

BIO-696

**Neuronal circuits underlying goal-directed behavior**

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Cursus	Sem.	Type
Neuroscience		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Project report
Workload	60h
<b>Hours</b>	<b>26</b>
Courses	26
<b>Number of positions</b>	<b>8</b>

**Frequency**

Every 2 years

**Remark**

Next time : to be announced

**Summary**

The brain can be viewed as a network of neurons receiving sensory input and carrying out experience- and context-dependent computations through complex synaptic interactions to drive motor output, i.e. behavior. Here, we will study recent advances in knowledge of neural circuits in the mouse brain.

**Content**

Students will learn state-of-the-art analyses of neuronal circuit function contributing to simple learned goal-directed behaviors in mice. We will critically evaluate current understanding through in depth discussion of various topics, guided by selected papers (Spring semester, Thursdays 9 - 11 am).

Week 1 - Thursday 20th February 2020 (Carl Petersen)

Yu J, Hu H, Agmon A, Svoboda K (2019) Recruitment of GABAergic interneurons in the barrel cortex during active tactile behavior. *Neuron* 104: 412-427. doi: 10.1016/j.neuron.2019.07.027

Week 2 - Thursday 27th February 2020 (Keita Tamura)

Takahashi N, Oertner TG, Hegemann P, Larkum ME (2016) Active cortical dendrites modulate perception. *Science* 354: 1587-1590. doi: 10.1126/science.aah6066

Week 3 - Thursday 5th March 2020 (Vahid Esmaeili)

Carrillo-Reid L, Han S, Yang W, Akrouh A, Yuste R (2019) Controlling visually guided behavior by holographic recalling of cortical ensembles. *Cell* 178: 447-457. doi: 10.1016/j.cell.2019.05.045.

Week 4 - Thursday 12th March 2020 (Sylvain Crochet)

Ceballos S, Piwkowska Z, Bourg J, Daret A, Bathellier B (2019) Targeted cortical manipulation of auditory perception. *Neuron* doi: 10.1016/j.neuron.2019.09.043.

Week 5 - Thursday 19th March 2020 (Keita Tamura)

Wang L, Gillis-Smith S, Peng Y, Zhang J, Chen X, Salzman CD, Ryba NJP, Zuker CS (2018) The coding of valence and identity in the mammalian taste system. *Nature* 558: 127-131. doi: 10.1038/s41586-018-0165-4

Week 6 - Thursday 26th March 2020 (Sylvain Crochet)

Economo MN, Viswanathan S, Tasic B, Bas E, Winnubst J, Menon V, Graybiel LT, Nguyen TN, Smith KA, Yao Z, Wang L, Gerfen CR, Chandrashekar J, Zeng H, Looger LL, Svoboda K (2018) Distinct descending motor cortex pathways and their roles in movement. *Nature* 563: 79-84. doi: 10.1038/s41586-018-0642-9.

Week 7 - Thursday 2nd April 2020 (Carl Petersen)

Gao Z, Davis C, Thomas AM, Economo MN, Abrego AM, Svoboda K, De Zeeuw CI, Li N (2018) A cortico-cerebellar loop for motor planning. *Nature* 563: 113-116. doi: 10.1038/s41586-018-0633-x.

Week 8 - Thursday 9th April 2020 (Vahid Esmaeili)

Inagaki HK, Fontolan L, Romani S, Svoboda K (2019) Discrete attractor dynamics underlies persistent activity in the frontal cortex. *Nature* 566: 212-217. doi: 10.1038/s41586-019-0919-7.

Week 9 - Thursday 23rd April 2020 (Keita Tamura)

Mohebi A, Pettibone JR, Hamid AA, Wong JMT, Vinson LT, Patriarchi T, Tian L, Kennedy RT, Berke JD (2019) Dissociable dopamine dynamics for learning and motivation. *Nature* 570: 65-70. doi: 10.1038/s41586-019-1235-y

Week 10 - Thursday 30th April 2020 (Carl Petersen)

Allen WE, Chen MZ, Pichamoorthy N, Tien RH, Pachitariu M, Luo L, Deisseroth K (2019) Thirst regulates motivated behavior through modulation of brainwide neural population dynamics. *Science* 364: 253-253. doi: 10.1126/science.aav3932

Week 11 - Thursday 7th May 2020 (Sylvain Crochet)

Nakajima M, Schmitt LI, Halassa MM (2019) Prefrontal cortex regulates sensory filtering through a basal ganglia-to-thalamus pathway. *Neuron* 103: 445-458. doi: 10.1016/j.neuron.2019.05.026

Week 12 - Thursday 14th May 2020 (Vahid Esmaeili)

Musall S, Kaufman MT, Juavinett AL, Gluf S, Churchland AK (2019) Single-trial neural dynamics are dominated by richly varied movements. *Nat Neurosci* 22: 1677-1686. doi: 10.1038/s41593-019-0502-4

Week 13 - Thursday 21st May 2020 - Ascension holiday - No class

Week 14 - Thursday 28th May 2020 (Keita Tamura)

Bari BA, Grossman CD, Lubin EE, Rajagopalan AE, Cressy JI, Cohen JY (2019) Stable representations of decision variables for flexible behavior. *Neuron* 103: 922-933. doi: 10.1016/j.neuron.2019.06.001

At the end of the course, the students should write a 2-page report on a topic of their choice related to the course content. Submission to Carl Petersen by Friday 12th June 2020. This will be the formal evaluation (pass/fail).

## Keywords

Neuronal circuits, Mouse behavior

## Learning Prerequisites

### Required courses

Strong interest in Neuronal Circuit function

Learning Outcome - to critically evaluate studies of neural circuits and behavior.