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Olfaction represents an ideal model system for the study of mammalian habituation given that it is an anatomically relatively simple system with strong reciprocal connections to the limbic system, driving both reflexive and non-reflexive (motivated) behaviors that are easily quantifiable.

OLFACTION AS A MODEL SYSTEM FOR THE NEUROBIOLOGY OF ...

Many types of computational models exist, and based on their primary purpose, models of the insect olfactory system may be divided into three categories: (a) feature-replication models, which try to reproduce an experimentally observed result to help understand the underlying mechanisms; (b) feature-prediction models, which extrapolate from what has been observed to predict unexplored aspects of neural circuits that can be tested later by experiments; and (c) role-detection models, which ...

Insect Olfaction: A Model System for Neural Circuit ...

The olfactory system can be divided into two main components: (1) the main olfactory system which consists of the main olfactory epithlium in the nasal cavity where transduction of volatile odors occurs, and the main olfactory bulb and its connections with other parts of the brain; and (2) the accessory olfactory system comprised of the vomeronasal organ where transduction of non-volatile pheremones occurs, and the accessory olfactory bulb and its connections with other brain areas.

Olfactory System - an overview | ScienceDirect Topics

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Olfaction: A Model System for Computational Neuroscience ...

Updated December 03, 2019 The olfactory system is responsible for our sense of smell. This sense, also known as olfaction, is one of our five main senses and involves the detection and identification of molecules in the air. Once detected by sensory organs, nerve signals are sent to the brain where the signals are processed.

Olfactory System - Sense of Smell - ThoughtCo

Olfaction - A Model System for Computational Neuroscience: Davis, Joel L.: Amazon.com.au: Books

Olfaction - A Model System for Computational Neuroscience ...

Olfaction turned into a modern model system Because it promises better understanding of ligand binding in GPCRs. Through advances in genetics. Because its ligand binding mechanism was demonstrated to work different from other GPCRs

What is so special about smell? Olfaction as a model ...

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(PDF) Olfaction as a model system for neurobiology: GPCRs ...

The sense of olfaction is complex. Odor perception is influenced by many factors unique to each individual as well as external environmental factors. The basis of odor perception is the contact between chemical molecules, mainly in the gaseous state, which can be detected by the olfactory epithelium. From : Pour la science # 218

What is the process of olfaction - odor perception

interest in olfaction as a model system in neurobiol-ogy. Focus lies on the olfactory receptors (ORs) and their identiﬁcation as G-protein-coupled recep-tors (GPCRs), which constitute the largest protein family in the mammalian genome. GPCRs regulate fundamental physiological processes, and they are one of the main targets of drug design studies. In

Review What is so special about smell? Olfaction as a ...

Created by Ronald Sahyouni. Watch the next lesson: https://www.khanacademy.org/test-prep/mcat/processing-the-environment/taste-gustation-and-smell-olfaction/...

Olfaction - structure and function | Processing the ...

The insect olfactory system has emerged as a prominent model in neuroscience. Investigation of its organization and function has revealed surprising answers to fundamental questions of how an animal detects, encodes, and processes sensory stimuli.

Insect olfaction from model systems to disease control | PNAS

Explore celebrity trends and tips on fashion, style, beauty, diets, health, relationships and more. Never miss a beat with MailOnline's latest news for women.

Computational neuroscientists have recently turned to modeling olfactory structures because these are likely to have the same functional properties as currently popular network designs for perception and memory. This book provides a useful survey of current work on olfactory system circuitry, including connections of this system to brain structures involved in cognition and memory, and describes the computational models of olfactory processing that have been developed to date. Contributions cover empirical investigations of the neurobiology of the olfactory systems (anatomy, physiology, synaptic plasticity, behavioral physiology) as well as the application of computer models to understanding these systems. Fundamental issues in olfactory processing by the nervous systems such as experimental strategies in the study of olfaction, stages of odor processing, and critical questions in sensory coding are considered across empirical/applied boundaries and throughout the contributions. Joel L. Davis is Program Manager of the Biological Intelligence Section at the Office of Naval Research. Howard Eichenbaum is Professor of Biological Sciences at Wellesley College. Contributors: 1. Fundamental Anatomy, Physiology, and Plasticity of the Olfactory System. Gordon M. Shepherd. John S. Kauer, S. R. Neff, Kathryn A. Hamilton, and Angel R. Cinelli. Kevin L. Ketchum, Lewis B. Haberly. Joseph L. Price, S. Thomas Carmichael, Ken M. Carnes, MarieChristine Clugnet, Masaru Kuroda, and James P. Ray. Michael Leon, Donald A. Wilson, and Kathleen M. Guthrie. Gary Lynch and Richard Granger. Howard Eichenbaum, Tim Otto, Cynthia Wible, and jean Piper. II. Developments in Computational Models of the Olfactory System. DeLiang Wang, Joachim Buhmann, and Christoph von der Marlsburg. Walter Freeman. Richard Granger, Ursula Staubi, José Ambrose-Ingersoll, and Gary Lynch. James M. Bower. Dan Hammerstrom and Eric Means.

Comprehensive Overview of Advances in Olfaction The common belief is that human smell perception is much reduced compared with other mammals, so that whatever abilities are uncovered and investigated in animal research would have little significance for humans. However, new evidence from a variety of sources indicates this traditional view is likely overly simplistic. The Neurobiology of Olfaction provides a thorough analysis of the state-of-the-science in olfactory knowledge and research, reflecting the growing interest in the field. Authors from some of the most respected laboratories in the world explore various aspects of olfaction, including genetics, behavior, olfactory systems, odorant receptors, odor coding, and cortical activity. Until recently, almost all animal research in olfaction was carried out on orthonasal olfaction (inhalation). It is only in recent years, especially in human flavor research, that evidence has begun to be obtained regarding the importance of retronasal olfaction (exhalation). These studies are beginning to demonstrate that retronasal smell plays a large role to play in human behavior. Highlighting common principles among various species - including humans, insects, Xenopus laevis (African frog), and Caenorhabditis elegans (nematodes) - this highly interdisciplinary book contains chapters about the most recent discoveries in odor coding from the olfactory epithelium to cortical centers. It also covers neurogenesis in the olfactory epithelium and olfactory bulb. Each subject-specific chapter is written by a top researcher in the field and provides an extensive list of reviews and original articles for students and scientists interested in further readings.

Many advances have been made in the last decade in the understanding of the computational principles underlying olfactory system functioning. Neuromorphic Olfaction is a collaboration among European researchers who, through NEUROCHEM (Fp7-Grant Agreement Number 216916)—a challenging and innovative European-funded project—introduce novel computing paradigms and biomimetic artifacts for chemical sensing. The implications of these findings are relevant to a wide audience, including researchers in artifical olfaction, neuroscientists, physiologists, and scientists working with chemical sensors. Developing neuromorphic olfaction from conceptual points of view to practical applications, this cross-disciplinary book examines: The biological components of vertebrate and invertebrate chemical sensing systems The early coding pathways in the biological olfactory system, showing how nonspecific receptor populations may have significant advantages in encoding odor intensity as well as odor identity The redundancy and the massive convergence of the olfactory receptor neurons to the olfactory bulb A neuromorphic approach to artificial olfaction in robots Reactive and cognitive search strategies for olfactory robots The implementation of a computational model of the mammalian olfactory system The book’s primary focus is on translating aspects of olfaction into computationally practical algorithms. These algorithms can help us understand the underlying behavior of the chemical senses in biological systems. They can also be translated into practical applications, such as robotic navigation and systems for uniquely detecting chemical species in a complex background.

A comprehensive Introduction to the world of brain and behavior computational models This book provides a broad collection of articles covering different aspects of computational modeling efforts in psychology and neuroscience. Specifically, it discusses models that span different brain regions (hippocampus, amygdala, basal ganglia, visual cortex), different species (humans, rats, fruit flies), and different modeling methods (neural network, Bayesian, reinforcement learning, data fitting, and Hodgkin-Huxley models, among others). Computational Models of Brain and Behavior is divided into four sections: (a) Models of brain disorders; (b) Neural models of behavioral processes; (c) Models of neural processes, brain regions and neurotransmitters, and (d) Neural modeling approaches. It provides in-depth coverage of models of psychiatric disorders, including depression, posttraumatic stress disorder (PTSD), schizophrenia, and dyslexia; models of neurological disorders, including Alzheimer’s disease, Parkinson’s disease, and epilepsy; early sensory and perceptual processes; models of olfaction; higher/systems level models and low-level models; Pavlovian and instrumental conditioning; linking information theory to neurobiology; and more. Covers computational approximations to intellectual disability in down syndrome Discusses computational models of pharmacological and immunological treatment in Alzheimer's disease Examines neural circuit models of serotonergic system (from microcircuits to cognition) Educates on information theory, memory, prediction, and timing in associative learning Computational Models of Brain and Behavior is written for advanced undergraduate, Master's and PhD-level students—as well as researchers involved in computational neuroscience modeling research.

Written by leaders in the field of chemosensation, Chemosensory Transduction provides a comprehensive resource for understanding the molecular mechanisms that allow animals to detect their chemical world. The text focuses on mammals, but also includes several chapters on chemosensory transduction mechanisms in lower vertebrates and insects. This book examines transduction mechanisms in the olfactory, taste, and somatosensory (chemesthetic) systems as well as in a variety of internal sensors that are responsible for homeostatic regulation of the body. Chapters cover such topics as social odors in mammals, vertebrate and invertebrate olfactory receptors, peptide signaling in taste and gut nutrient sensing. Includes a foreword by preeminent olfactory scientist Stuart Firestein, Chair of Columbia University’s Department of Biological Sciences in New York, NY. Chemosensory Transduction describes state-of-the-art approaches and key findings related to the study of the chemical senses. Thus, it serves as the go-to reference for this subject for practicing scientists and students with backgrounds in sensory biology and/or neurobiology. The volume will also be valuable for industry researchers engaged in the design or testing of flavors, fragrances, foods and/or pharmaceuticals. Provides a comprehensive overview for all chemosensory transduction mechanisms Valuable for academics focused on sensory biology, neurobiology, and chemosensory transduction, as well as industry researchers in new flavor, fragrance, and food testing Edited by leading experts in the field of olfactory transduction Focuses on mammals, but lower vertebrates and invertebrate model systems are also included

JOHN G. HILDEBRAND Research on insect olfaction is important for at least two reasons. First, the olfactory systems of insects and their arthropod kin are experi mentally favourable models for studies aimed at learning about general principles of olfaction that apply to vertebrates and invertebrates alike. Detailed comparisons between the olfactory pathways in vertebrates and insects have revealed striking similarities of functional organisation, physiol ogy, and development, suggesting that olfactory information is processed through neural mechanisms more similar than different in these evolution arily remote creatures. Second, insect olfaction itself is important because of the economic and medical impact of insects that are agricultural pests and disease vectors, as well as positive impact of beneficial species, such as the bees and moths responsible for pollination and production of honey. The harm or benefit attributable to an insect is a function of what it does - that is, of its behaviour - which is shaped by sensory information. Often olfaction is the key modality for control of basic insect behaviour, such as ori entation and movement toward, and interactions with, potential mates, appro priate sites for oviposition, and sources of food. Not surprisingly, therefore, much work on insect olfaction has been motivated by long-term hopes of using knowledge of this pivotal sensory system to design strategies for mon itoring and managing harmful species and fostering the welfare of beneficial ones.

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This book provides a valuable information source for olfaction and taste which includes a comprehensive and timely overview of the current state of knowledge of use for olfaction and taste machines Presents original, latest research in the field, with an emphasis on the recent development of human interfacing Covers the full range of artificial chemical senses including olfaction and taste, from basic through to advanced level Timely project in that mobile robots, olfactory displays and odour recorders are currently under research, driven by commercial demand

A common challenge across sensory processing modalities is forming meaningful associations between the neural responses and the outside world. These neural representations of the world must then be integrated across different sensory systems contributing to each individuals perceptual experience. While there has been considerable study of sensory representations in the visual system of humans and multiple model organisms, other sensory domains, including olfaction, are less well understood. In this thesis, I set out to better understand the sensory representations of the mouse accessory olfactory system (AOS), a part of the olfactory system. The mouse AOS, our model chemosensory system, comprises peripheral vomeronasal sensory neurons (VSNs), the accessory olfactory bulb (AOB), and downstream effectors. Our work describes the neural representations of multiple sensory inputs in the AOS, specifically the representations of odorants in high dimensional chemical sensory space in the AOB, and how these representations are shaped by interactions within the circuit. Given the complex nature of olfactory chemosensory representations, the features of our model system may give new perspectives on the neural representation of the outside world. In a neural representation of olfactory information, both the interactions between each receptor and odor compounds as well as the circuit mediated interactions could potentially affect the neural representations of the outside world. The initial neural response comprises component interactions between each receptor and the odor; chemical signals must interact with physical receptors. However, chemosensory processing, such as olfaction, requires interpreting a large variety of potentially overlapping chemical cues from the environment with only a finite number of receptor types. This means that each chemical cue does not necessarily activate only one receptor type or region of the circuit, but rather the cue is likely to be represented by multiple receptor and odor component interactions. Also, the component parts of odors may be processed differently when presented in isolation versus in a more complex mixture, thus allowing the response to a particular odor to vary with chemical context. Moreover, once these component representations exist, interactions within the neural circuit may further shape these responses. For example, one might expect component parts of a complex odor to specifically inhibit other component parts. In the case of the accessory olfactory system this inhibition could be at the receptor level or at the level of the sensory representation in the accessory olfactory bulb (AOB). In Chapter 3, I describe the overall organization of chemosensory representations in the accessory olfactory bulb (AOB), which is found to be a modular map in which the primary associations of functional sensory responses are spatially organized relative to one another. I find these primary associations are condensations of the first order sensory neuron axon terminals, which form population response pooling structures called glomeruli. In these glomeruli, similar response types from those sensory neurons expressing one of the approximately 300 receptor types in the vomeronasal organ (VNO) co-converge. One purpose of converging inputs of neurons expressing the same receptor is likely to minimize noise, and I demonstrate that pooling of like receptor responses into glomeruli does increase neural signal relative to noise. However, I also observed a modular organization among and between glomeruli in which certain types or patterns of chemosensory responses are always spatially adjacent to one another, while others are much farther apart than would be expected by chance. I found this spatial modularity for both ethological stimuli (urine collected from conspecifics with widely divergent physiological endocrine status) and individual sulfated steroids. In Chapter 4, I explore the consequences of changing sensory context, specifically the presentation of multiple compounds, and the role that inhibition plays in the neural representation of the sensory stimuli. First, I tested whether the circuit responds differently to demands to represent a single odor than to demands to represent multiple odors by using odors that activate glomeruli both inside and outside of modules. I found that responses to mixtures rapidly diverge from the responses of individual component parts. Moreover, there was an effect of inhibition in modulating the response to preferred stimuli in all glomeruli. However, initial analysis of one type of pregnanolone responsive glomeruli demonstrated that the divergent response to mixtures in this type of glomerulus was not mediated by inhibition at the glomerular level, but was rather attributable to bottom-up effects from the interactions of multiple ligands with chemosensory receptors in the VNO. Nonetheless, I also demonstrated that in the AOB, the axon terminals of the same sensory neurons (glomeruli) are organized into modules that allow for feedback inhibition. Significant ionotropic glutamate receptor signal modulation was observed within modules, demonstrating that there are inhibition mediated effects in the representation of complex mixtures when glomeruli are co-locally arranged. Specifically, at both the level of the VSNs and also in AOB glomeruli, the response to allopregnanolone sulfate is inhibited by co-presentation with estradiol sulfate. This both significantly increases the relative representation of estradiol sulfate and shifts representation of allopregnanolone primarily within modules. These types of context dependent interactions depend on the spatial organization described in Chapter 3 as well as mixture context, and have the potential to optimize the representation of some chemical cues in a context specific manner.