Sensation, Reward, and the Gut-Brain Axis

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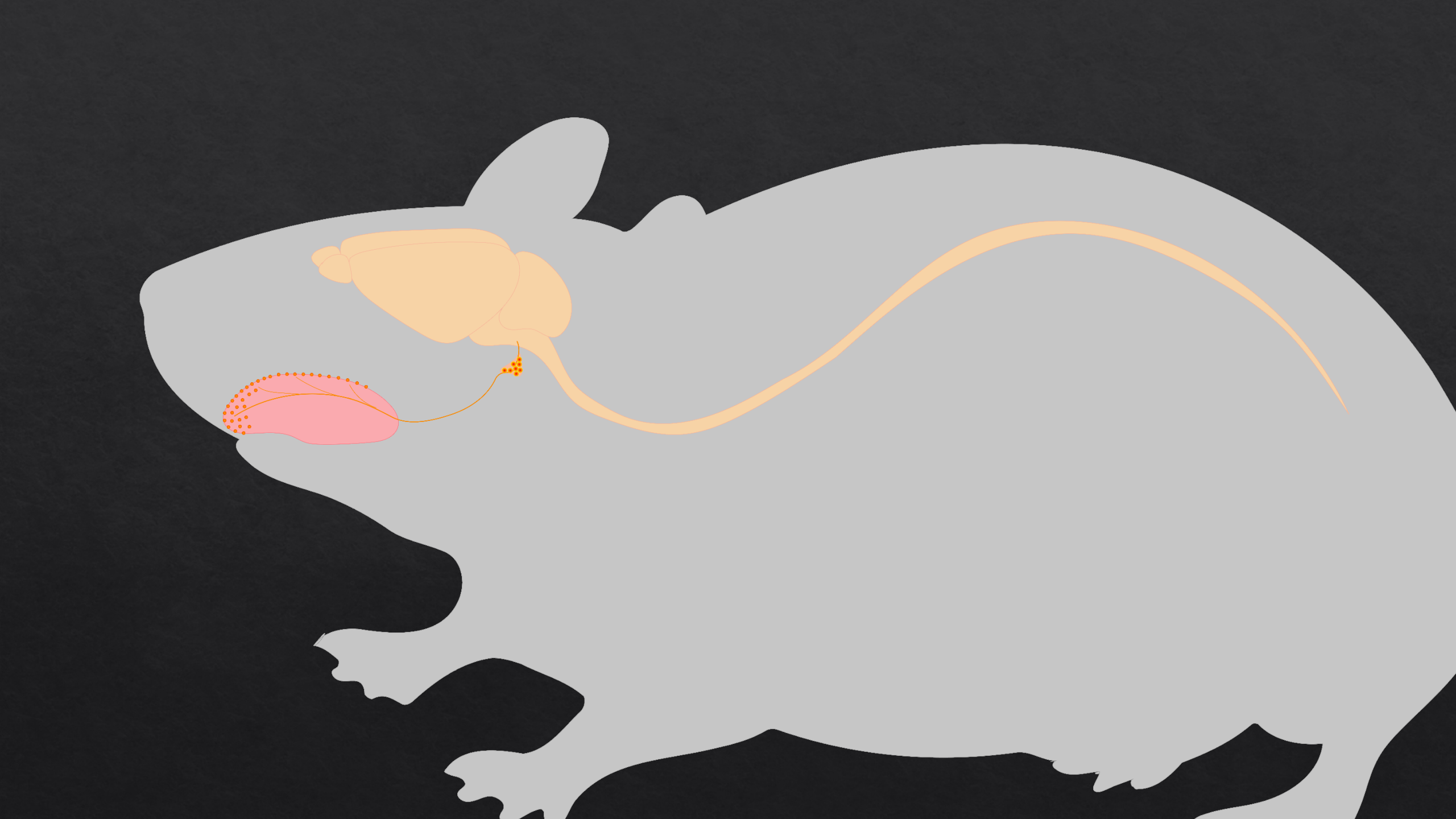
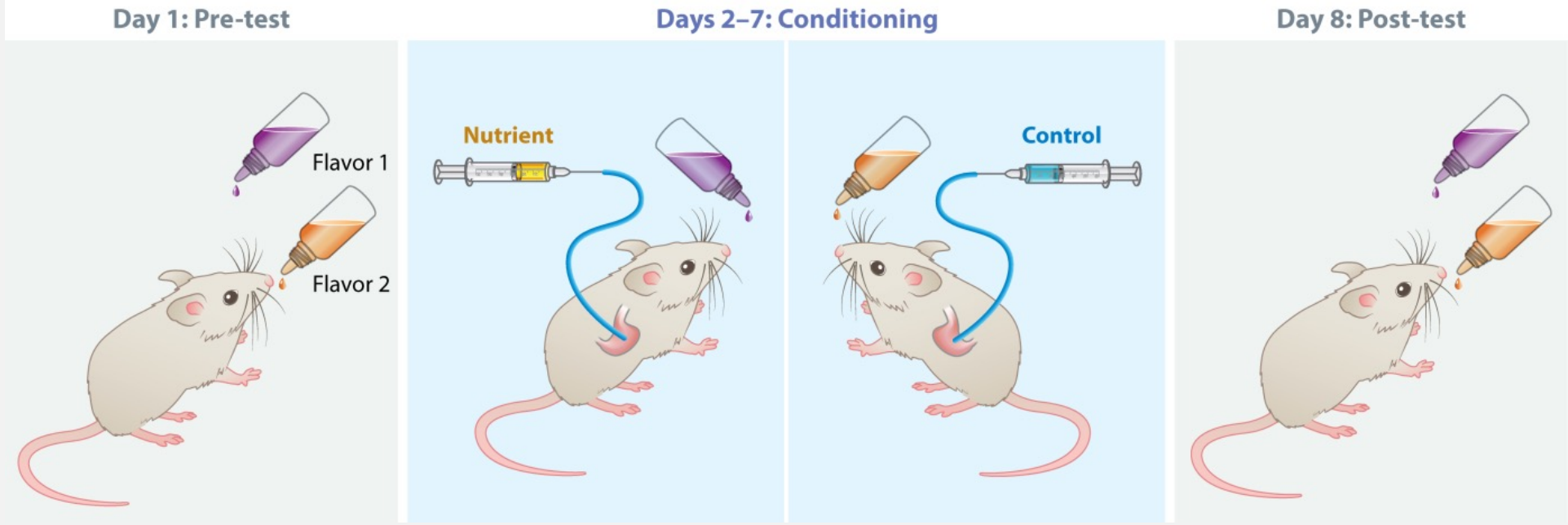
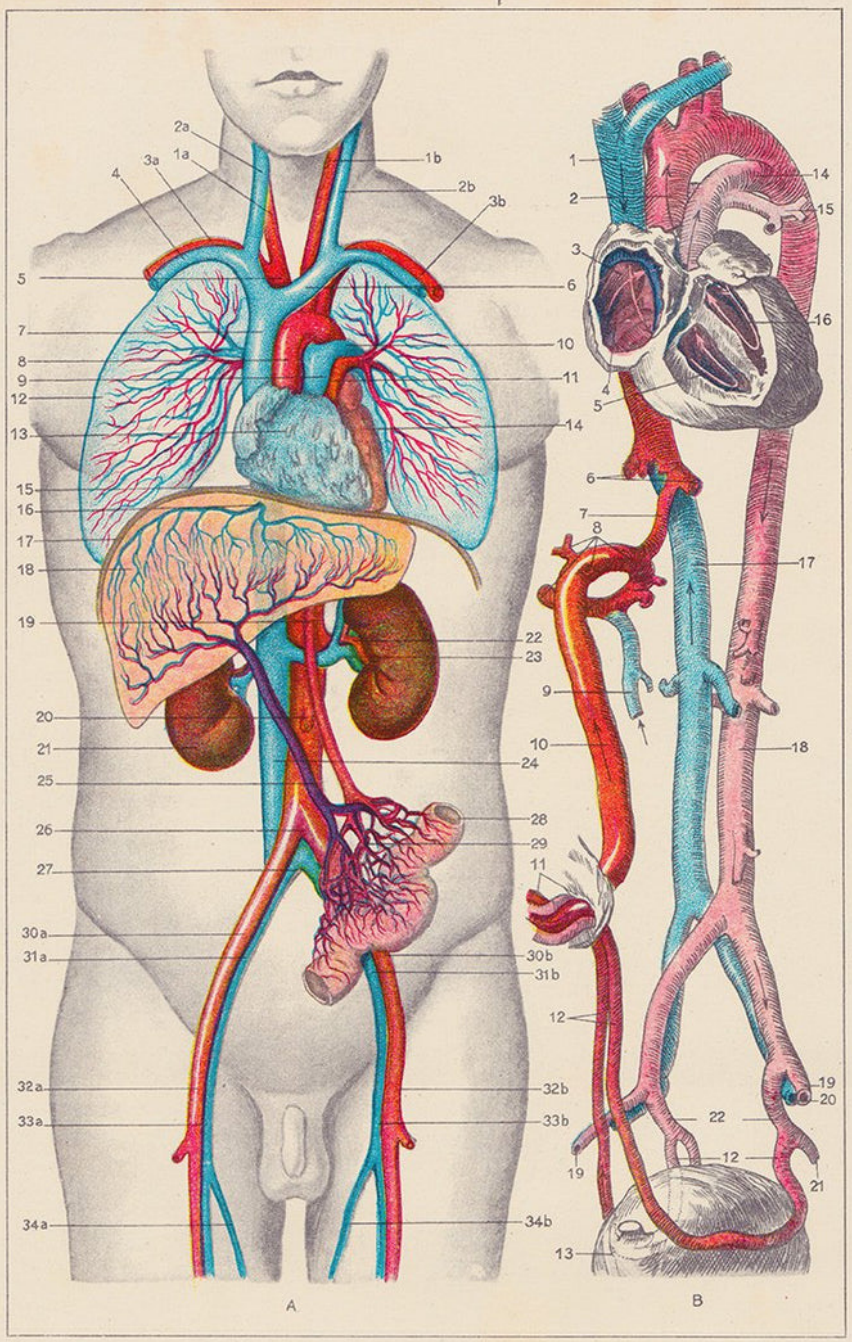
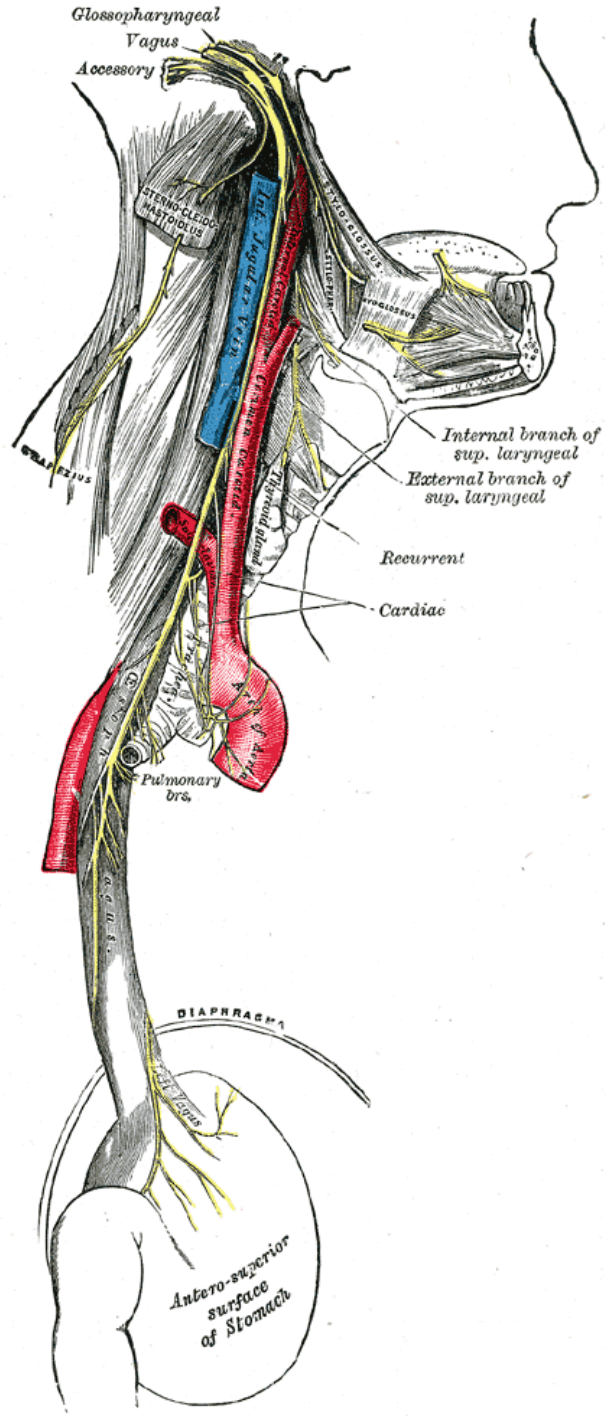
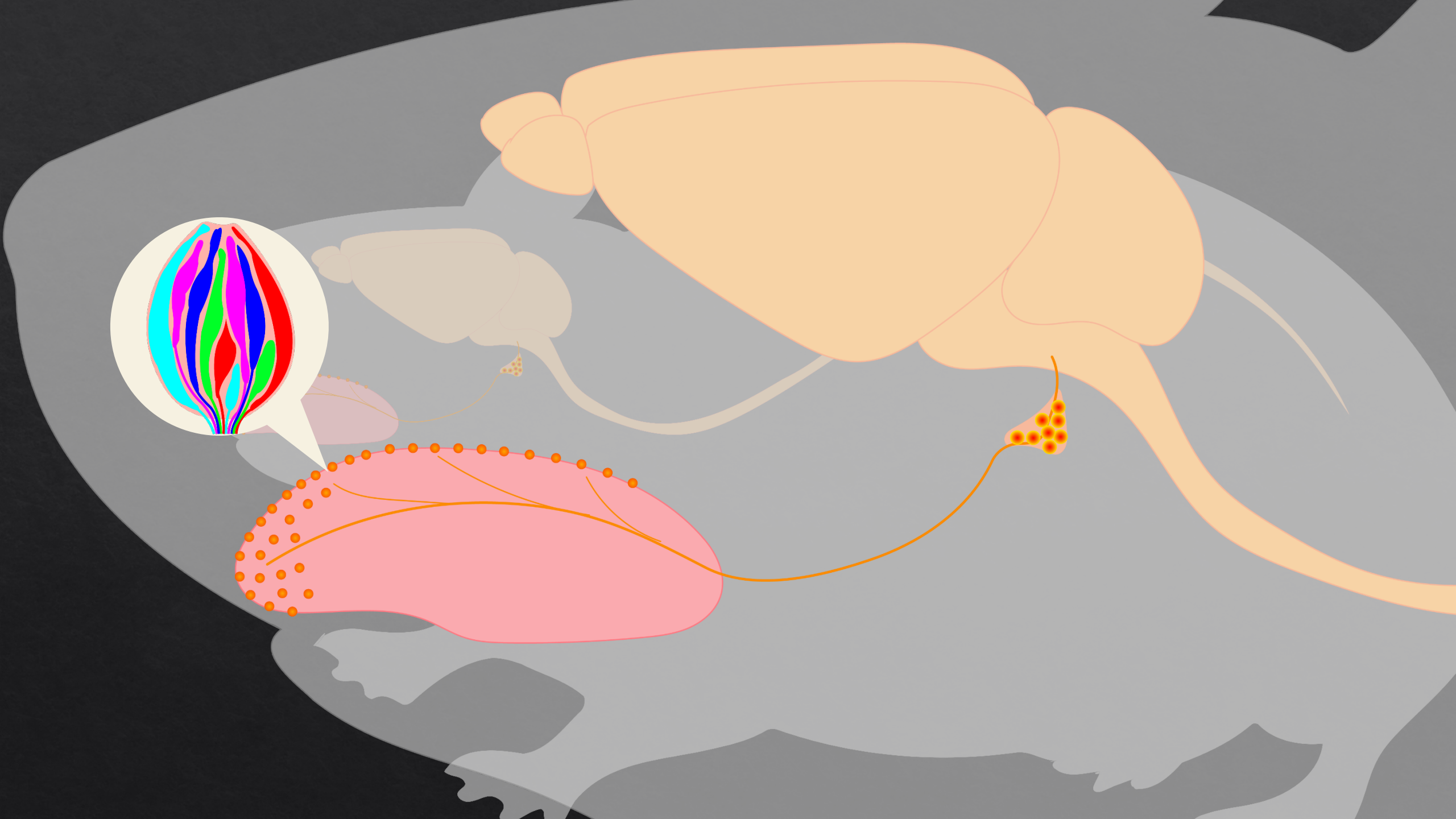


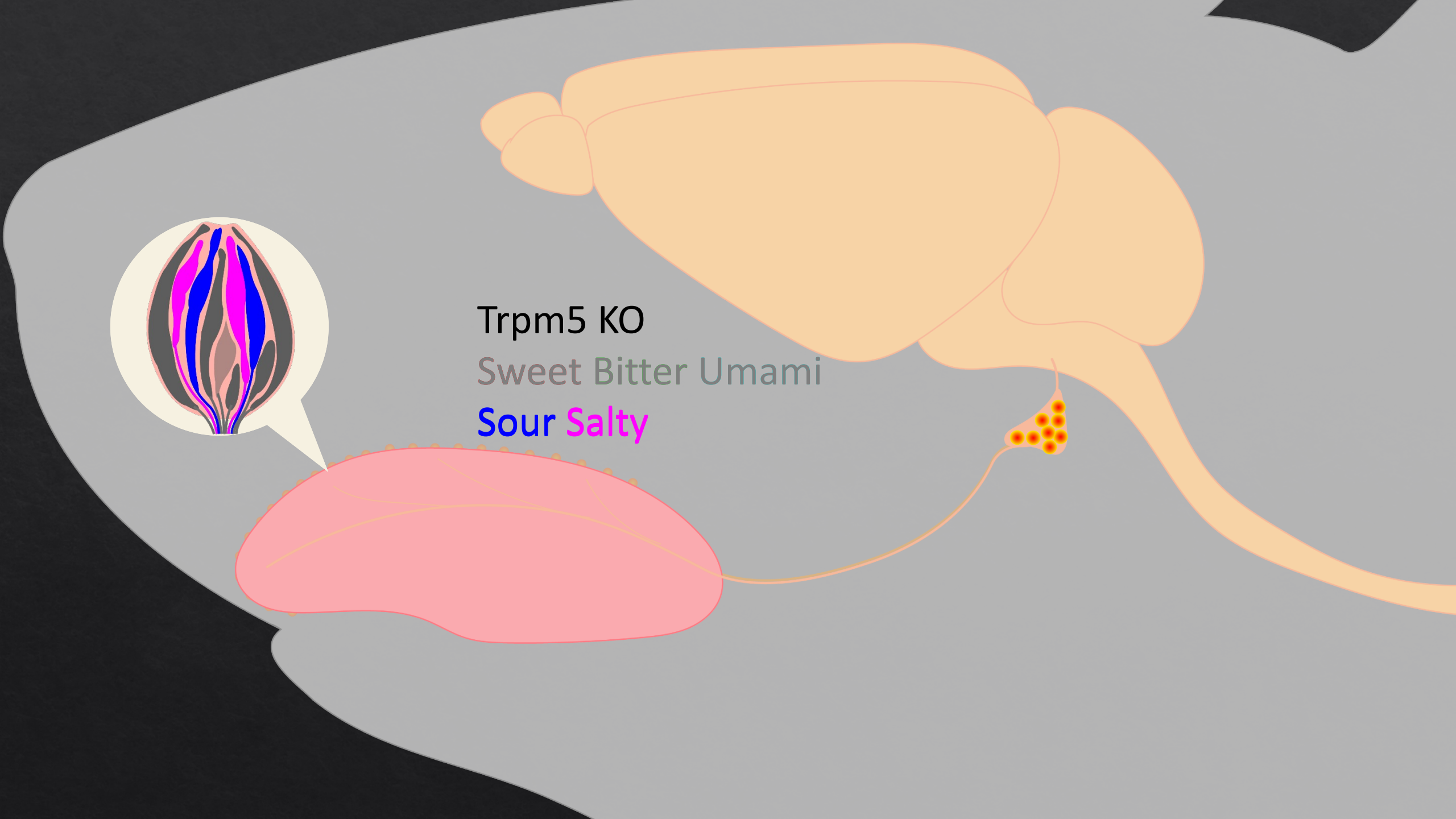

Day 1: Pre-test
Days 2–7: Conditioning
Day 8: Post-test
Flavor 1
Flavor 2
Nutrient
Control

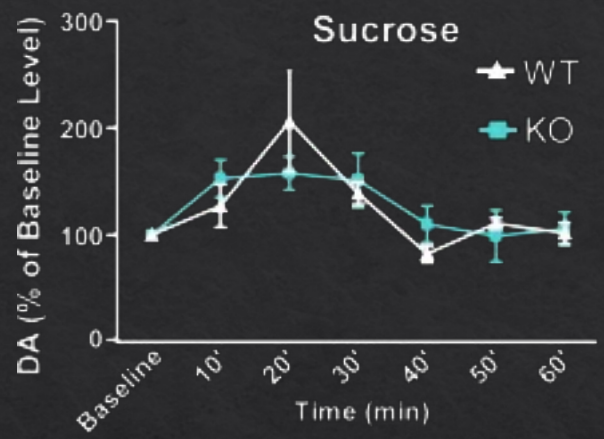
Blutkreislauf II.

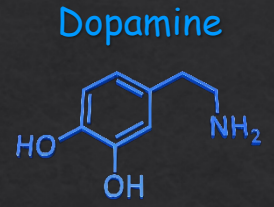



Glossopharyngeal
Vagus
Accessory
Internal branch of sup. laryngeal
External branch of sup. laryngeal
Recurrent
Cardiac
Pulmonary brs.
DIAPHRAGM
Antero-superior surface of Stomach



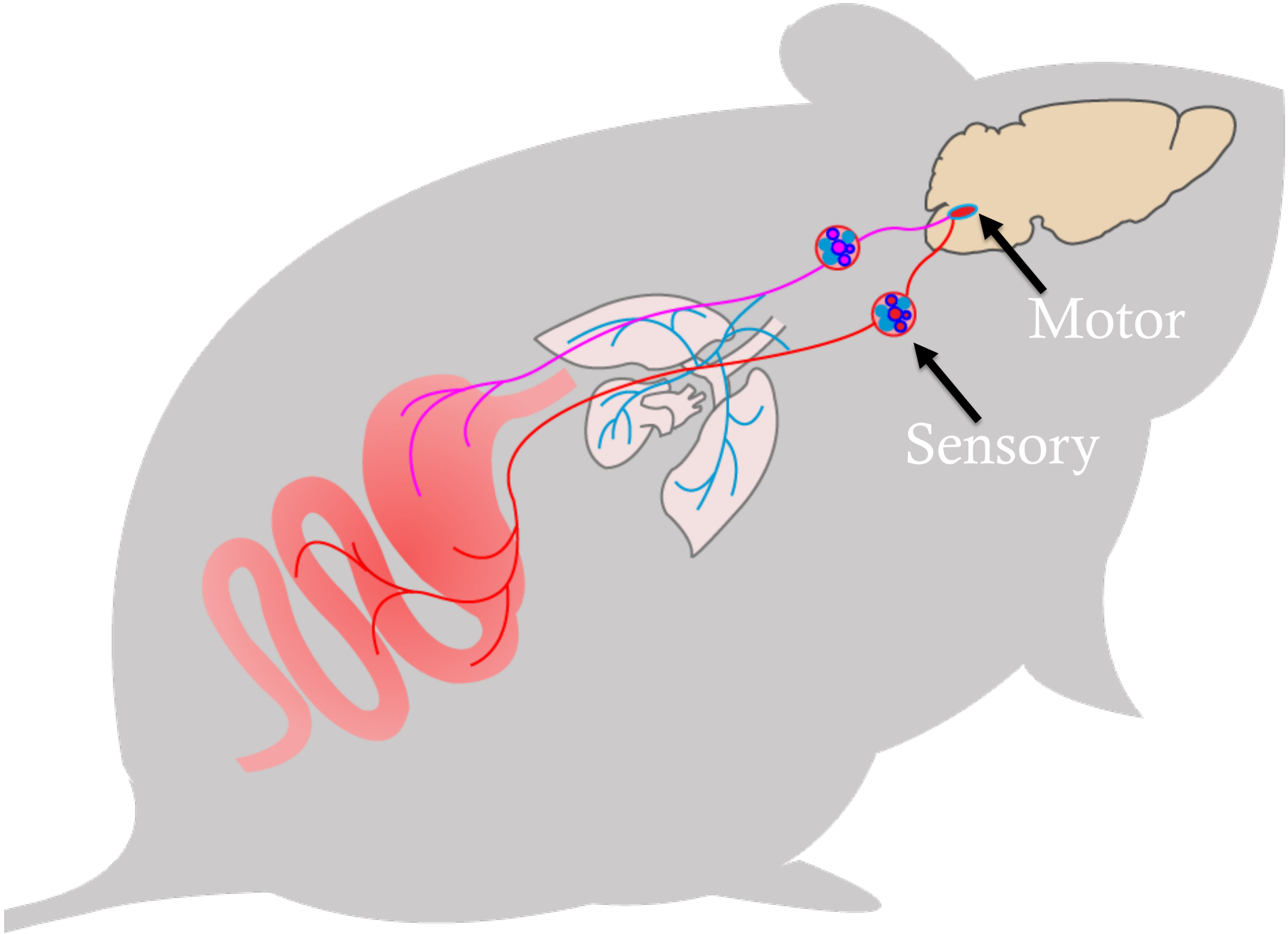

Trpm5 KO
Sweet Bitter Umami
Sour Salty

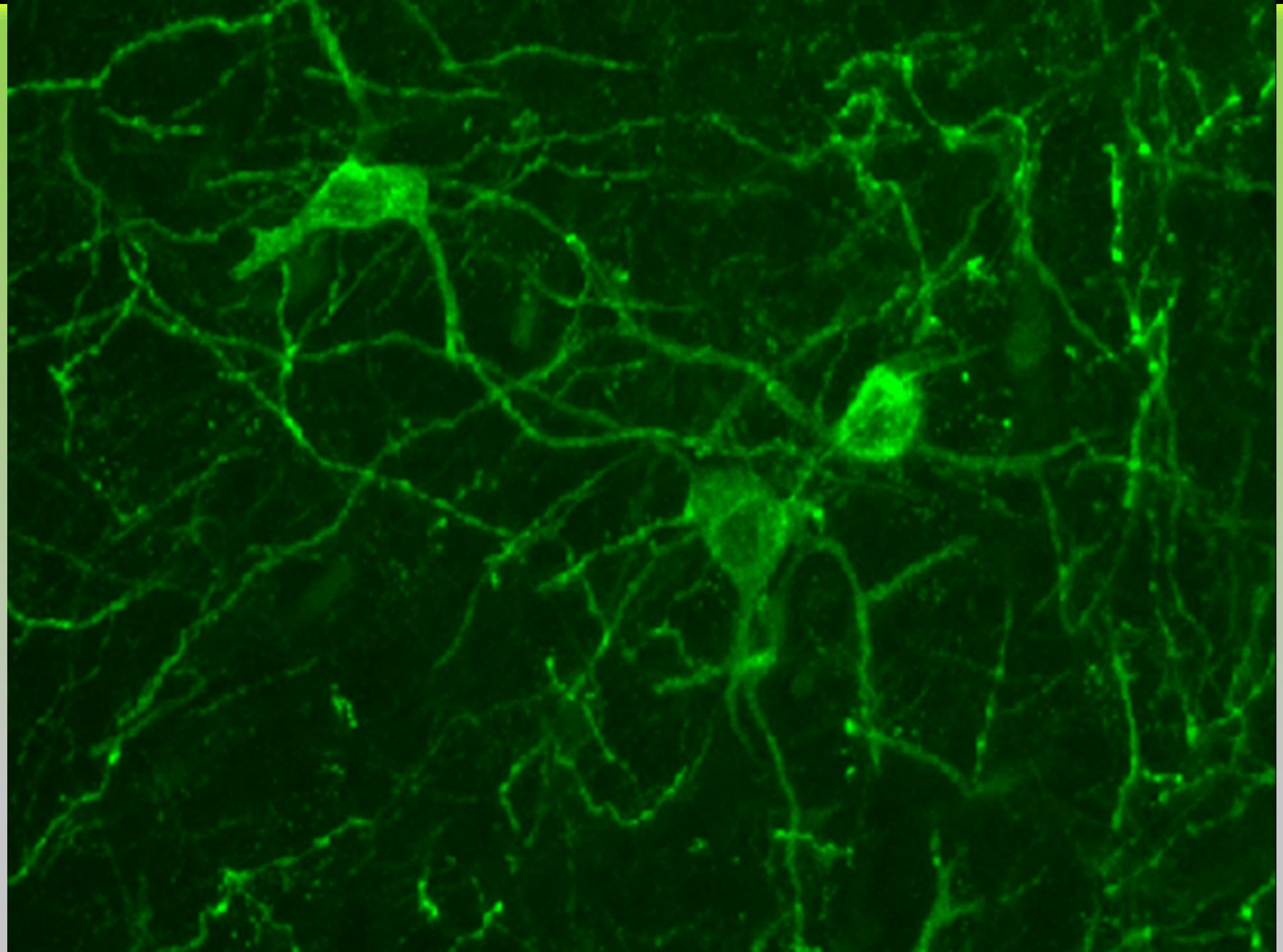


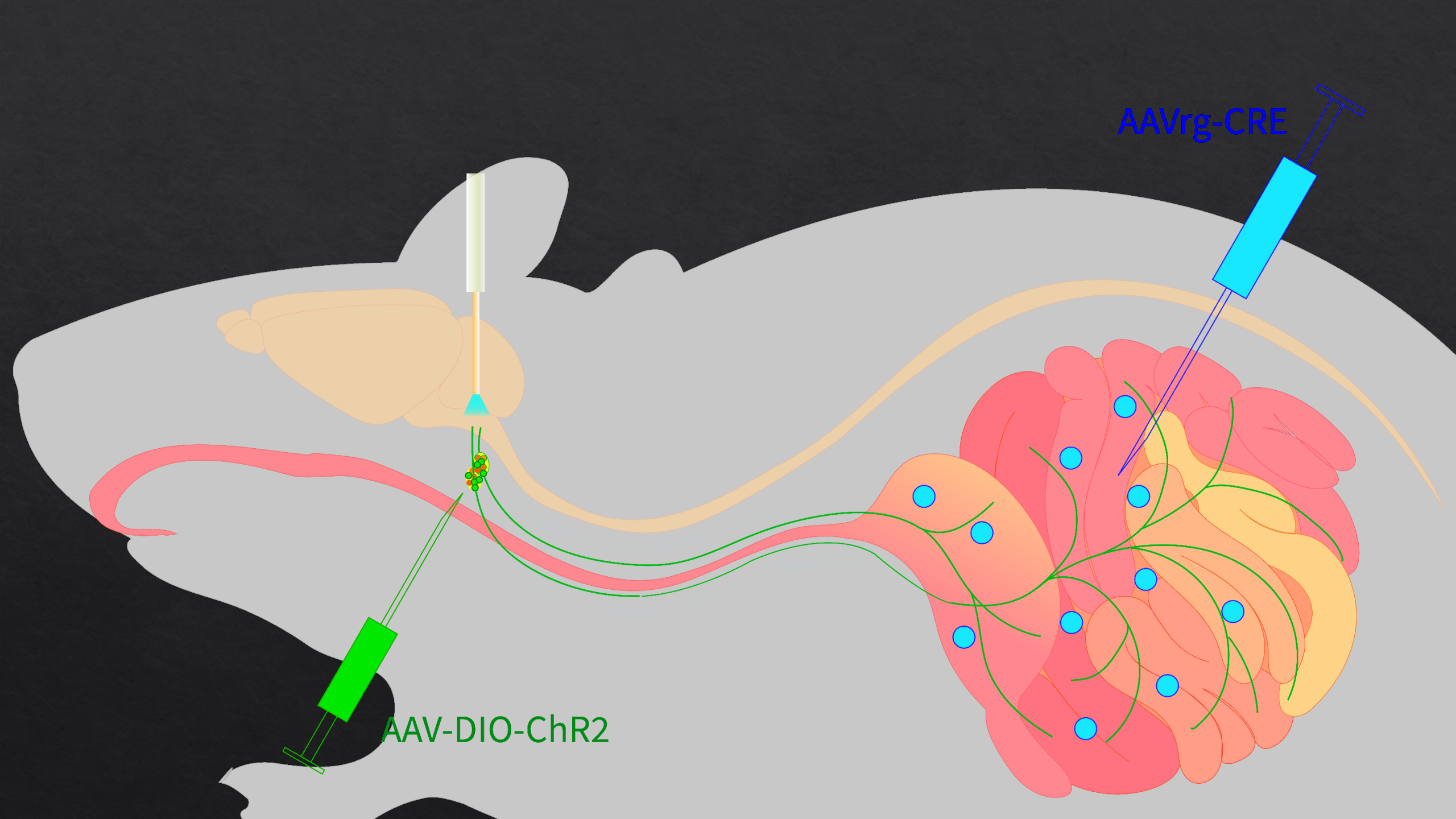


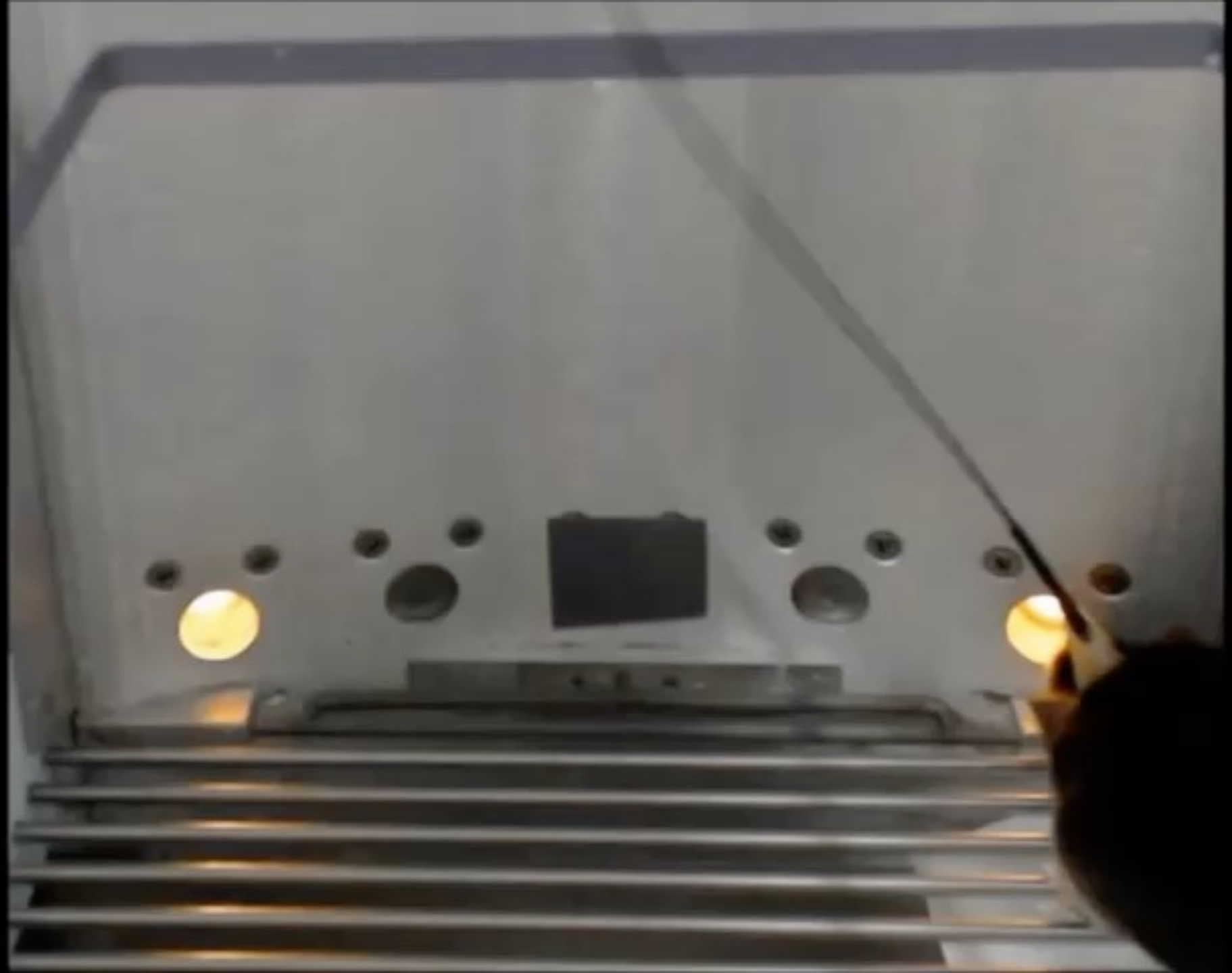
de Araujo, I. et al. “Food Reward in the Absence of Taste Receptor Signaling” *Neuron 2008*

Tellez, L. et al. *Science 2013*

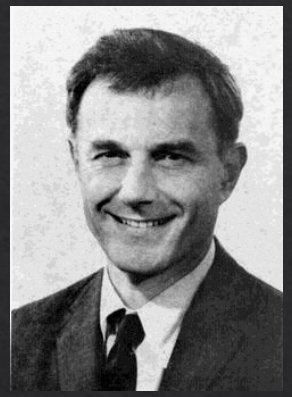

Motor
Sensory



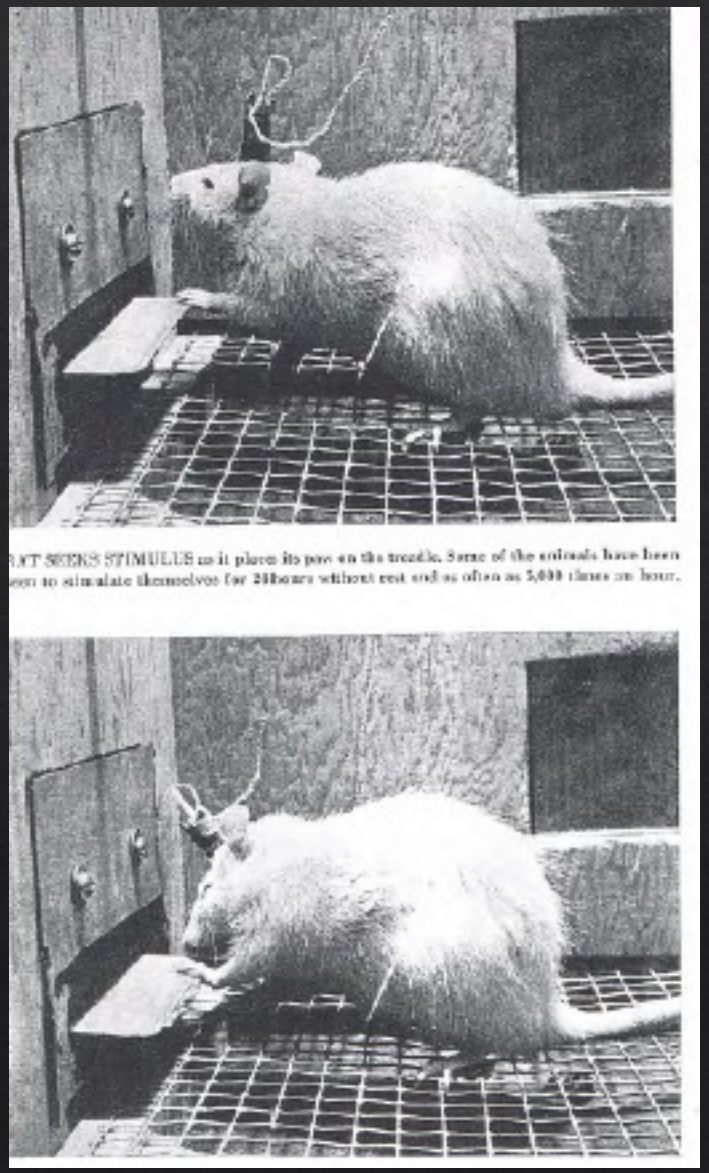

AAVrg-CRE
AAV-DIO-ChR2



1954: “Pleasure centers in brain”

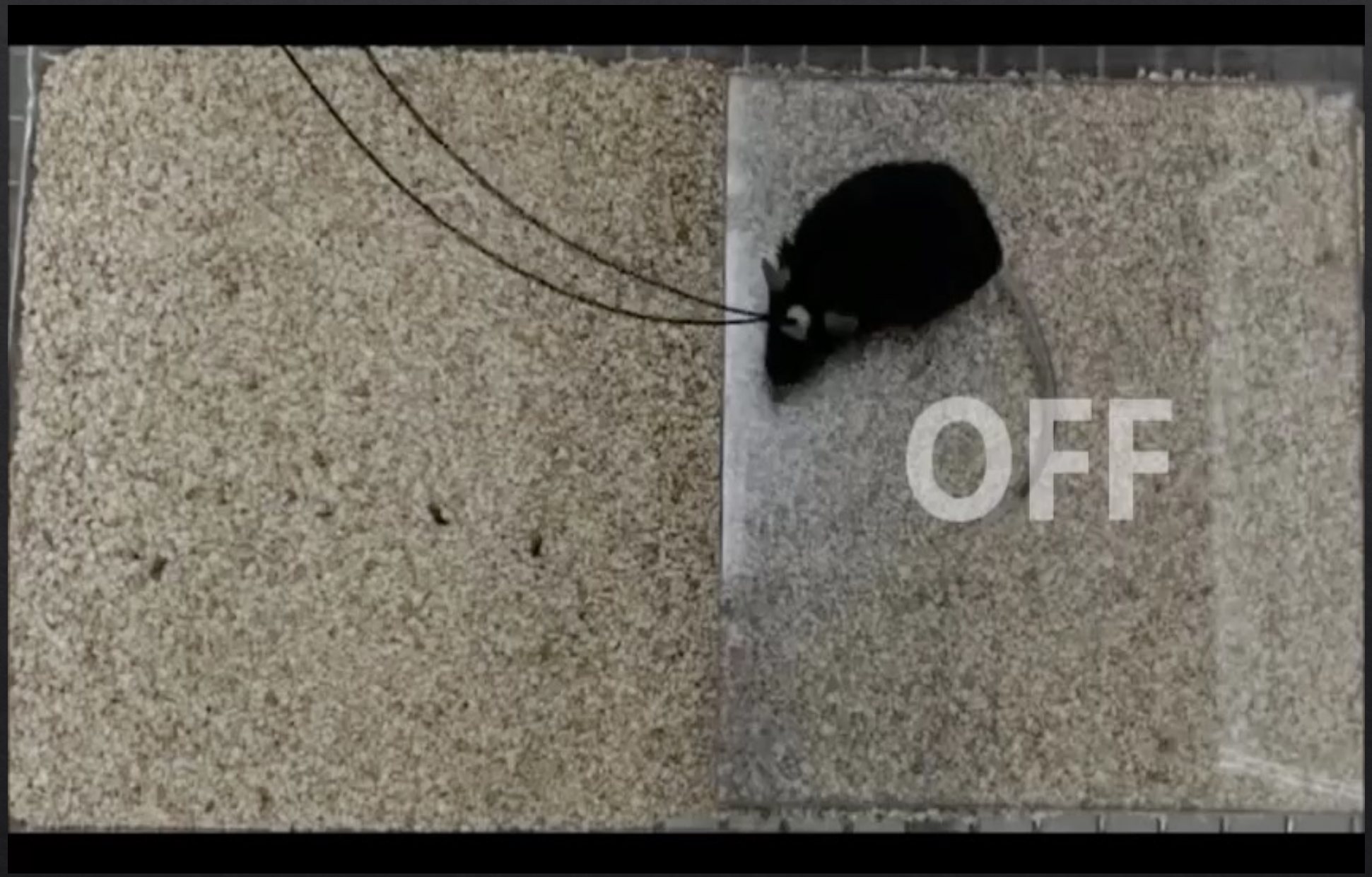


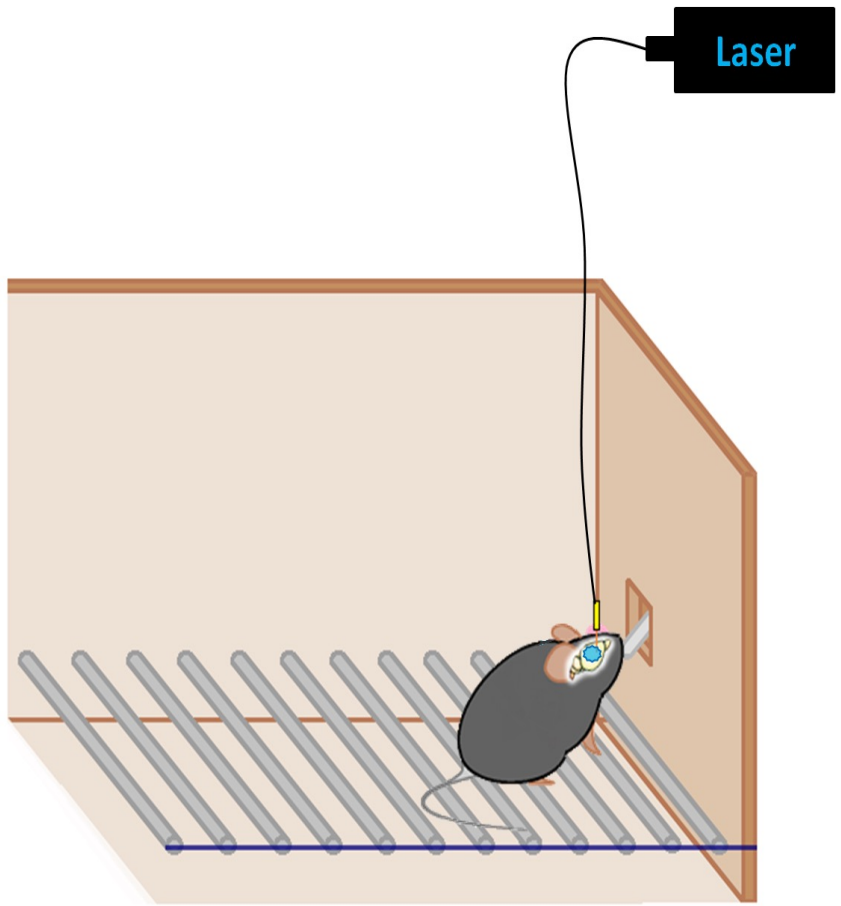
James Olds

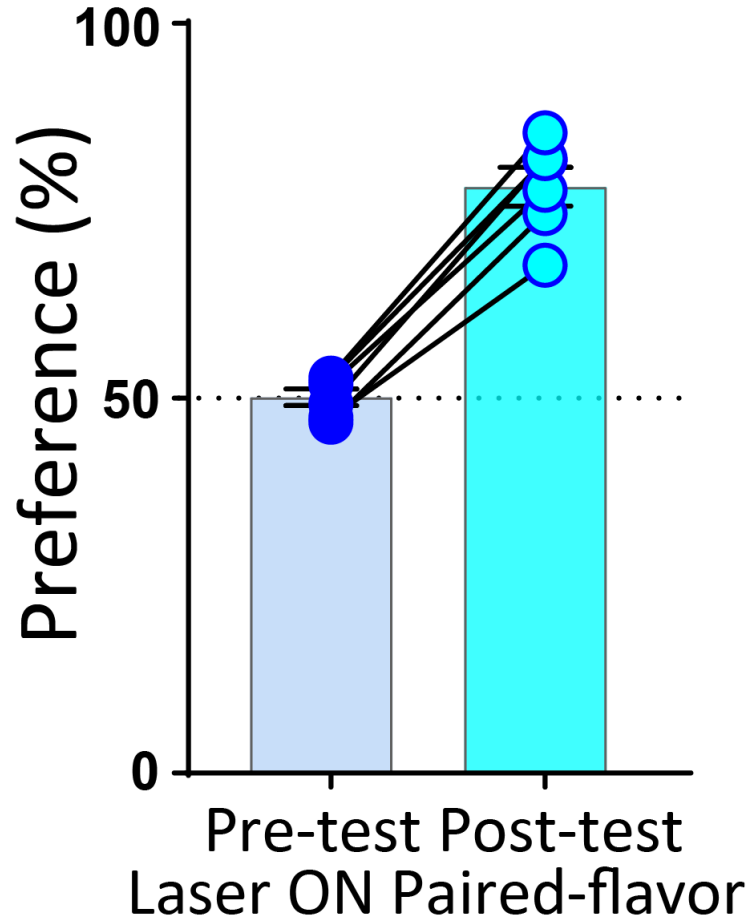


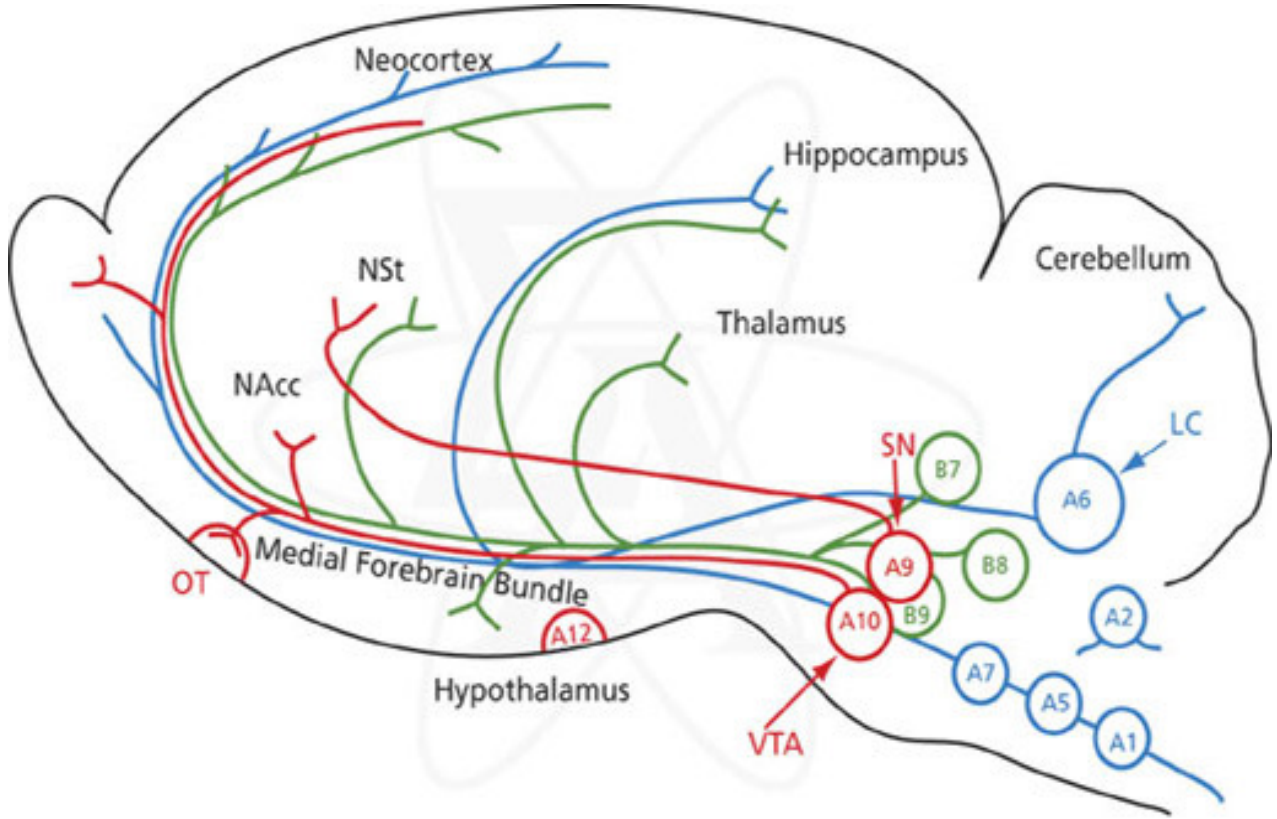
RAT SEEKS STIMULUS as it places its paw on the treadle. Some of the animals have been seen to stimulate themselves for 24hours without rest and as often as 5,000 times an hour.

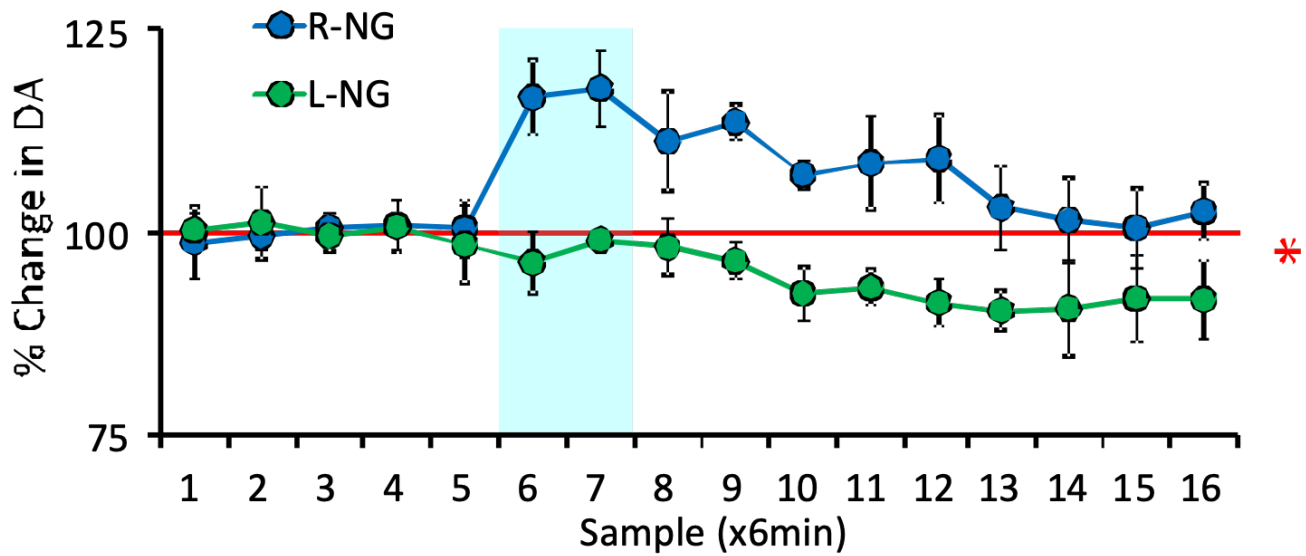
Olds, James, and Peter Milner. “Positive Reinforcement Produced by Electrical Stimulation of Septal Area and Other Regions of Rat Brain.” J Comp Physiol Psychol 47, no. 6 (1954): 419–427.

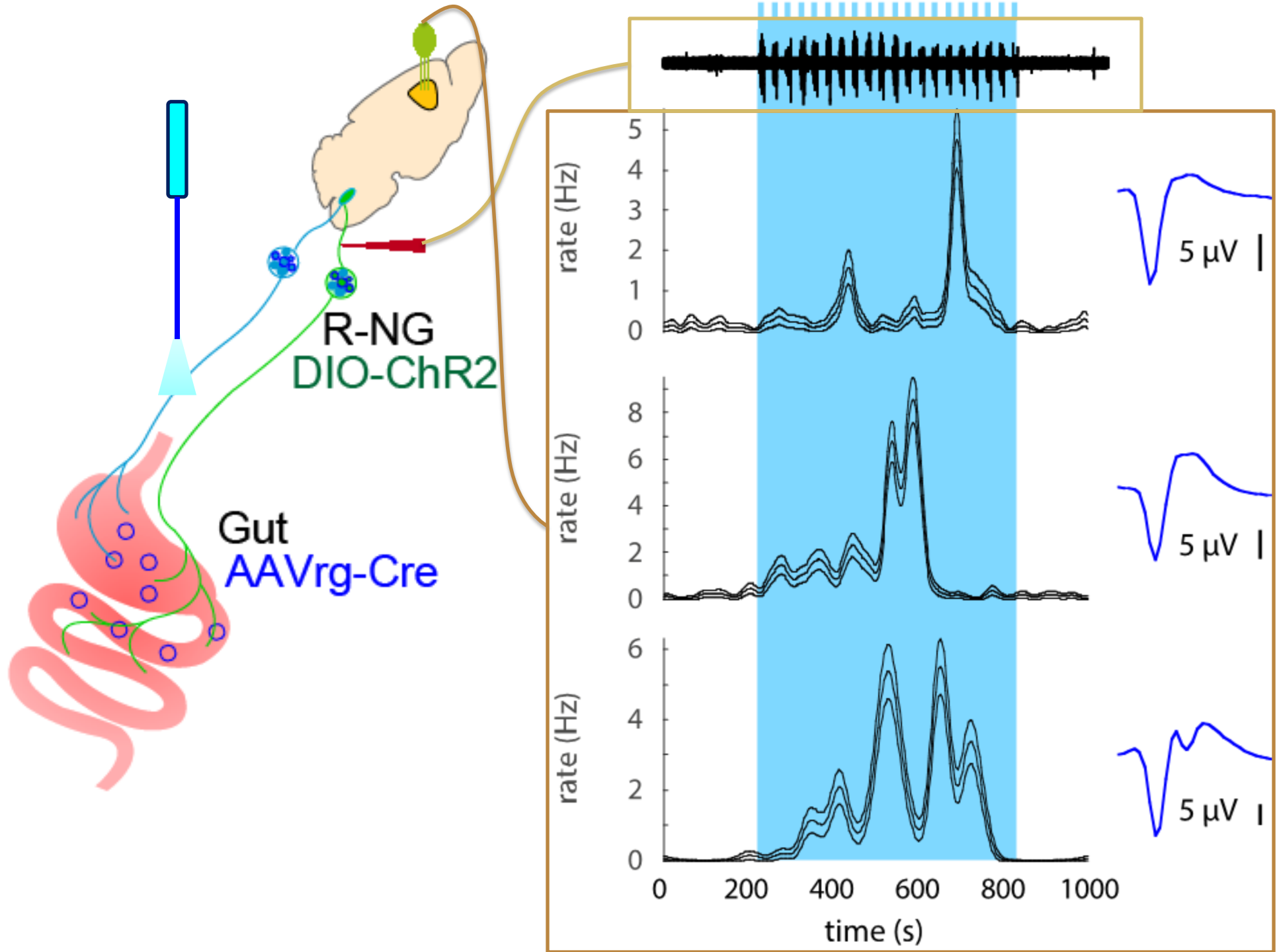

OFF

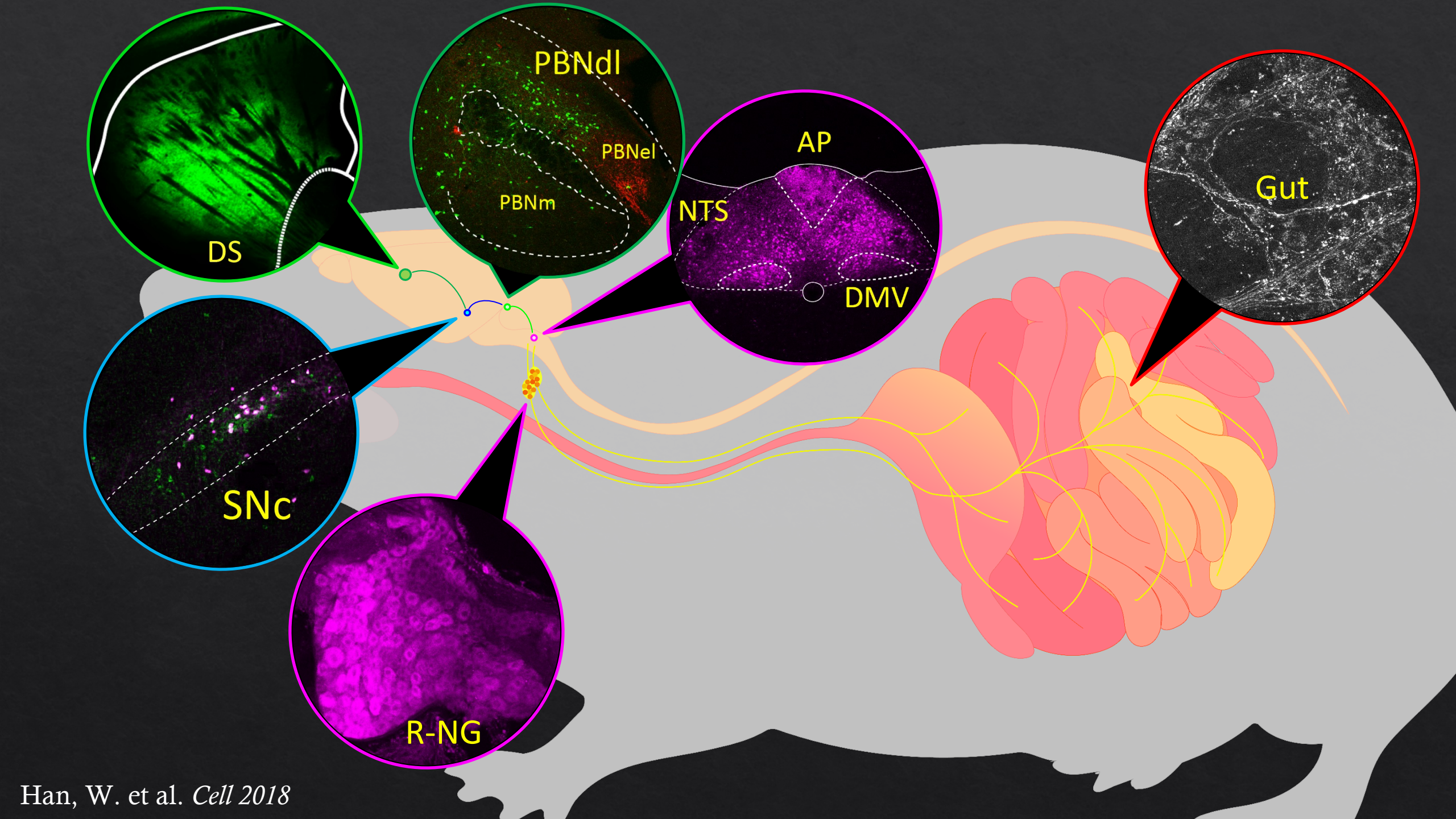

Laser


100
50
0
Preference (%)
Pre-test Post-test
Laser ON Paired-flavor

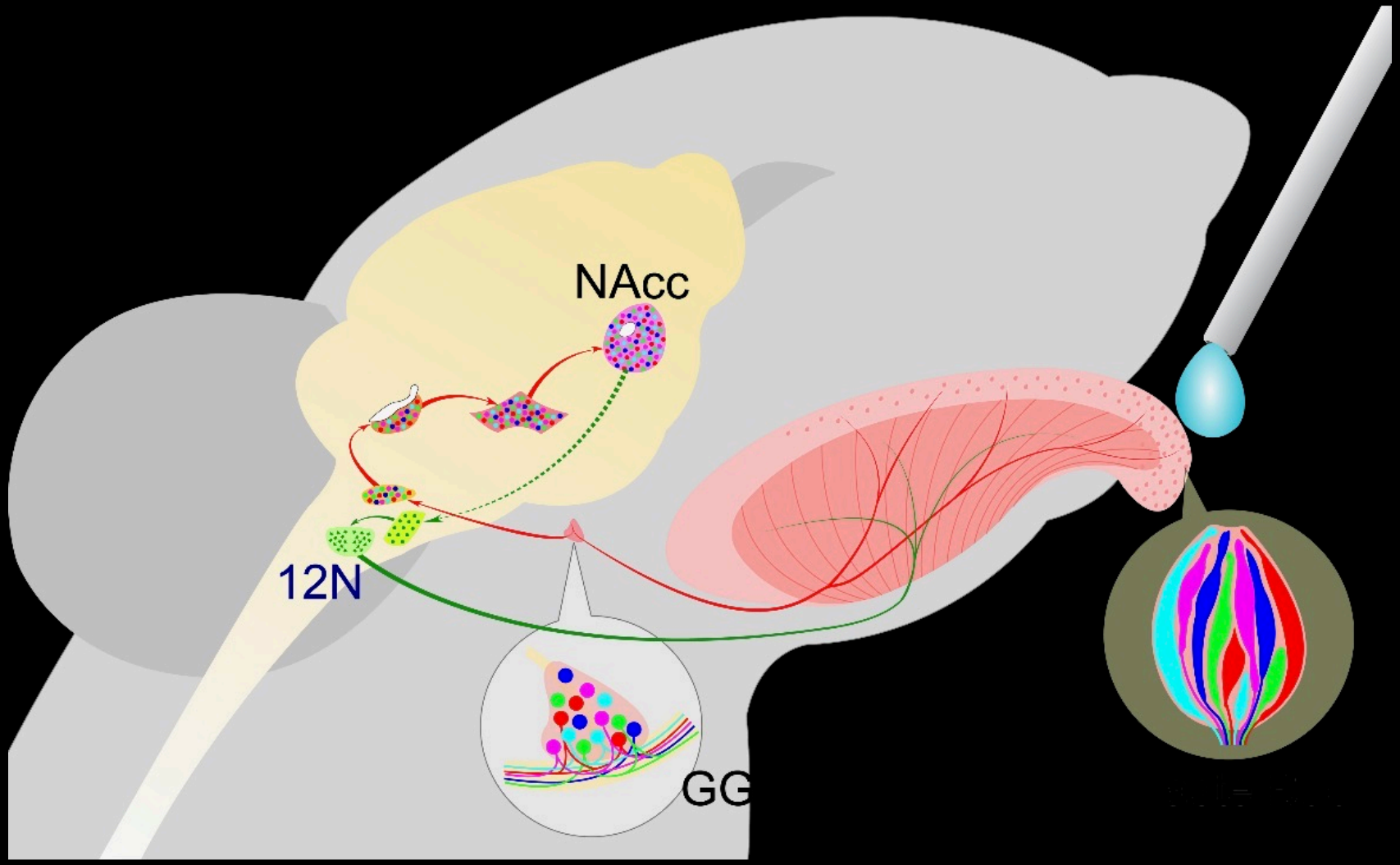

Neocortex
Hippocampus
Cerebellum
NSt
Thalamus
NAcc
LC
SN
B7
A6
A9
B8
OT
Medial Forebrain Bundle
A10
B9
A2
A12
A7
A5
Hypothalamus
VTA
A1

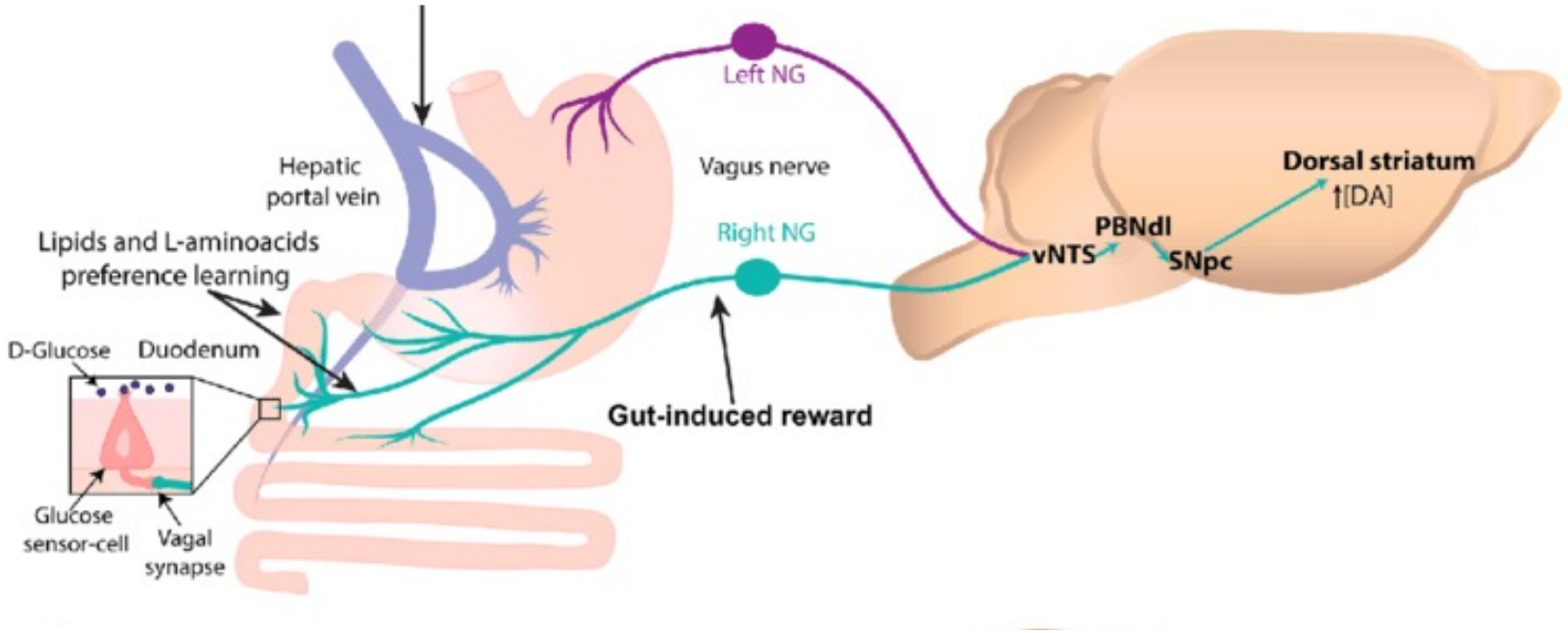

R-NG
L-NG
125
100
75
% Change in DA
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Sample (x6min)
*


R-NG
DIO-ChR2
Gut
AAVrg-Cre
rate (Hz)
5 µV
rate (Hz)
5 µV
rate (Hz)
5 µV
0
200
400
600
800
1000
time (s)



Han, W. et al. *Cell 2018*


NAcc
12N
GG



Nature. 2022 Oct;610(7933):722-730

Nature. 2020 Apr;580(7804):511-516

Nat Neurosci. 2022 Feb;25(2):191-200

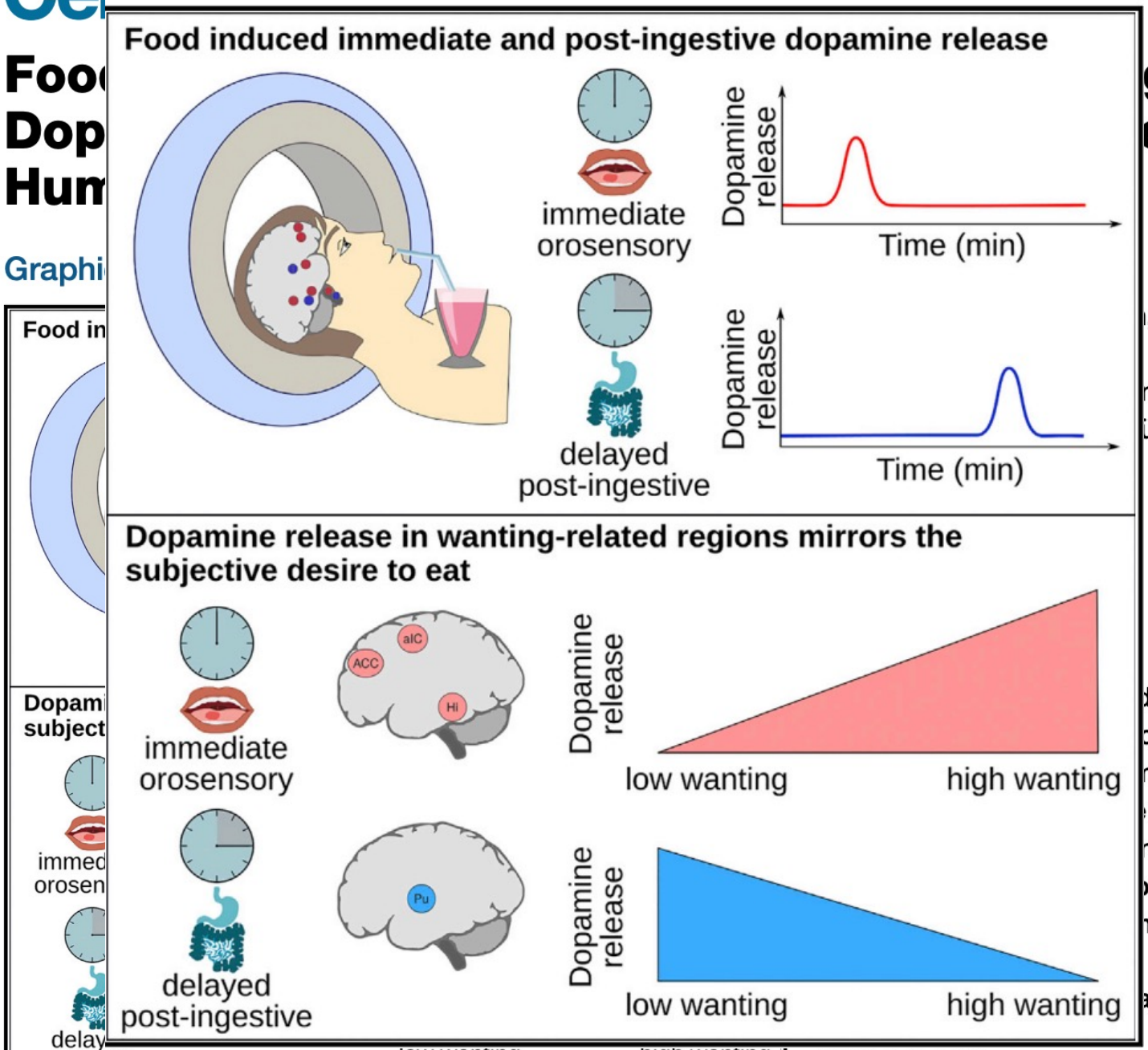
Cell Metab. 2021 Mar 2;33(3):676-687.e5

Neuron. 2020 Jun 3;106(5):778-788.e6

Cell Metabolism

Food ... Dop... Hum... ...gestive ...e in

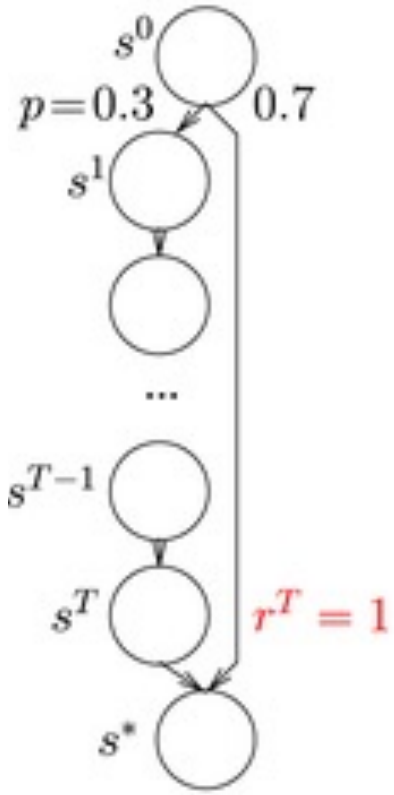
Graphi...



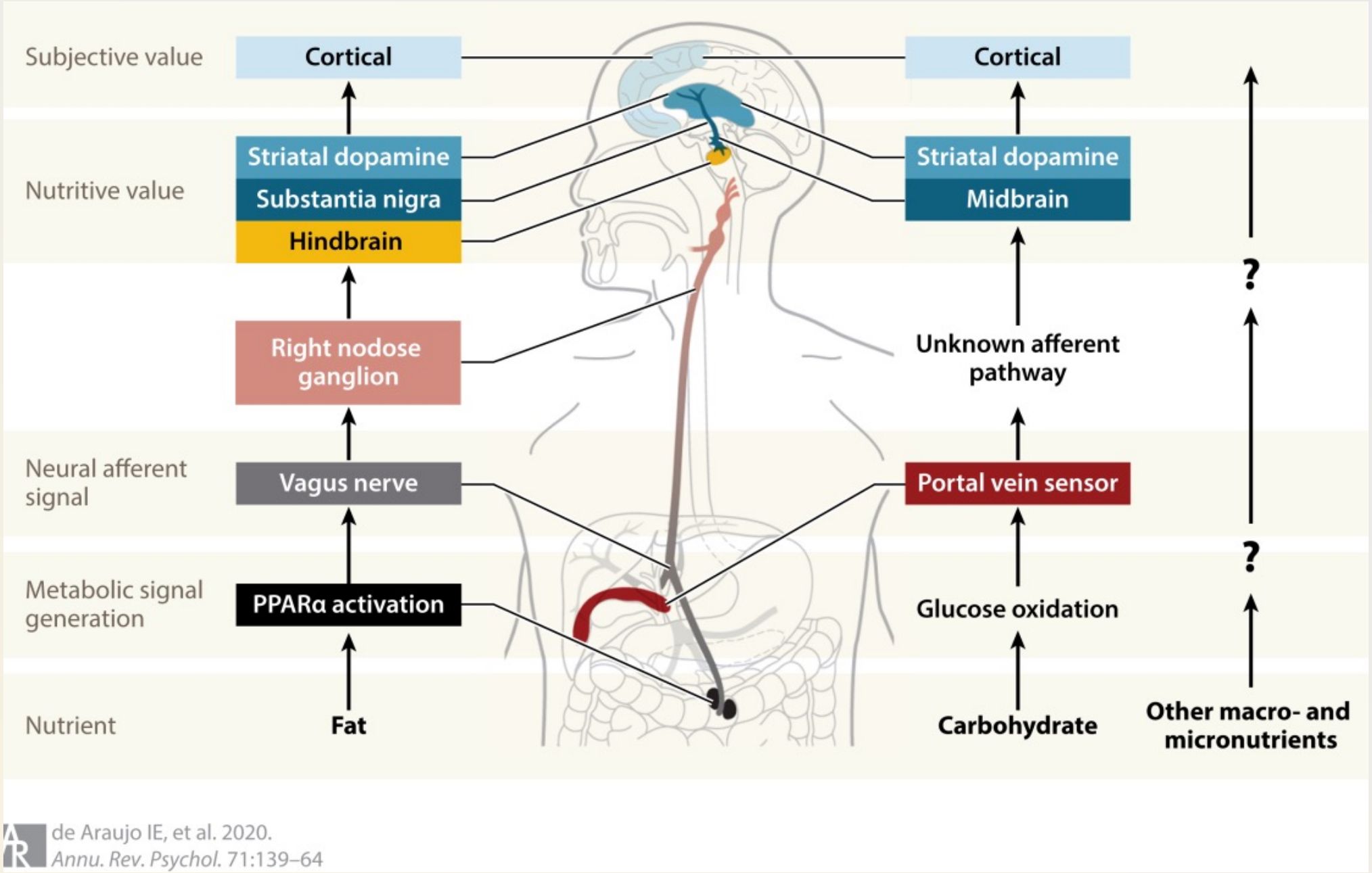
...nio, ...,
...üning,

...d fMRI and PET
...onse to food
...mediate and
... in distinct
...n addition, they
...pamine release
...ng to eat,
... brain
...als into the

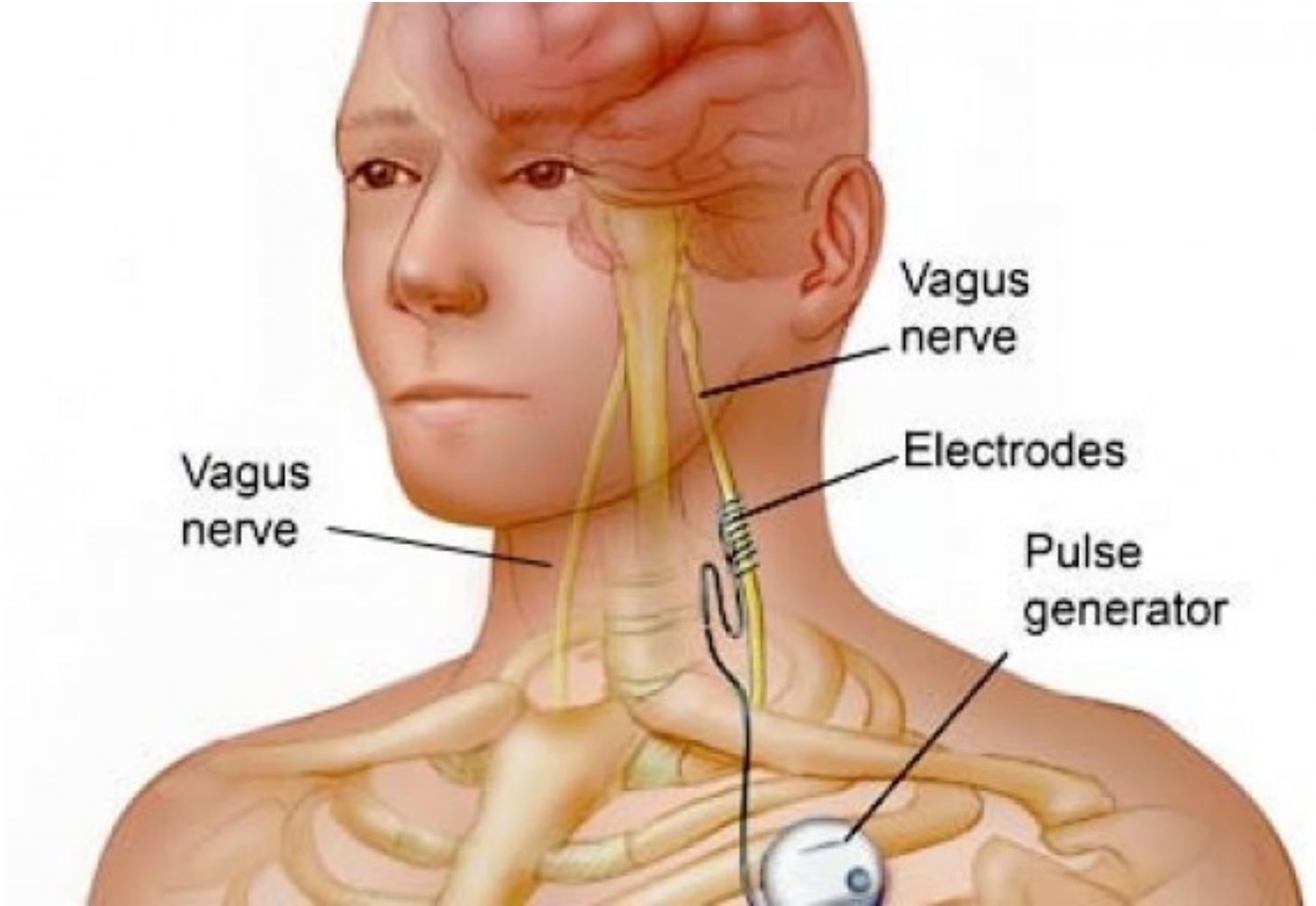
Fig 1. TD-based Markov prediction.

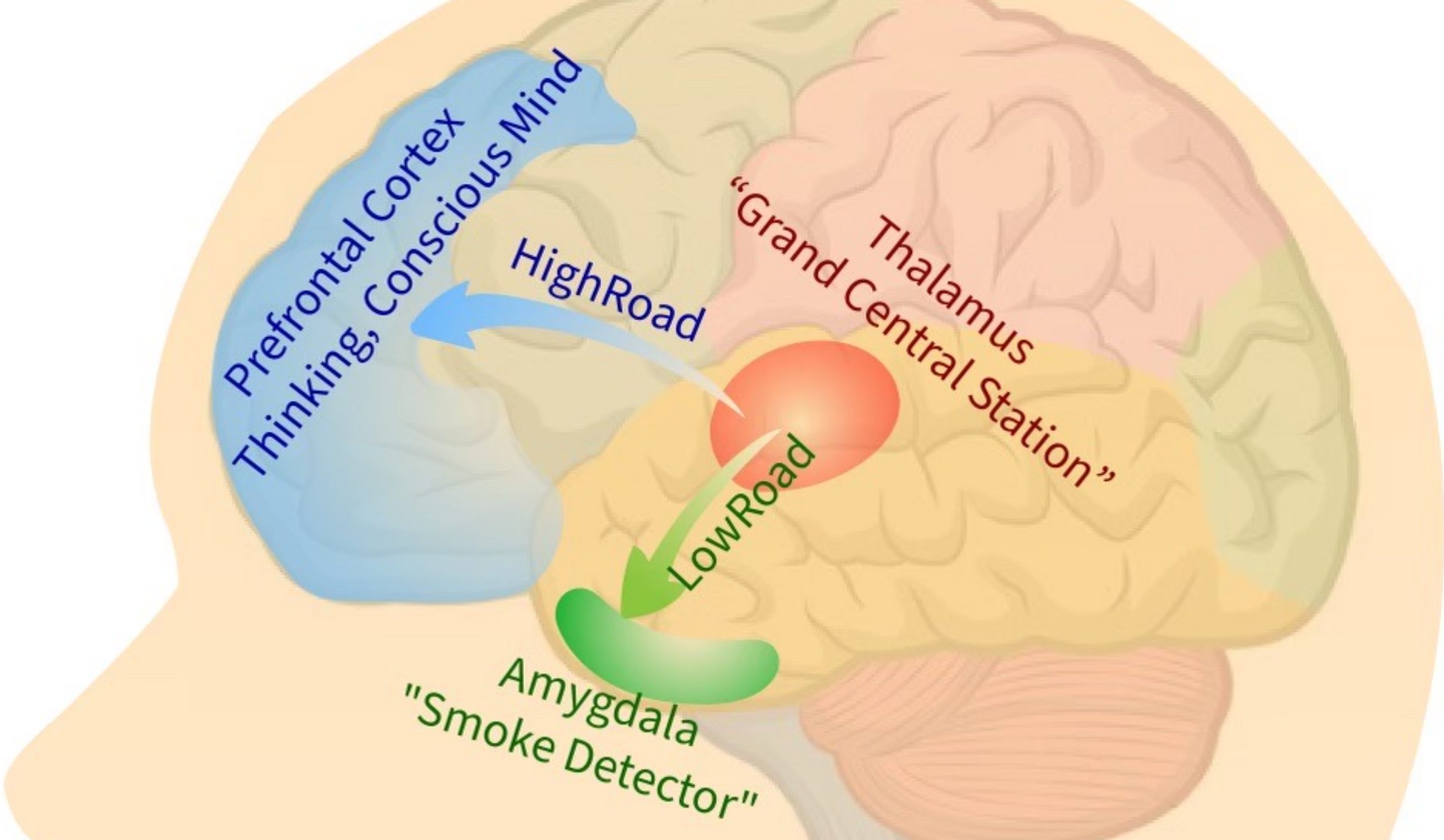


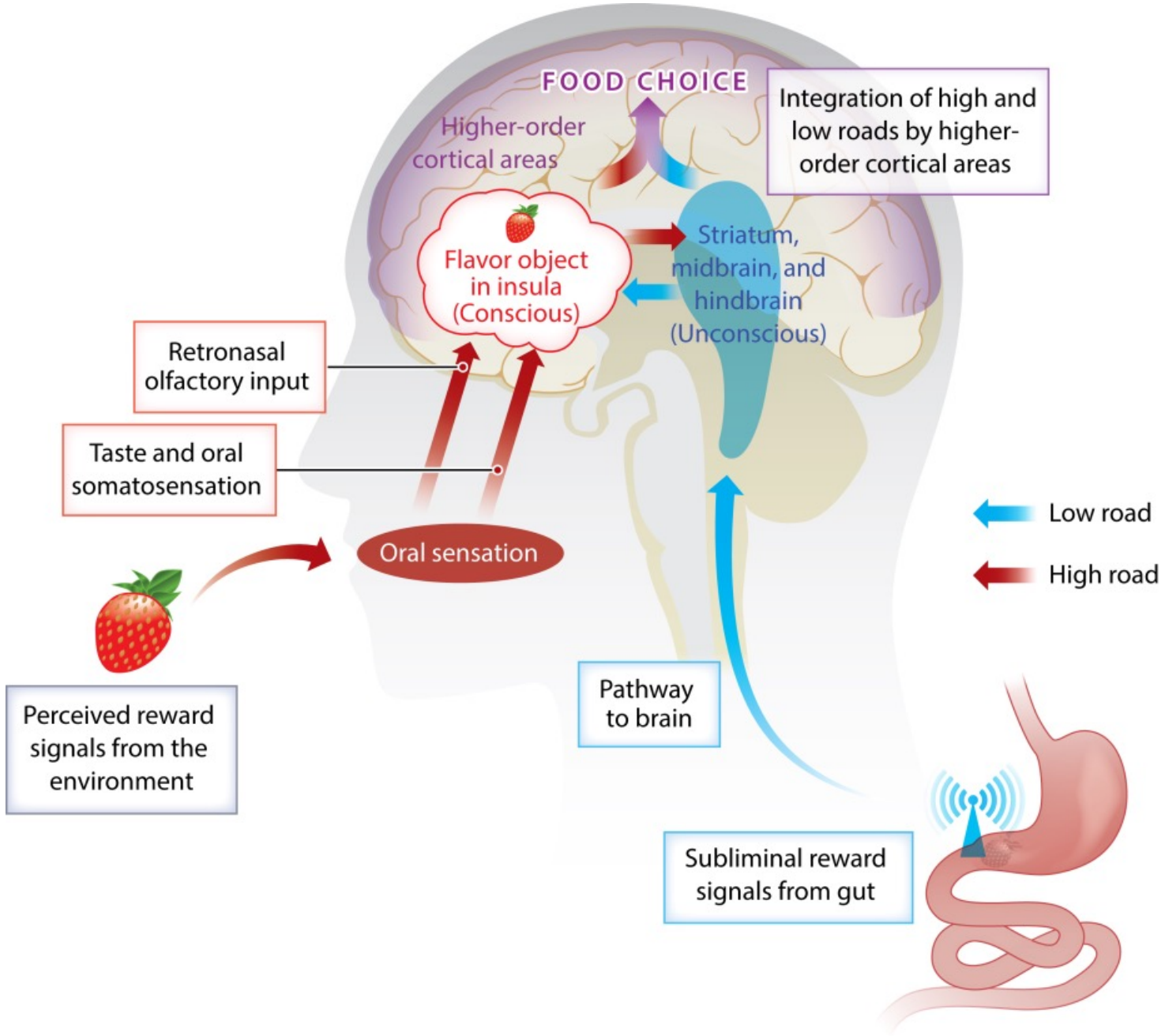
Dayan P (2022) “Liking” as an early and editable draft of long-run affective value. PLOS Biology 20(1): e3001476.



de Araujo IE, et al. 2020.
Annu. Rev. Psychol. 71:139–64


Vagus nerve
Electrodes
Vagus nerve
Pulse generator


Prefrontal Cortex
Thinking, Conscious Mind
HighRoad
Thalamus
"Grand Central Station"
LowRoad
Amygdala
"Smoke Detector"

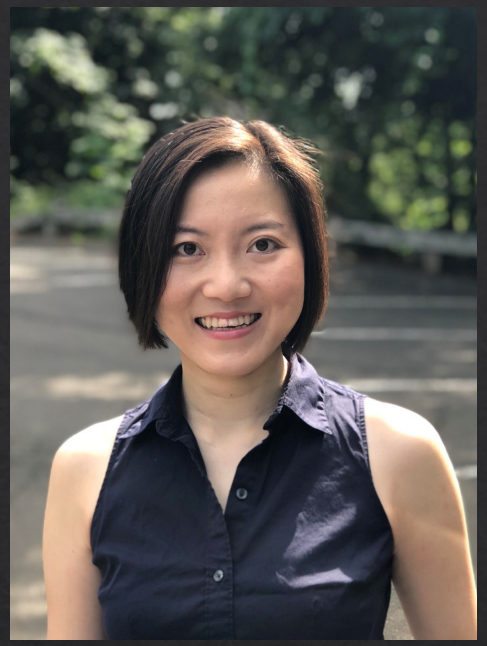


de Araujo IE, et al. 2020.
Annu. Rev. Psychol. 71:139–64

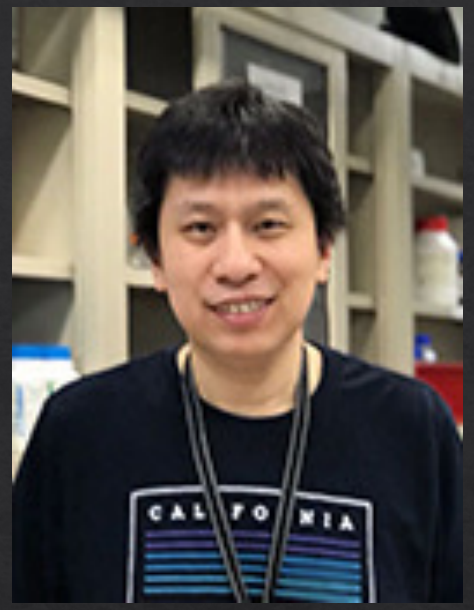
NIH NCCIH

FASI FOOD ALLERGY SCIENCE INITIATIVE

Icahn School of Medicine at Mount Sinai

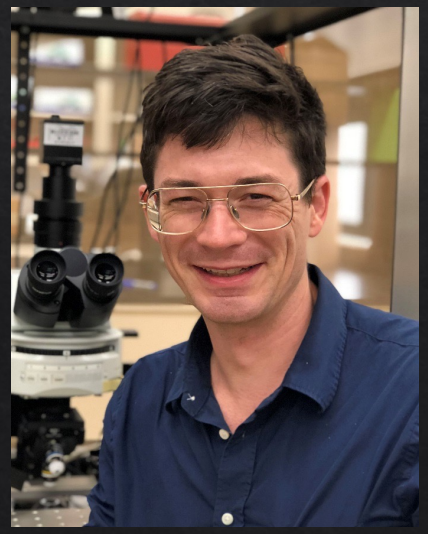


Wenfei Han, MD, PhD

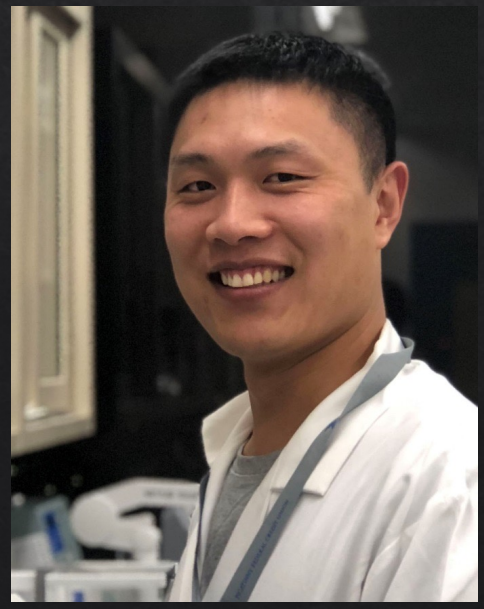


Hao Chang, PhD

Wanqing Du, MD



Matthew Perkins, PhD



Tong Zhang, MD

Leonardo Novaes, PhD