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Head Direction Cells And The Neural Mechanisms Of Spatial Orientation

Sheri J.Y. Mizumori

Head Direction Cells And The Neural Mechanisms Of Spatial Orientation:

Head Direction Cells and the Neural Mechanisms of Spatial Orientation Sidney I. Wiener, Jeffrey S.

Taube, 2005-07-29 A comprehensive examination of head direction signals and their importance in explaining orienting and navigation behaviors Head direction cells neurons that fire only when an animal orients its head in a certain direction are found in several different brain areas with different neurons selective for different head orientations they are influenced by landmarks as well as motor and vestibular information concerning how the head moves through space These properties suggest that head direction cells play an important role in determining orientation in space and in navigation Moreover the prominence strength and clarity of head direction signals indicate their importance over the course of evolution and suggest that they can serve as a vital key for understanding brain function This book presents the latest findings on head direction cells in a comprehensive treatment that will be a valuable reference for students and researchers in the cognitive sciences neuroscience computational science and robotics The book begins by presenting head direction cell properties and an anatomical framework of the head direction system It then looks at the types of sensory and motor information that control head direction cell firing covering topics including the integration of diverse signals the relationship between head direction cell activity and an animal s spatial behavior and spatial and directional orientation in nonhuman primates and humans The book concludes with a tutorial demonstrating the implementation of the continuous attractor network a computational model of head direction cells and an application of this approach for a navigational system for mobile robots The Neurobiology of Spatial Behaviour K. J. Jeffery, 2003-11-06 This book explores the relationship between cellular processes and animal behaviour It does this by focusing on the domain of navigation bringing together scientists from either side of the brain behaviour divide in an attempt to explain the linkage between spatial behaviour and the underlying activity of neurons The Neurobiology of Spatial Behaviour is organised into two sections Section one deals with the so called higher levels of description studies of spatial behaviour and the brain areas that might underlie such behaviour The section begins with insects remarkably sophisticated navigators and ends with humans examining along the way issues such as whether animal brains contain maps and whether spatial and non spatial information interact and if so how Section two delves further into the brain and focuses on the mammalian representation of space and the role of place cells These issues have far wider ramifications that simply helping us to understand the process of navigation This system might provide a model for how other forms of knowledge beliefs and intentions are encoded in neurons As such the book will be of interest to an interdisciplinary audience including ethologists psychologists behavioural neuroscientists computational modellers physiological neuroscientists and molecular biologists Encyclopedia of Behavioral Neuroscience, 2010-04-16 Behavioral Neuroscientists study the behavior of animals and humans and the neurobiological and physiological processes that control it Behavior is the ultimate function of the nervous system and the study of it is very multidisciplinary Disorders of behavior in

humans touch millions of people's lives significantly and it is of paramount importance to understand pathological conditions such as addictions anxiety depression schizophrenia autism among others in order to be able to develop new treatment possibilities Encyclopedia of Behavioral Neuroscience is the first and only multi volume reference to comprehensively cover the foundation knowledge in the field This three volume work is edited by world renowned behavioral neuroscientists George F Koob The Scripps Research Institute Michel Le Moal Universit Bordeaux and Richard F Thompson University of Southern California and written by a premier selection of the leading scientists in their respective fields Each section is edited by a specialist in the relevant area The important research in all areas of Behavioral Neuroscience is covered in a total of 210 chapters on topics ranging from neuroethology and learning and memory to behavioral disorders and psychiatric diseases The only comprehensive Encyclopedia of Behavioral Neuroscience on the market Addresses all recent advances in the field Written and edited by an international group of leading researchers truly representative of the behavioral neuroscience community Includes many entries on the advances in our knowledge of the neurobiological basis of complex behavioral psychiatric and neurological disorders Richly illustrated in full color Extensively cross referenced to serve as the go to reference for students and researchers alike The online version features full searching navigation and linking functionality An essential resource for libraries serving neuroscientists psychologists neuropharmacologists and psychiatrists Handbook of in Vivo Neural Plasticity Techniques, 2018-09-01 Handbook of in Vivo Neural Plasticity Techniques Volume 28 A Systems Neuroscience Approach to the Neural Basis of Memory and Cognition gives a comprehensive overview of the current methods and approaches that are used to study neural plasticity from a systems neuroscience perspective In addition the book offers in depth methodological advice that provides the necessary foundation for researchers establishing methods and students who need to understand the theoretical and methodological bases of these approaches This is the ideal resource for anyone new to the study of cognitive and behavioral neuroscience who seeks an introduction to state of the art techniques Offers a comprehensive overview of state of the art approaches to studying neuroplasticity in vivo Combines discussions of theoretical underpinnings with the methodological and technical aspects necessary to guarantee success Arranged in a uniform format that clearly and concisely lays out descriptions methods and the pitfalls of various techniques Space, Time and Memory in the Hippocampal Formation Dori Derdikman, James J. Knierim, 2014-07-08 The discovery of new cell types such as grid and time cells in the hippocampus has been accompanied by major anatomical and theoretical insights in the recent years This book provides comprehensive up to date information about the hippocampal formation and especially the neural basis of episodic memory spatial location the formation of the cognitive map and temporal representation The first part of the book describes the information flow from pre hippocampal areas into the hippocampus the second part discusses the different types of hippocampal processing and finally the third part depicts the influence that the hippocampal processing has on other brain structures that are perhaps more closely tied to explicit cognitive or behavioral output This book is

intended for neuroscientists especially for those who are involved in research on the hippocampus as well as for behavioral scientists and neurologists Spatial Processing in Navigation, Imagery and Perception Fred W. Mast, Lutz Jäncke, 2007-06-13 Spatial Processing in Navigation Imagery and Perception Since the decade of the brain cognitive processes have found their way to the study of brain functions and an increasing number of research studies are dealing with the aspect of spatial processing In fact a tremendous part of the cognitive domains studied pertain to spatial processing However there is also a growing tendency for diversification in relation to the subprocesses underlying spatial processing Not only are there studies looking at the well known place cells in rats rabbits and other animals there is also an increasing number of studies looking at related topics in humans and monkeys such as spatial orientation spatial construction and spatial imagery These studies although diverse at first glance have many aspects in common We are now on the root to understand the underlying neuroanatomy and neurophysiology much better than ever before This is made possible by the advent of novel techniques such as structural and functional in vivo anatomy modeling and several sophisticated behavioral research tools such as virtual reality techniques and simulators Spatial processing is fundamental for understanding human cognition However compared to other domains such as memory language and attention the exploration of spatial functions has been understudied in the past years Towards Autonomous Robotic Systems Roderich Groß, Lyuba Alboul, Chris Melhuish, Mark Witkowski, Tony T. Prescott, Jacques Penders, 2011-08-19 This book constitutes the refereed proceedings of the 12th Annual Conference Towards Autonomous Robotics Systems TAROS 2011 held in Sheffield UK in August September 2011 The 32 revised full papers presented together with 29 two page abstracts were carefully reviewed and selected from 94 submissions Among the topics addressed are robot navigation robot learning human robot interaction robot control mobile robots reinforcement learning robot vehicles swarm robotic systems etc Spatial Cognition, Spatial Perception Francine L. Dolins, Robert W. Mitchell, 2010-03-25 An analysis of human and non human animals spatial cognitive perceptual and behavioural processes through mapping internal and external spatial knowledge **Brain Computations and Connectivity** Edmund T. Rolls, 2023 Brain Computations and Connectivity is about how the brain works and elucidates what is computed in different brain systems and describes current biologically plausible computational approaches and models of how each of these brain systems computes Strategies of Orientation in Environmental Spaces Tobias Meilinger, 2008

Hippocampal Place Fields Sheri J.Y. Mizumori,2008-02-26 Data from neuropsychological and animal research suggest that the hippocampus plays a pivotal role in two relatively different areas active navigation as well as episodic learning and memory Recent studies have attempted to bridge these disparate accounts of hippocampal function by emphasizing the role that hippocampal place cells may play in processing the spatial contextual information that defines situations in which learned behaviors occur A number of established laboratories are currently offering complementary interpretations of place fields and this book will present the first common platform for them Bringing together research from behavioral genetic

physiological computational and neural systems perspectives will provide a thorough understanding of the extent to which studying place field properties has informed our understanding of the neural mechanisms of hippocampus dependent memory Hippocampal Place Fields Relevance to Learning and Memory will serve as a valuable reference for everyone interested in hippocampal function The Cognitive Thalamus Yuri B. Saalmann, Sabine Kastner, 2015-06-17 Cognitive processing is commonly conceptualized as being restricted to the cerebral cortex Accordingly electrophysiology neuroimaging and lesion studies involving human and animal subjects have almost exclusively focused on defining roles for cerebral cortical areas in cognition Roles for the thalamus in cognition have been largely ignored despite the fact that the extensive connectivity between the thalamus and cerebral cortex gives rise to a closely coupled thalamo cortical system However in recent years growing interest in the thalamus as much more than a passive sensory structure as well as methodological advances such as high resolution functional magnetic resonance imaging of the thalamus and improved electrode targeting to subregions of thalamic nuclei using electrical stimulation and diffusion tensor imaging have fostered research into thalamic contributions to cognition Evidence suggests that behavioral context modulates processing in primary sensory or first order thalamic nuclei for example the lateral geniculate and ventral posterior nuclei allowing attentional filtering of incoming sensory information at an early stage of brain processing Behavioral context appears to more strongly influence higher order thalamic nuclei for example the pulvinar and mediodorsal nucleus which receive major input from the cortex rather than the sensory periphery Such higher order thalamic nuclei have been shown to regulate information transmission in frontal and higher order sensory cortex according to cognitive demands This Research Topic aims to bring together neuroscientists who study different parts of the thalamus particularly thalamic nuclei other than the primary sensory relays and highlight the thalamic contributions to attention memory reward processing decision making and language By doing so an emphasis is also placed on neural mechanisms common to many if not all of these cognitive operations such as thalamo cortical interactions and modulatory influences from sources in the brainstem and basal ganglia The overall view that emerges is that the thalamus is a vital node in brain networks supporting cognition From Association To Rules: Connectionist Models Of Behavior And Cognition - Proceedings Of The Tenth Neural Computation And Psychology Workshop Robert M French, Elizabeth Thomas, 2008-01-18 This book introduces a host of connectionist models of cognition and behavior The major areas covered are high level cognition language categorization and visual perception and sensory and attentional processing All of the articles cover unpublished research work The key contribution of this book is that it focuses exclusively on the advances in connectionist modeling in psychology The papers are relatively short and were explicitly written to be accessible to both connectionist modelers and experimental psychologists Encyclopedia of Neuroscience, Volume 1 Larry R. Squire, 2009-06-12 The Encyclopedia of the Neuroscience explores all areas of the discipline in its focused entries on a wide variety of topics in neurology neurosurgery psychiatry and other related areas of

neuroscience Each article is written by an expert in that specific domain and peer reviewed by the advisory board before acceptance into the encyclopedia Each article contains a glossary introduction a reference section and cross references to other related encyclopedia articles Written at a level suitable for university undergraduates the breadth and depth of coverage will appeal beyond undergraduates to professionals and academics in related fields **Space, Time and Number** in the Brain Stanislas Dehaene, Elizabeth Brannon, 2011-07-13 The study of mathematical cognition and the ways in which the ideas of space time and number are encoded in brain circuitry has become a fundamental issue for neuroscience How such encoding differs across cultures and educational level is of further interest in education and neuropsychology This rapidly expanding field of research is overdue for an interdisciplinary volume such as this which deals with the neurological and psychological foundations of human numeric capacity A uniquely integrative work this volume provides a much needed compilation of primary source material to researchers from basic neuroscience psychology developmental science neuroimaging neuropsychology and theoretical biology The first comprehensive and authoritative volume dealing with neurological and psychological foundations of mathematical cognition Uniquely integrative volume at the frontier of a rapidly expanding interdisciplinary field Features outstanding and truly international scholarship with chapters written by leading experts in a variety of fields Biomimetic and Biohybrid Systems Vasiliki Vouloutsi, José Halloy, Anna Mura, Michael Mangan, Nathan Lepora, Tony J. Prescott, Paul F.M.J. Verschure, 2018-07-07 This book constitutes the proceedings of the 7th International Conference on Biomimetic and Biohybrid Systems Living Machines 2018 held in Paris France in July 2018 The 40 full and 18 short papers presented in this volume were carefully reviewed and selected from 60 submissions. The theme of the conference targeted at the intersection of research on novel life like technologies inspired by the scientific investigation of biological systems biomimetics and research that seeks to interface biological and artificial systems to create biohybrid systems Cerebral Cortex Edmund T. Rolls, 2018-01-26 The aim of this book is to provide insight into the principles of operation of the cerebral cortex These principles are key to understanding how we as humans function There have been few previous attempts to set out some of the important principles of operation of the cortex and this book is pioneering The book goes beyond separate connectional neuroanatomical neurophysiological neuroimaging neuropsychiatric and computational neuroscience approaches by combining evidence from all these areas to formulate hypotheses about how and what the cerebral cortex computes As clear hypotheses are needed in this most important area of 21st century science how our brains work I have formulated a set of hypotheses about the principles of cortical operation to guide thinking and future research The book focusses on the principles of operation of the cerebral cortex because at this time it is possible to propose and describe many principles and many are likely to stand the test of time and provide a foundation for further developments even if some need to be changed In this context I have not attempted to produce an overall theory of operation of the cerebral cortex because at this stage of our understanding such a theory would be incorrect or incomplete However many of

the principles described will provide the foundations for more complete theories of the operation of the cerebral cortex This book is intended to provide a foundation for future understanding and it is hoped that future work will develop and add to these principles of operation of the cerebral cortex The book includes Appendices on the operation of many of the neuronal networks described in the book together with simulation software written in Matlab Modeling, Simulation and Optimization of Bipedal Walking Katja Mombaur, Karsten Berns, 2013-02-28 The model based investigation of motions of anthropomorphic systems is an important interdisciplinary research topic involving specialists from many fields such as Robotics Biomechanics Physiology Orthopedics Psychology Neurosciences Sports Computer Graphics and Applied Mathematics This book presents a study of basic locomotion forms such as walking and running is of particular interest due to the high demand on dynamic coordination actuator efficiency and balance control Mathematical models and numerical simulation and optimization techniques are explained in combination with experimental data which can help to better understand the basic underlying mechanisms of these motions and to improve them Example topics treated in this book are Modeling techniques for anthropomorphic bipedal walking systems Optimized walking motions for different objective functions Identification of objective functions from measurements Simulation and optimization approaches for humanoid robots Biologically inspired control algorithms for bipedal walking Generation and deformation of natural walking in computer graphics Imitation of human motions on humanoids Emotional body language during walking Simulation of biologically inspired actuators for bipedal walking machines Modeling and simulation techniques for the development of prostheses Functional electrical stimulation of walking Brain Computations Edmund T. Rolls, 2021 In order to understand how the brain works it is essential to know what is computed by different brain systems and how those computations are performed This is the aim of Brain Computations What and How Pioneering in its approach this book will be of interest to all scientists interested in brain function and how the brain works Why People Get Lost Paul A. Dudchenko, 2010 At some point in our lives most of us have been lost How does this happen What are the limits of our ability to find our way Do we have an innate sense of direction How people get lost reviews the psychology and neuroscience of navigation It starts with a history of studies looking at how organisms solve mazes It then reviews contemporary studies of spatial cognition and the wayfinding abilities of adults and children It then considers how specific parts of the brain provide a cognitive map and a neural compass This book also considers the neurology of spatial disorientation and the tendency of patients with Alzheimer s disease to lose their way Within the book the author proposes that we get lost because our brain s compass becomes misoriented This book is written for anyone with an interest in navigation and the brain It assumes no specialised knowledge of neuroscience but covers recent advances in our understanding of how the brain represents space

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