

References for Methods and Supplementary Information

1. Ueno, A. *et al.* Mouse intragastric infusion (iG) model. *Nat Protoc* **7**, 771–781 (2012).
2. Murray, A. J. *et al.* Parvalbumin-positive CA1 interneurons are required for spatial working but not for reference memory. *Nature Neuroscience* **14**, 297–299 (2011).
3. Guenthner, C. J., Miyamichi, K., Yang, H. H., Heller, H. C. & Luo, L. Permanent genetic access to transiently active neurons via TRAP: Targeted recombination in active populations. *Neuron* (2013) doi:10.1016/j.neuron.2013.03.025.
4. Allen, W. E. *et al.* Thirst-associated preoptic neurons encode an aversive motivational drive. *Science* (2017) doi:10.1126/science.aan6747.
5. DeNardo, L. A. *et al.* Temporal evolution of cortical ensembles promoting remote memory retrieval. *Nature Neuroscience* **22**, 460 (2019).
6. Reardon, T. R. *et al.* Rabies Virus CVS-N2cδG Strain Enhances Retrograde Synaptic Transfer and Neuronal Viability. *Neuron* (2016) doi:10.1016/j.neuron.2016.01.004.

7. Paxinos, G. & Franklin, K. *The Mouse Brain in Stereotaxic Coordinates, Second Edition*. (Academic Press, 2001).
8. Callaway, E. M. & Luo, L. Monosynaptic Circuit Tracing with Glycoprotein-Deleted Rabies Viruses. *Journal of Neuroscience* **35**, 8979–8985 (2015).
9. Lerner, T. N. *et al.* Intact-Brain Analyses Reveal Distinct Information Carried by SNc Dopamine Subcircuits. *Cell* **162**, 635–647 (2015).
10. Gunaydin, L. A. *et al.* Natural Neural Projection Dynamics Underlying Social Behavior. *Cell* **157**, 1535–1551 (2014).
11. Barretto, R. P. J. *et al.* The neural representation of taste quality at the periphery. *Nature* (2015) doi:10.1038/nature13873.
12. Cyphert, J. M. Bilateral Vagotomy as a Tool for Determining Autonomic Involvement in Airway Responses in Mouse Models of Asthma. in *Mouse Models of Allergic Disease: Methods and Protocols* (ed. Allen, I. C.) 219–227 (Humana Press, 2013). doi:10.1007/978-1-62703-496-8_17.
13. Lee, H., Macpherson, L. J., Parada, C. A., Zuker, C. S. & Ryba, N. J. P. Rewiring the taste system. *Nature* **548**, 330–333 (2017).
14. Zukerman, S., Ackroff, K. & Sclafani, A. Post-oral appetite stimulation by sugars and nonmetabolizable sugar analogs. *Am J Physiol Regul Integr Comp Physiol* 840–853 (2013) doi:10.1152/ajpregu.00297.2013.
15. NoRMCorre: An online algorithm for piecewise rigid motion correction of calcium imaging data - ScienceDirect. <https://www.sciencedirect.com/science/article/pii/S0165027017302753?via%3Dihub>.
16. Cell Magic Wand. <https://www.maxplanckflorida.org/fitzpatricklab/software/cellMagicWand/>.
17. Keemink, S. W. *et al.* FISSA: A neuropil decontamination toolbox for calcium imaging signals. *Scientific Reports* **8**, 3493 (2018).
18. Fast online deconvolution of calcium imaging data. <https://journals.plos.org/ploscompbiol/article?rev=2&id=10.1371/journal.pcbi.1005423>.
19. Sclafani, A., Marambaud, P. & Ackroff, K. Conditioned flavor preferences in sweet ageusic T1r3 and Calhm1 knockout mice. *Physiology & Behavior* **126**, 25–29 (2014).
20. Nelson, G. *et al.* Mammalian sweet taste receptors. *Cell* **106**, 381–390 (2001).

21. Moriya, R., Shirakura, T., Ito, J., Mashiko, S. & Seo, T. Activation of sodium-glucose cotransporter 1 ameliorates hyperglycemia by mediating incretin secretion in mice. *American Journal of Physiology-Endocrinology and Metabolism* **297**, E1358–E1365 (2009).
22. Sleigh, J. N., Weir, G. A. & Schiavo, G. A simple, step-by-step dissection protocol for the rapid isolation of mouse dorsal root ganglia. *BMC Research Notes* **9**, 82 (2016).
23. Martin, G. *Neuroanatomy Text and Atlas, Fourth Edition*. (McGraw Hill, 2003).
24. Luo, L., Callaway, E. & Svoboda, K. Genetic Dissection of Neural Circuits. *Neuron* **57**, 634–660 (2008).
25. Mei, N. Vagal glucoreceptors in the small intestine of the cat. *J Physiol* **282**, 485–506 (1978).
26. Han, W. *et al.* A Neural Circuit for Gut-Induced Reward. *Cell* (2018) doi:10.1016/j.cell.2018.08.049.
27. Conte, W. L., Kamishina, H. & Reep, R. L. The efficacy of the fluorescent conjugates of cholera toxin subunit B for multiple retrograde tract tracing in the central nervous system. *Brain Struct Funct* **213**, 367–373 (2009).
28. Williams, E. K. *et al.* Sensory Neurons that Detect Stretch and Nutrients in the Digestive System. *Cell* **166**, 209–221 (2016).