

Bases neuronales de la gustation chez les insectes (et la drosophile)



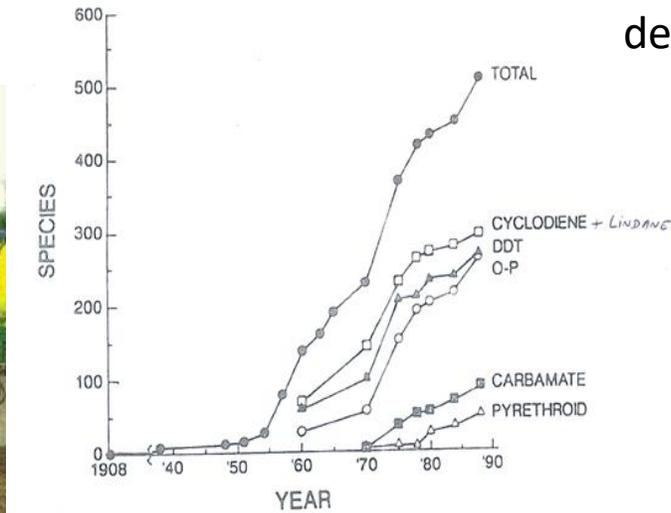
Frédéric MARION-POLL

AgroParisTech, Département Sciences de la Vie
et Santé

CNRS-Paris XI-IRD, UMR Evolution, Génomes,
Comportement et Ecologie(EGCE)

Pourquoi étudier le goût chez les insectes?

Lutter contre les insectes avec des insecticides est simple et efficace...

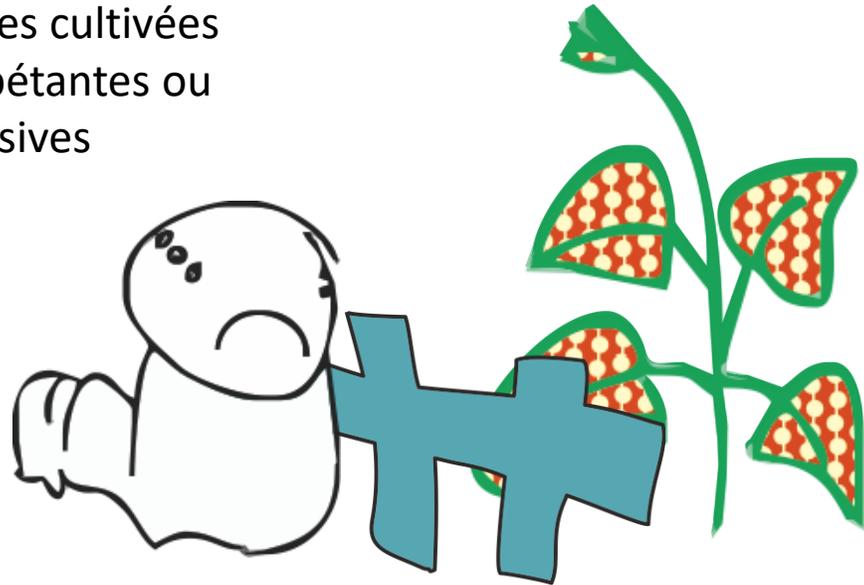


Mais en utilisant régulièrement des insecticides, on sélectionne des insectes résistants



Trouver de nouveaux moyens de lutte ?

Une première approche
serait de rendre les
plantes cultivées
inappétantes ou
répulsives



Une autre approche
pourrait être d'attirer les
insectes à contrôler dans
des pièges alimentaires
avec un insecticide



Le goût (en général) est un sens
multi-modal



Le déjeuner des canotiers
Auguste Renoir

Basé sur des cellules réceptrices
localisées dans la bouche

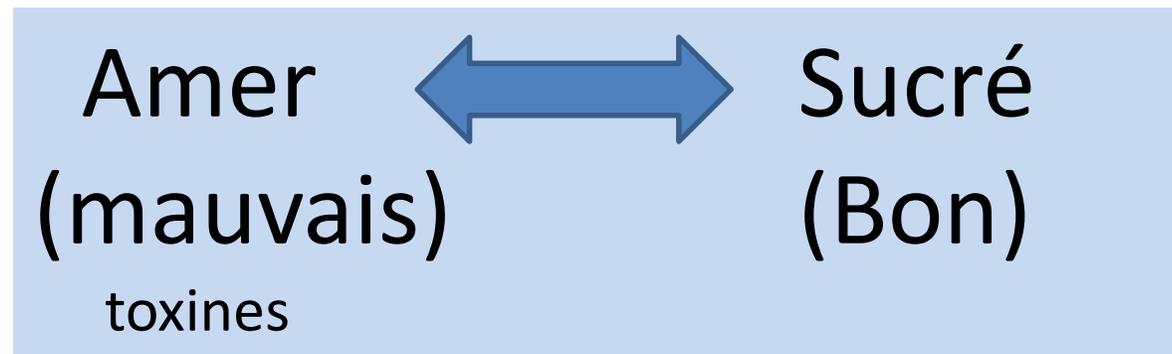


Localisation des organes du goût

- Bouche:
 - Papilles gustatives et bourgeons du goût
 - Nerfs sensoriels
 - Centres supérieurs
- Autres:
 - Pharynx
 - Tube digestif
 - Homéostasie: cerveau

Rôles du goût

- Stimule ou inhibe directement l'ingestion
- Distingue les toxines des nutriments
- Satiété provoque un plaisir hédonique



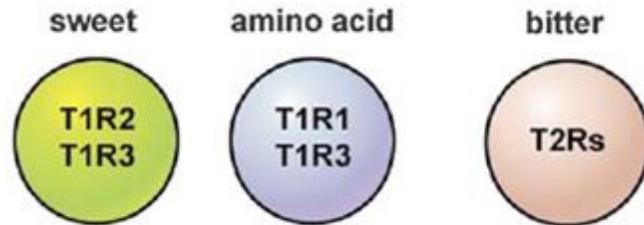
5 goûts élémentaires



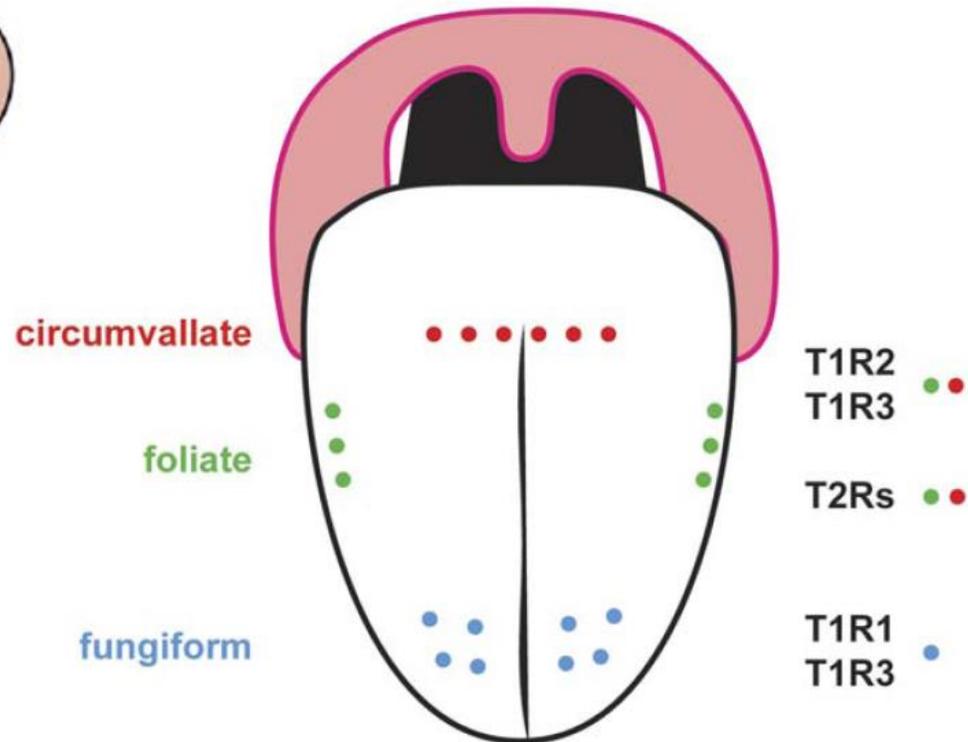
- Acide
- Salé
- Amer

- Umami
- Sucré

Distribution récepteurs



- Récepteurs dimériques; 2 familles:
- T1R: 3 gènes; T1R2 non fonctionnel chez les chats = pas détection sucres
- T2Rs: 25 gènes chez l'homme, 35 chez la souris



Scott (2005) Neuron

Autres modalités?

- Amidon (polycose) [Sclafani, 2004]
- Gras (acides gras) [Gilbertson, 1998]
- ...

Scott (2005) Neuron

Éléments additionnels

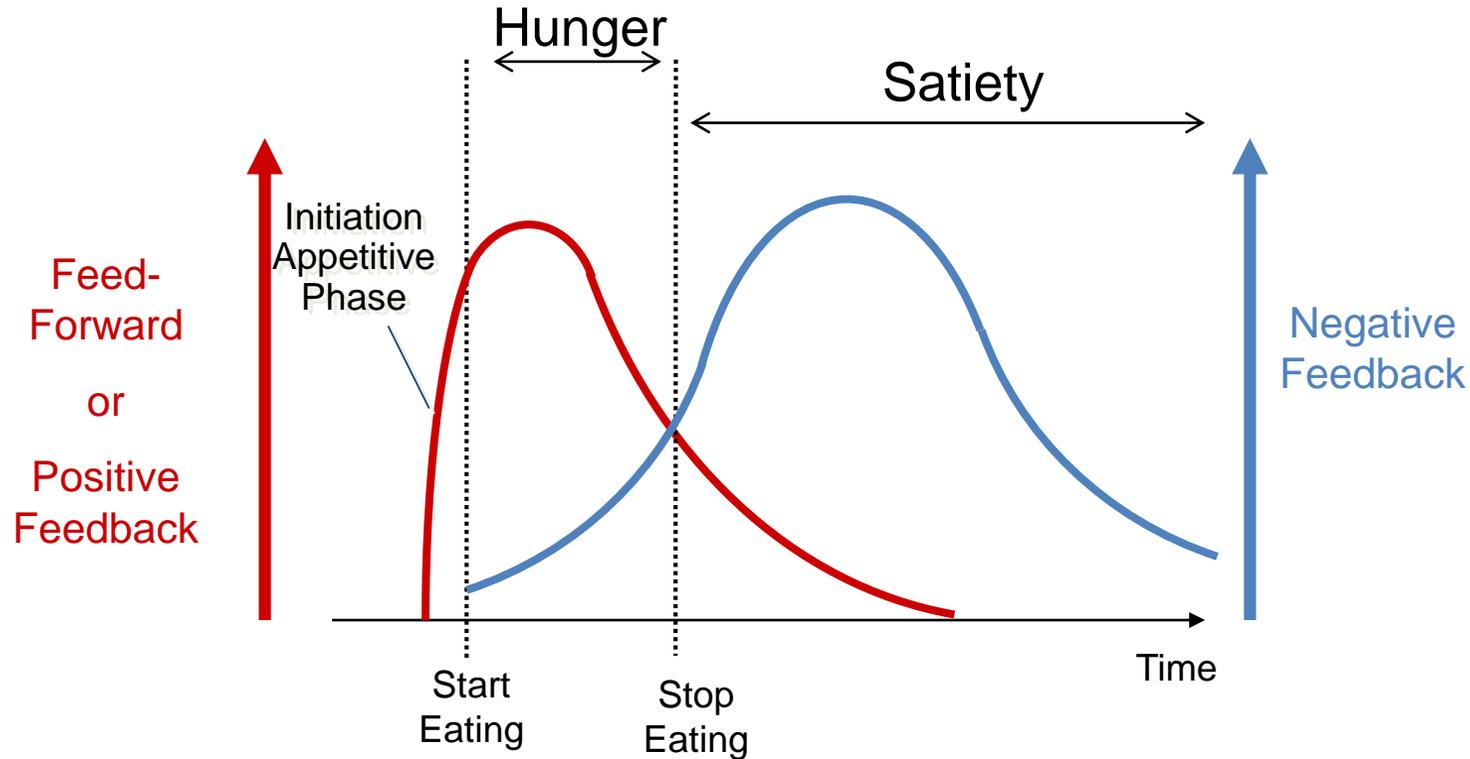
- Composition de la salive
- Enzymes de dégradation des molécules sapides
 - cytochrome P450 monooxygenases
 - carboxylesterases
 - glutathione-S-transferases

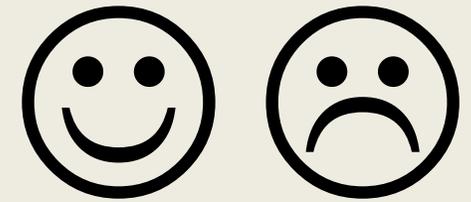
En résumé

- Le système gustatif comporte des cellules sensorielles exprimant des récepteurs, des canaux ioniques et des cascades de transduction
- Ce système gustatif chez les vertébrés est très développé dans la bouche et le système digestif
- Les informations obtenues permettent d'identifier des classes de molécules et surtout à préparer l'organisme à traiter ces molécules
- De nombreuses inconnues persistent



Feeding is modulated by pre- and post-ingestive feedbacks





Le goût est un sens hédonique chez « toutes » les espèces





<http://justbeer.wordpress.com/tag/samuel-adams/>



Youtube: eating grapefruit



B Sucrose Bob

Head - Extend, Flex	—————		—————		—————		—————		—————		—————		—————		—————		—————		—————		—————		
Mouth - Open, Close					→	←	→	←															
Tongue - Protrude, Retract					→	←																	
Lips - Parted, Closed					→	←	→	←															
Ears - Forward	—————		—————→																				
	FPS	0	1	2	3	4	5	6	7	8													



B Quinine Gape

Head - Extend, Flex	—————		—————		—————		—————		—————		—————		—————		—————		—————		—————		—————		—————	
Mouth - Open, Close																								
Tongue - Protrude, Retract																								
Lips - Retract, Relax																								
Ears - Back	—————		—————→																					
	FPS	0	1	2	3	4	5	6	7	8	9	10	11	12	13									



Fig. 1 Hedonic and aversive affective orofacial responses to sweet (upper row) and bitter (lower row) tastants in three different species — rat, primate, and human. Note the homologous tongue protrusion in response to a 'liked' taste and the gaping responses...

Charles Spence

Managing sensory expectations concerning products and brands: Capitalizing on the potential of sound and shape symbolism

Journal of Consumer Psychology, Volume 22, Issue 1, 2012, 37 - 54

<http://dx.doi.org/10.1016/j.jcps.2011.09.004>

**AVANT D'EXPLORER LE GOÛT CHEZ LA
DROSOPHILE, QUELQUES OUTILS GÉNÉTIQUES...**

(1) Marker mutations



white



bar



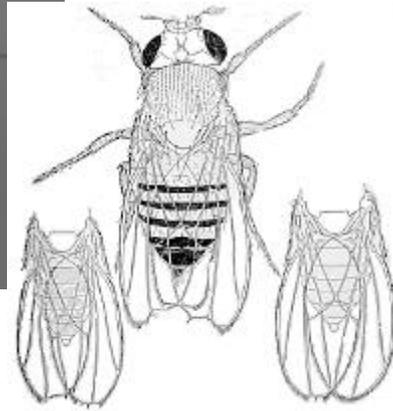
curly



bithorax



wingless



notch

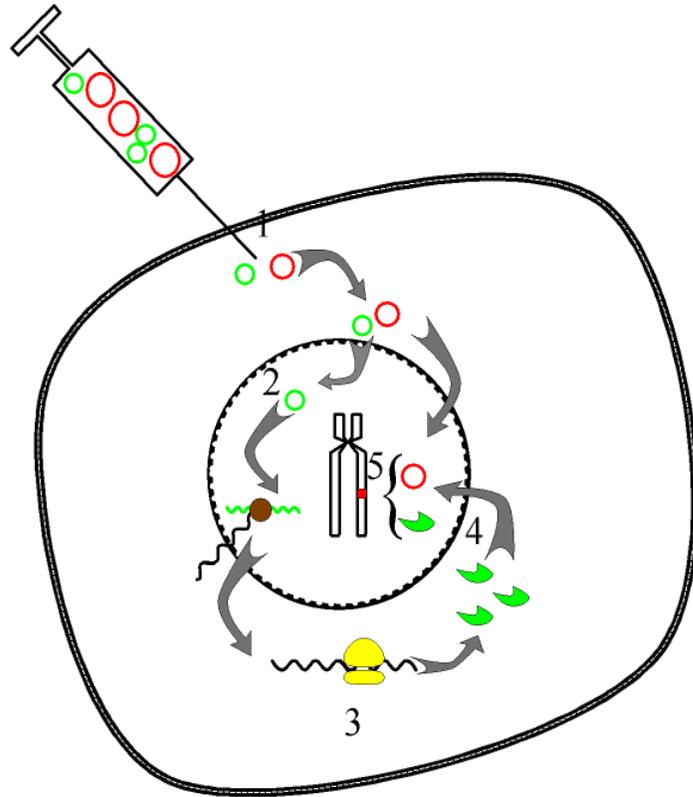


vestigial

(2) Balancer chromosomes

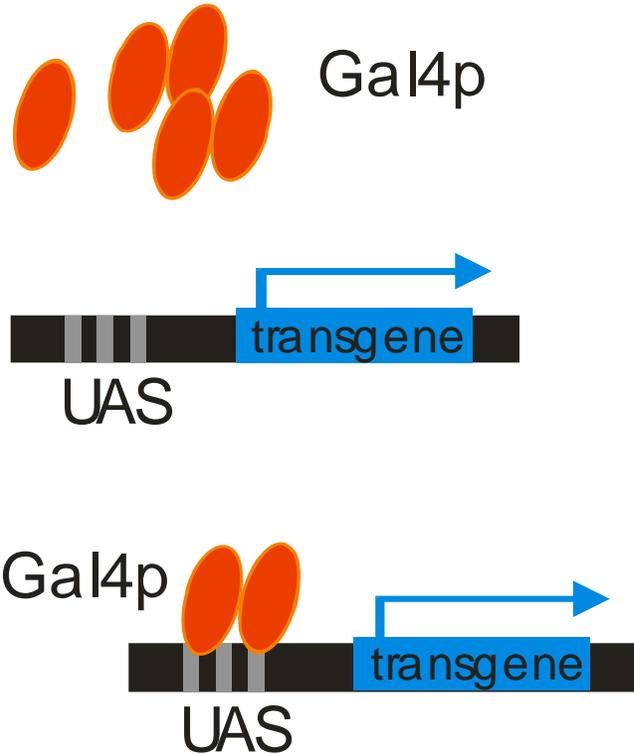
- To prevent divergence of the character and the marker mutation, geneticists have established flies with scrambled chromosomes which will not recombine with regular chromosomes; these chromosomes are called **balancers**.
- Ideally, balancer chromosomes in the fruit fly contain the following:
 1. an inversion or inversions to suppress the recovery of viable recombination products over the length of the chromosome;
 2. a dominant phenotype that enables the inheritance of the chromosome to be tracked easily in subsequent crosses; and
 3. a recessive lethal mutation that eliminates the homozygous balancer from the population of breeding flies.

(3) Modified P elements & transgenesis



1. Inject embryo with modified P elements and RNA for transposase
2. Transcription of the helper
3. ARNm -> transposase
4. Insert transposon
5. Replication

Yeast: Gal4 -> UAS



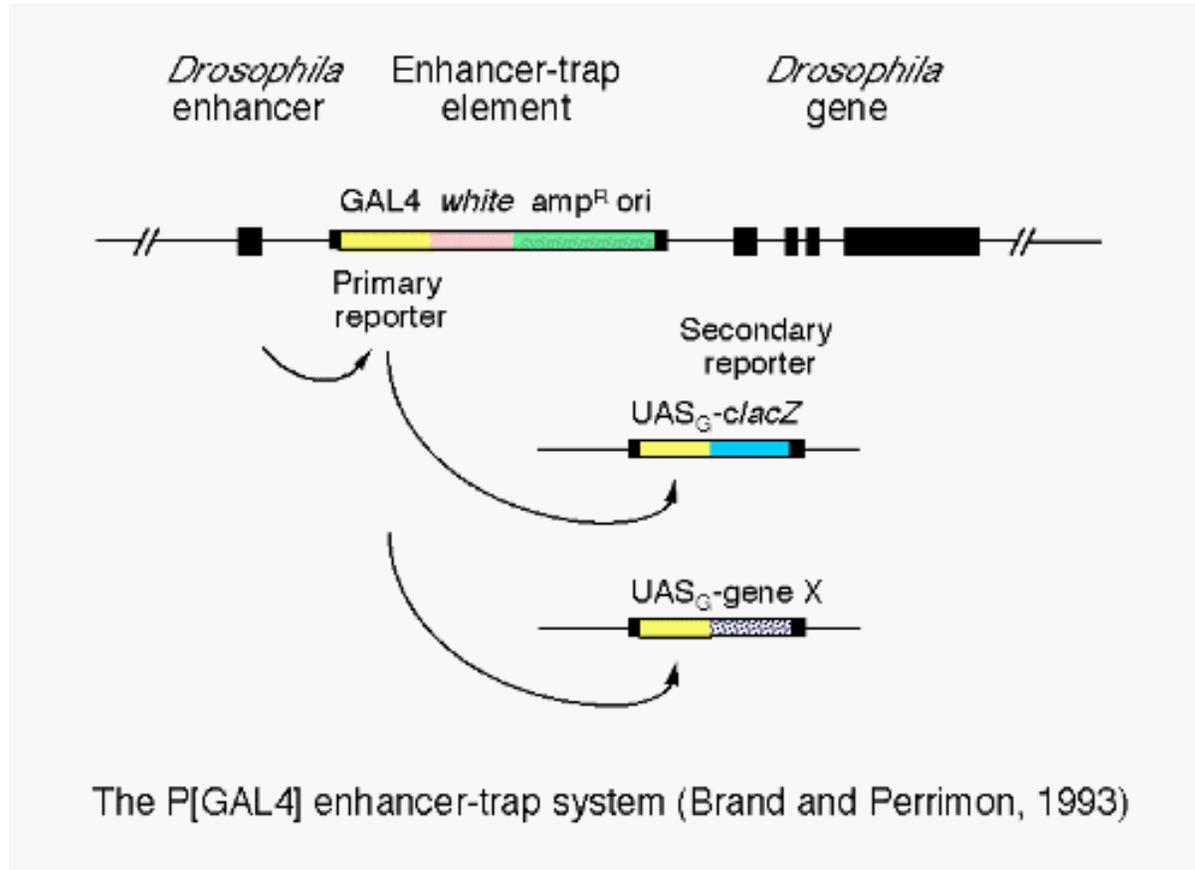
UAS = upstream regulated activating sequence

GAL4 = transcription activator

<http://info.bio.cmu.edu/Courses/BiochemMols/MolBiol/1D66.html>

- Gal4 protein regulates the the expression of genes with a USA promoter
- Gal4 / UAS is not present in insects
- Gal4 can accumulate in a cell without damaging it.
- The gene behind UAS is not expressed in the absence of Gal4

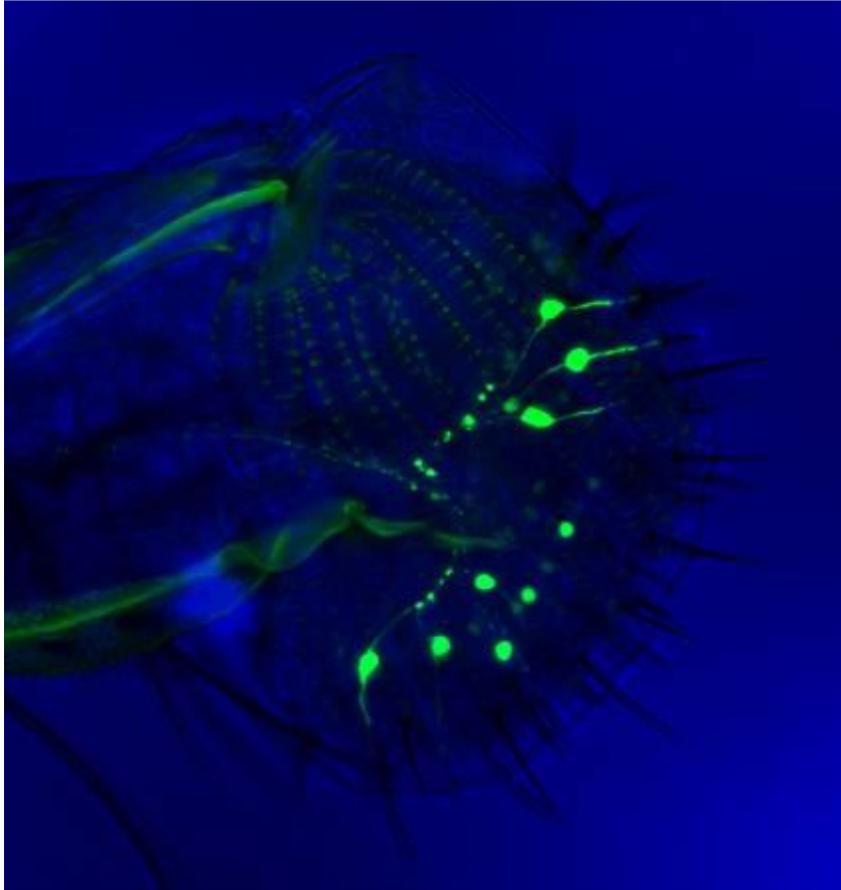
(4) P[GAL4] x P[UAS X]



P[UAS X]

- P[Gal4] need a partner to “convert” Gal4 into the product of another reporter gene.
- P[UAS X] : Example P [UAS GFP]
- P[UAS TNT]
- P[UAS *Reaper*]
- P[UAS *tra*]
- ...

Drosophila genetic tools



Hiroi et al (2001) Zool. Sci.: Gr32d1

- Balancer chromosomes
- Transgenesis easier than in vertebrates
- UAS-Gal4 can be used to mark neurons expressing a given Gr with GFP
- Bloomington & other repository of mutants
- Flybase.org

Bases de données et stock centers

FB2020_05, released Oct 14, 2020

FlyBase

A Database of *Drosophila* Genes & Genomes

Home Tools Downloads Links Community Species About Help Archives Search Search FlyBase Go

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 GBrowse
 JBrowse
 Resources
 RNA-Seq
 Vocabularies
 ImageBrowse
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DroID [\[edit \]](#)

The Drosophila Interactions Database developed by [Russell L. Finley's](#) labo National Human Genome Research Institute, Proteome Consortium, and Wayne St

FlyBase [\[edit \]](#)

FlyBase is the major online database species, gene annotations, gene function genome. ^[5] FlyBase was developed in consortium of groups from Harvard U ^{[6][5]}

FlyFactorSurvey [\[edit \]](#)

FlyFactorSurvey is a database of *Drc* developed by the laboratories of [Mick](#) 2011, and was funded by the Nationa

FlyMine [\[edit \]](#)

FlyMine is a database of transcription was originally developed by [Gos Mick](#) Trust, with elements of the database : Biological Sciences Research Council

OnTheFly [\[edit \]](#)

OnTheFly is a database of *D. melanc* the laboratory of Barry Honig at Colu

REDfly [\[edit \]](#)

REDfly (Regulatory Element Databas laboratory of [Marc S. Halfon](#) at the Ur and the National Institute of General I

StockCenters/Links

Index

Stock Centers of Drosophila strains, antibodies

National Institute for Genetics (Mishima, Japan)

- East Asian Distribution Center for Segmentation Antibodies
- Asia Drosophila P1 Clone Distribution Center
- "Drosophila Genetic Resources" Stock Center of wild type

FlyBase

- Access to Drosophila stock centres of the world (Bloomington Center, Szeged Center)

Flybrain: An Online Atlas and Database

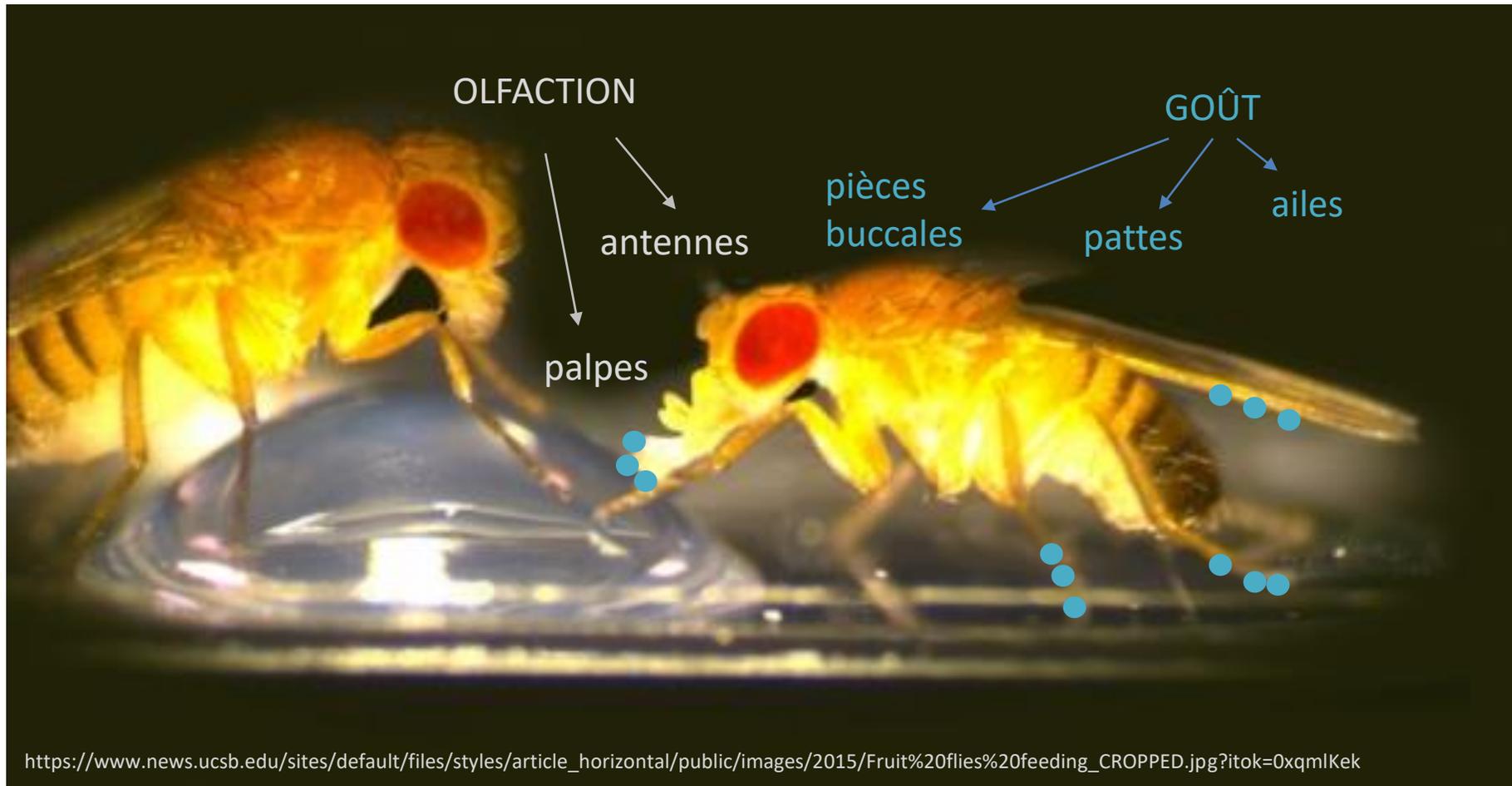
A database of Drosophila CNS anatomical figures (server maintai

Other WWW pages

- FlyBase Japan Mirror Server (Iken-Ken, Mishima)
- FlyBase other mirror servers
- Bionet Drosophila Newsgroup : Archives
- Bionet Newsgroup Home Page
- Berkeley Drosophila Genome Project (BDGP: Berkeley, CA)
- European Drosophila Genome Project (EDGP: Cambridge, UK)
- Drosophila Virtual Library (Gerard Manning's Drosophila USA)
- The Interactive Fly (Purdue, USA)
- Educational Tour of the Fly Brain (Freiburg, Germany)
- FlyView (Muenster, Germany)
- A 2D-PAGE Protein Database of Drosophila melanogaster

LE GOUT CHEZ LA DROSOPHILE

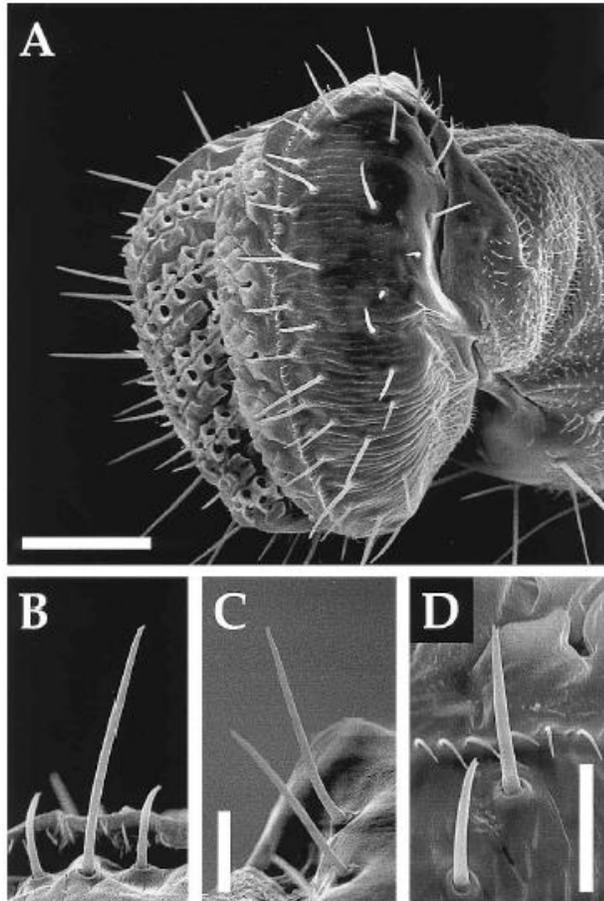
Les organes du goût chez la drosophile



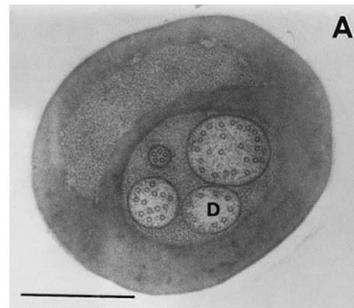
Sommaire :

Les organes du goût
Détection de la texture
Modulations du goût

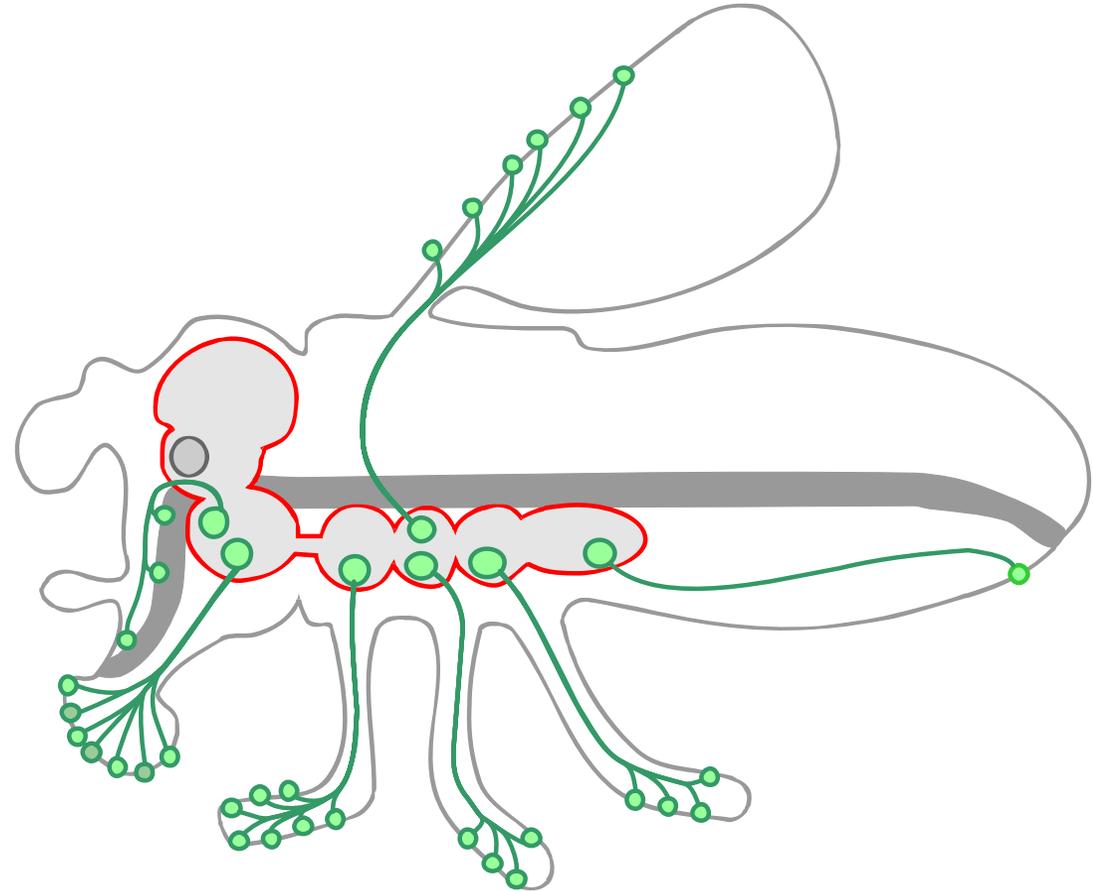
Gustation chez l'insecte



Hiroi *et al.* , Zool J 2003

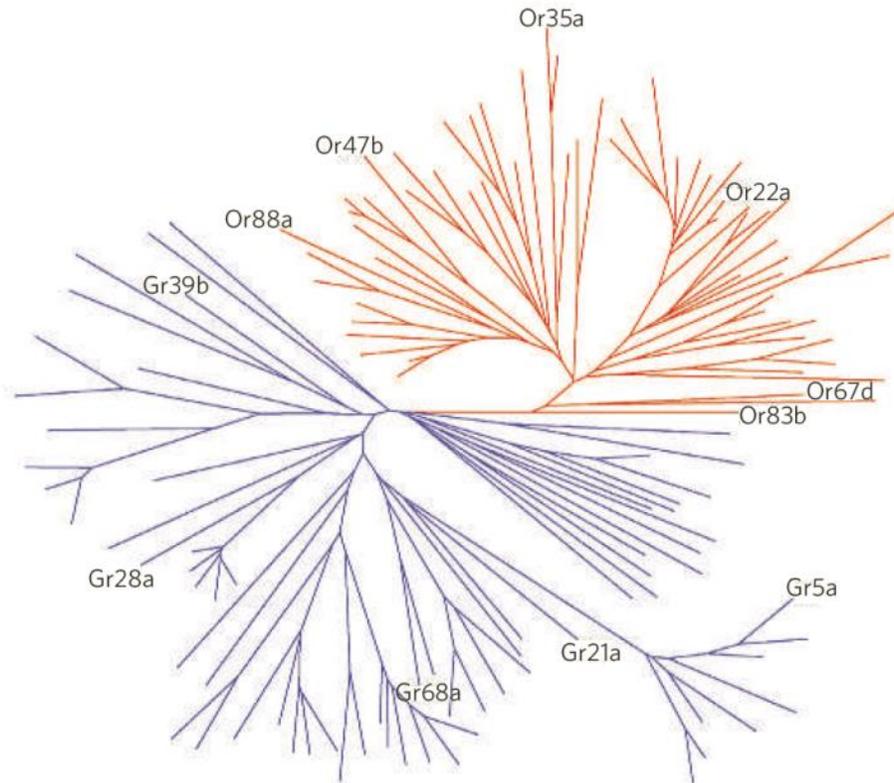


Shanbhag *et al.* , Cell Tissue Res 2001



de Bruyne et Warr (2006)

Taste receptors



van Naters & Carlson (2006) Nature

- 60 putative taste receptors
→ 68 proteins
- Large divergence (about 8% homology)
- Structurally close from Ors

Clyne, P. J., C. G. Warr, et al. (2000) "Candidate taste receptors in Drosophila." Science 287: 1830-1834

Taste receptors

- 60 taste receptors
- Proteins with 7 trans-membrane domains
- 68 proteins encoded

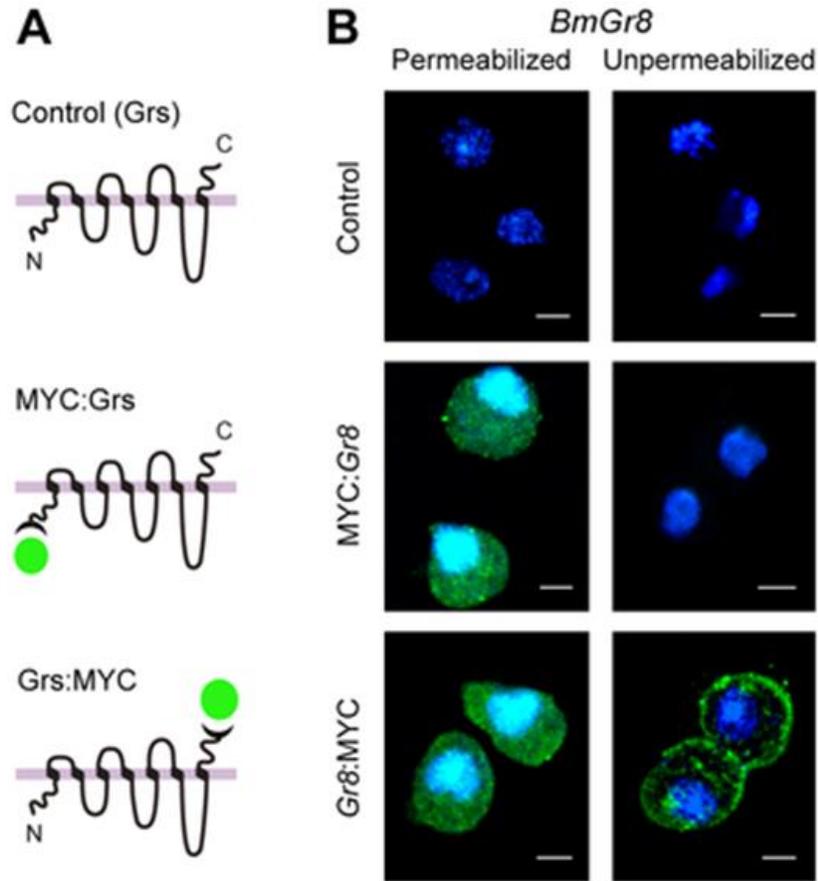
Clyne, P. J., C. G. Warr, et al. (2000) "Candidate taste receptors in *Drosophila*." *Science* 287: 1830-1834

- Structurally close to Ors
- Large divergence (about 8% homology)

Amrein & Thorne (2005) *Curr. Biol.*



Topology « inverted »



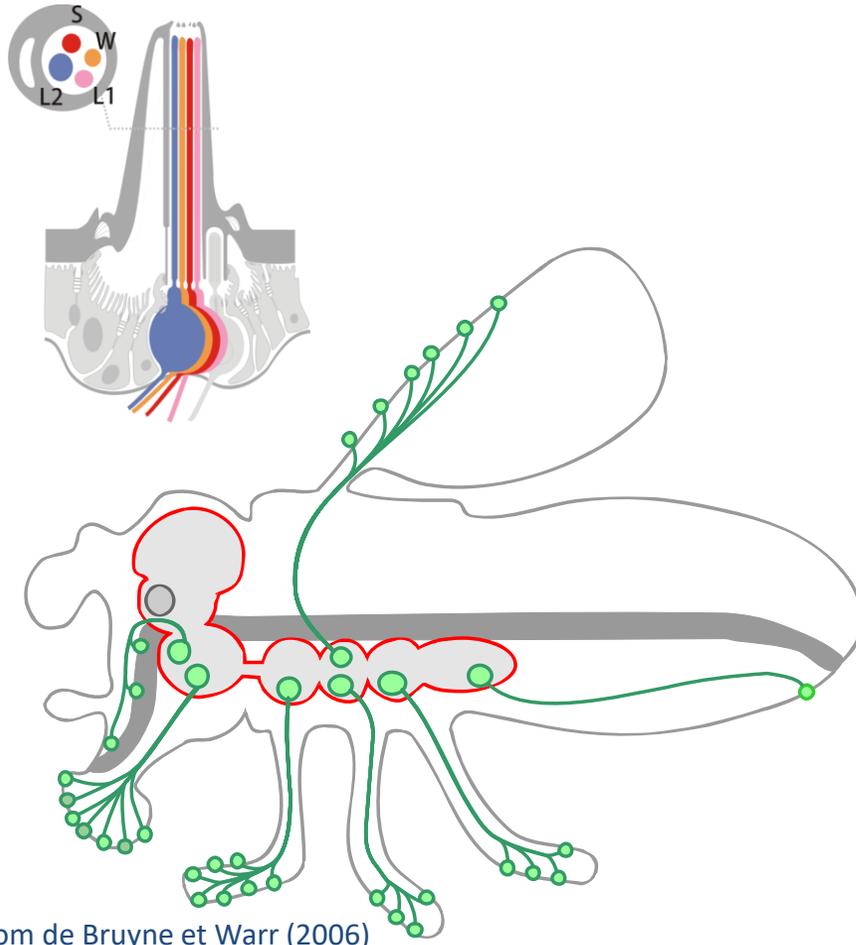
- N-terminus is intracellular contrary to vertebrate receptors (?connection with G-proteins?)

Zhang et al. (2011) PLoS ONE 6(8): e24111

Other taste « receptors »

- In addition to Grs, taste neurons of *Drosophila* also express:
 - IR receptors : ionotropic receptors initially found in olfactory neurons. They belong to the glutamate family of receptors
 - TRP channels, and in particular TRPA1 which enable insects to detect pungent stimuli
 - DEG/Nac channels and ppk channels involved in the detection of pheromones, salts, water
 - Odorant binding proteins (OBP) which help to solubilize non-water soluble tastants

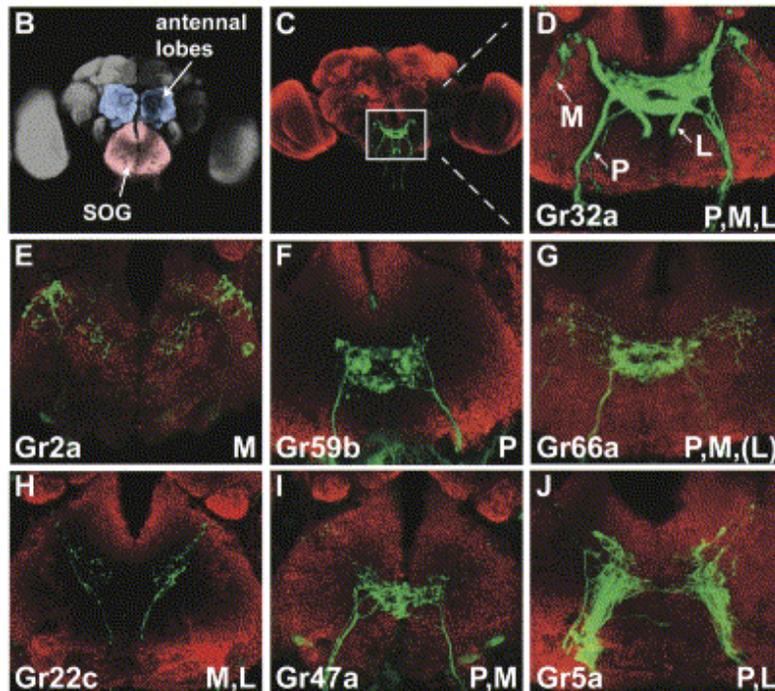
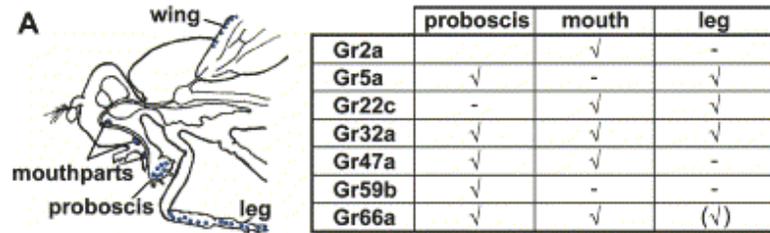
Taste system in *Drosophila*



From de Bruyne et Warr (2006)

- 660 taste neurons
- Legs, mouthparts, wings, ovipositor
- CNS = 1 « taste-brain » / segment
- Positional mapping
- Several receptors co-expressed in a taste neuron

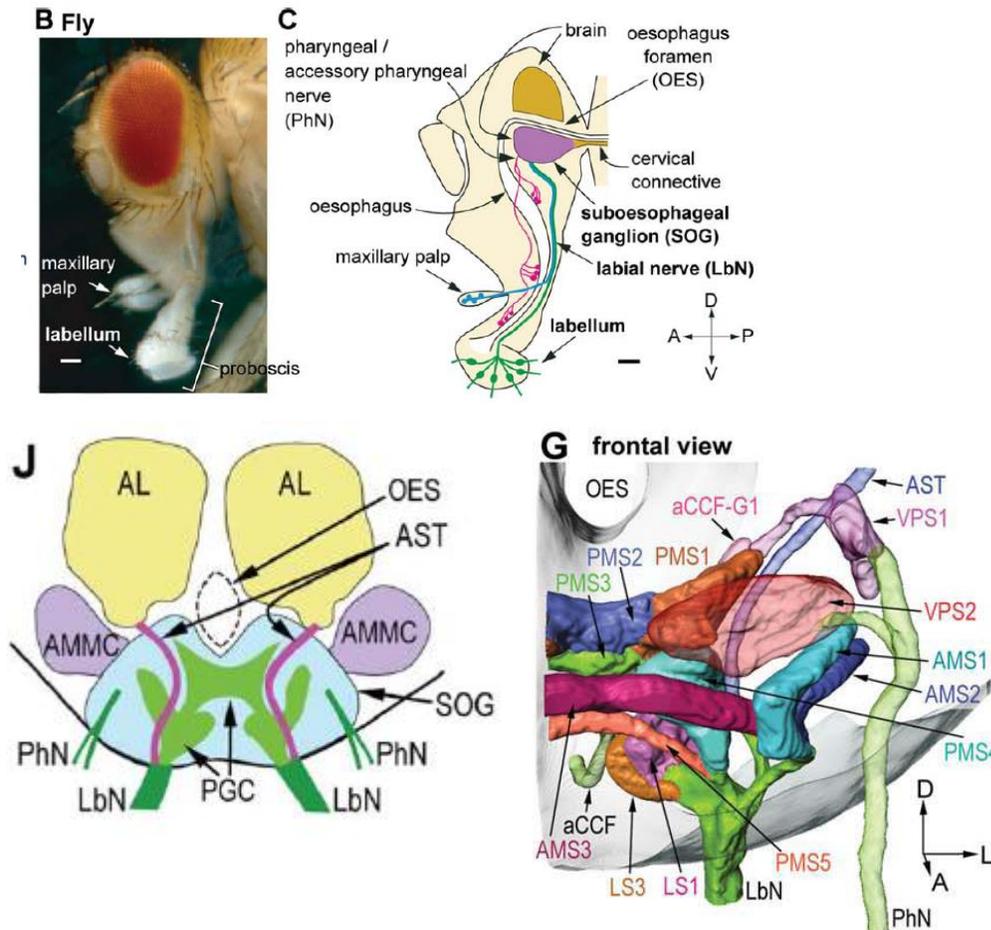
CNS taste projections (1)



From Wang *et al*, Cell 2004

- UAS-Gal4 strains
- Stain specific cells and monitor where they project
- *Gr5a* cells (sugar) different from *Gr66a* cells (bitter)

CNS taste projections (2)



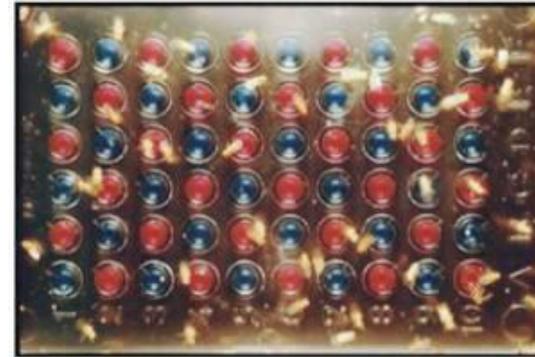
- Sweet (*Gr5a*) and bitter (*Gr66a*) neurons project in different areas
- Mechanoreceptors project in a separate area
- Water cells project in both *Gr5a* and *Gr66a* areas

Miyazaki & Ito (2010) *J. Comp. Neurol.*

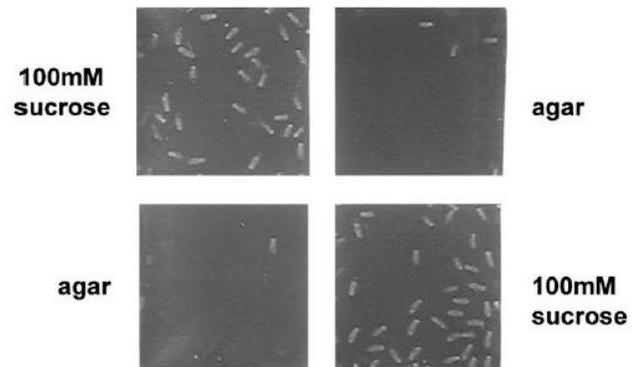
Behavior



Proboscis extension reflex

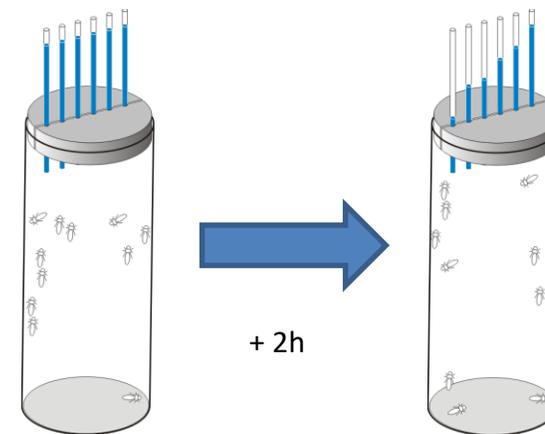


Binary choices



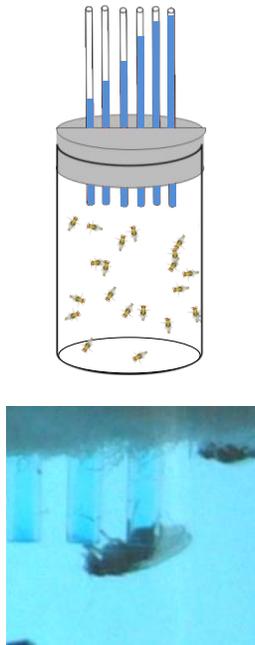
Ambulatory test

Marella *et al.* Neuron 2006

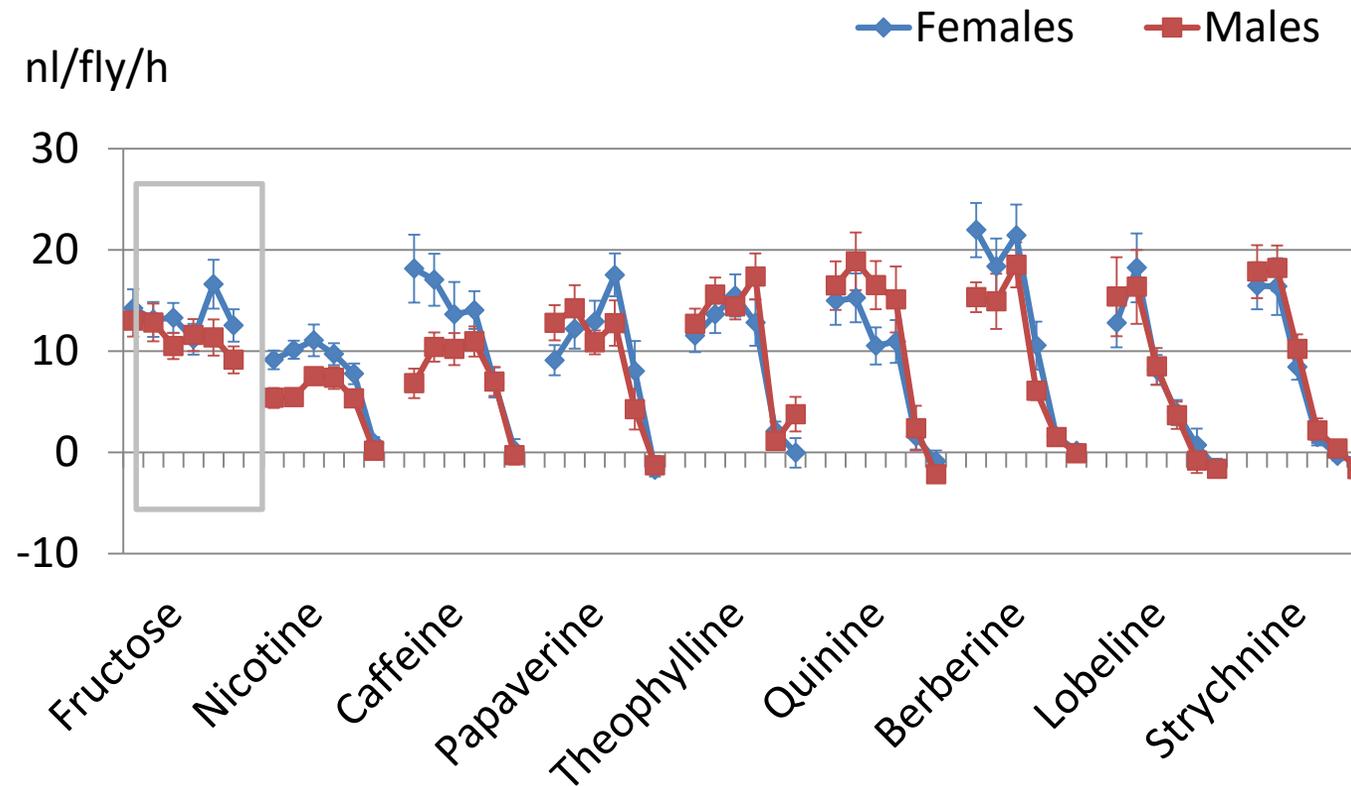


MultiCAFE

Drosophila avoid ingesting alkaloids



multiCAFE

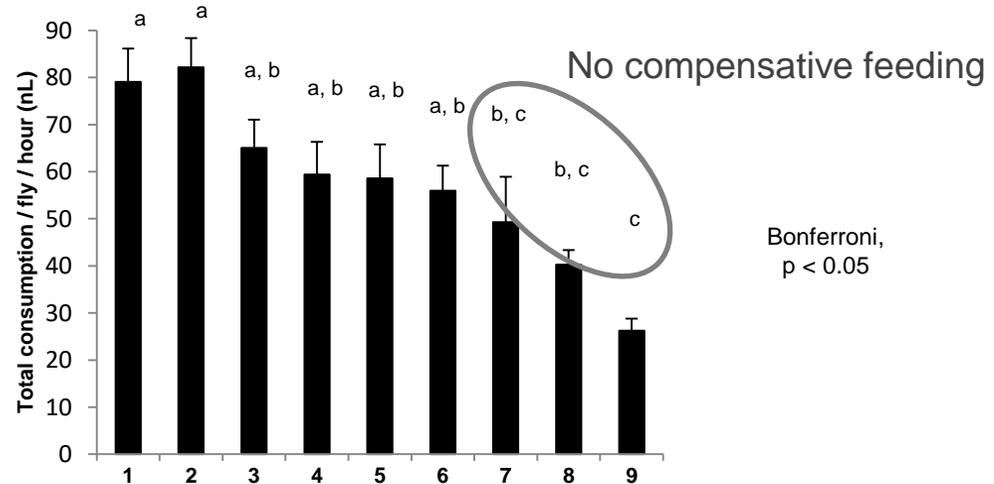


Concentrations (+ 35 mM Fru):
0 / 0.001 / 0.01 / 0.1 / 1 / 10 mM

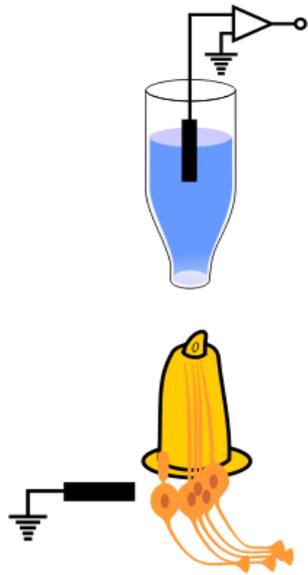
Sellier et al. (2011) Chem. Senses

Avoidance vs toxicity?

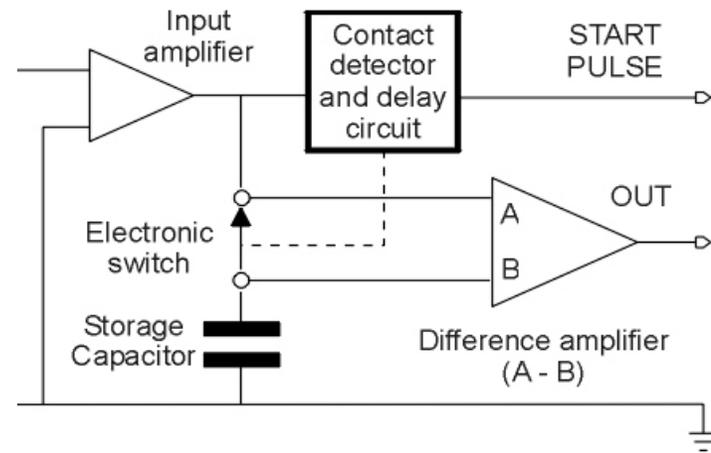
Antifeedancy	Compound	EC ₅₀ (mM)	
↑ +	Strychnine	0.005	
	Lobeline	0.011	
	Berberine	0.06	
	Theophylline	0.4	
	Quinine	0.5	
	Caffeine	1.1	
	Papaverine	3	
	↓ -	Nicotine	4



Electrophysiology

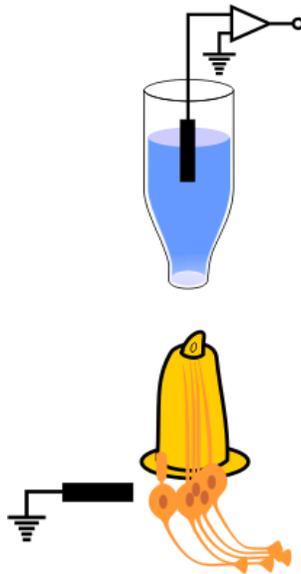


TIP-RECORDING

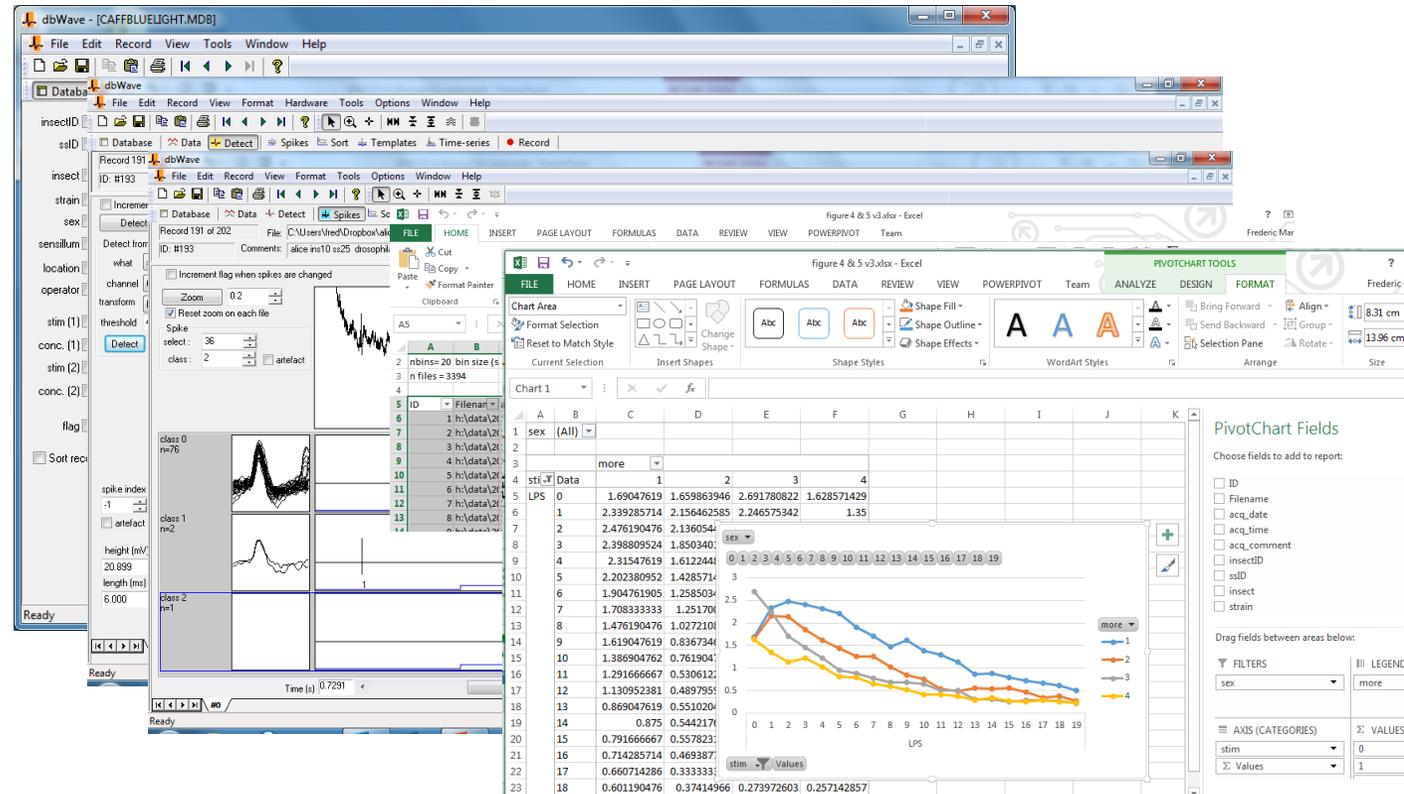


TASTEPROBE

Analysis



TIP-RECORDING

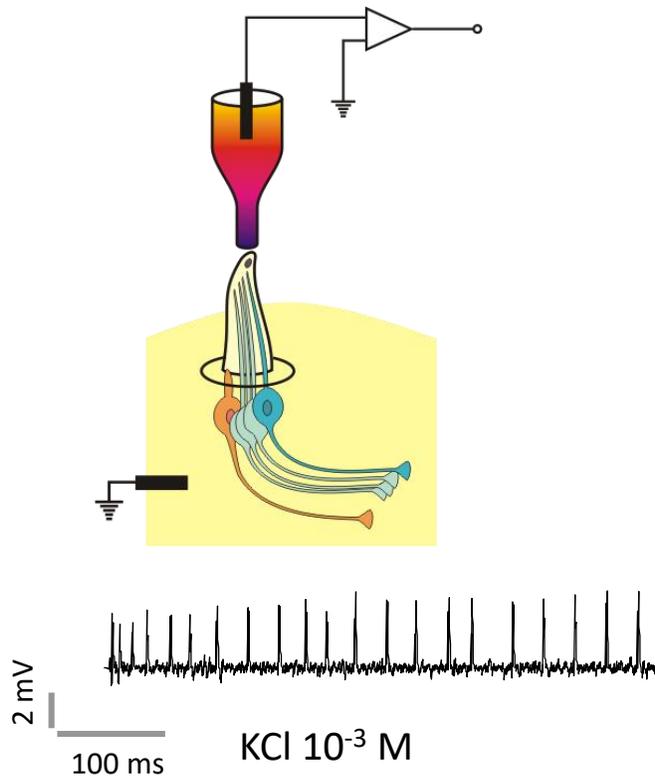


dbWAVE

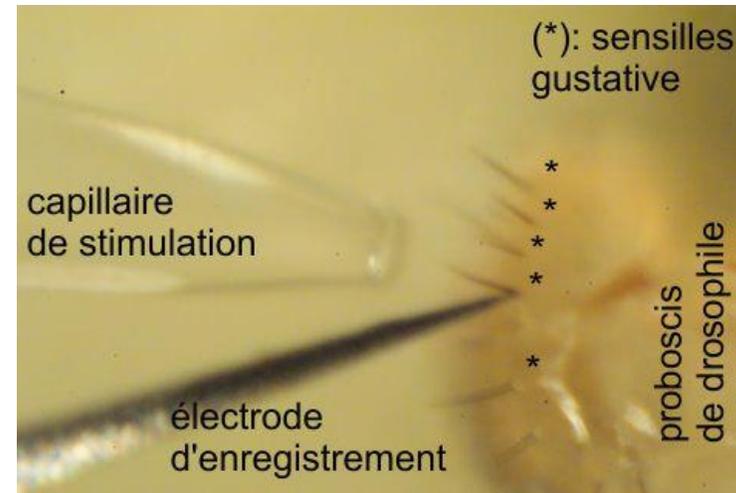
Excel

The pore allows us to stimulate & record the response of taste neurons

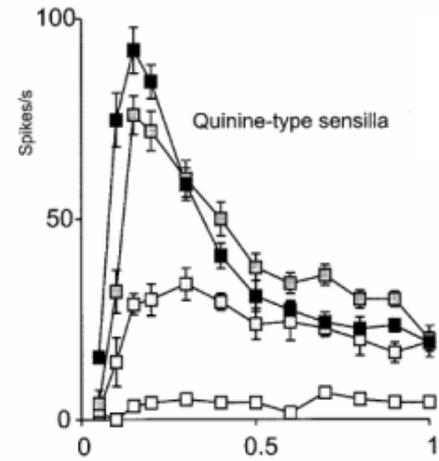
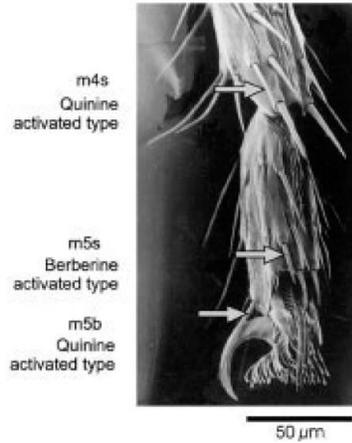
Tip-recording method



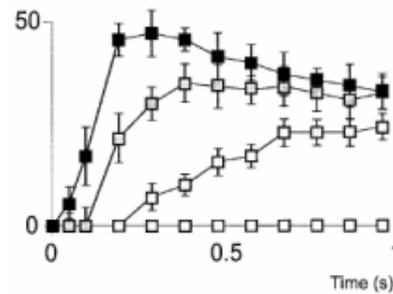
Double-electrode method



Each sensilla is different...



Berberine-type sensilla



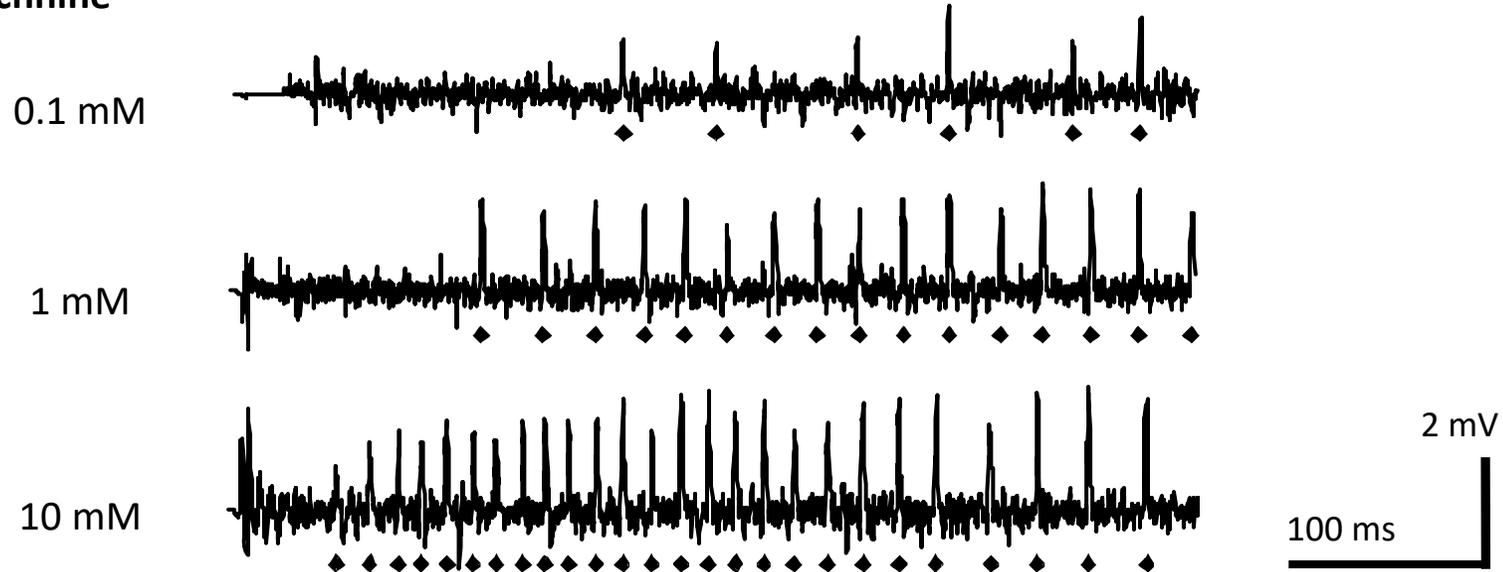
■ 10^{-3} M
 □ 10^{-4} M
 □ $3 \cdot 10^{-5}$ M
 □ 10^{-5} M

	quinine-type	berberine-type
mM -> 20 spk/s		
in L2 cell	5b/4s	5s
Berberine	no	0.05
Quinine	0.1	no
Denatonium	0.05	0.05
Strychnine	3	3
Caffeine	no	13
Aristolochic acid	no	no
Salicin	no	no

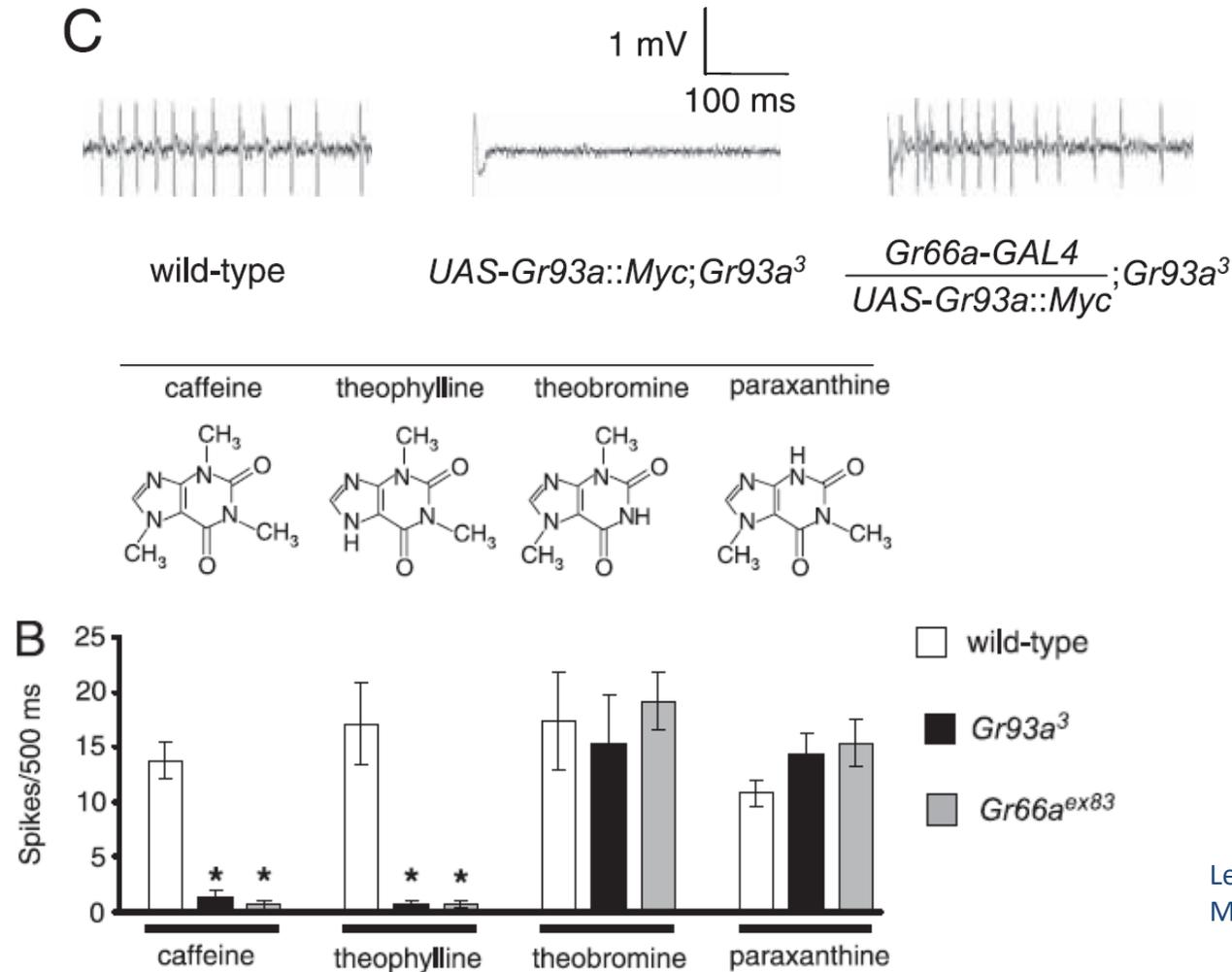
Proboscis i-type: bitter responses

Compounds	Berberine	Caffeine	Quinine	Strychnine	Denatonium	Salicine	Aristolochic acid
Response	+	+	+	+	-	-	-

Strychnine

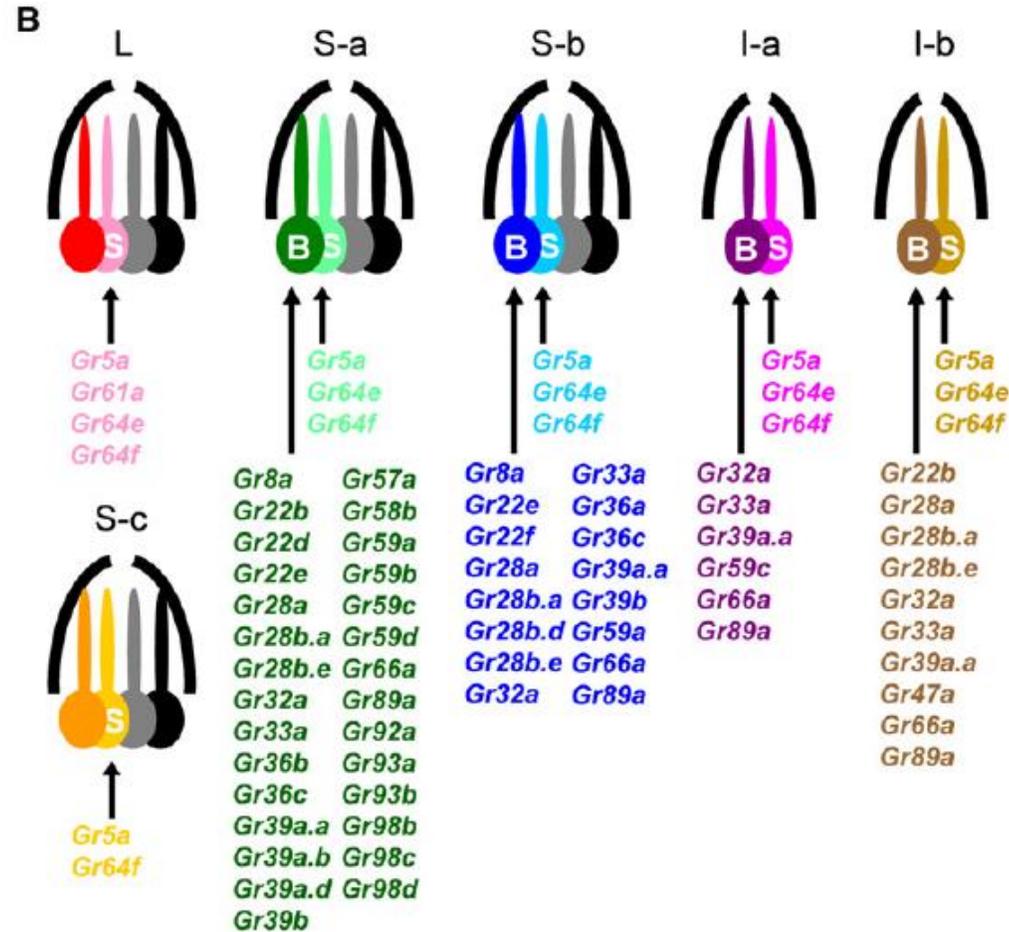


Bitter receptors ? Gr66a, Gr33a, Gr93a



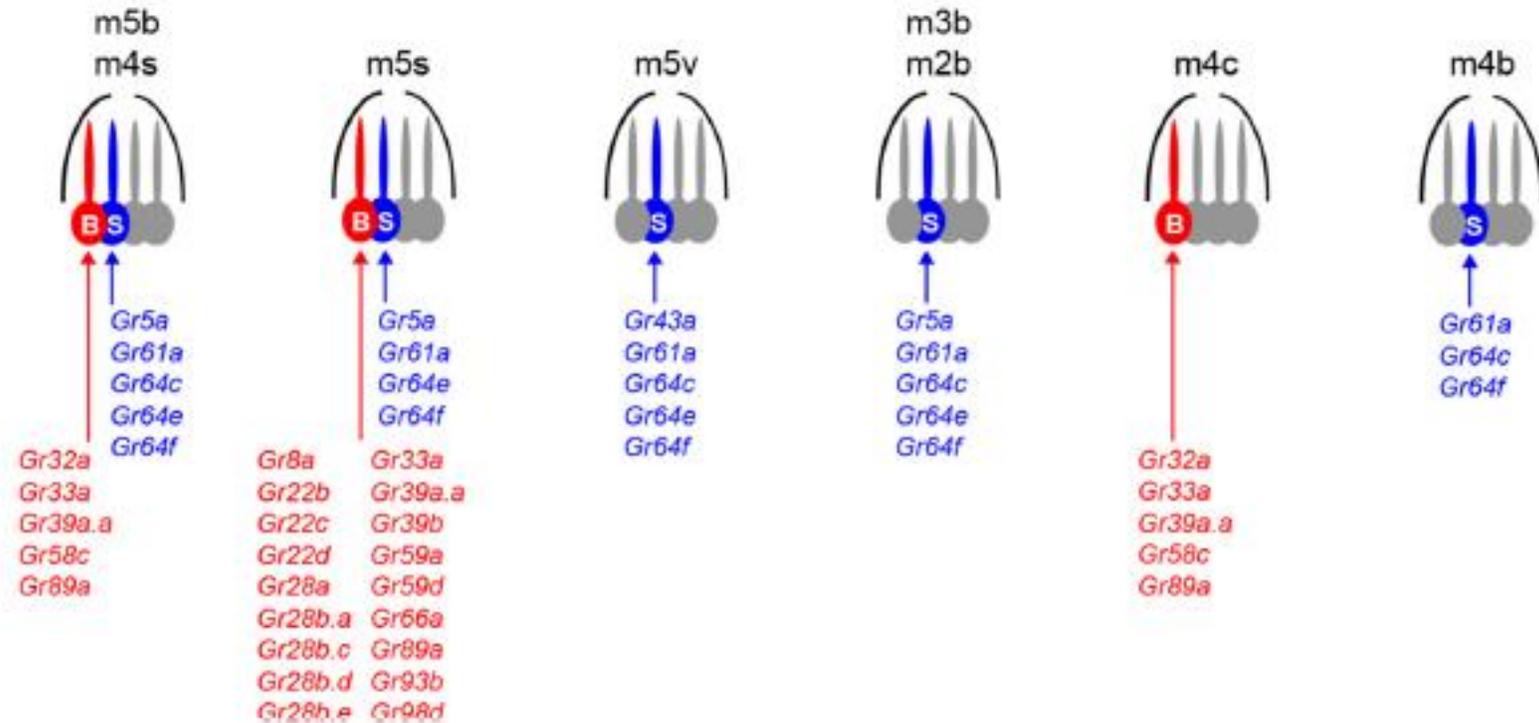
Lee et al. (2009) PNAS
Moon et al. (2009) Curr. Biol.

Gr expression in taste neurons on the proboscis

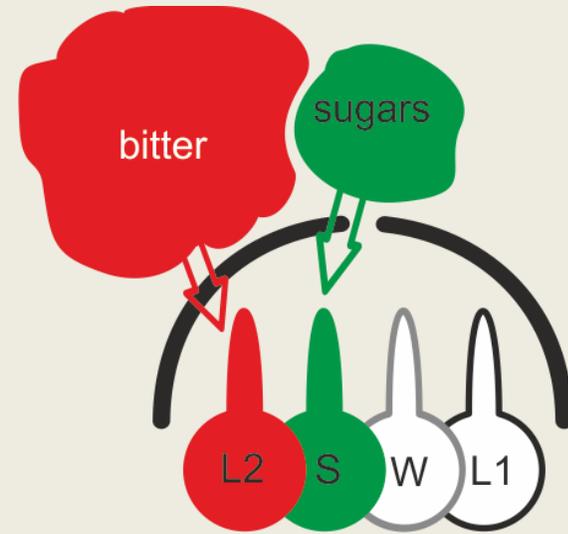


Weiss et al. (2011) *Neuron* 69(2): 258-272

Gr expression in taste neurons on the legs



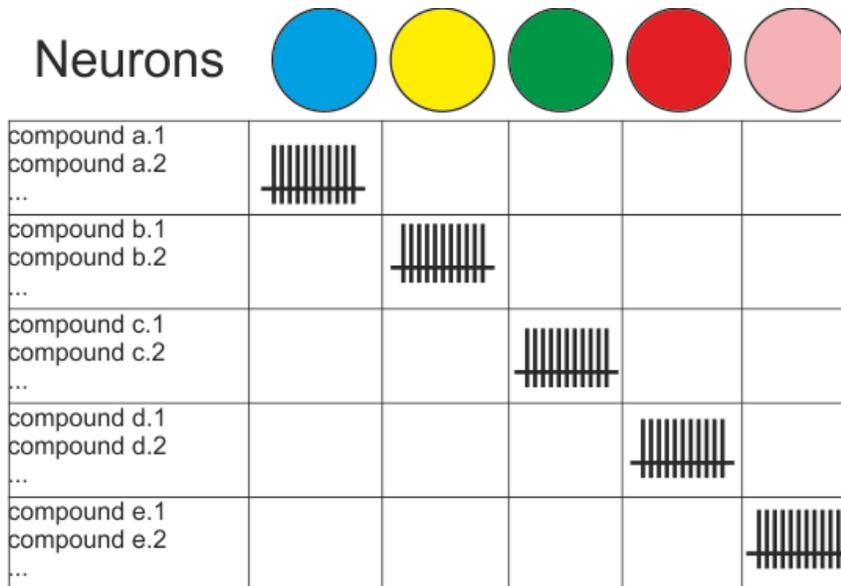
Ling et al. (2014) J Neurosci 34(21):7148 –7164



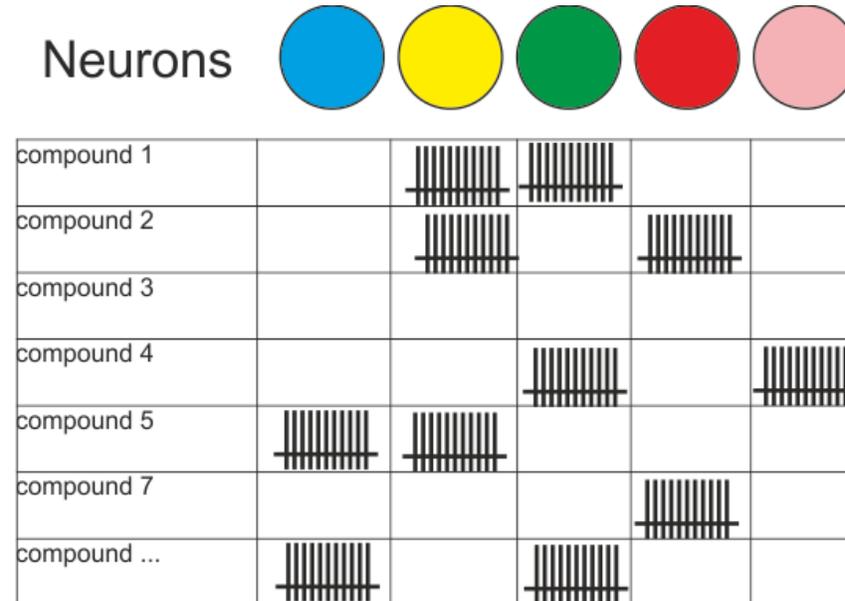
(1) TASTE = LABELED LINE CODING

Coding chemical information

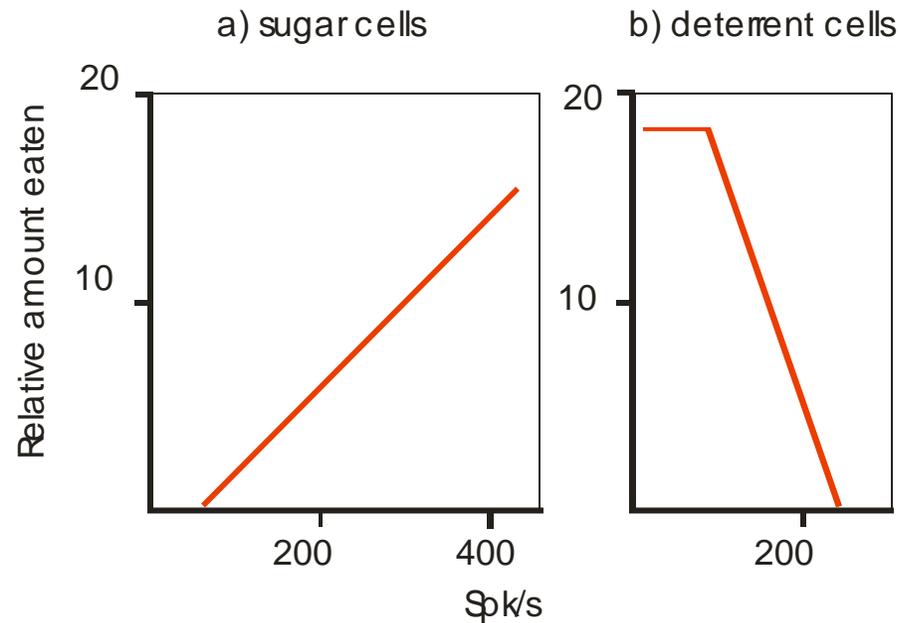
Labeled lines



Across fiber



Sugar and « deterrent » cells



- S stimulates feeding
- L2 inhibits feeding
- CNS integrates the two type of inputs to produce behavior
- Concept of « deterrent » cells

Relationship between sensory input and amount eaten in the larva of *Pieris brassicae*.

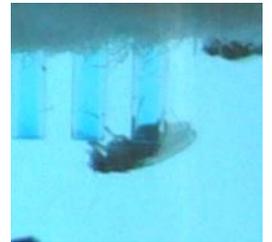
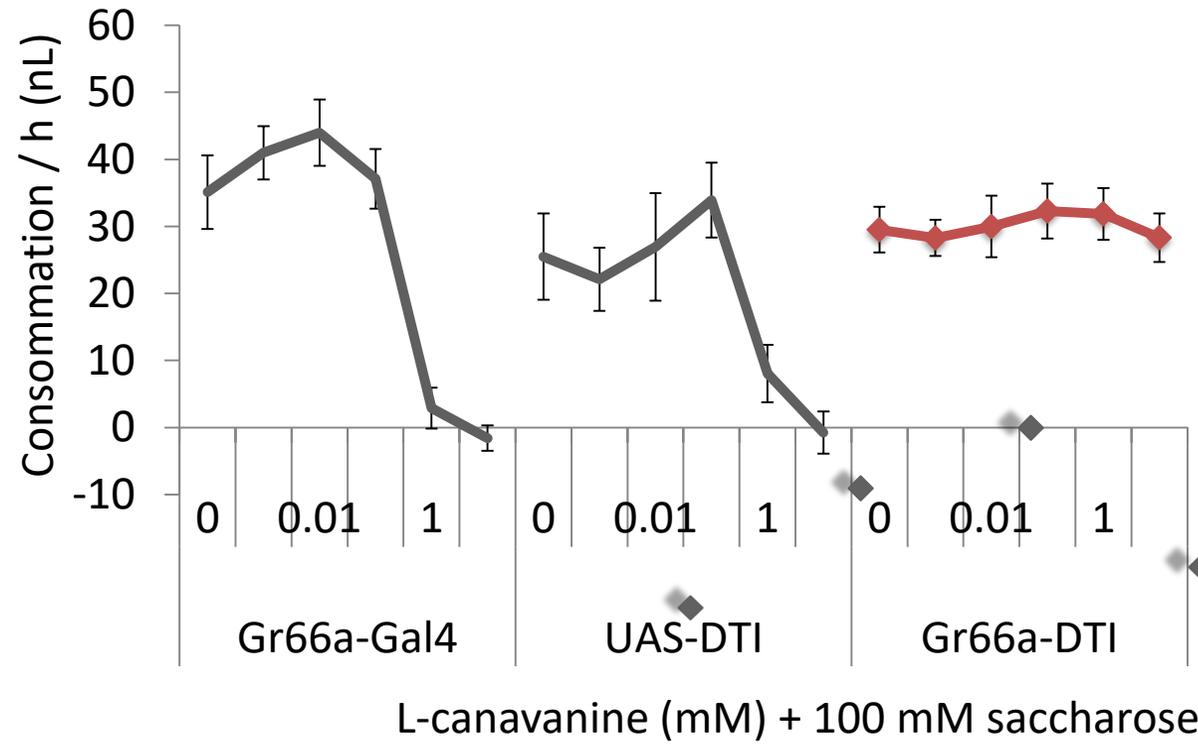
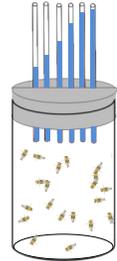
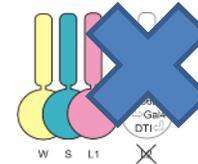
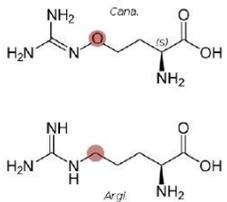
- Amount eaten in relation to the combined activities of the three sugar-sensitive cells when stimulated by sucrose
- Amount eaten in relation to the combined activities of two deterrent cells when stimulated by strychnine in the presence of 0.02 M sucrose.

Amount eaten was based on the production of feces (after Schoonhoven and Blom, 1988)

Une ablation génétique des neurones de l'amer supprime l'aversion pour la L-canavanine

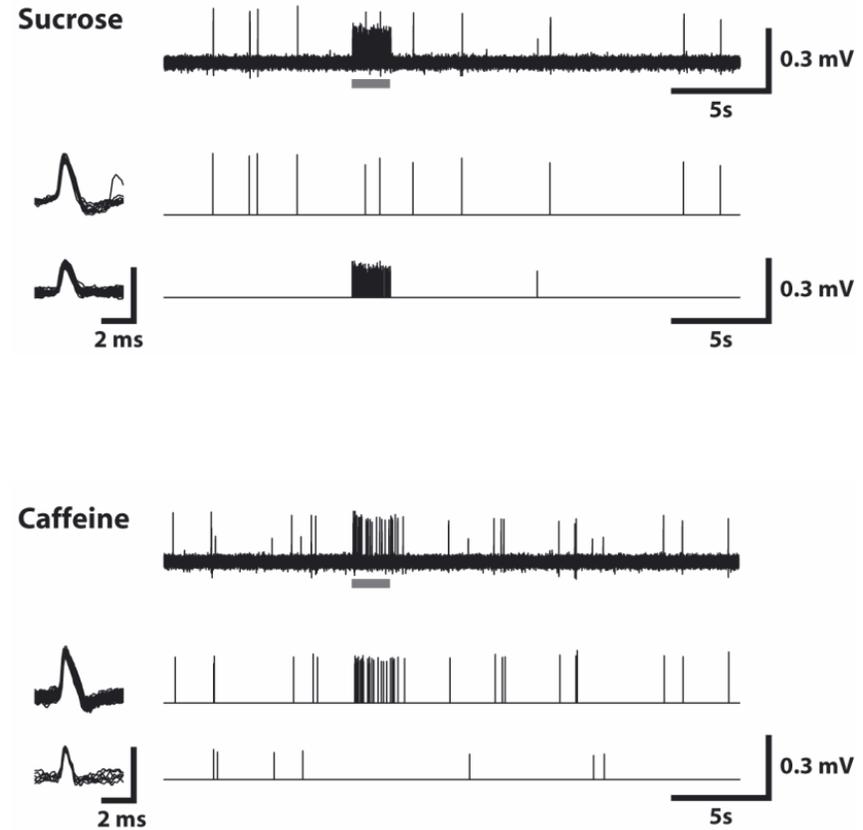
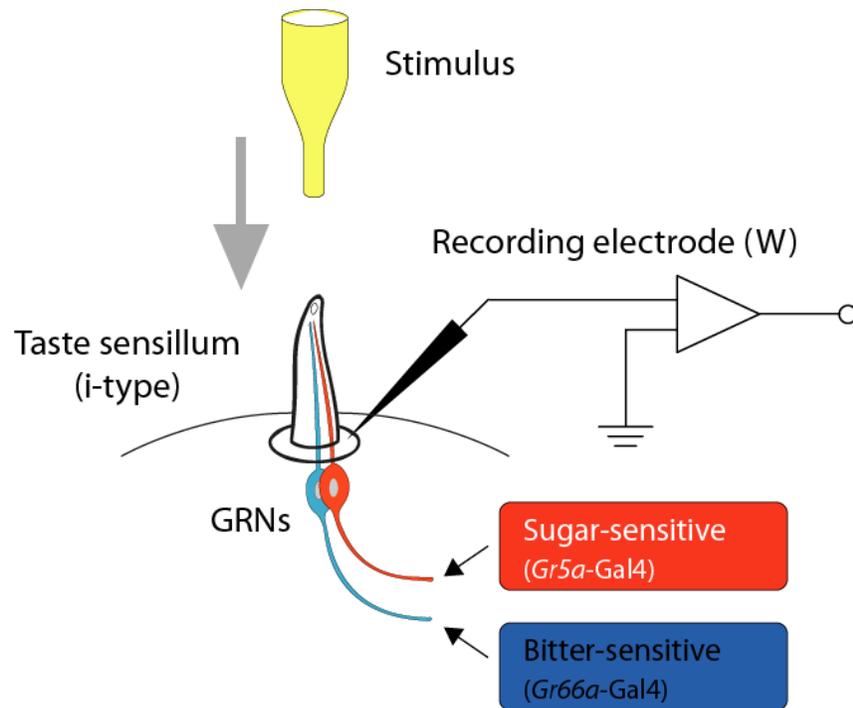
Canavanine is found in seeds (alfalfa)

- Functions as an analogue to arginine

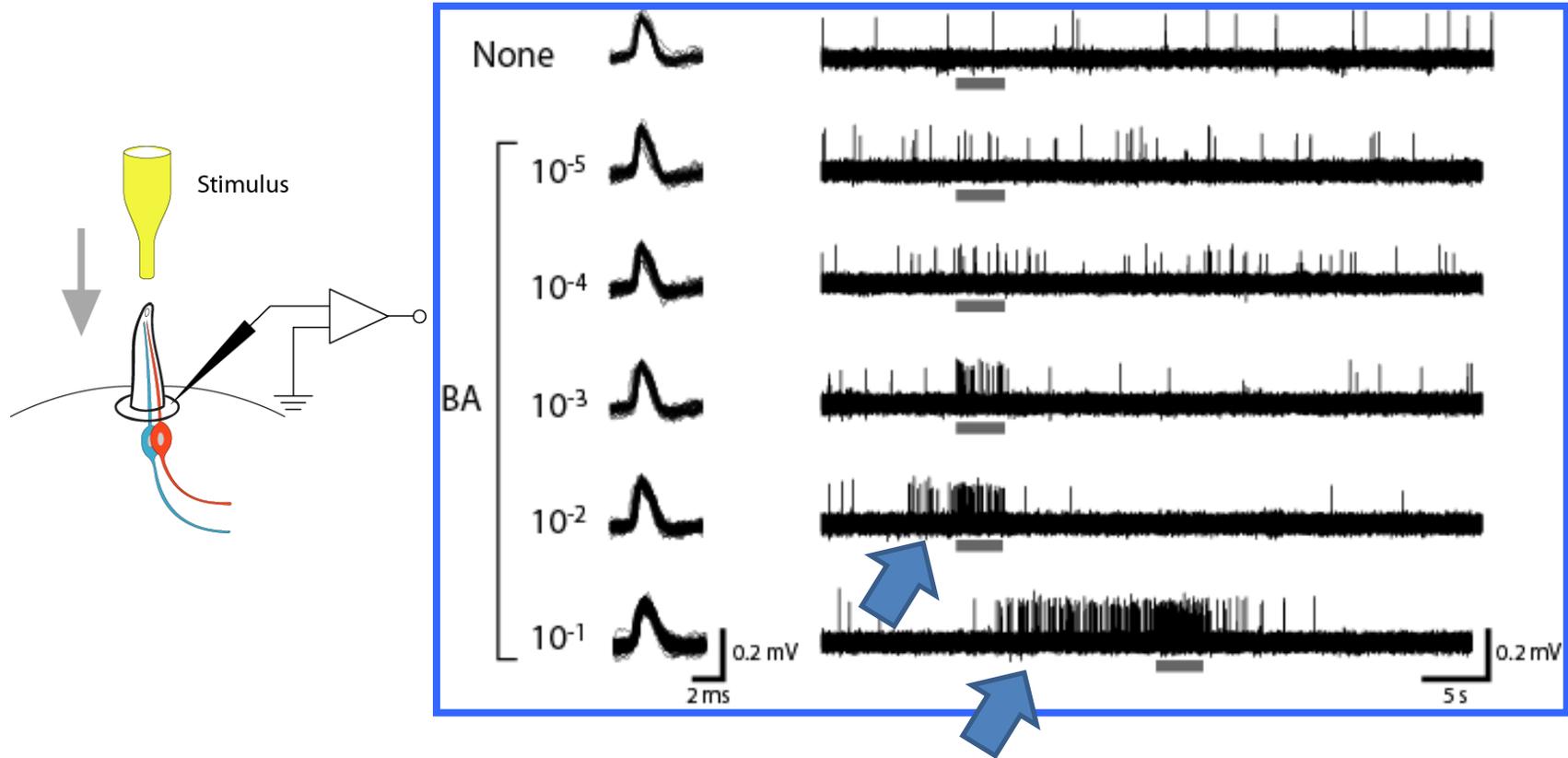


French et al. (2015)
J. Neurosci.

Sucrose/bitter

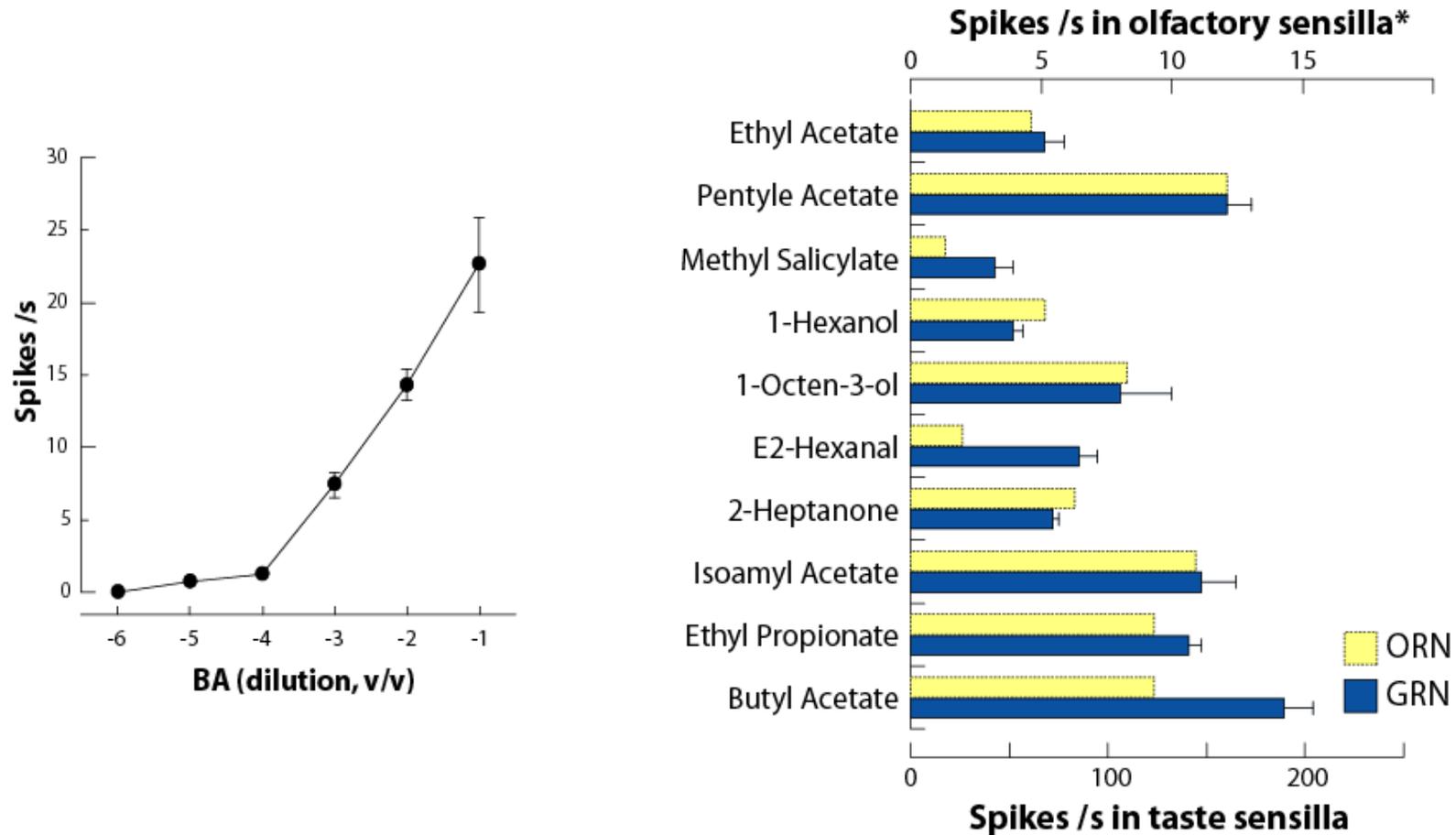


« Taste » before contact

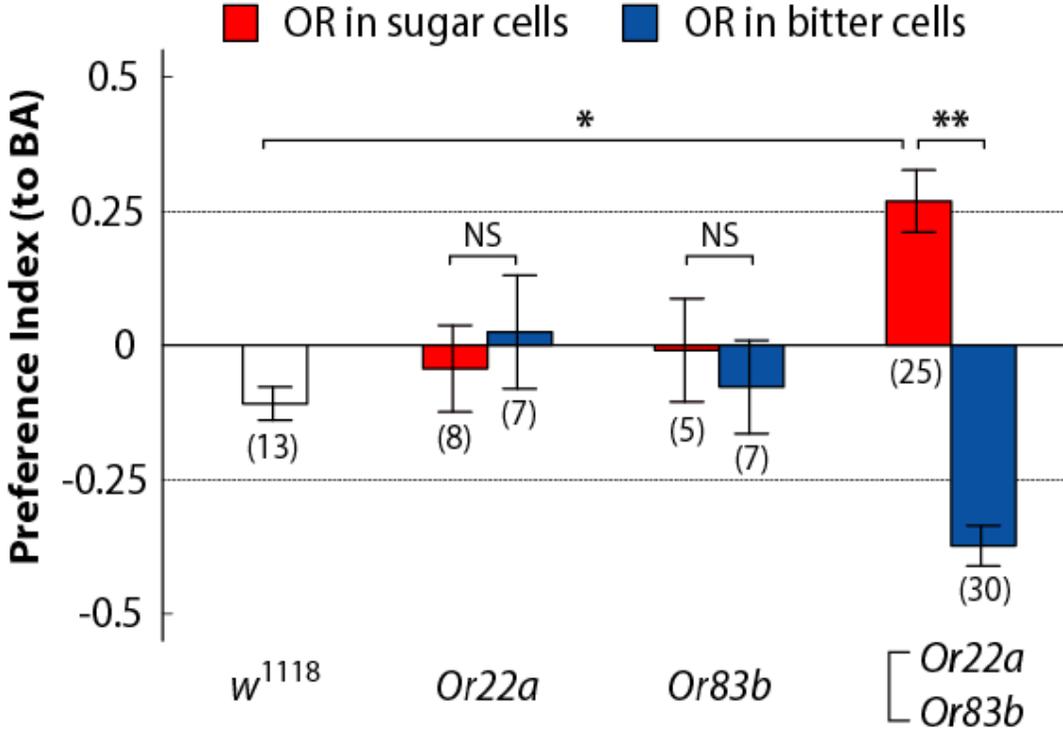
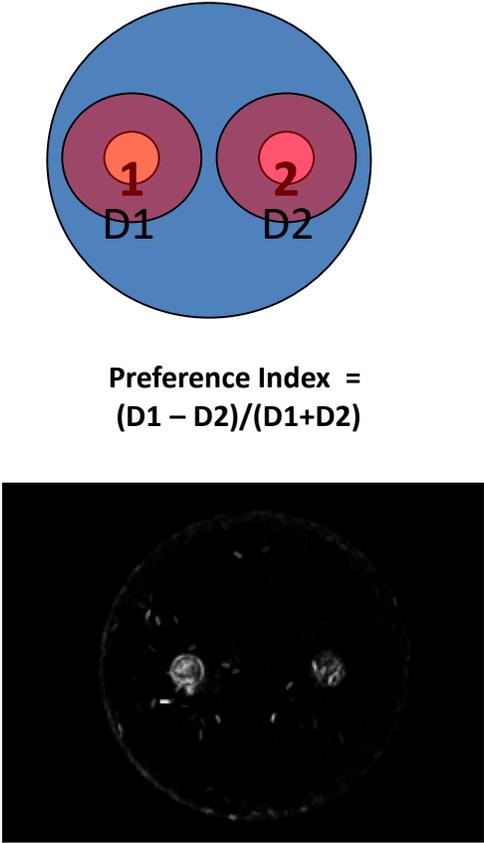


Hiroi et al PLoS ONE 2007

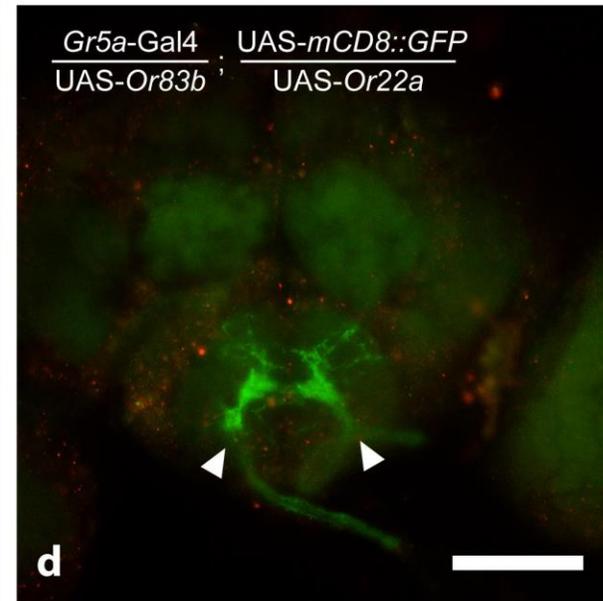
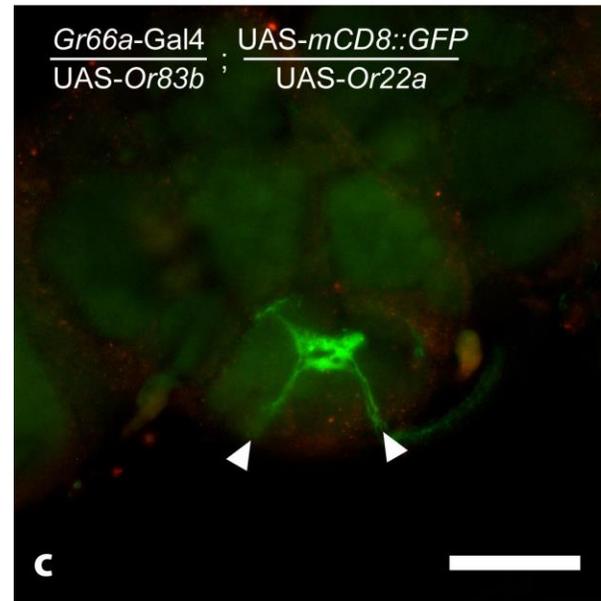
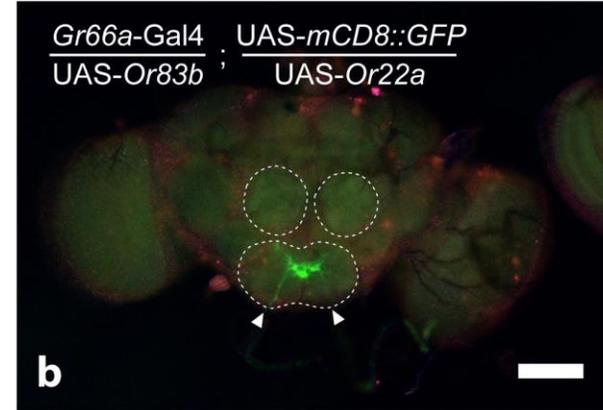
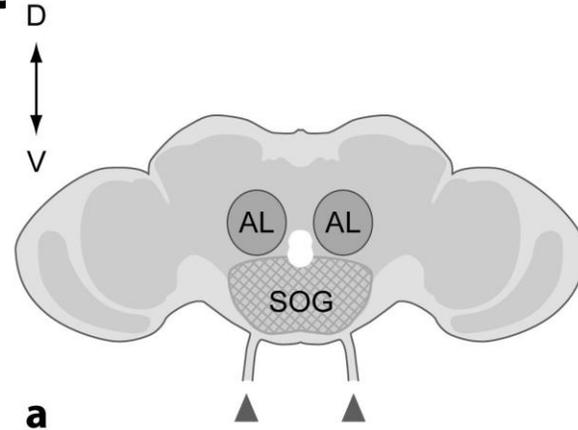
Sensitivity and response profile



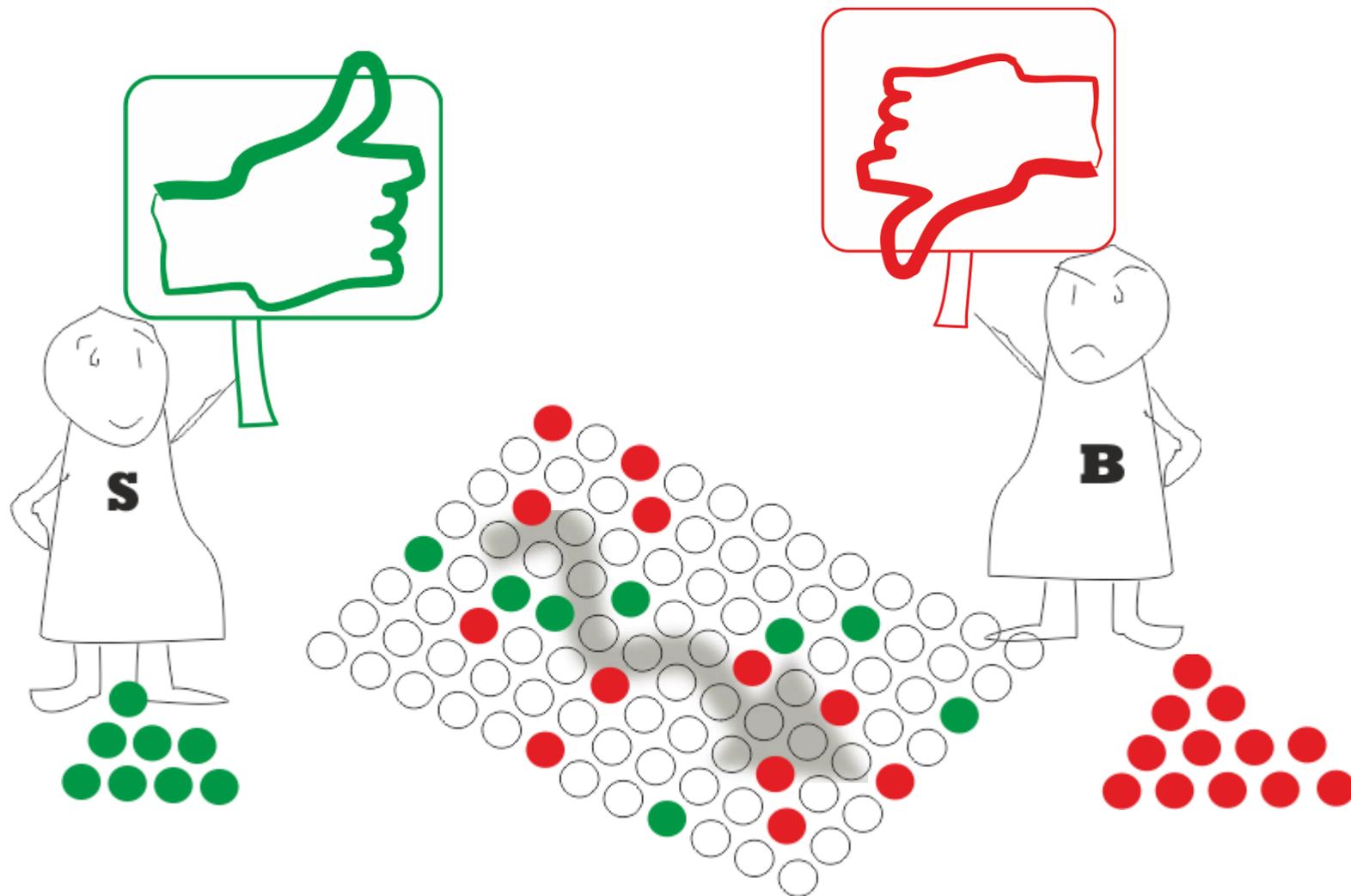
Behavioral effects

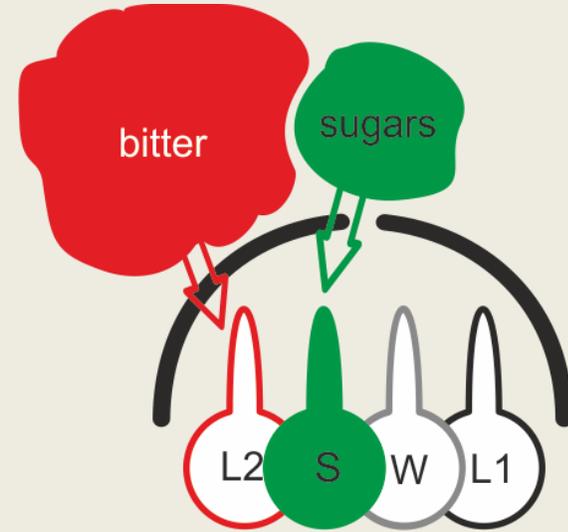


Taste projections are unchanged



Labeled lines



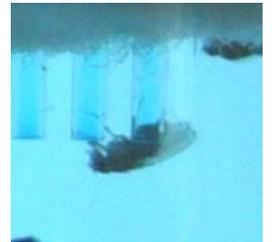
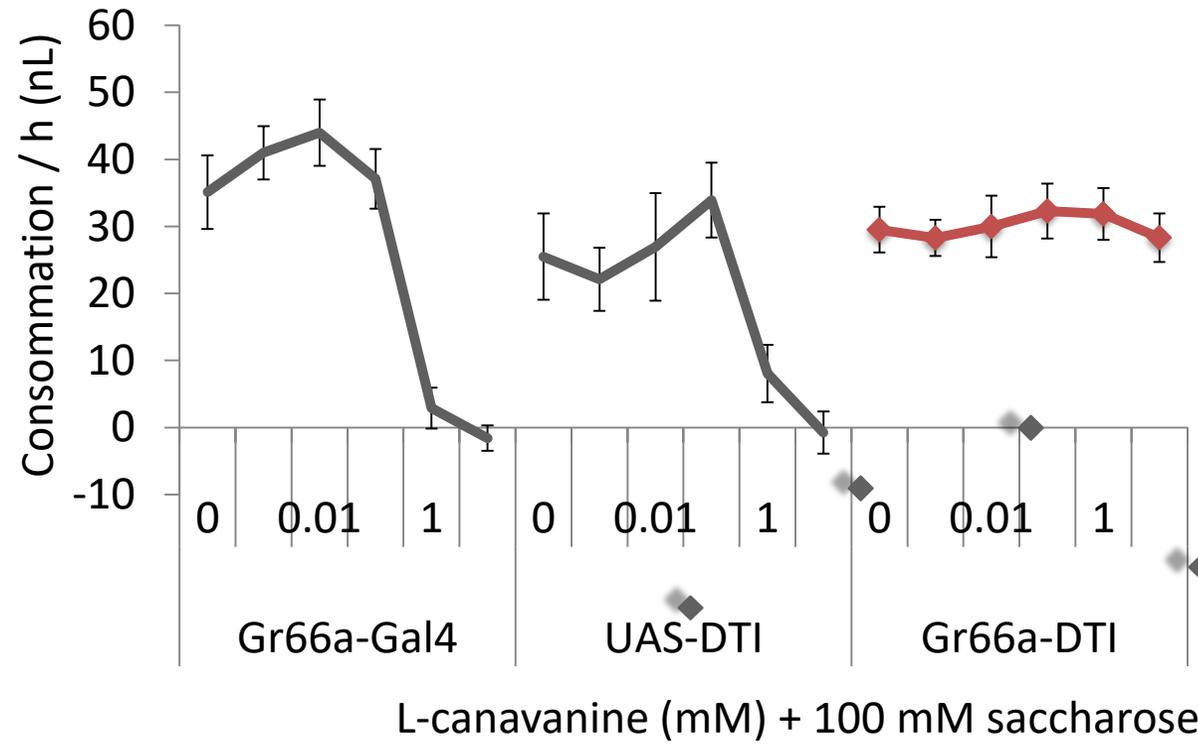
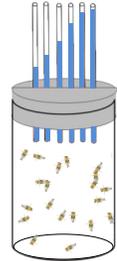
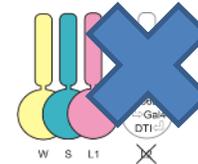
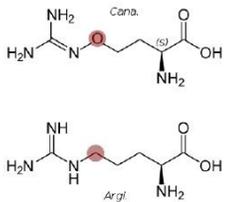


**(2) SUGAR/BITTER:
2 CHANNELS IN 1**

Une ablation génétique des neurones de l'amer supprime l'aversion pour la L-canavanine

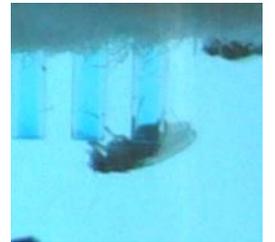
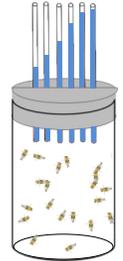
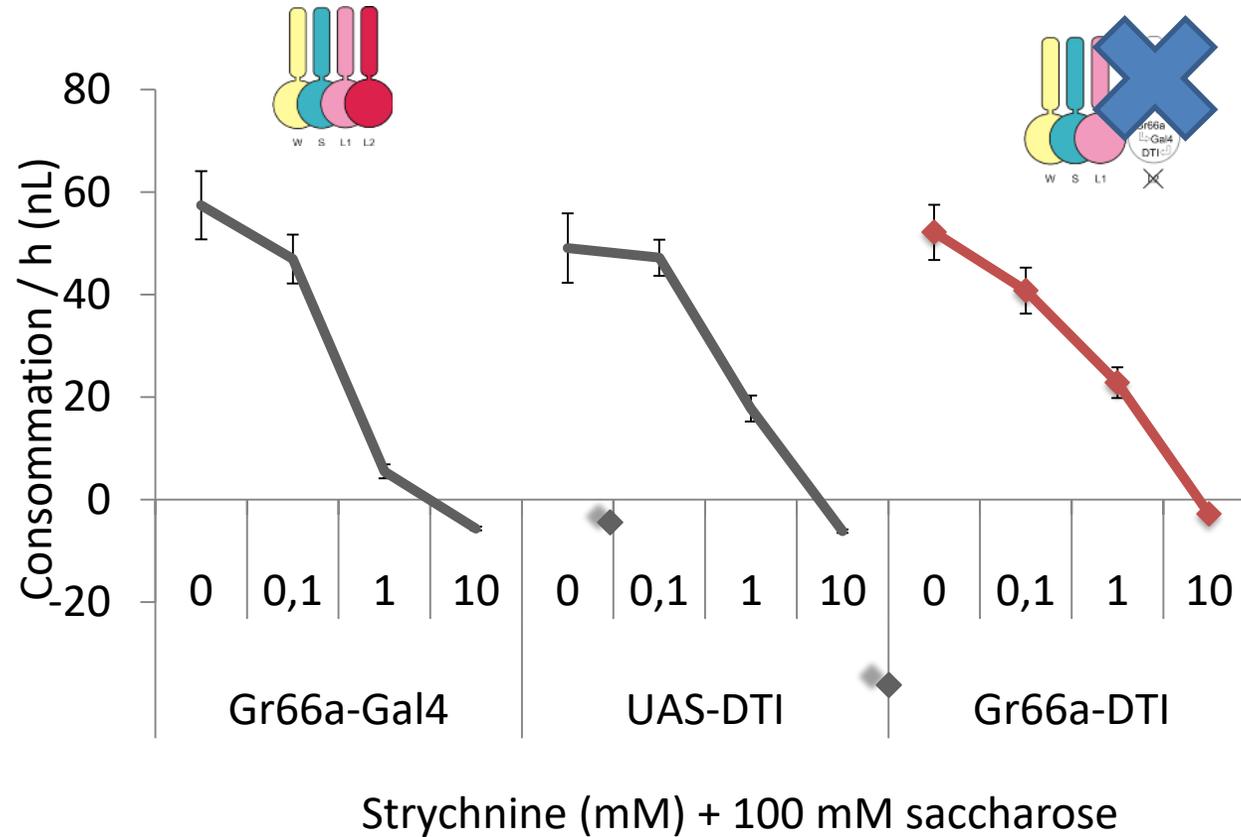
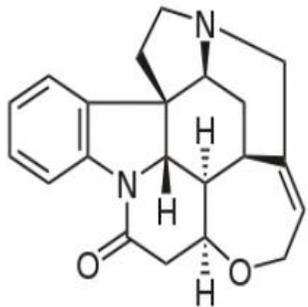
Canavanine is found in seeds (alfalfa)

- Functions as an analogue to arginine



French et al. (2015)
J. Neurosci.

Une ablation génétique des neurones de l'amer ne supprime pas l'aversion pour la strychnine

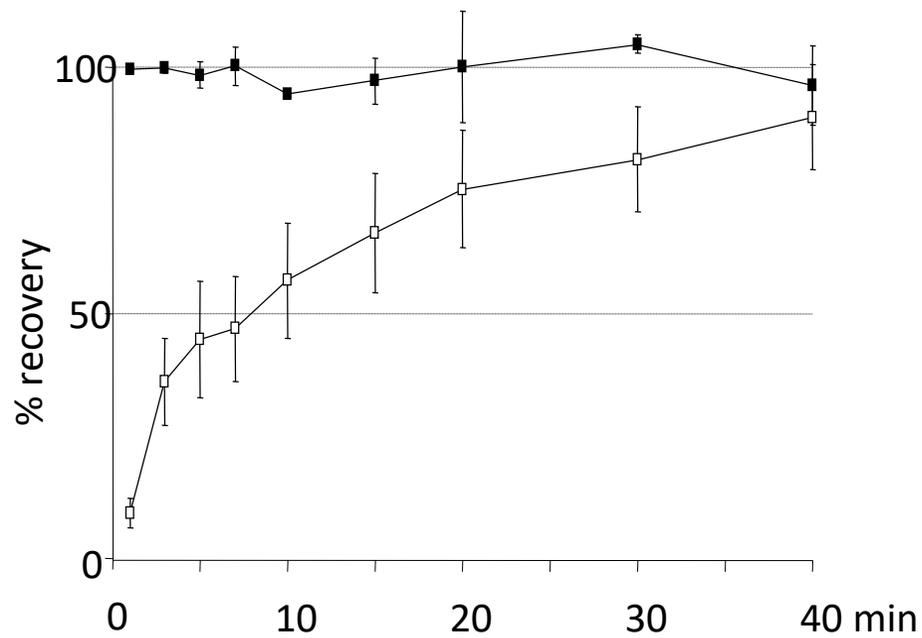


French et al. (2015)
J. Neurosci.

MANOVA,
Profile analysis,
 $p < 0.05$

Mixture interactions

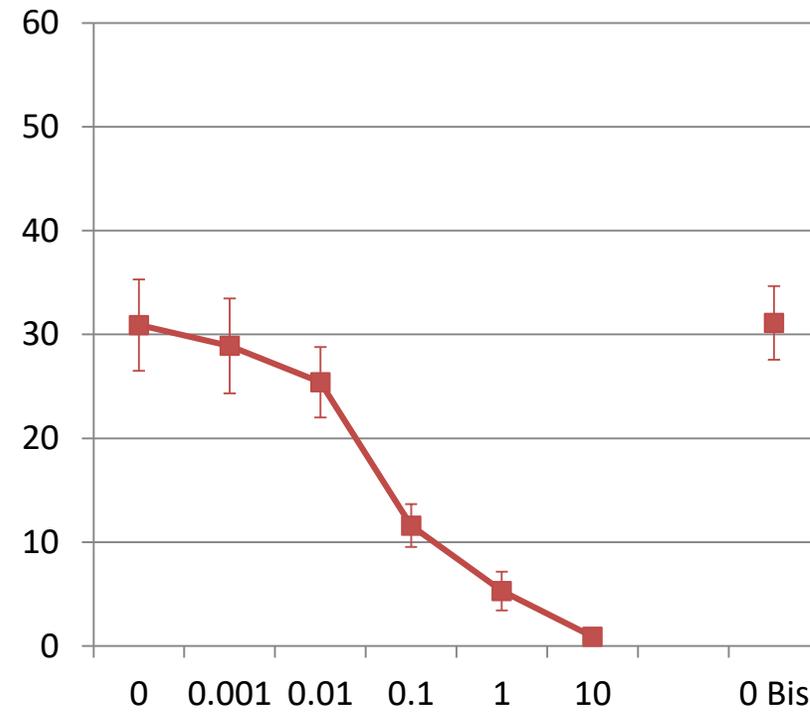
50 mM sucrose
after 5 mM quinine



Meunier et al., 2003

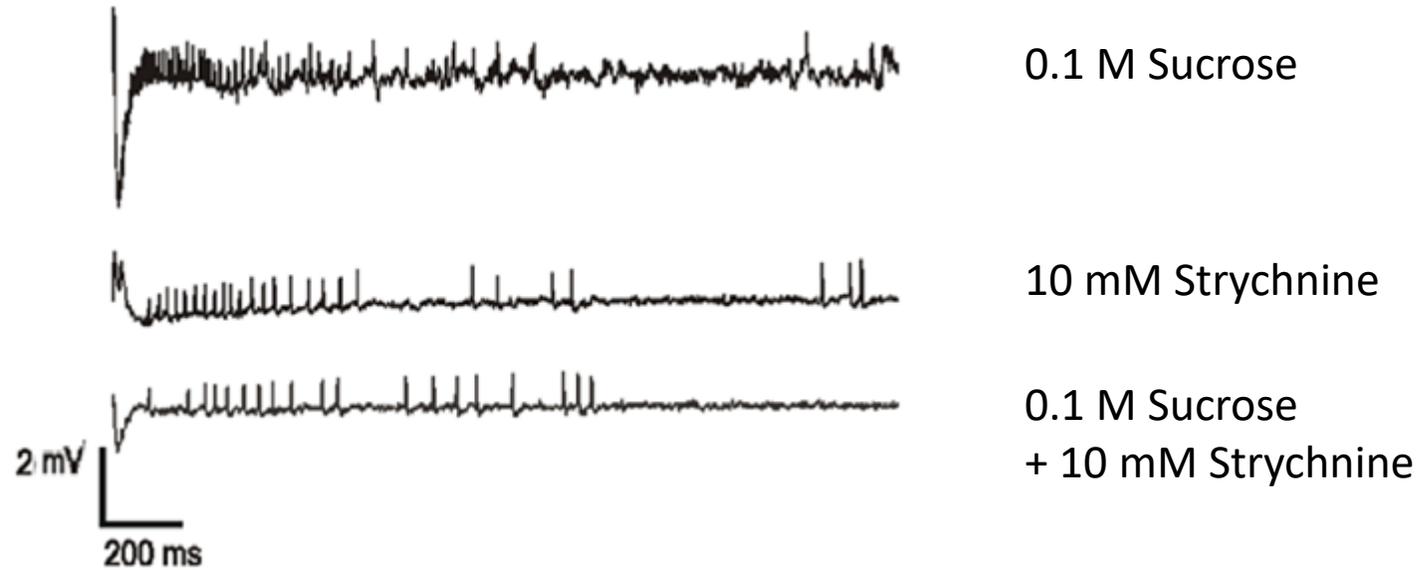
35 mM Fru + Quinine

L5 sensillum

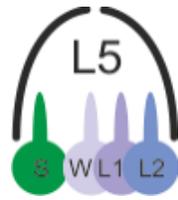


Sellier & Marion-Poll - poster

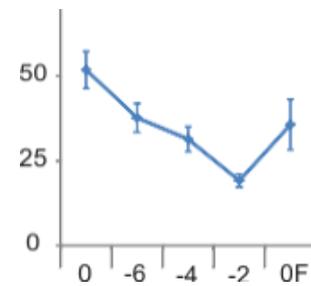
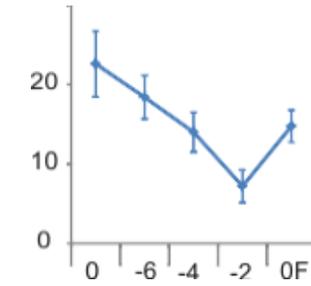
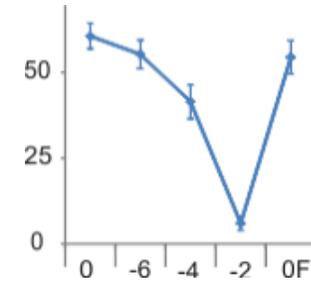
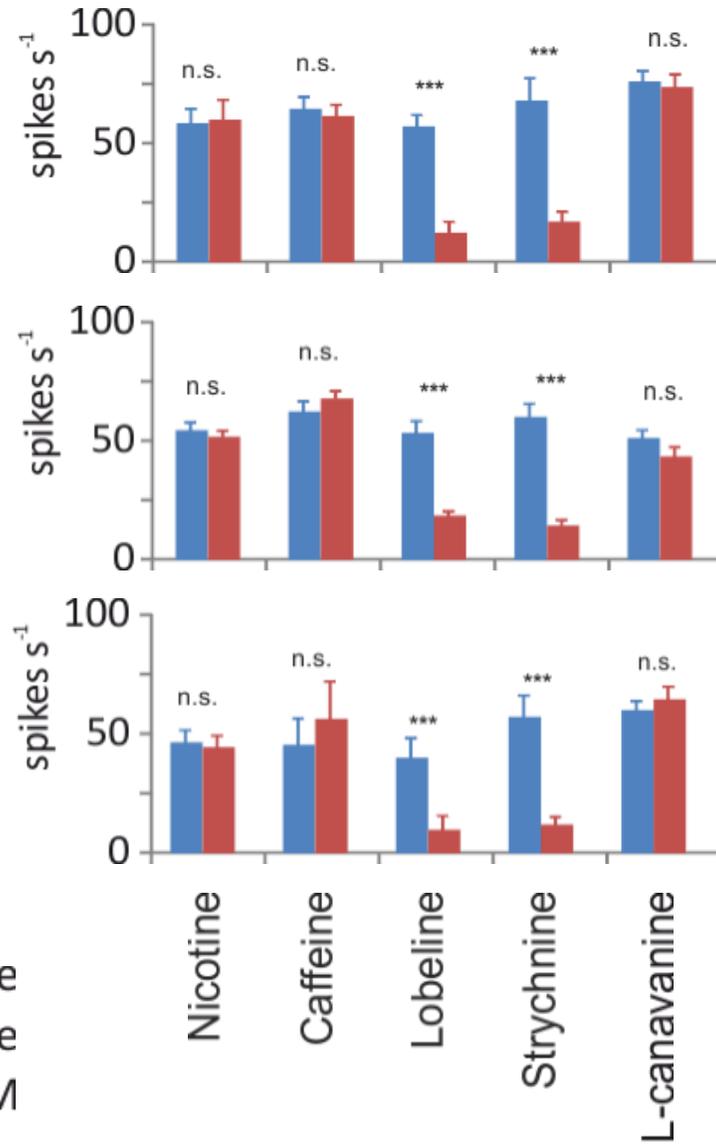
Individual components \neq mixture



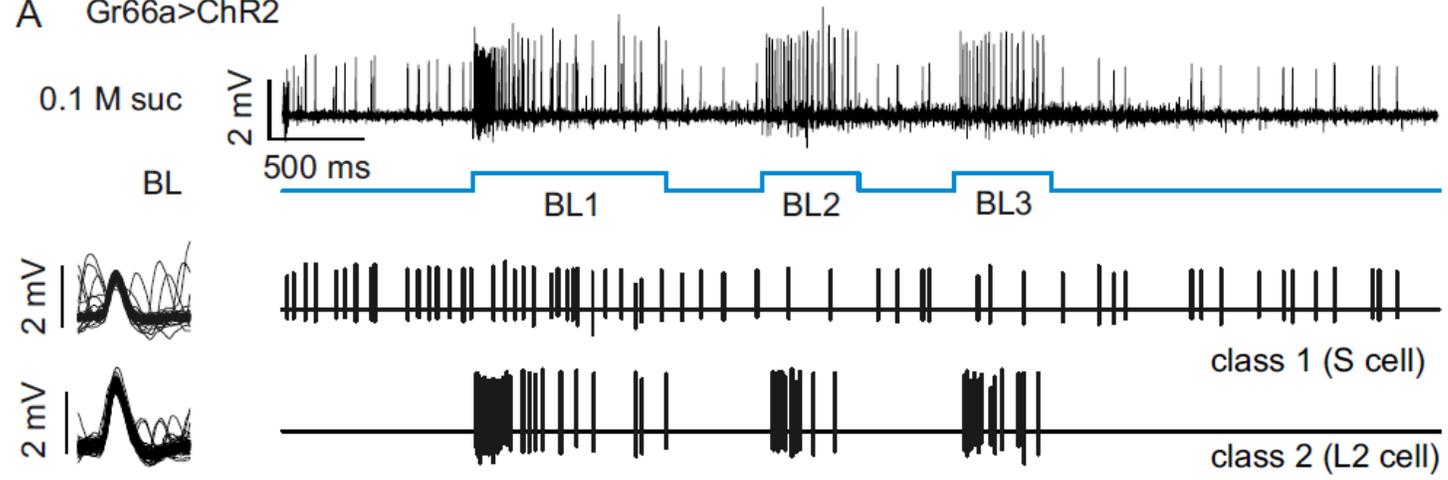
Moutaz ALI AGHA (2010) unpubl.

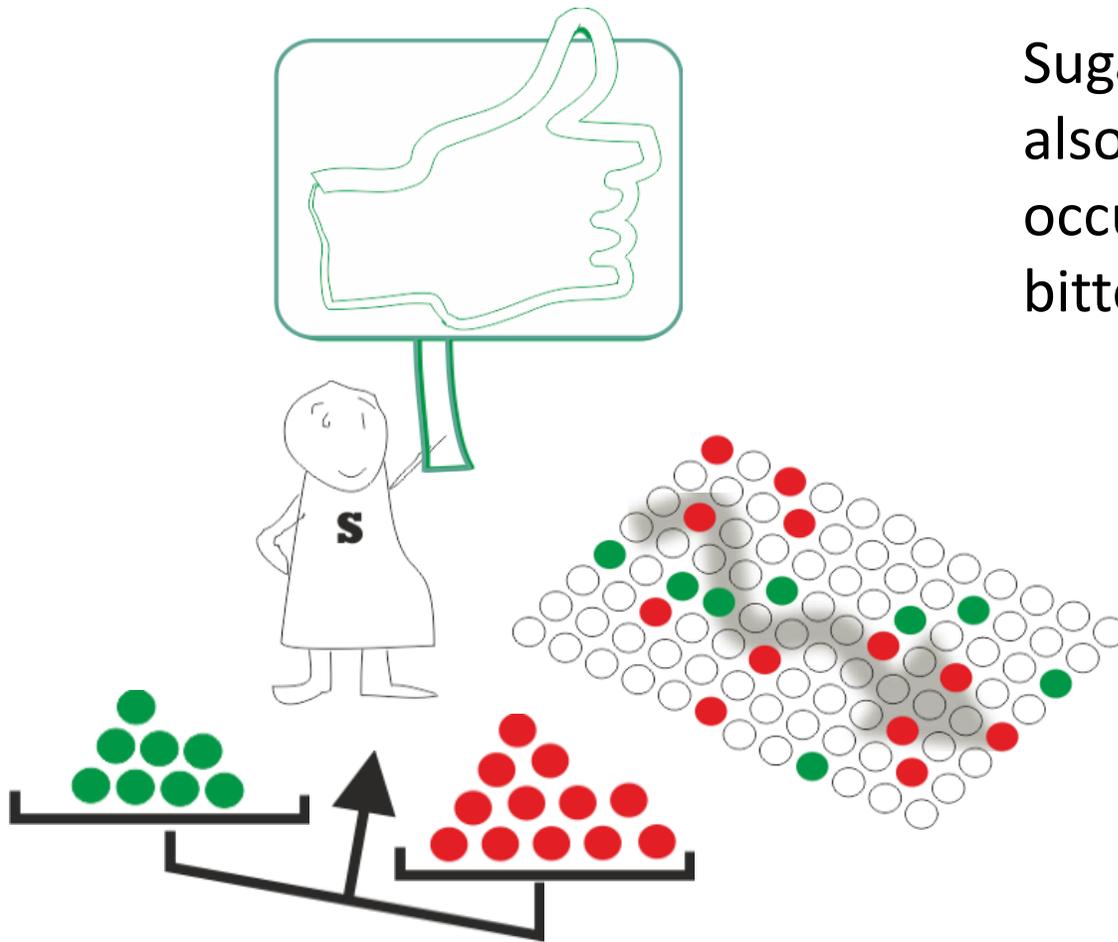


■ sucrose
 ■ sucrose + 1 mM bitter



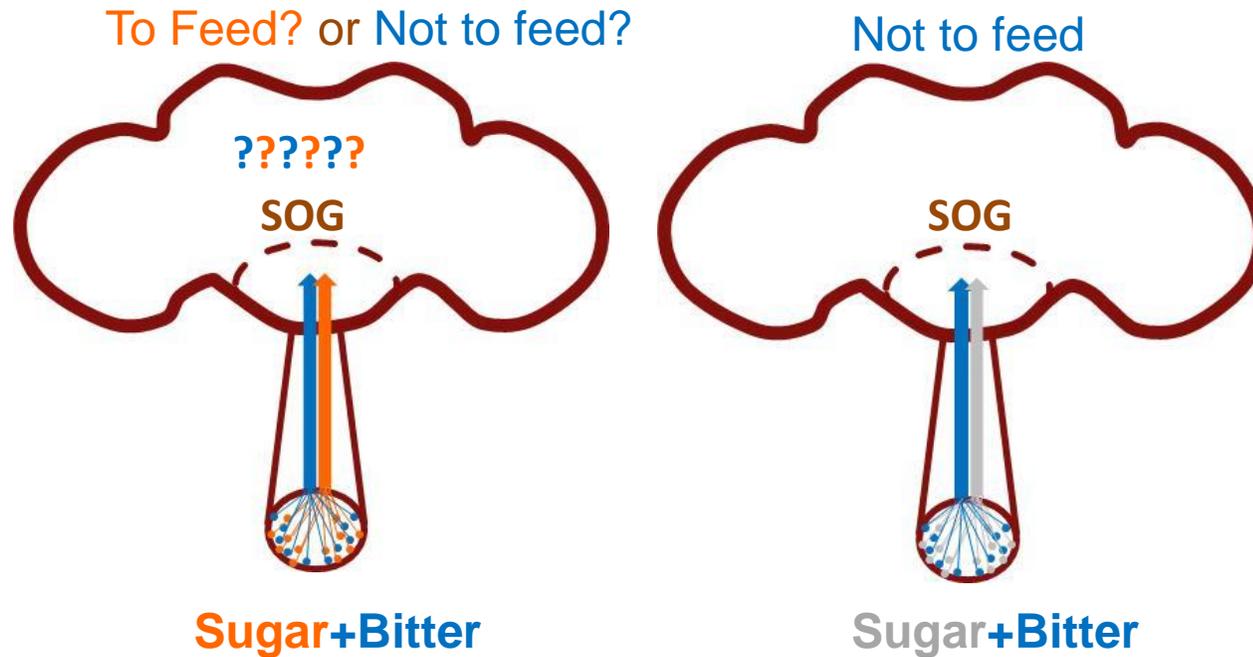
A Gr66a>ChR2





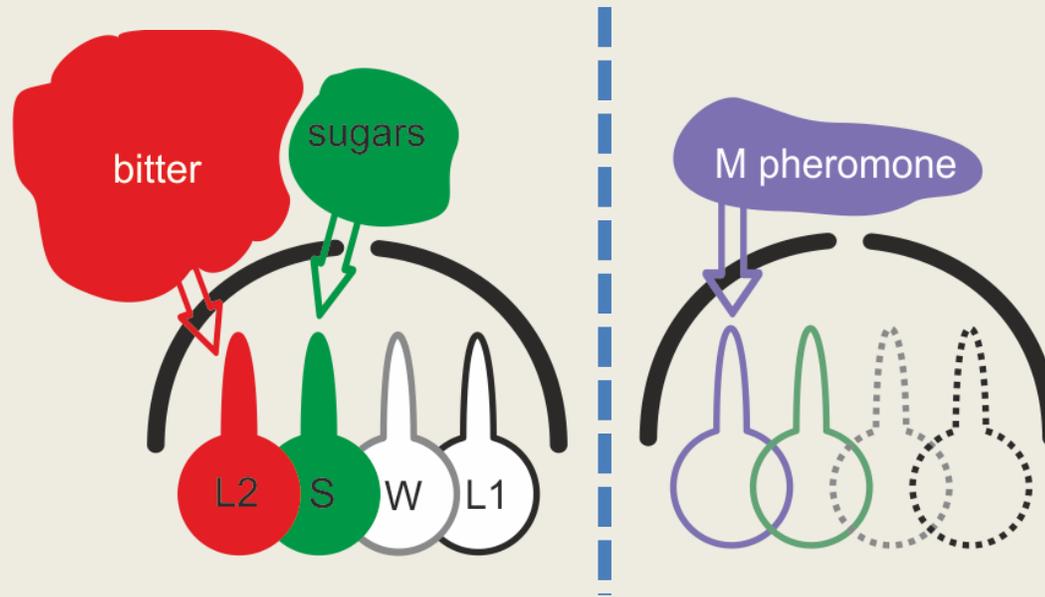
Sugar-sensitive cells also monitor the occurrence of bitter molecules...

Why is sugar inhibition important?



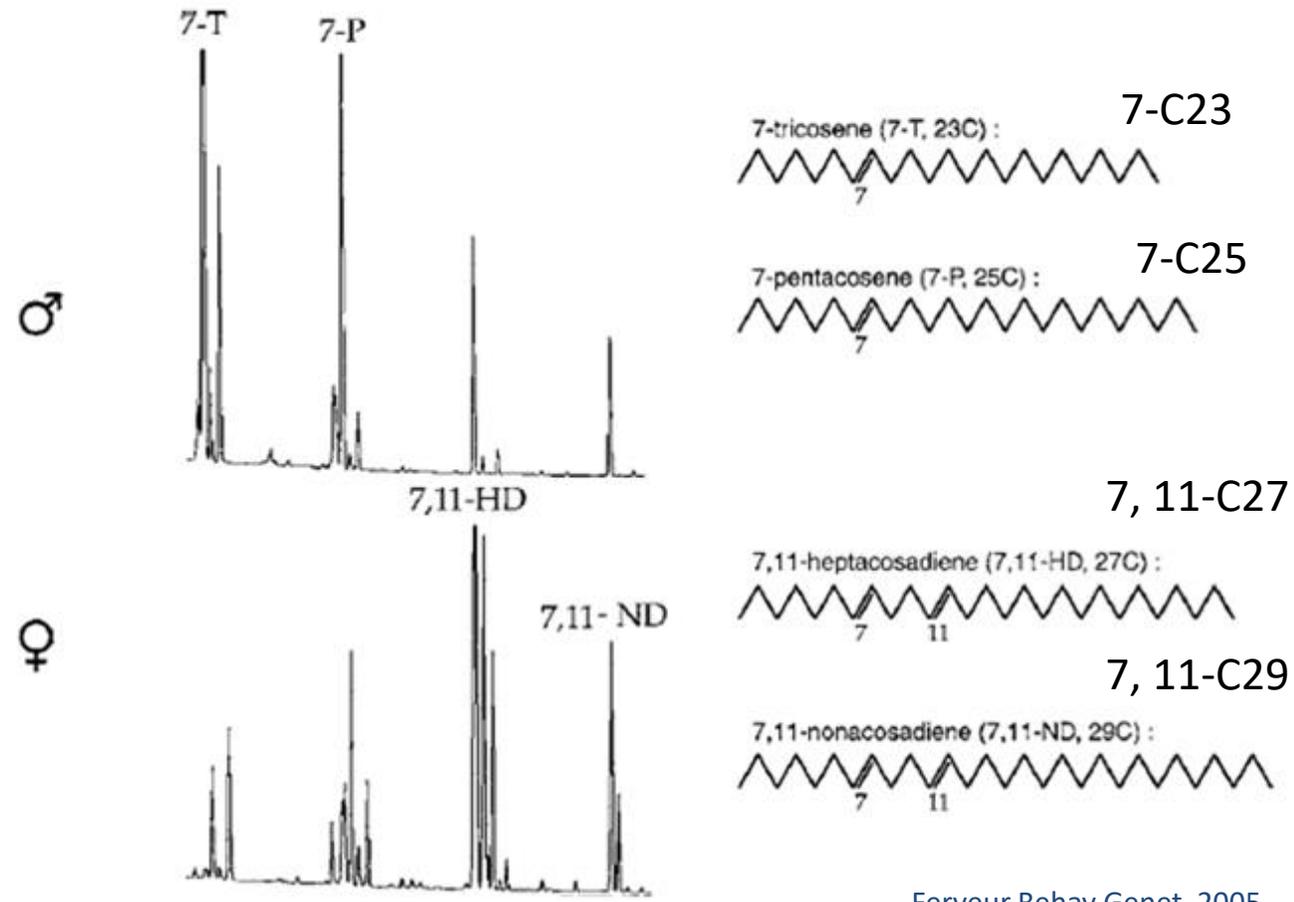
Mechanism to
silence conflicting
messages

'override' to prevent
ingestion of
bitter/toxic foods



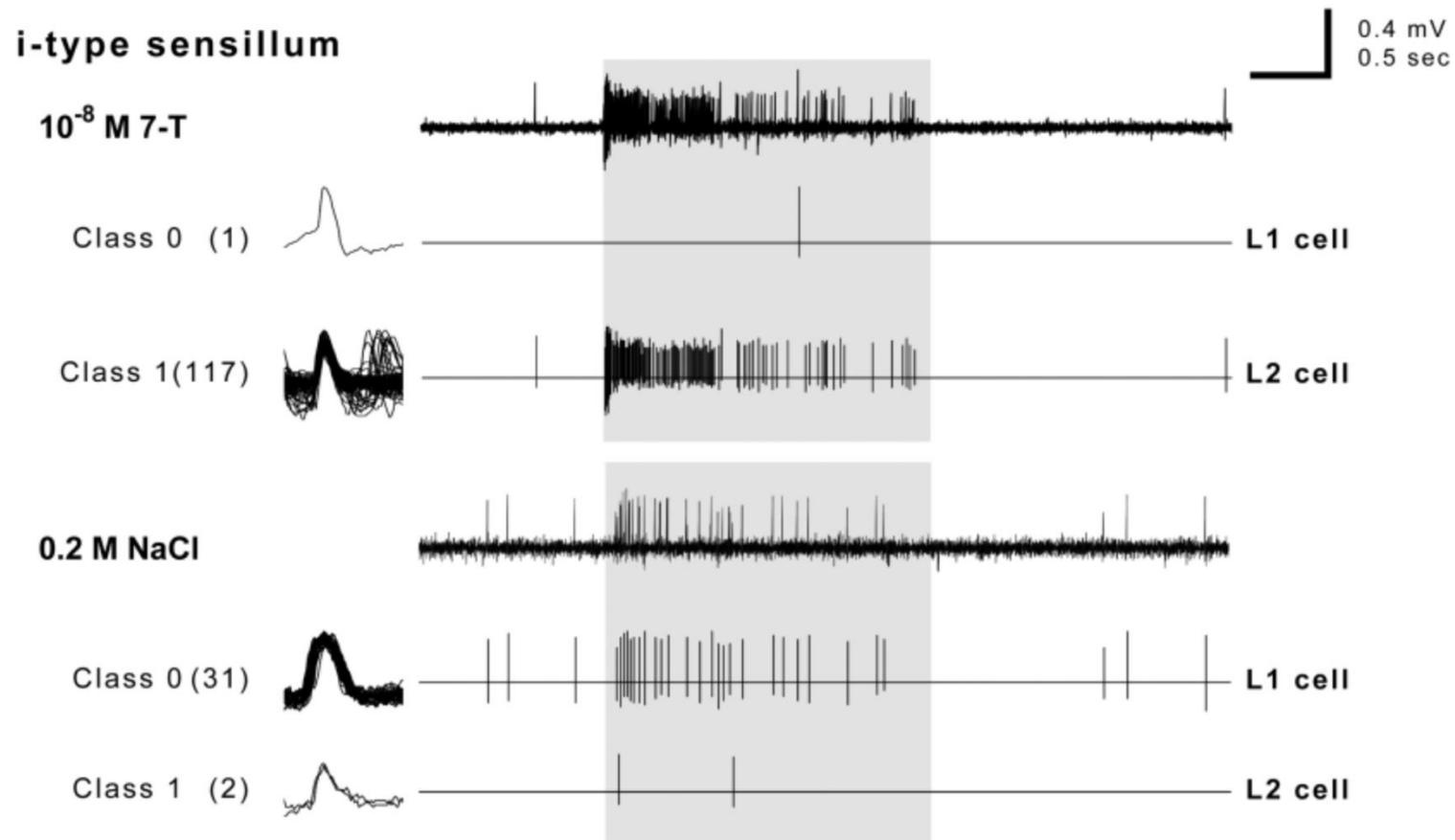
PHEROMONE AND FOOD

Cuticular hydrocarbons in *Drosophila*



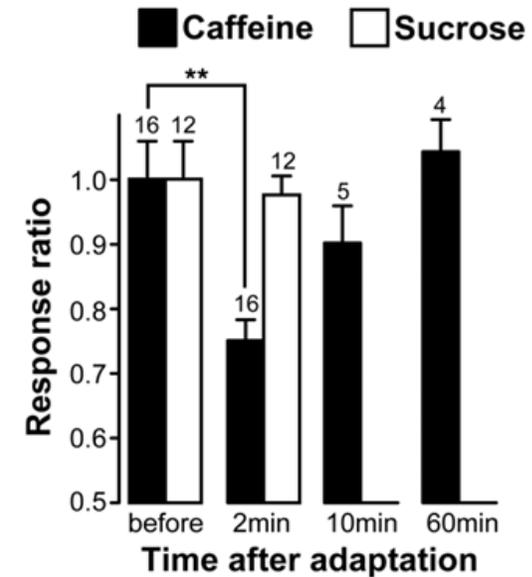
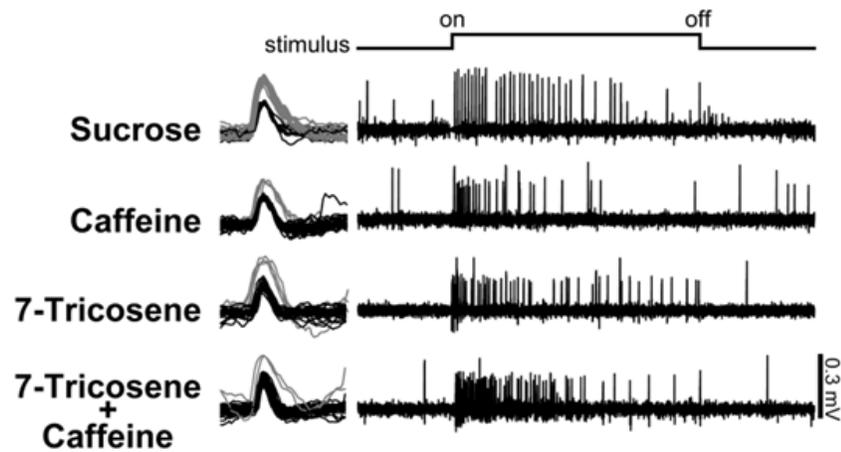
Ferveur Behav Genet 2005

i-type sensilla: detect 7-T



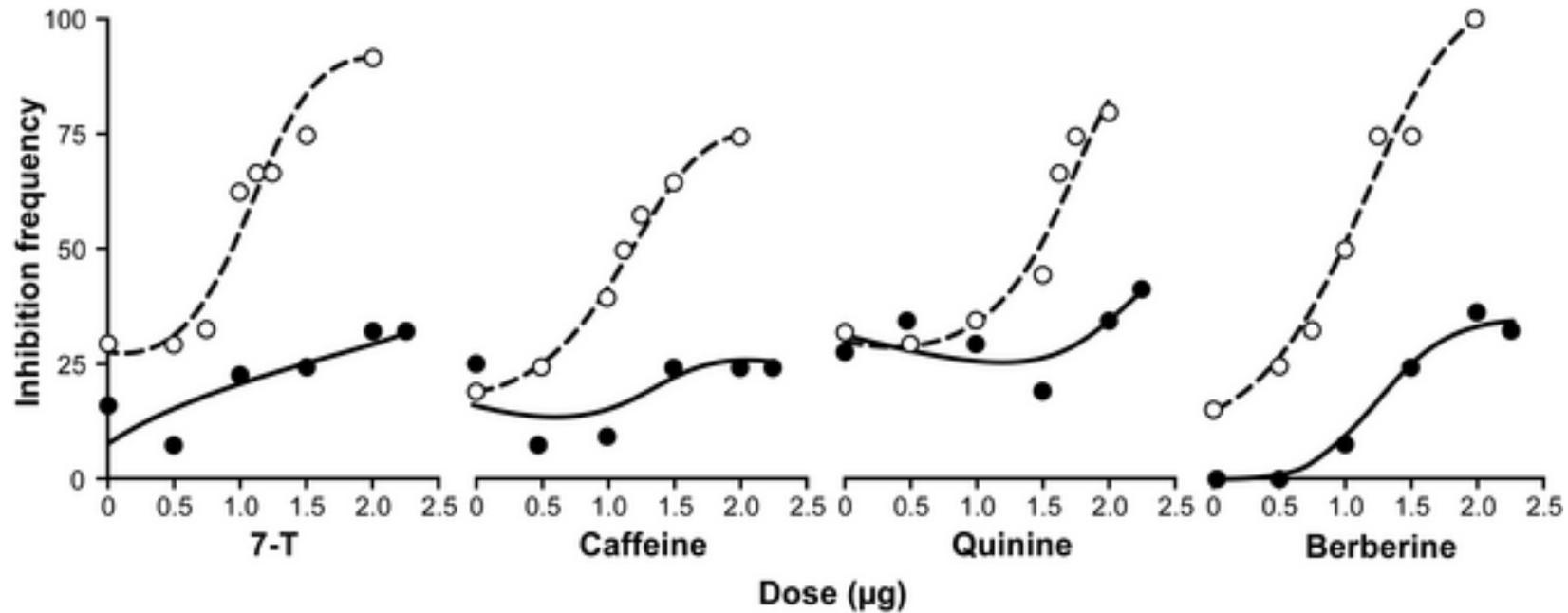
Lacaille et al (2007) PLoS One

7-T & bitter: same cell



Lacaille et al (2007) PLoS One

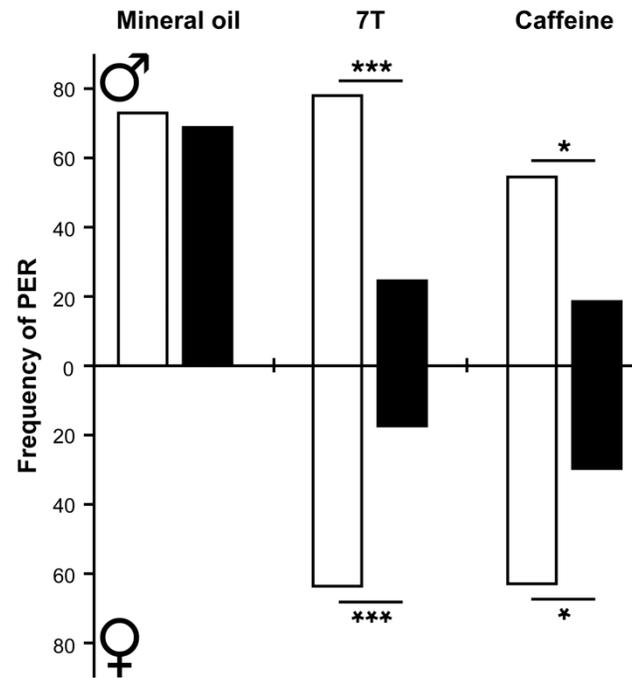
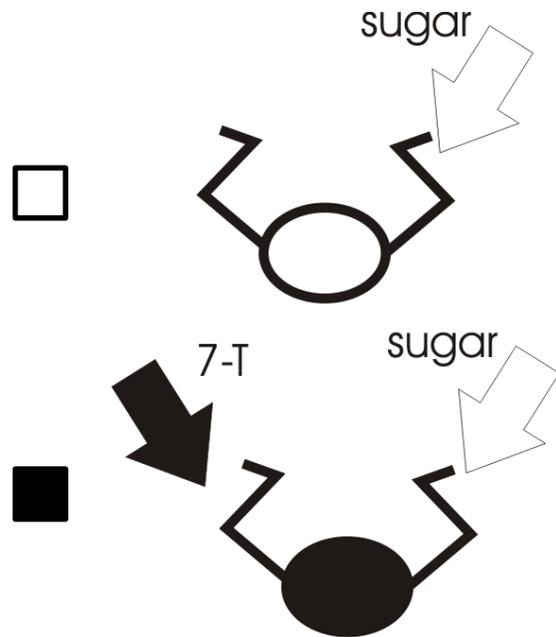
Bitter compounds inhibit courting



Lacaille et al (2007) PLoS One

- WT males
- Gr66a-Gal4/WT males

7-T inhibits feeding



Lacaille et al (2007) PLoS One

GOÛT ET TOUCHER?

Les drosophiles détectent aussi la texture

- Zhang, Y. V., et al. (2016) Neuron **91**(4): 863-877

Neuron The Basis of Food Texture Sensation in *Drosophila*

- Sánchez-Alcañiz, J. A., et al. (2017) Nature Communications **8**: 14192

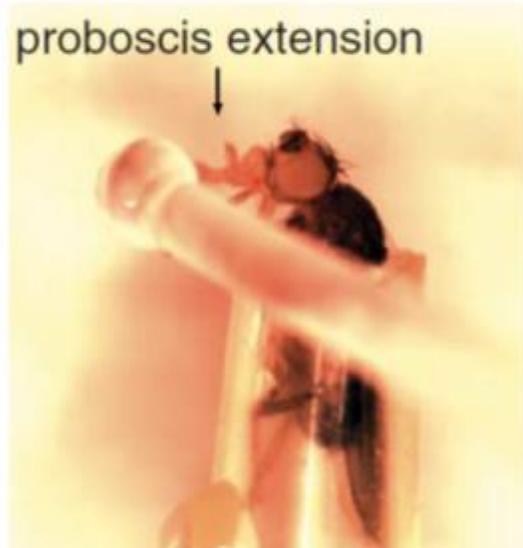


A mechanosensory receptor required for food texture detection in *Drosophila*

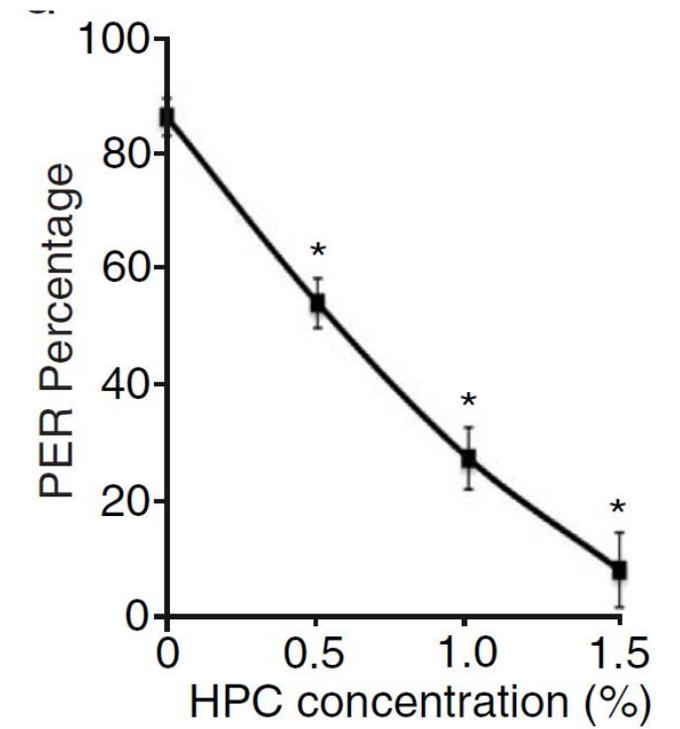
no stimuli



100 mM sucrose



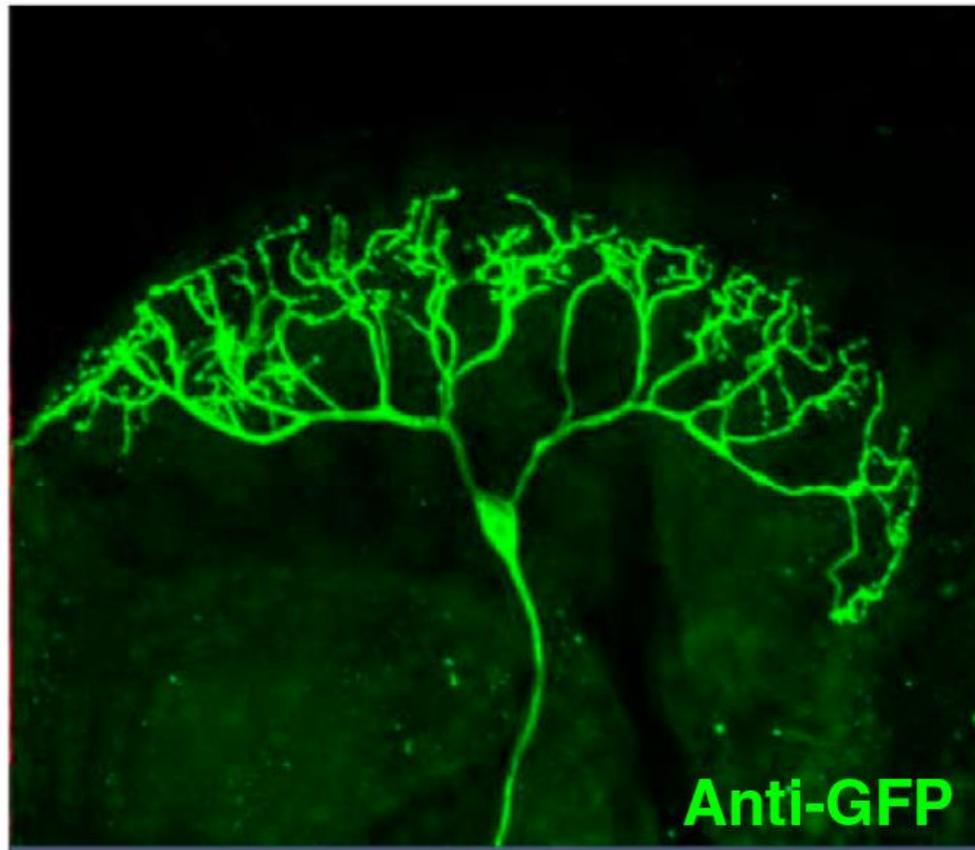
1.5% HPC
+ 100 mM sucrose



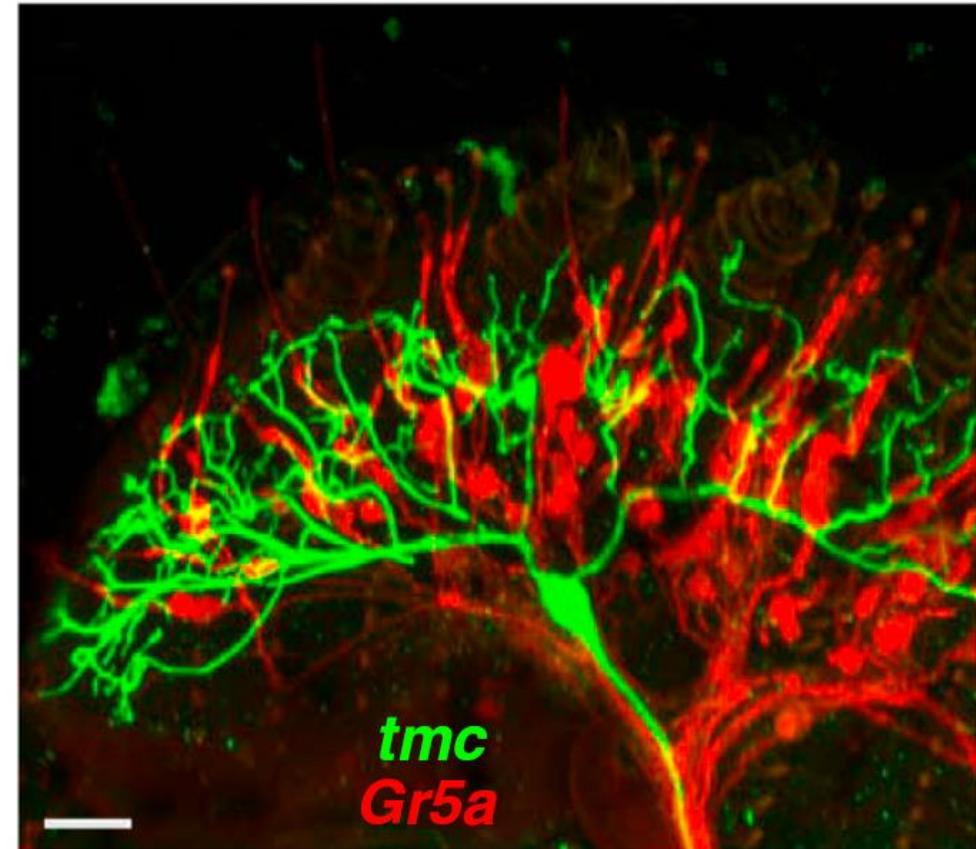
HPC = hydroxypropyl cellulose

C

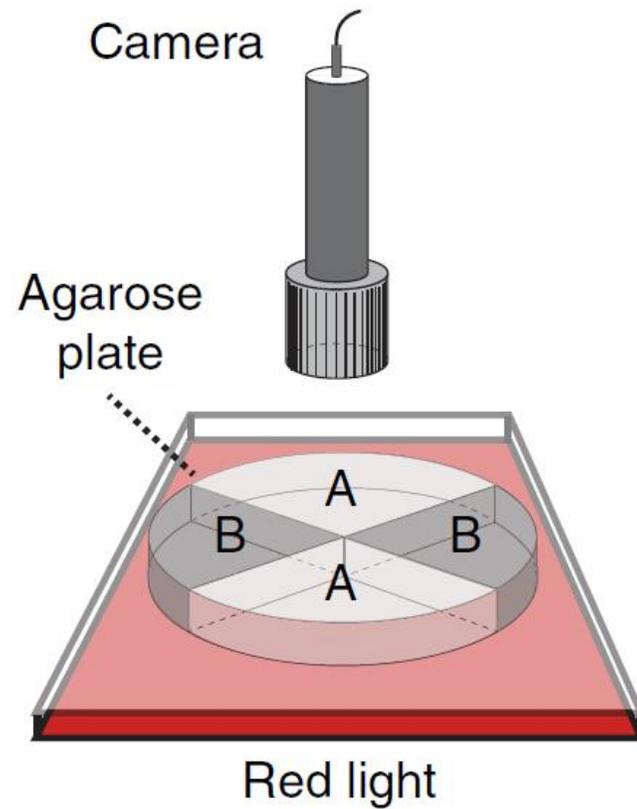
tmc-Gal4
UAS-mCD8::GFP

**F**

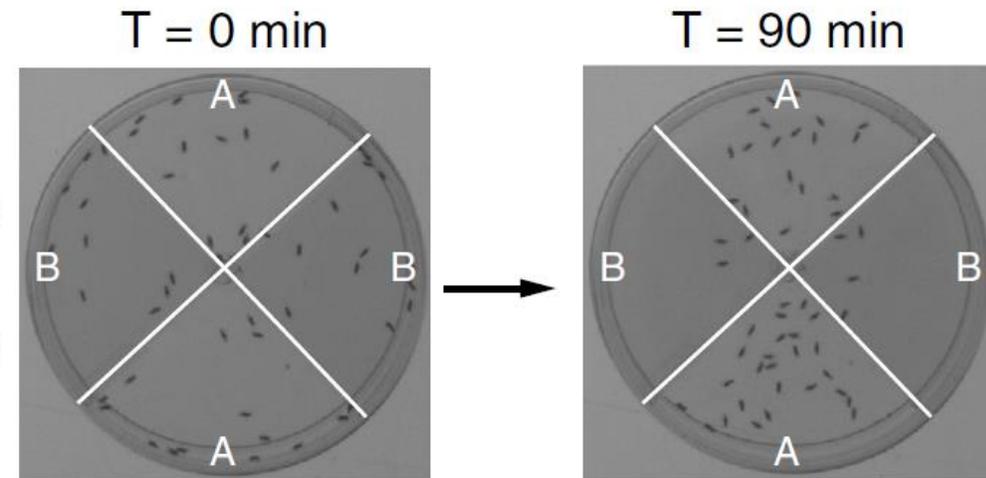
tmc-QF-mCD8:GFP
Gr5a-Gal4-DsRed



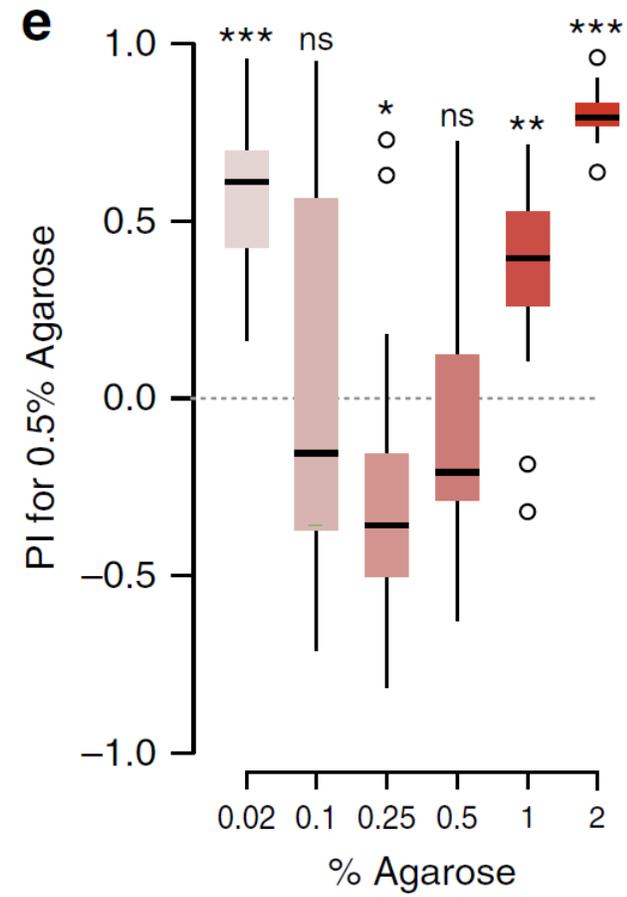
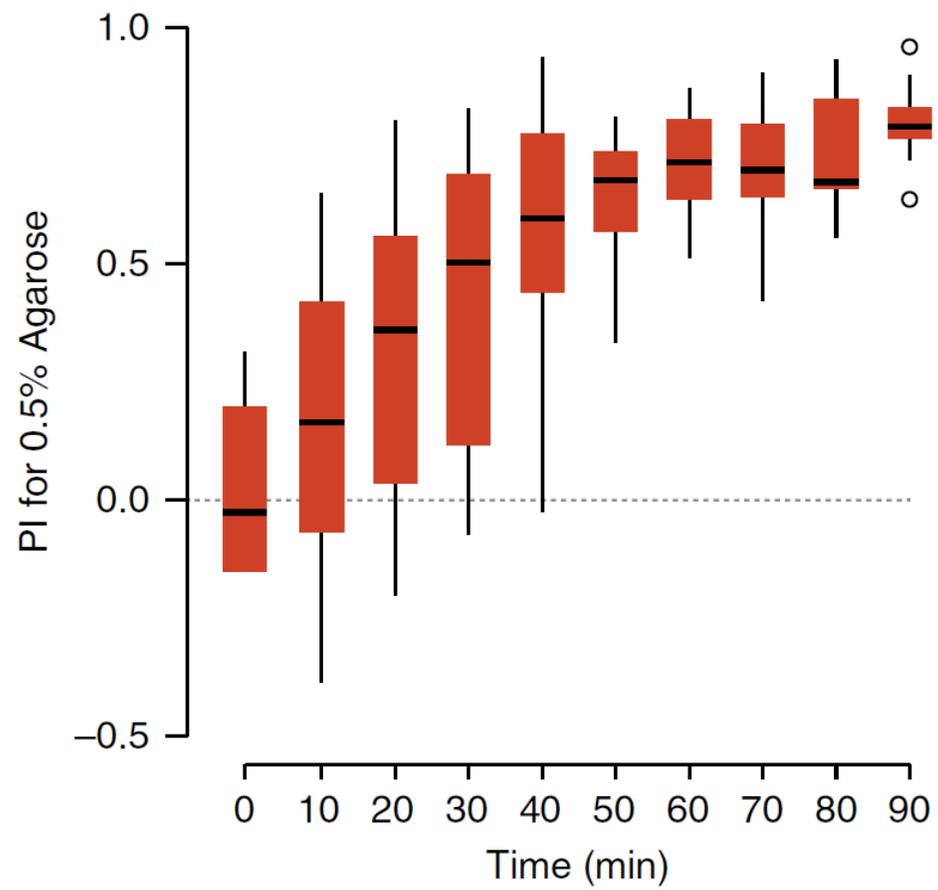
Mesure de préférence pour la texture



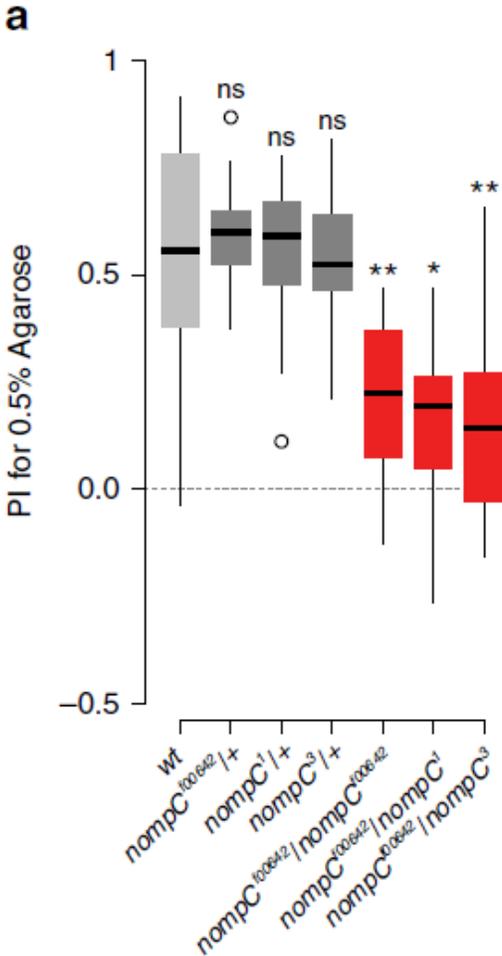
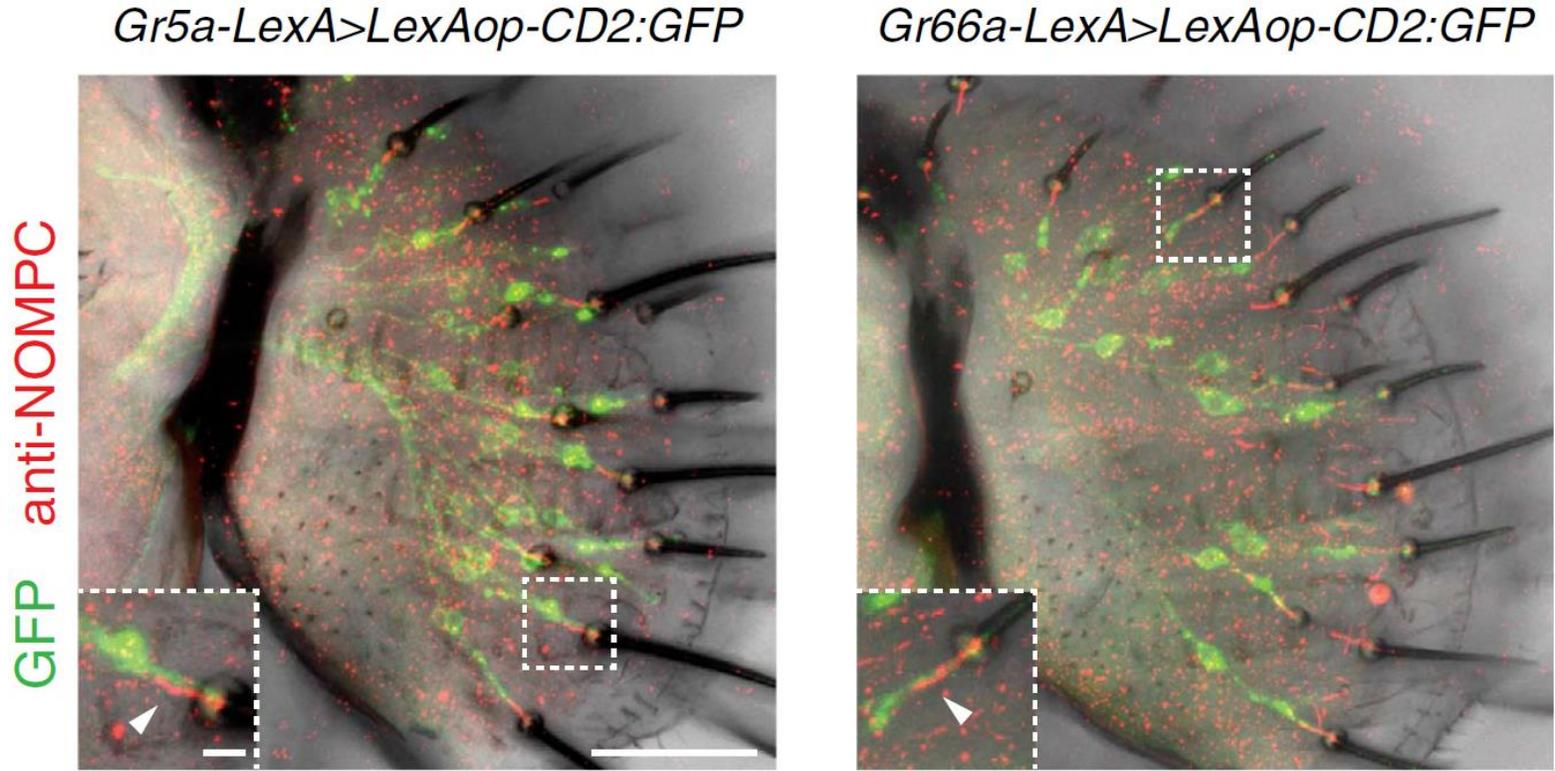
A% versus B%
Agarose
+
5 mM Sucrose

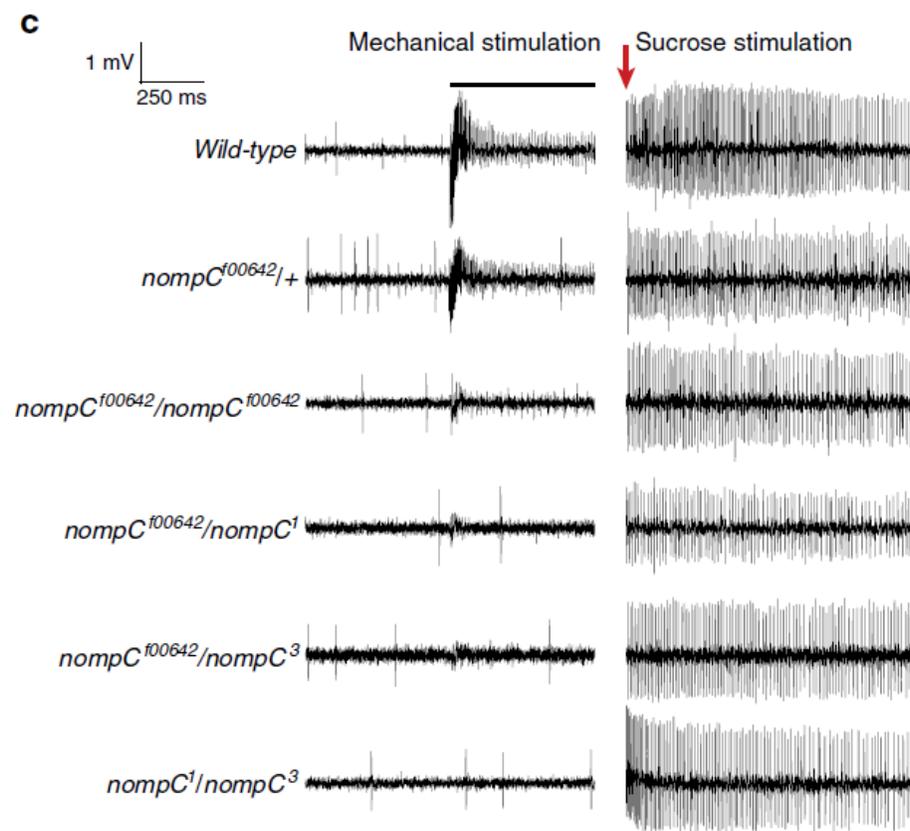
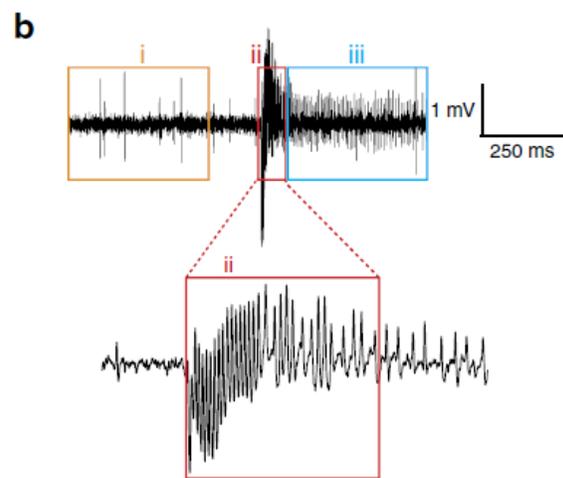
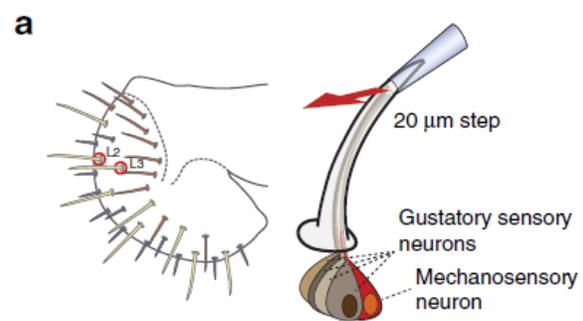


$$\text{Preference Index}_A = \frac{N_A - N_B}{N_{\text{TOTAL}}}$$

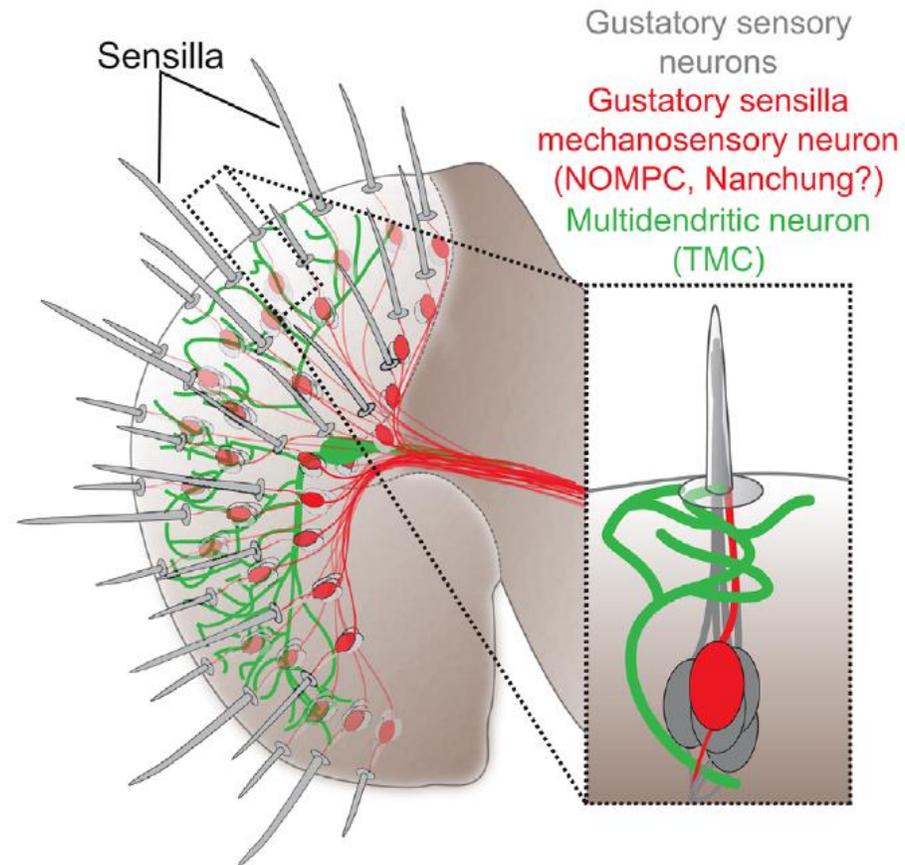


NompC joue un role majeur dans la détection





Pour la drosophile, goûter, c'est aussi toucher



Sanchez-Alcaniz, J. A. and R. Benton (2017)
Bioessays 39(8): 11.

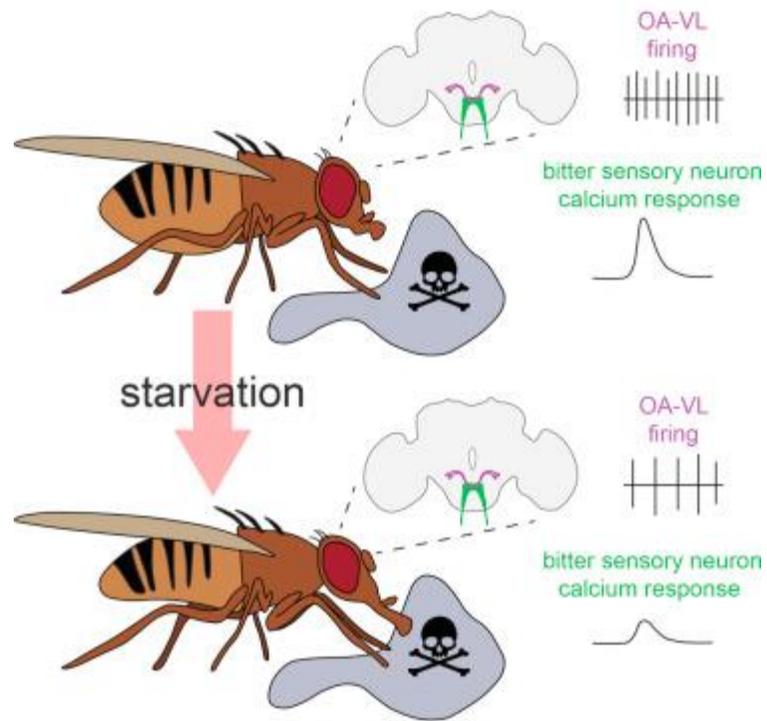
MODULATION DES RÉPONSES GUSTATIVES

L'alimentation est régulée par des mécanismes pré- et post-ingestifs



Pool, A. H., et al. (2014). "Four GABAergic interneurons impose feeding restraint in *Drosophila*." *Neuron* 83(1): 164-177.

La faim diminue l'amertume



Current Biology

Volume 26, Issue 21, 7 November 2016, Pages 2854-2861

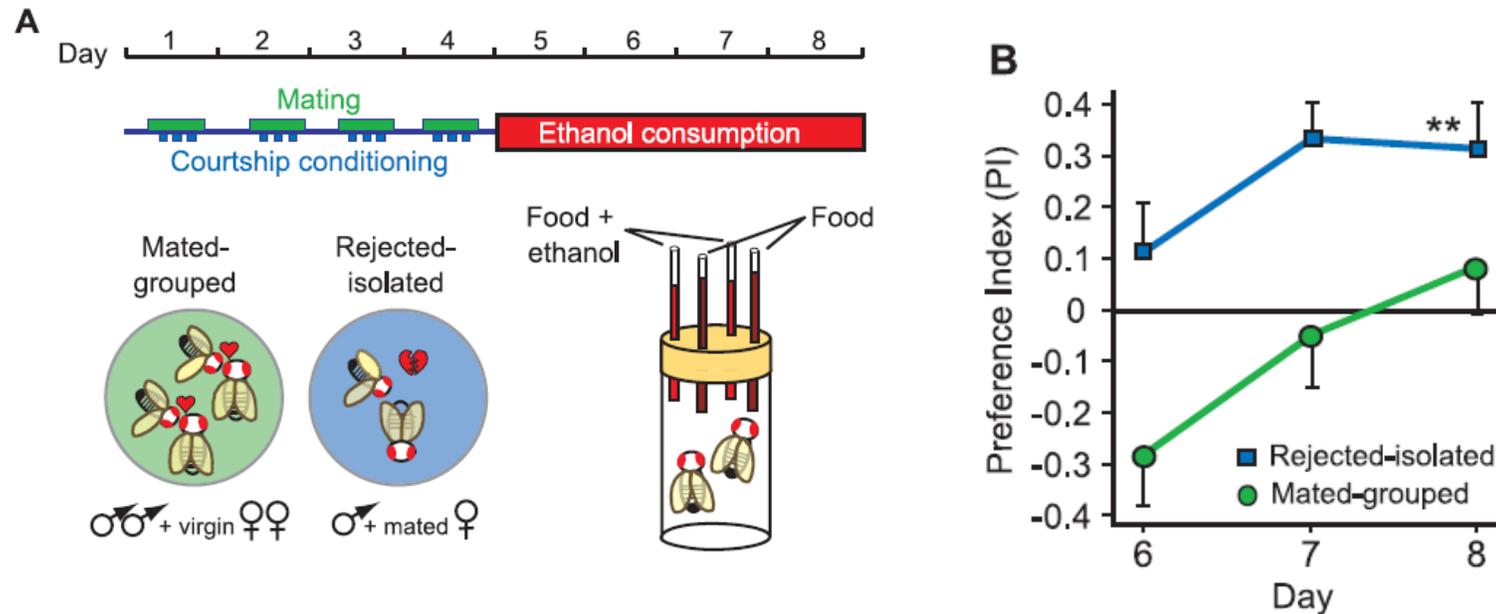


Article

Starvation-Induced Depotentiation of Bitter Taste in *Drosophila*

Emily E. LeDue¹, Kevin Mann¹, Ellen Koch¹, Bonnie Chu¹, Roslyn Dakin¹, Michael D. Gordon^{1,2}✉

Noyer son chagrin dans l'alcool



Sexual Deprivation Increases Ethanol Intake in *Drosophila*

G. Shohat-Ophir,^{1,2*} K. R. Kaun,^{1,2} R. Azanchi,^{1,2} U. Heberlein^{1,2*}

SCIENCE VOL 335 16 MARCH 2012

Fig. 1. Mating and chronic sexual deprivation have opposite effects on voluntary ethanol consumption.

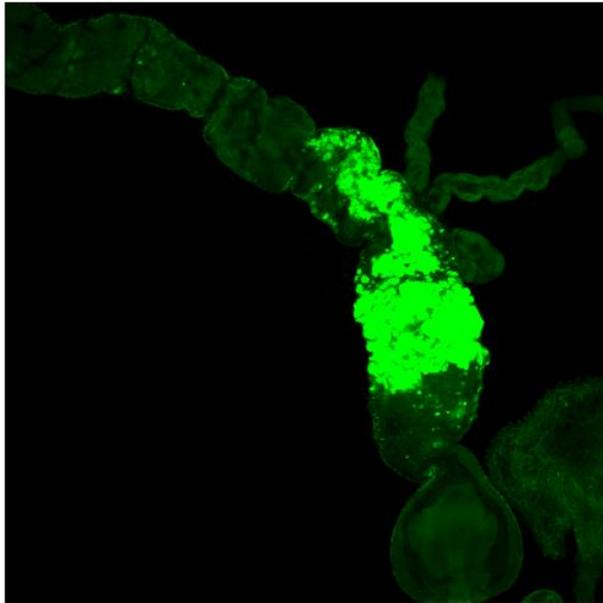
- (A) Schematic of the behavioral assay. Virgin wild-type males were allowed to mate with virgin females (groups of 4 males and 20 females) for 6 hours daily (“mated-grouped”; green blocks) or were subjected to courtship conditioning for 1 hour, three times daily (“rejected-isolated”; blue squares). Training was repeated for 4 days, after which males were placed in vials where they could choose to feed from capillaries containing food solutions with (red) or without (brown) 15% ethanol (10). Ethanol consumption was measured on days 6 to 8.
- (B) Rejected-isolated males exhibited higher ethanol preference than mated-grouped males (** $P < 0.005$, $n = 12$).

Tumeurs et stress

Social environment mediates cancer progression in *Drosophila*

Erika H. Dawson^{1,2}, Tiphaine P. M. Bailly¹, Julie Dos Santos¹, Céline Moreno¹, Maëlle Devilliers³, Brigitte Maroni³, Cédric Sueur^{4,5}, Andreu Casali⁶, Beata Ujvari⁷, Frederic Thomas⁸, Jacques Montagne³ & Frederic Mery¹

NATURE COMMUNICATIONS | (2018)9:3574 | DOI: 10.1038/s41467-018-05737-w | www.nature.com/naturecommunications



(C) 21 days post induction

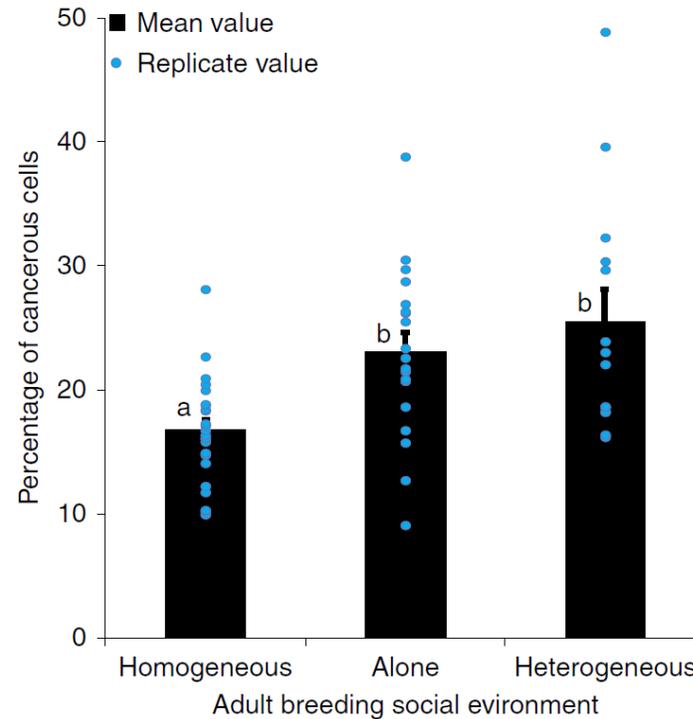
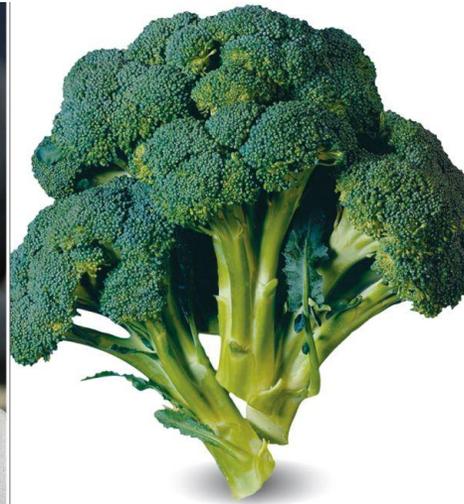
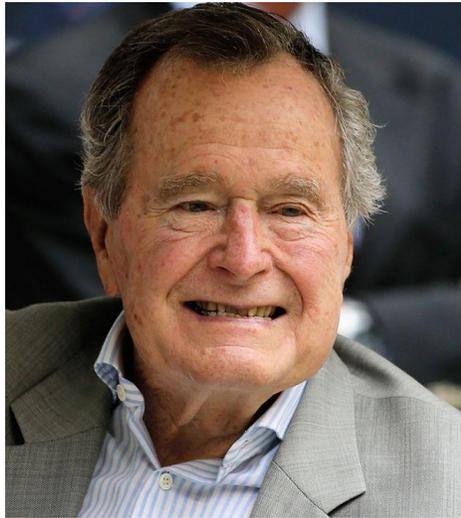


Fig. 1 Gut tumor progression as a function of social environment. FACS analysis of GFP-positive cells in guts dissected from 21 days post-HS cancerous females as a function of social environment. Blue dots indicate mean value for each replicate. Error bars: standard error of the mean. N = 15 measures for each treatment. Letters are Tukey's post-hoc classification

Variabilité génétique du goût?



George H.W. Bush still hates broccoli
By Daniella Diaz, CNN
Updated June 25, 2016

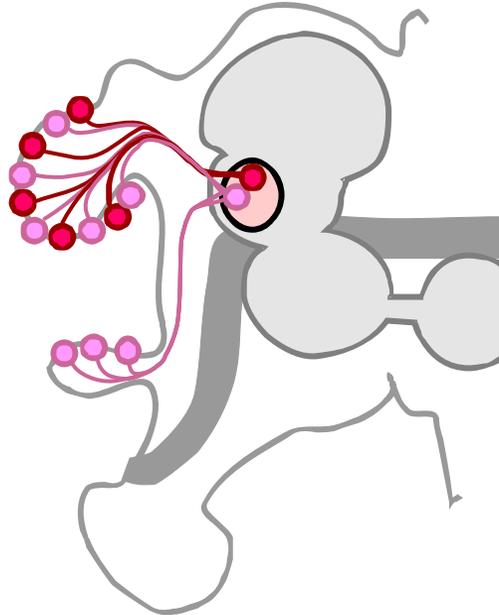


Drosophila genetic reference panel
200 lignées isofemelles
Mackay, T. F. C., et al. Nature (2012)

TASTE, OLFACTION?...

Drosophila: olfaction

~ 60 receptor genes
62 proteins

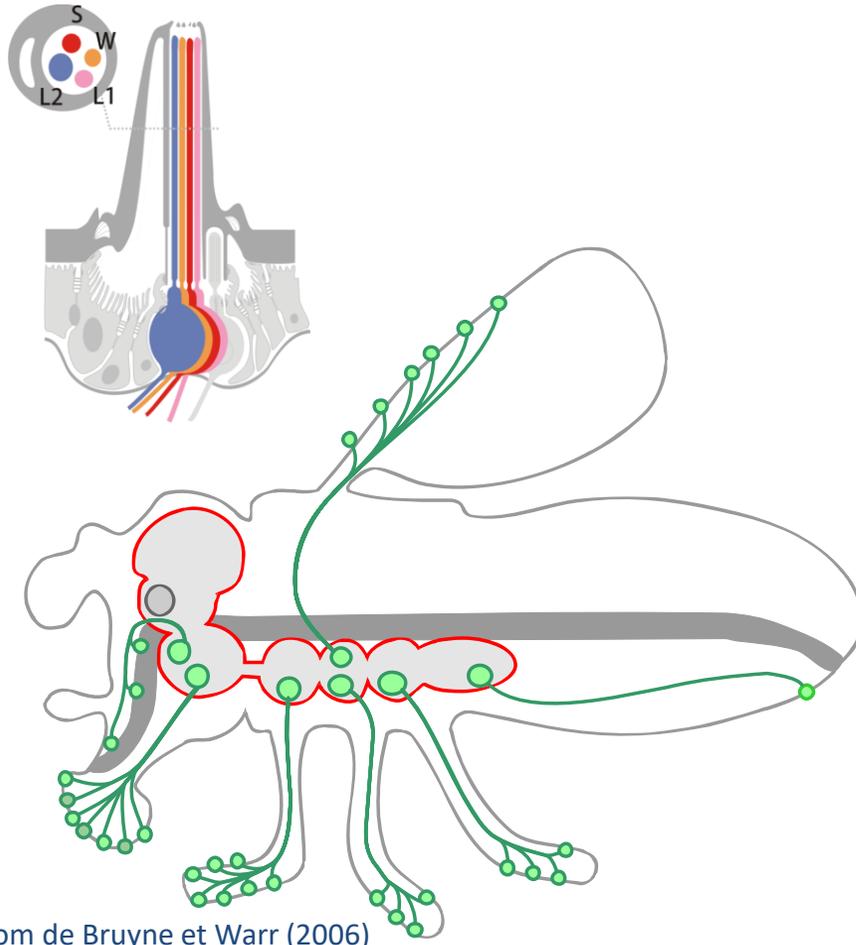


- Adult:
 - 1200 + 120 olfactory neurons
 - CNS: 1 sensory center , 40 glomeruli
 - 1 neuron = 1,2 receptors expressed from 40
 - 1 receptor → 1 glomerulus

= Chemotopy

from de Bruyne et Warr (2006)

Taste system in *Drosophila*

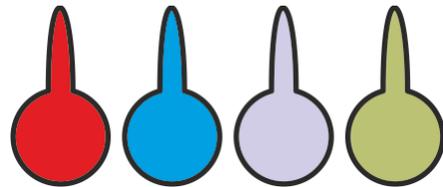


From de Bruyne et Warr (2006)

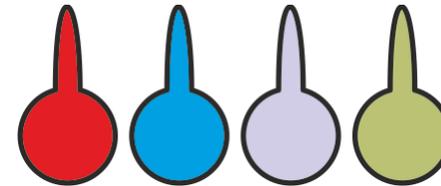
- 660 taste neurons
- Legs, mouthparts, wings, ovipositor
- CNS = 1 « taste-brain » / segment
- Positional mapping
- Several receptors co-expressed in a taste neuron

(not?)
«Taste» is different from olfaction

TASTE



OLFACTION



Species	Grs	Ors
<i>Tribolium castaneum</i>	200	265
<i>Apis mellifera</i>	10	163
<i>Bombyx mori</i>	60	50
<i>Aedes aegypti</i>	88	105
<i>Anopheles gambiae</i>	90	79
<i>Drosophila melanogaster</i>	68	60
<i>Pediculus humanus humanus</i>	6	10

«Taste» is different from olfaction

Contact
chemoreception

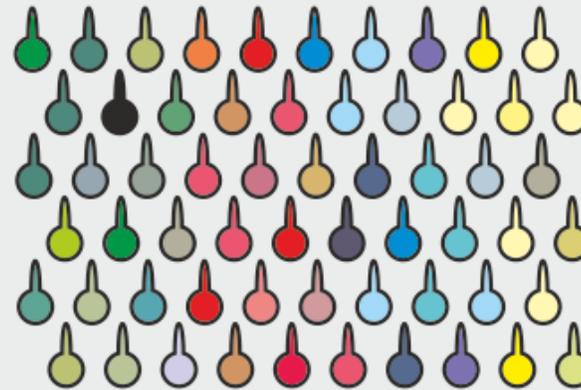
1 neuron: up to 20 Grs



Fast (few computations)
Poor discrimination
Low sensitivity

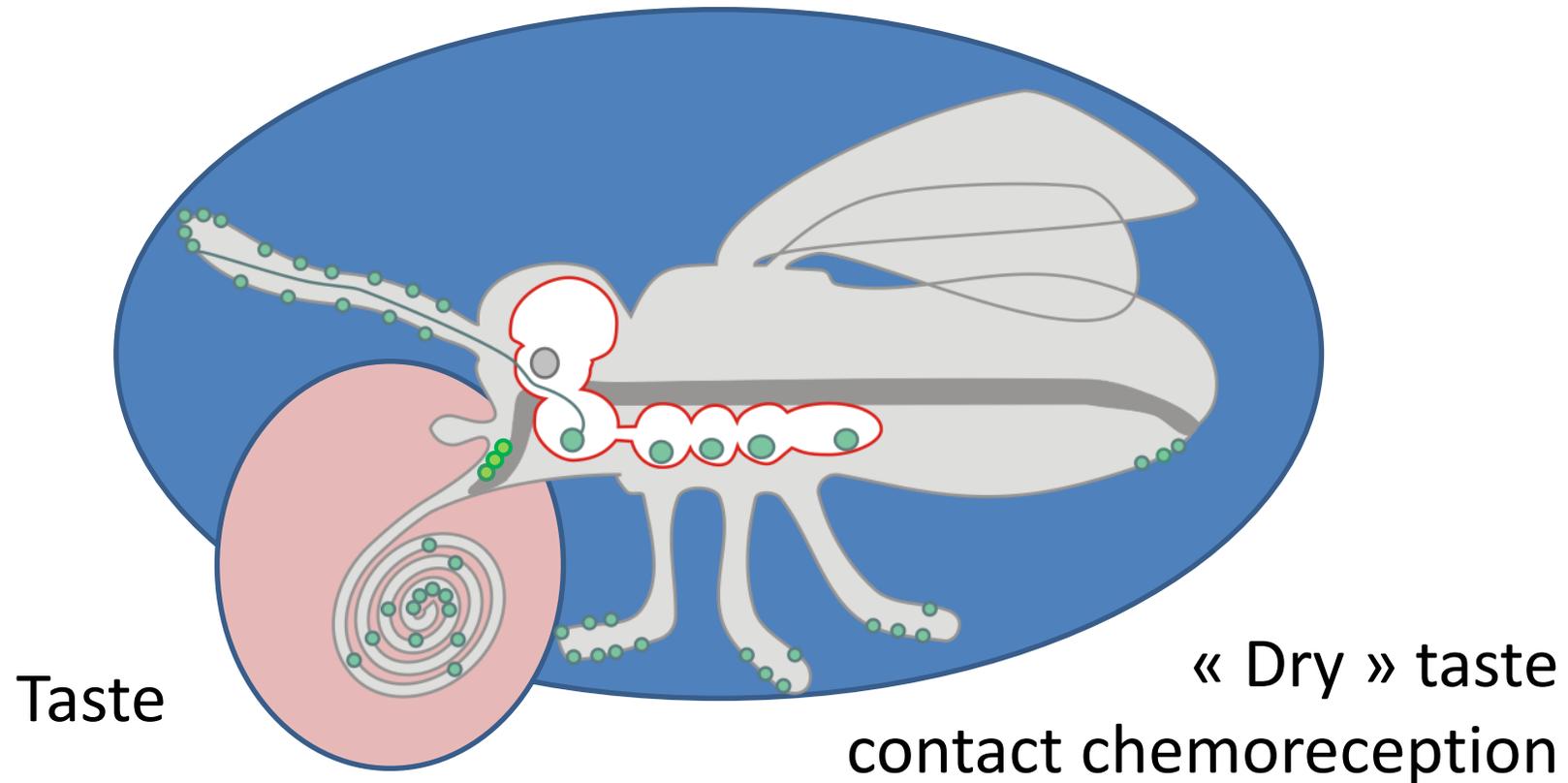
Olfaction

1 neuron: 1 OR



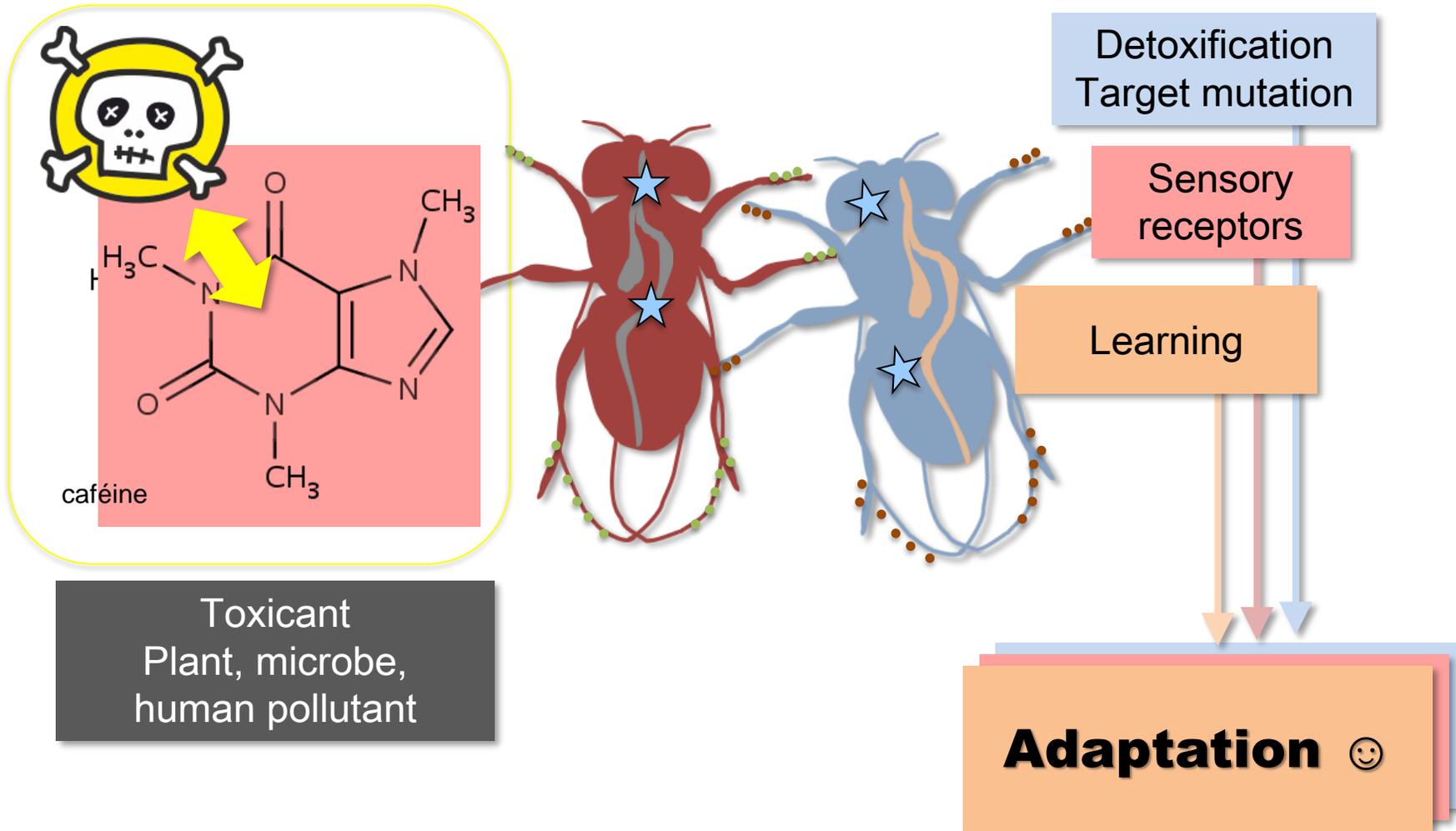
Slow (computation-intensive)
Fine discrimination
High sensitivity

Taste in insects: mouthparts but also contact



BITTER TASTE = AVOID NOXIOUS MOLECULES?

Hypothesis: bitter = adaptation to toxic compounds



Exemple: glucose = « bitter »



Normal cockroaches

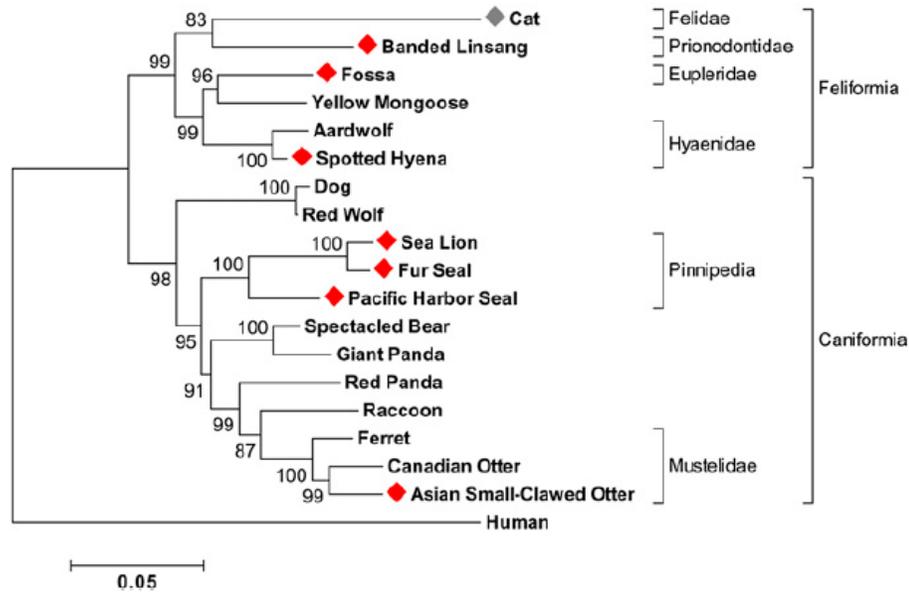


Glucose-averse cockroaches



Wada-Katsumata et al. Science (2013)

Taste receptors reflect food habits



Most carnivorous mammals have lost their sugar receptor (Jiang et al, 2012 PNAS)



Vampire bats have lost their bitter receptors (Hong et al., 2014 Proc Roy Soc B)



Whales have lost sweet, bitter and umami but not salt taste (Feng et al., 2014 Gen Biol Evol)



Drosophila sechellia adapted to toxic fruit *Morinda citrifolia* (octanoic acid) are resistant to OA and have lost the corresponding taste receptor (Dworkin & Jones (2009) Genetics)

Conclusions

- Chez l'homme, comme chez la mouche, goûter implique des voies multisensorielles
- L'organisation des récepteurs gustatif est fondamentalement différent de celle du système olfactif
- Les fonctions du système gustatif sont similaires chez l'homme et la mouche:
 - Estimer rapidement si les aliments en bouche seront nutritifs ou dangereux
 - Préparer l'organisme à la digestion
 - Ce système prédictif est modulable par des processus post-ingestifs, liés à la digestion, à l'immunité, au stress et au contexte social
- Au-delà de ces ressemblances à un niveau macroscopique ou cellulaire, la Drosophile peut être utilisée pour étudier des dysfonctionnements liés à des gènes particulier qui ont un homologue chez l'humain

Acknowledgements

Co-workers:

Marie-Jeanne Sellier (PhD)
Alexandra Guigue (PhD)
Moutaz Ali Agha (M2R/PhD)
Marie-Ange Chabaud (Postdoc)
Nicolas Meunier (PhD)
Makoto Hiroi (PhD)
Alice French (PhD)
Philippe Touton (INRA)
Aniruddha Mitra (Postdoc)



Support:

ANR INSAVEL, ADAPTANTHROP
MNESER, DGER

Institutions:

AgroParisTech, INRA, UPMC, CNRS

Collaboration:

Yves Grau, CNRS, Montpellier
Pablo Reeb, Argentina

