ÉCOLE POLYTECHNIQUE
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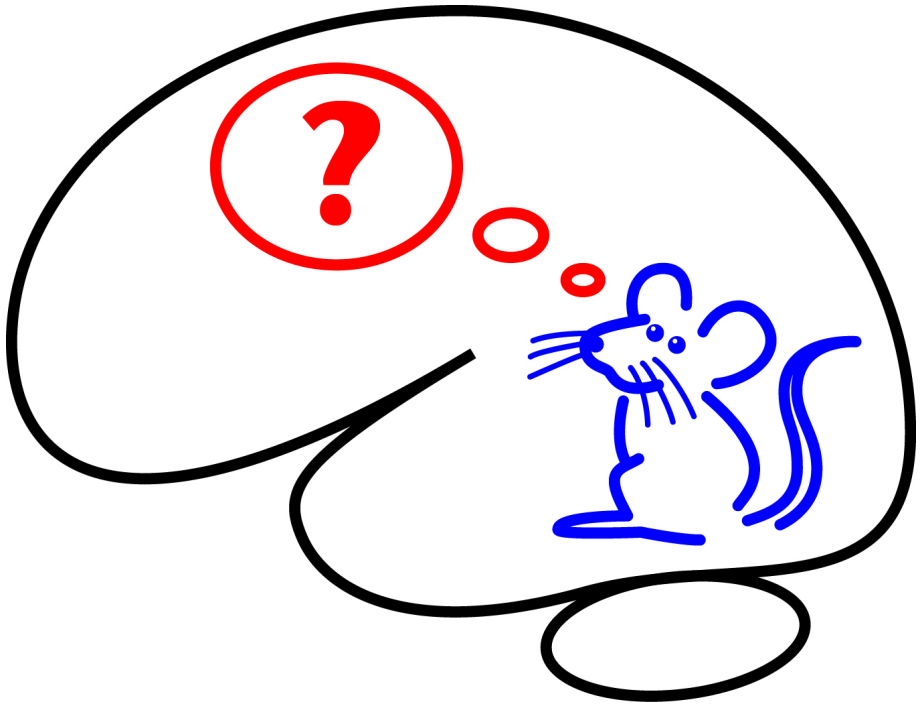


7.2 Sensory perception

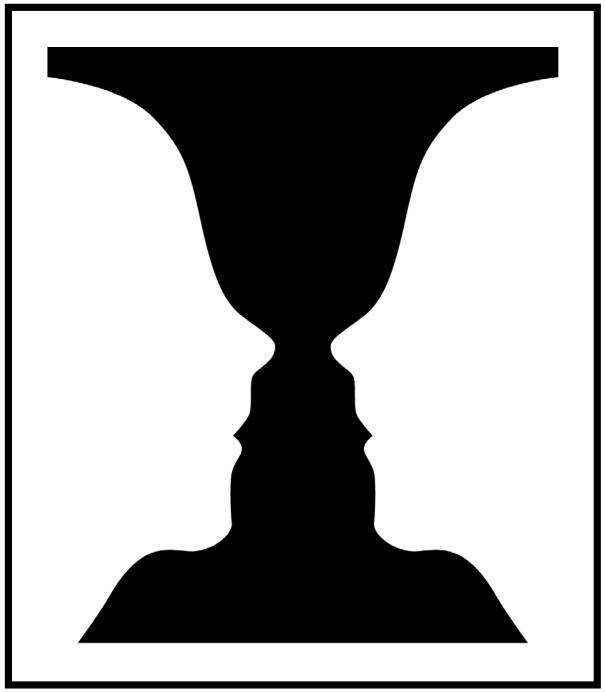
Cellular Mechanisms of Brain Function

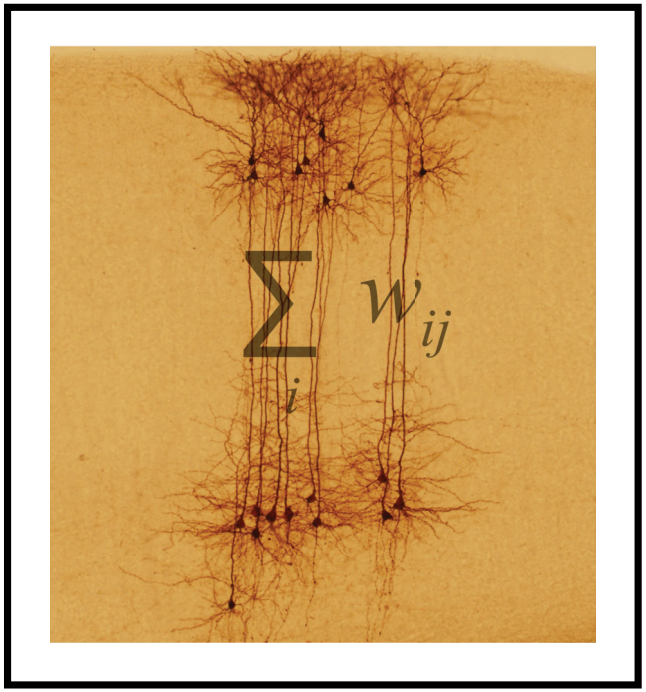
Prof. Carl Petersen

Sensory perception

Sensory percepts are subjective

Sensory percepts are internal contructs, created by neuronal activity.

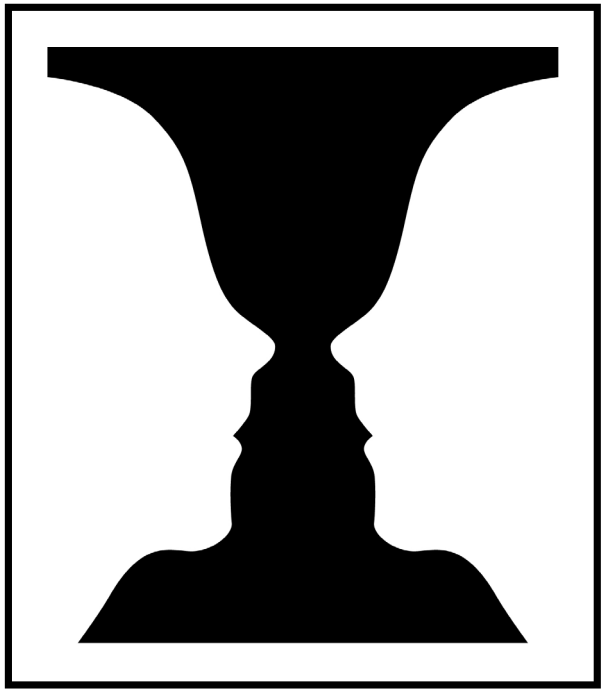




Lefort, Tomm, Sarria & Petersen, 2009

Sensory percepts are learned

Sensory percepts are learned through experience.

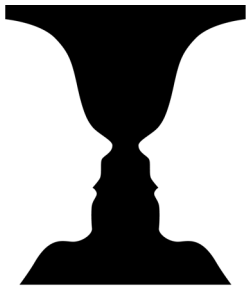


We can recognise objects because we have previously seen closely-related images.

We learn to see the world.

Experimental investigation of sensory perception

Sensory stimulus



Neural computation of sensory percept

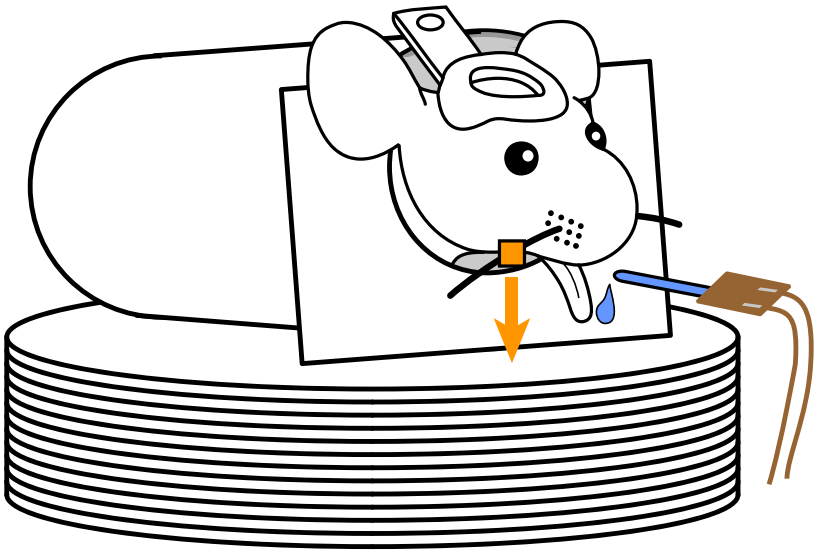
Behavioral report by motor output

"I see two faces"

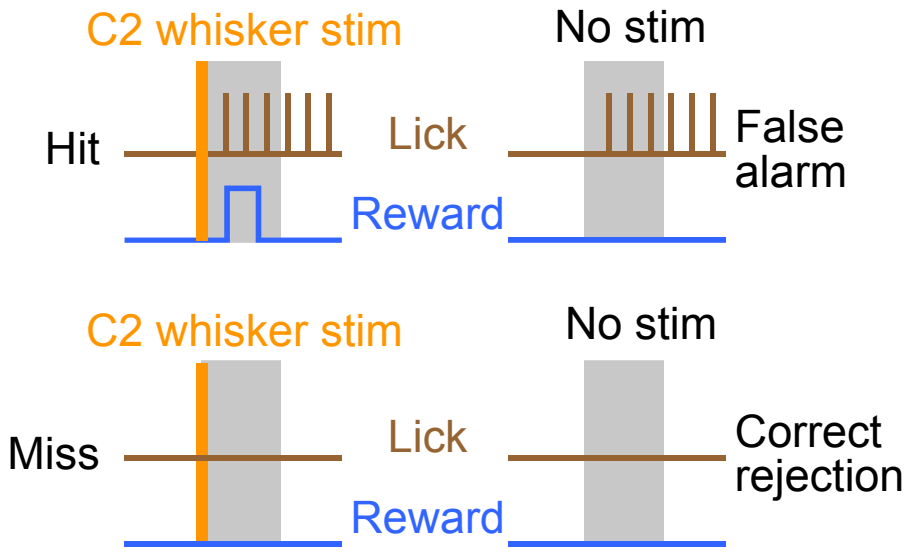
"I see a black cup"

Sensory percepts must be reported through motor output to allow experimental investigation. Learned abstract sensorimotor transforms are therefore minimal essential core features of sensory perception.

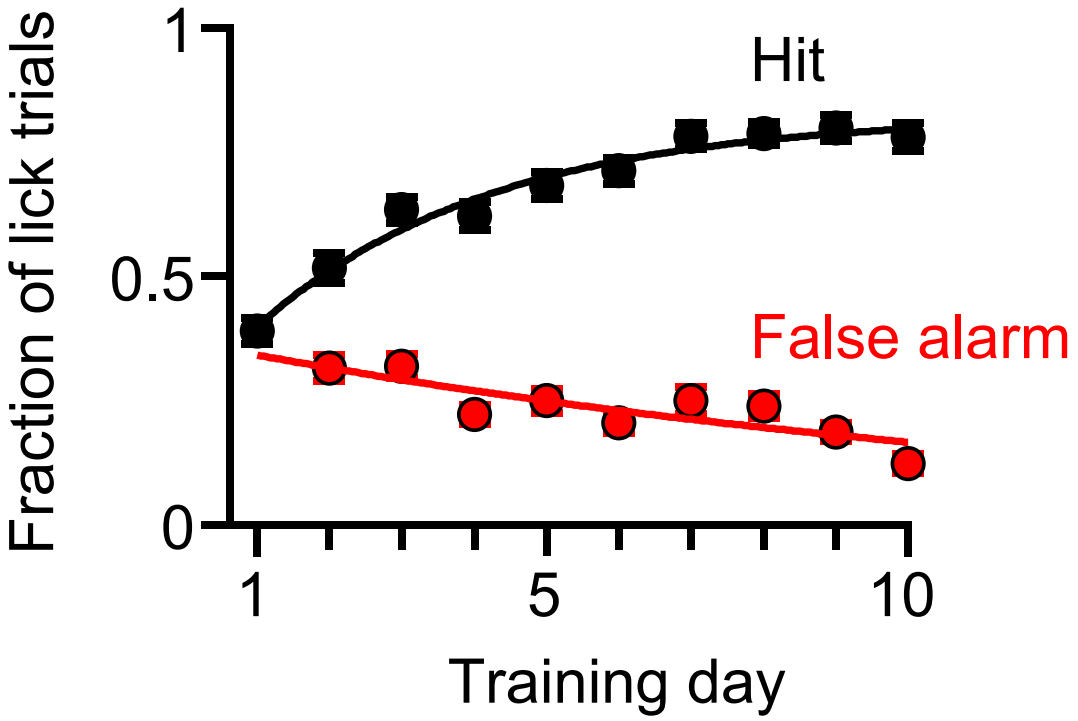
Whisker detection task



Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

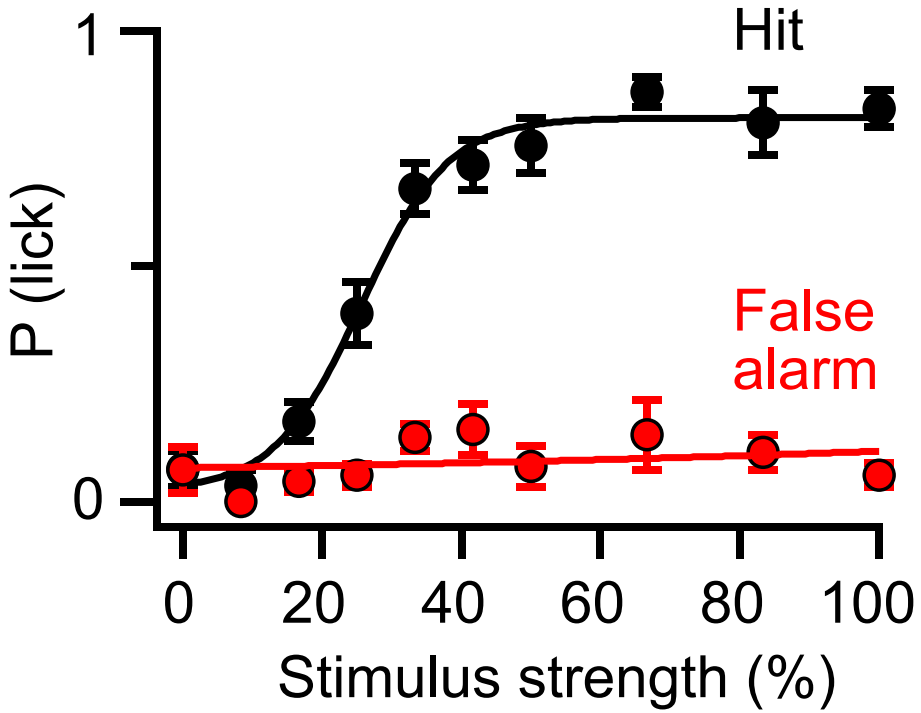


Learning



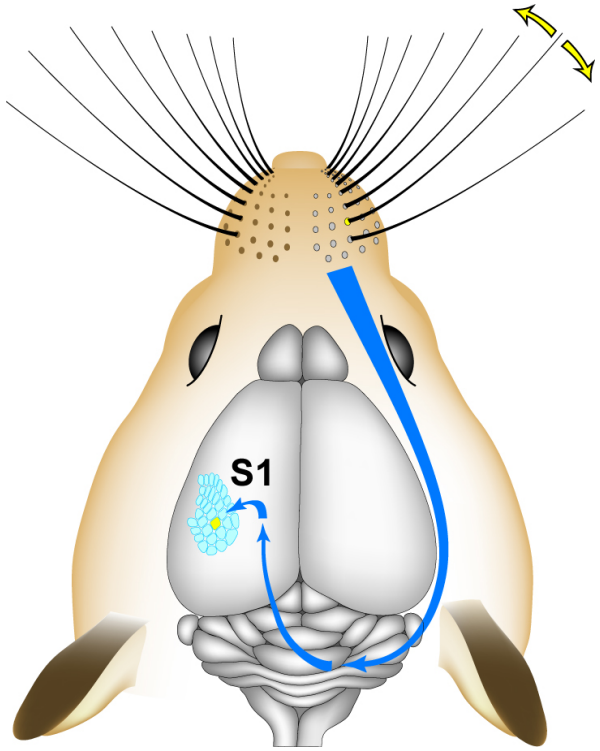
Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

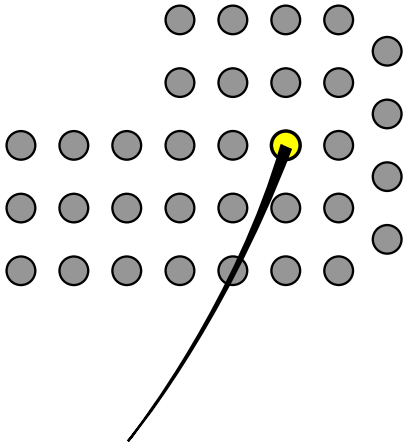
Psychophysics

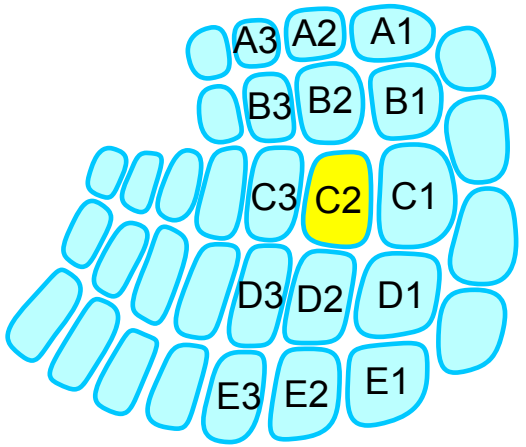


Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

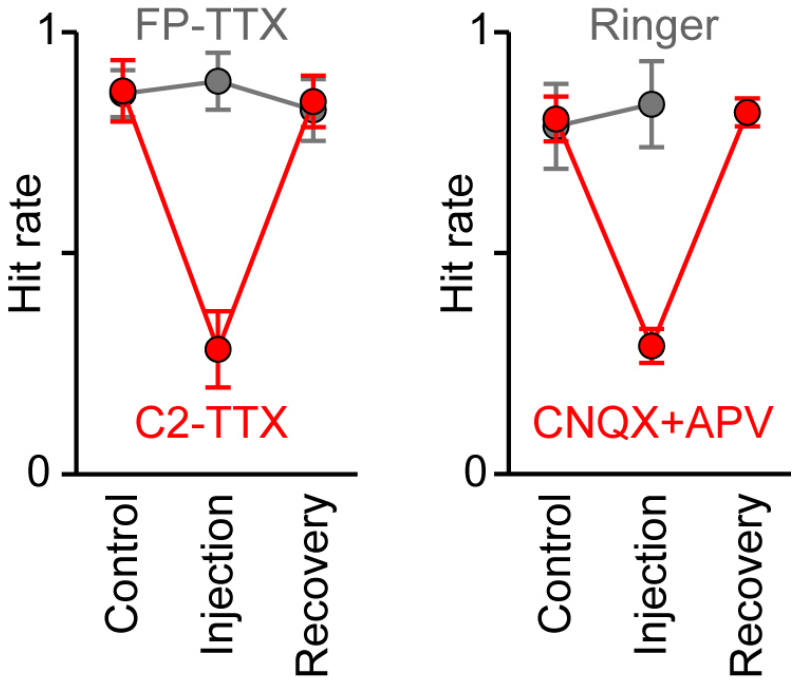
Primary somatosensory barrel cortex - S1





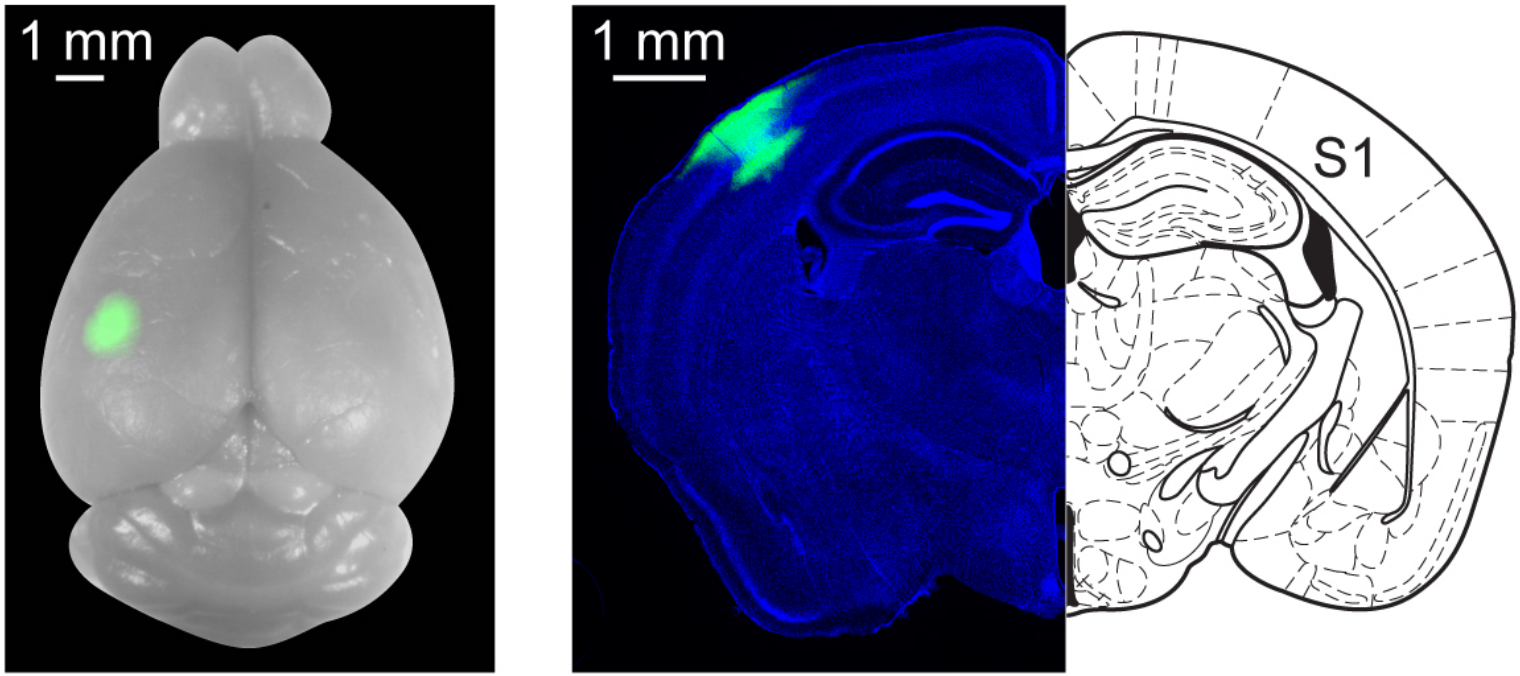


S1 is necessary for detection task



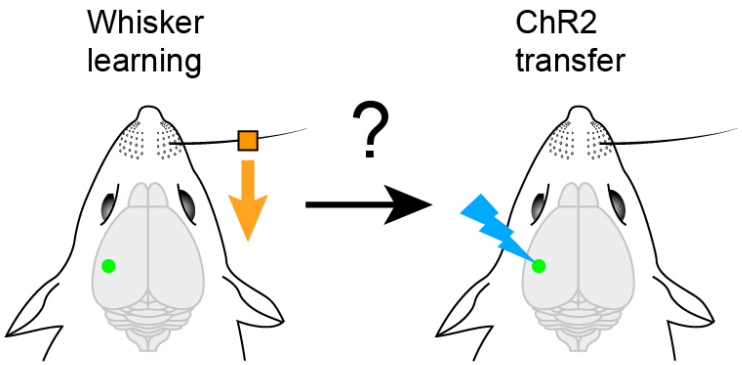
Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

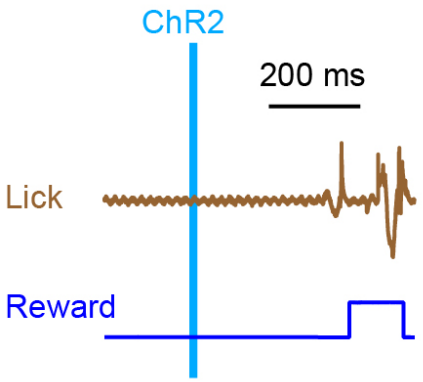
Optogenetic substitution for whisker stimulus

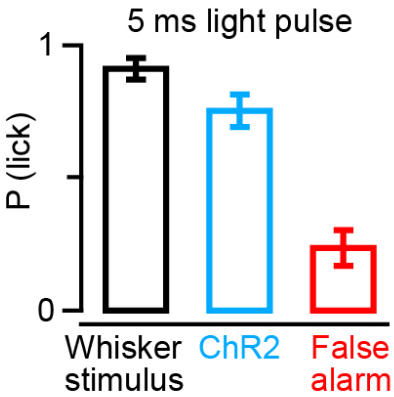


Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

Optogenetic substitution for whisker stimulus

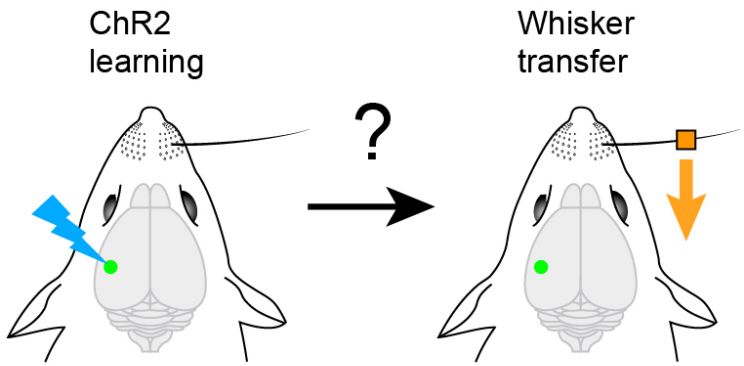


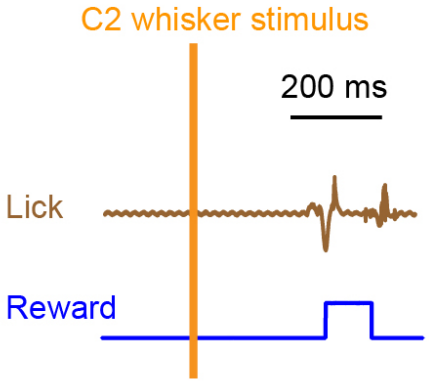


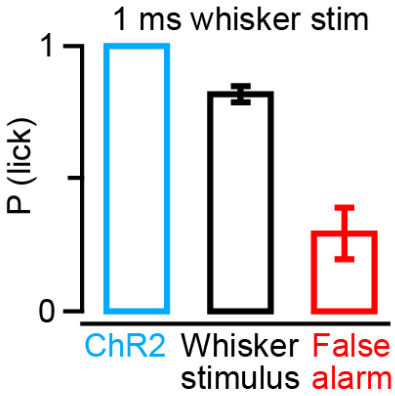


Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

Optogenetic programming of behavior







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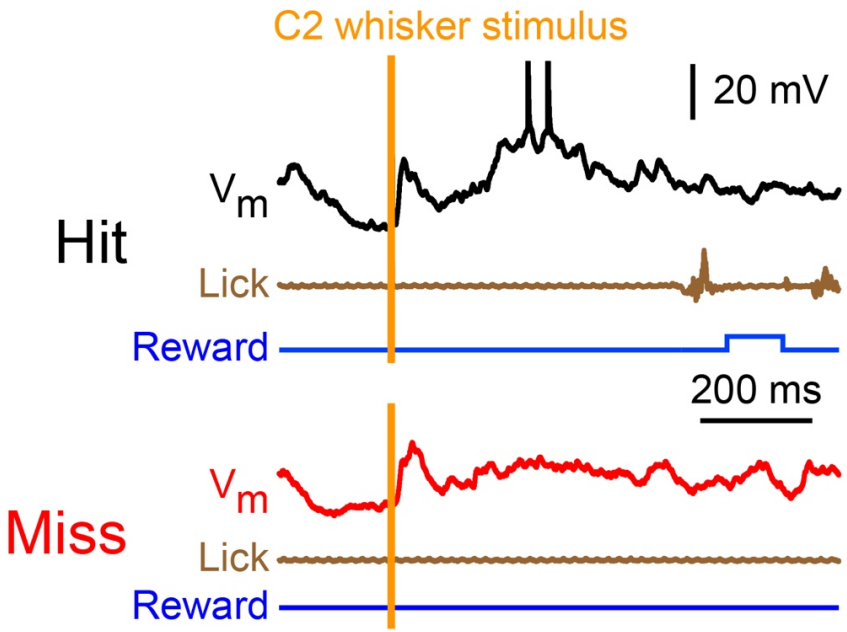
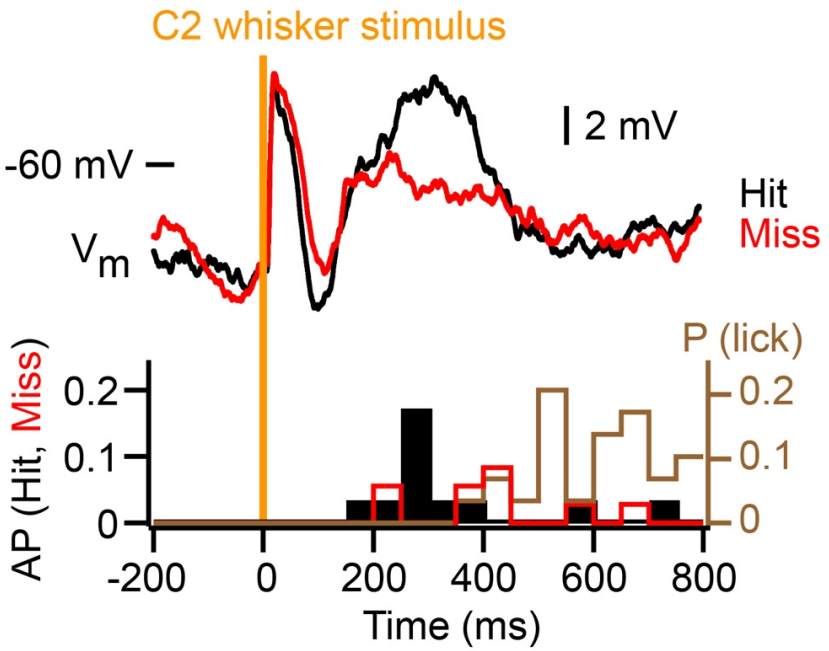
Membrane potential correlates of perception





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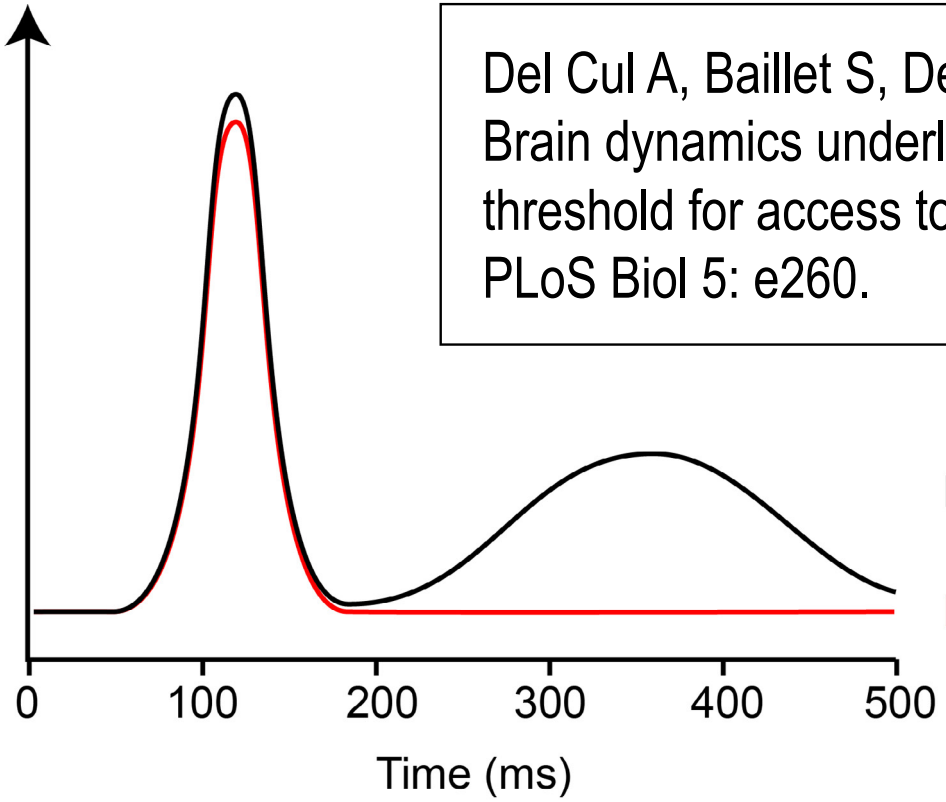
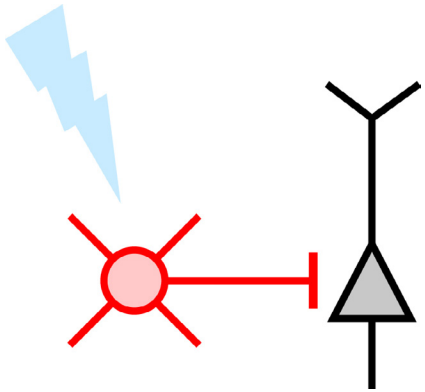
Correlates of perception in humans

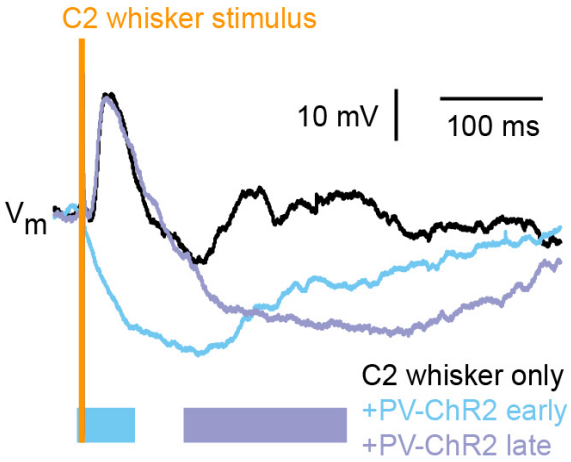
EEG signal strength
in early visual cortex

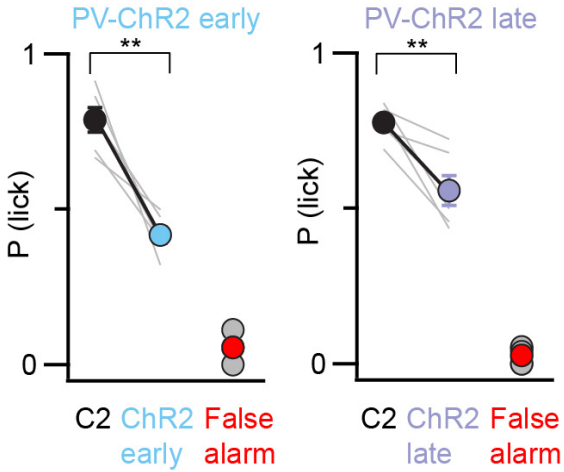


Del Cul A, Baillet S, Dehaene S (2007)
Brain dynamics underlying the nonlinear threshold for access to consciousness.
PLoS Biol 5: e260.

Late depolarisation contributes to perception







Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013

Cellular mechanisms of sensory perception

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- Head-restrained mice can be trained to perform simple perceptual tasks, allowing detailed investigation of the underlying goal-directed sensorimotor transformation.
- In a whisker detection task, an early sensory response in S1 reliably encodes stimulus, and a late component codes subjective percept.