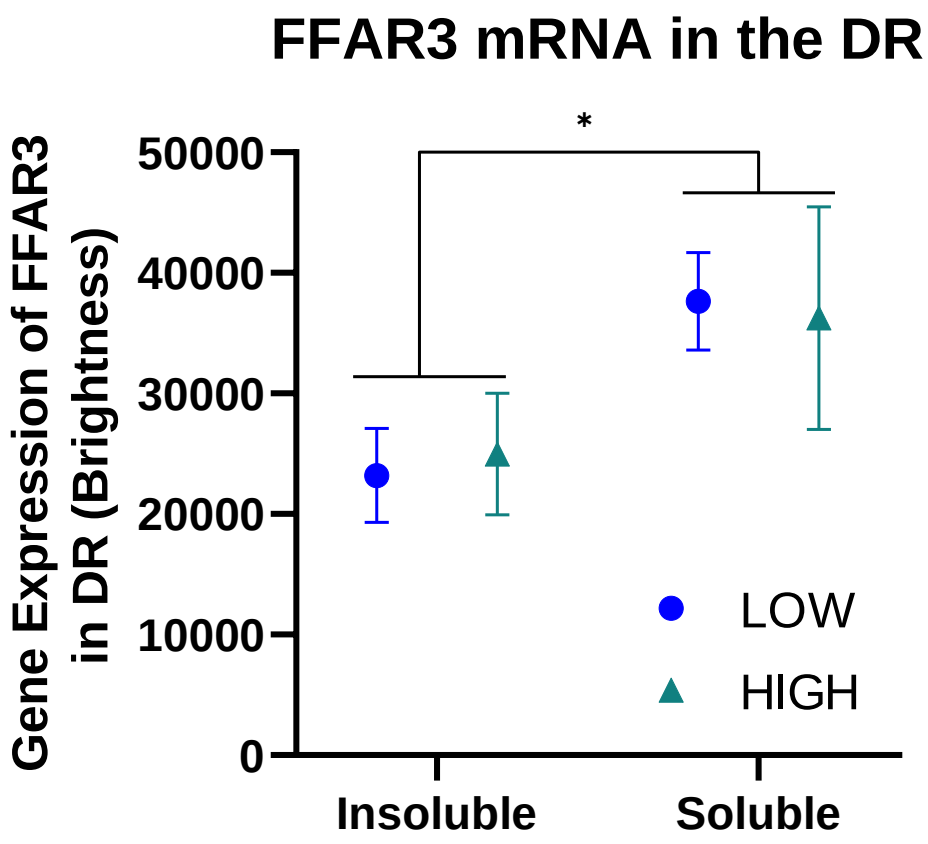
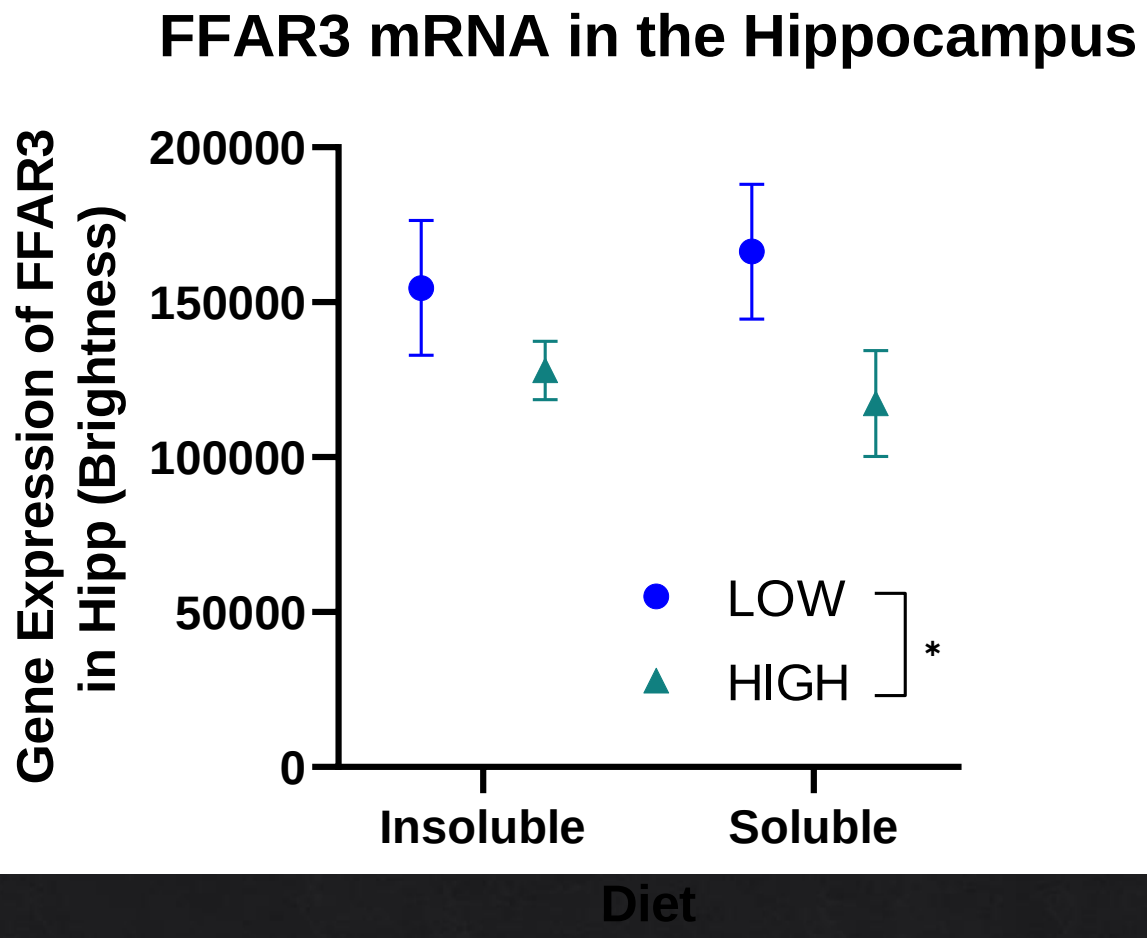




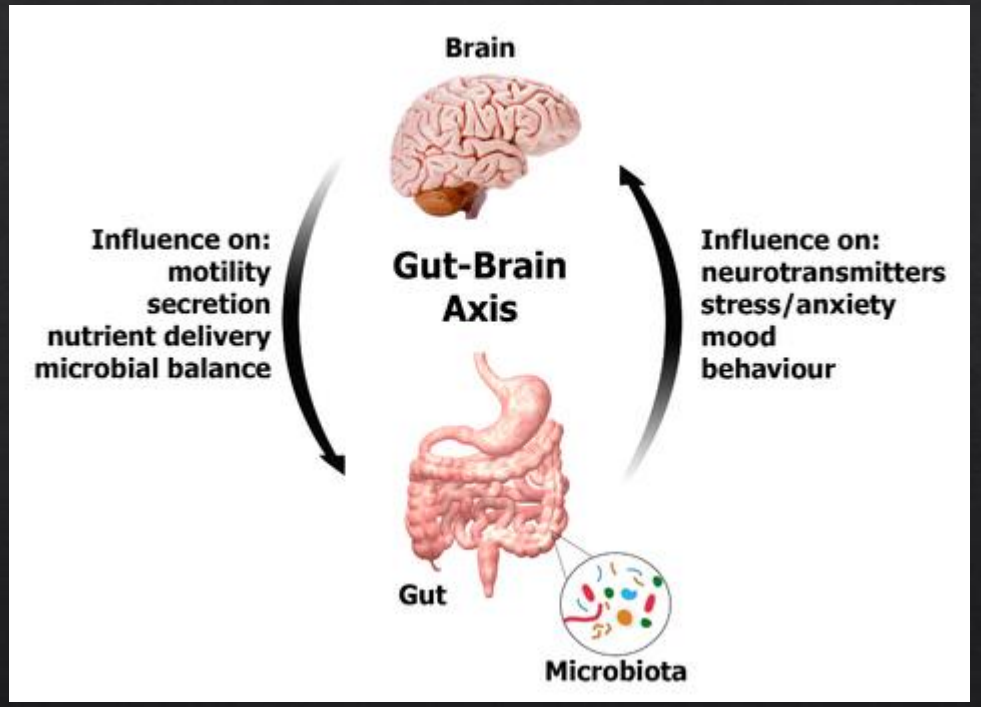
So what does it all mean?

SCFA receptors are in the hippocampus and dorsal raphe

Found on important cells for brain health

Dietary fiber can be used to change the brain

Treatments for mental health



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