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Born in 1963 in Rome

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PROJECT

Olfactory Coding in the Brain

Olfaction is far from understood—not in humans, and not in any animal species. The structure of neural networks is quite similar across many species in the animal kingdom, but when comparing honeybees and humans, the significance of odorants is very specific to each: a positive odor for us (e.g. the smell of a banana) may mean something different to a bee (in this case: alarm, and sting the intruder!). From a neurobiological point of view, a major question is: How does the coding of odors with an innate meaning differ—if at all—from the coding of odors that appear not to have had any role in the evolution of a species?

I will analyze this question using insects, in particular honeybees and fruit flies. It will be necessary to understand how single olfactory receptors respond to a large panel of chemicals—i.e., to understand their molecular response range, or, in other words, to understand which odorants they are tuned to. From there, we need to follow the neuronal circuits into the brain, and we need to create computer models of brain circuitry.

A new aspect we are moving into right now is: What does disease smell like? Honeybees fight diseases in the hive using collective behavior: sick bees are isolated and kept away from the queen, infected brood is killed, and dead bees are quickly removed from the hive. All of these behaviors are controlled by odors, some released by the sick animal, some by the pathogens itself. How do bees recognize and attribute meaning to these odors?

Understanding how neural networks in the brain attribute information to a sensory stimulus will help us understand how our brain creates a representation of the world, a prerequisite for higher order brain functions such as intelligence, sentience, and consciousness—though the latter will be a big leap.

Recommended Reading

Galizia, C. Giovanni, and Pierre-Marie Lledo, eds. (2013). Neurosciences: From Molecule to Behavior; A University Textbook. Springer.

Galizia, C. Giovanni (2014). "Olfactory Coding in the Insect Brain: Data and Conjectures." European Journal of Neuroscience 39 (11): 1784–1795. https://doi.org/10.1111/ejn.12558.

Paoli, Marco, and C. Giovanni Galizia (2021). "Olfactory Coding in Honeybees." Cell and Tissue Research 383: 35–58. https://doi.org/10.1007/s00441-020-03385-5.

COLLOQUIUM, 27.09.2022

Odor Songs in the Bee Brain

How are odors coded in the brain?

How do we distinguish an apple scent from a banana – or a stink bug?

Where are the open questions?

Honeybees communicate about flowers (nectar and pollen sources) within the hive, using a waggle dance for distance and direction, nectar probes for taste, and odor traces in their fur for odor. Follower bees who liked the probe can then fly in the indicated direction and for the indicated distance and locate the flower using their olfactory memory.

In my research I study olfactory coding in the insect brain. I will present

1) the experimental approach taken at the University of Konstanz (how do we measure odor-evoked brain activity?);

2) the conceptual questions behind "olfactory coding" (in musical language, is it a chord or a melody or both?);

3) some longer-ranging questions of my research at the Wissenschaftskolleg (do honeybees dream?).

PUBLICATIONS FROM THE FELLOW LIBRARY

Galizia, Giovanni (Oxford [u.a.],2025)

Olfactory receptor responses to pure odorants in Drosophila melanogaster

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1925491277

Galizia, Giovanni (Jerusalem,2015)

Forgetting : an interdisciplinary conversation

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1621796140

Martin Buber Society of Fellows notebook series

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1621796140

Galizia, Giovanni (Oxford,2014)

Olfactory coding in the insect brain : data and conjectures

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668688921

Galizia, Giovanni (Berlin, Heidelberg,2013)

Neurosciences - from molecule to behavior : a university textbook

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=717618935

Galizia, Giovanni (Dordrecht,2012)

Honeybee neurobiology and behavior : a tribute to Randolf Menzel

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=663491436

Galizia, Giovanni (Palo Alto, Calif.,2010)

Parallel olfactory systems in insects : anatomy and function

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1668778521

Galizia, Giovanni (Konstanz,2010)

Wie kommen die Düfte ins Gehirn? : Bericht aus der Werkstatt der Neurobiologie ; [... erweiterte Fassung des Vortrags, der am 7. November 2008 im Rahmen des 25. Wissenschaftsforums der Stiftung "Wissenschaft und Gesellschaft" und der Universität Konstanz ... gehalten wurde]

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=600233219

Konstanzer Universitätsreden ; 235

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